2010 Mercedes-Benz E-Class, Part II

CHASSIS

Double-Link Strut Suspension in Front

The new-generation E-Class sedan and coupe make use of a strut-type front suspension that combines two lower links with a coil spring strut, along with twin-tube gas shocks and a stabilizer bar. Rather than a single "A" arm like conventional struts, two separate lower links help provide better impact absorption in the case of a frontal impact. Their low mass also contributes to more precisely tuned wheel control and damping. In addition, sensitivity to wheel imbalance or brake fluctuations is minimized. While the forward links are forged aluminum, the links behind them are made of forged steel.

The top of the struts are connected to the body by triple-path head bearings, in which spring forces are transmitted directly to the body, but damping forces (via the shock absorber piston rod) go through a rubber bushing that turns with the bearing during steering. The third path involves forces exceeding suspension travel, which are directed through a buffer stop directly to the body.

The front suspension links are mounted to a sub-frame of high-strength steel that also carries the engine and transmission as well as the aluminum rack-and-pinion steering unit, which is mounted in front of the wheel center.

Multi-Link Rear Suspension

The proven, Mercedes-patented five-link rear suspension design has been refined for its application in the new E-Class. Built up from variable-thickness sheet steel, a lightweight subframe carries the suspension links and the rear final drive gears. The links, wheel carriers and struts have all been revised. While four of the rear suspension links are steel, one link that's not subjected to bending (only stretching and compression) is made of forged aluminum.

AGILITY CONTROL

Standard on E350 sedan and coupe models, AGILITY CONTROL provides the best of both worlds for a conventional coil-spring suspension. A small piston is connected to a bypass port in the hydraulic flow of each shock absorber. Its design provides a softer, quieter ride on normal roads but retains full shock damping over dips and twisty roads when it's really needed.

The suspension on the E350 coupe can be upgraded to the AGILITY CONTROL Sport Suspension with stiffer damping. The E550 Coupe is equipped with the Dynamic Handling suspension which includes electronically-adjustable shock absorbers as well as modified throttle response.

AIRMATIC: Computer-Controlled Air Suspension (V8 sedans only)

Standard on the E550 sedan and E63 AMG sedan, AIRMATIC air suspension uses compressed air in special

rubber bellows instead of conventional coil springs to provide simultaneous computer-controlled springing and damping. When the vehicle is in motion, an electrically powered compressor charges the struts with compressed air via fast-acting solenoid valves. The solenoid valves regulate air volume and hence air pressure and the springing rate. A charge valve combines a central pressure sensor and the connectors for the pneumatic lines, which are made from polyamide plastic. At low speed or at a standstill, the system draws on pressure from the accumulator (central reservoir) with a charging pressure of 227 psi (16 bar) to ensure rapid and noise-free ride height control.

Comfort and Sport Suspension In One

The AIRMATIC system offers a sports suspension and comfort suspension in one. The system's adaptability solves the usual suspension tuning conflict between comfort and high dynamic handling by adjusting the springing and damping rates in response to driving input and road conditions. Under normal driving conditions, the entire air volume remains active to provide optimal comfort - as with soft-rate conventional springs. When cornering at speed, however, AIRMATIC briefly releases a portion of the air volume, resulting in a "harder" spring rate to reduce pitch and roll. The air reservoirs are integrated into the spring struts in front and remotely mounted on the subframe in the rear.

The suspension computer considers input from two body level sensors on the front suspension and a third on the rear suspension. In addition, the AIRMATIC control unit receives signals from three acceleration sensors on the body and a steering angle sensor, and uses these to determine the required shock absorber force and spring rate.

Solenoid valves on the shock absorbers provide four levels of damping, determined by the computer in response to sensor input. The valves can switch damping rates in less than 0.05-second. The four damping levels include:

Stage 1: Soft compression and rebound stage during steady-state driving
Stage 2: Soft rebound setting and, at the same time, hard compression damping
Stage 3: Soft compression / hard rebound damping
Stage 4: Hard rebound and compression for maximum damping stiffness during cornering

The E-Class uses stage 1 where there are small body movements, such as in steady-state driving. If the speed of movement on the part of the body exceeds a certain level, the system switches back and forth between the second and third damping stages to compensate for body pitch and roll.

Driver-Selectable Shock Absorber Damping

In addition, the driver can select from two suspension damping settings, from maximum comfort to sporty. The system switches thresholds between the four stages and the spring rate. When the driver selects the sport program, the harder springing and damping stages are activated earlier than in the comfort program. In addition, the body lowers by 0.6-inch. Damping and springing remain constantly "hard."

Automatic level control maintains the same spring travel regardless of vehicle load. For traveling over rough roads, the driver can raise the body by one inch at the touch of a button. The car automatically returns to

normal ride height if speed briefly exceeds about 75 mph, or if the vehicle sustains 50 mph or higher for more than five minutes.

Brakes

All E-Class models come with four-wheel vented disc brakes and a tandem vacuum brake booster. E350 models use single-piston floating calipers up front, while the E550 employs four-piston fixed calipers. To provide braking power commensurate with its high performance, the new E63 AMG has perforated, vented discs with six-piston calipers in front and four-piston ones at the rear.

Wheel and Tires

The E350 and E550 Luxury sedans come with 17-inch wheels shod with 245 / 45 all-season tires, while Sport sedan models the E63 AMG sedan come with 18-inch wheels and staggered-width tires - 245 / 40 in front and 265 / 35 at the rear. E350 coupes come standard with 17-inch wheels with staggered-width 235/45 tires at the front and 255/40 tires at the rear. E350 coupes with the optional Appearance Package and E550 coupes come with 18-inch wheels and staggered-width 235/40 tires up front and 255/35 tires at the rear.

Tire Pressure Monitoring

All tires slowly lose some air through the rubber, and, as a result, maintaining correct tire pressure is easy to overlook. At the least, low tire pressure degrades handling and causes more rapid tire wear, but it can also lead to a tire blowout that can trigger a collision or rollover.

On the new E-Class line, sensors mounted inside each tire (on the inner wheel) transmit radio signals about tire pressure, temperature, direction of rotation and an ID number (to identify each wheel) to a control unit over the rear axle. If there's significant pressure loss, a "Check Tires" warning message appears in the central display, and if there's a rapid pressure loss, a "Caution Tire Failure" warning appears. The warning disappears automatically when correct tire pressure is restored. The system also provides displays individual tire pressures.

New Systems Help Maximize Fuel Economy

A number of refinements help provide the new E-Class with outstanding fuel economy:

The power steering pump in the new E-Class has a special bypass valve that supplies hydraulic pressure to the steering only during turns. This means the steering pump draws almost no engine power when the car is driving straight ahead.

Whenever the battery is at least 80 percent charged, the engine does not turn the alternator. Under these conditions, the alternator only recharges the battery when the car is decelerating or braking.

The electric fuel pump for the fuel injection system now operates on a variable on-demand basis, so the load on the alternator is reduced.

The final drive gears have also been modified, so that the gears operate with less friction and, as a result, require less energy from the engine.

From an ecological standpoint, an impressive 85 percent of the materials in the new E-Class are recyclable. Additionally, Mercedes-Benz is the only automotive brand in the world to be granted an ISO 14062 environmental certificate, which is based on a comprehensive evaluation of environmental compatibility - from manufacturing and on-road use to eventual recycling.

V6 ENGINE

High-Torque V6

The E350 sedan and coupe are powered by a 3.5-liter all-aluminum V6 that produces 268 horsepower and 258 pound-feet of torque, with maximum torque available from 2,400 rpm all the way up to 5,000 rpm. And, from only 1500 rpm, the V6 engine develops 87 percent of its maximum torque.

DOHC Layout For Variable Intake and Exhaust Valve Timing

Variable intake and exhaust valve timing requires separate camshafts for the intake and exhaust valves. While variable valve timing gets a lot of credit for the engine's unusually broad torque curve, a two-stage intake manifold and intake tumble flaps play a key role as well.

Tumble Flaps Improve Fuel Efficiency

One of the most powerful engines for its size, the 3.5-liter V6 is equipped with innovative tumble flaps in the intake passages near the combustion chamber. The tumble flaps pivot open under part load, improving combustion by creating additional turbulence around the intake valve and in the combustion chamber. During higher engine loads such as full throttle, the tumble flaps are completely recessed in the wall of the intake manifold.

Better combustion helps improve engine torque, but the primary purpose of the tumble flaps is to further increase fuel economy, and tests show that the tumble flaps indeed boost fuel mileage by about two percent.

From Start to Finish

First, a forged crankshaft with four main bearings is placed into an all-aluminum engine block that features wide main-bearing saddles and transverse bearing supports that minimize vibration. To compensate for the inherent imbalance and vibration of a 90-degree V6 engine, a balance shaft is then installed in the block between the two cylinder banks, about where the camshaft is located on a pushrod-type V6 or V8 engine. The balance shaft is driven from the crankshaft by a long double chain that loops around one camshaft in each cylinder head and engages the underside of the balance shaft sprocket. This means the balance shaft counter-rotates at crankshaft speed, and its balancing "lobes" cancel out the inherent vibration of the 90-degree V6.

Iron-coated aluminum pistons are pinned onto forged steel connecting rods that are about 20 percent lighter than other comparable engines. The pistons slide into the cylinders, and the connecting rods are clamped around the crankshaft journals. When the aluminum-silicon engine block is pressure-cast, its cylinder bores are etched to expose a surface of almost pure silicon - a long-life, low-friction running surface for the piston rings. In addition, the block is nearly seven pounds lighter than if it was fitted with conventional cylinder

sleeves.

The cylinder heads are bolted onto the block, and twin camshafts are installed in each cylinder head. The intake camshafts are driven by a double chain, and small helical gears on the intake cams in turn drive the exhaust camshafts.

Five Mufflers and Three Catalysts

All new E-Class models come with a dual exhaust system that begins with a catalytic converter and front muffler on each side. Both exhaust pipes then flow into a center muffler and catalyst before separating into two rear mufflers. This design provides relatively low back pressure for good power and fuel economy, excellent noise muffling for quiet engine operation and exemplary exhaust gas cleaning for low exhaust emissions. The E-Class coupe features a more sporty exhaust note.

V8 ENGINE

Four-Cam Engine Design

Known inside the company as the M273, the 5.5-liter V8 in the E550 sedan and coupe produces 382 horsepower and 391 pound-feet of torque, with maximum torque available from 2,800 rpm all the way up to 4,800 rpm. Characterized by double overhead camshafts in each cylinder bank and variable valve timing for both the intake and exhaust valves, the V8 engine makes use of the latest advances in lightweight design, with an aluminum block and cylinder heads as well as low-friction silicon-aluminum cylinder liners. This engine also features intake "tumble flaps" for even better fuel economy and a two-stage intake manifold that helps broaden the power curve.

In the 1990s, Mercedes-Benz pioneered advanced engine technologies that featured three valves per cylinder, in which a single exhaust valve kept exhaust temperature high and emissions low. In the ensuing years, Mercedes engineers have developed new ways to minimize emissions, allowing them to utilize higher-flow four-valve architecture for the new engine family.

In addition to internal exhaust gas recirculation and secondary air injection, the new engine uses two close-coupled catalysts with linear oxygen sensors to ensure low exhaust emissions.

Variable Intake and Exhaust Valve Timing

Valve timing on the V8 is automatically adjusted within a range of 40 degrees using electro-hydraulic vane-type adjusters on the end of each camshaft. At part throttle, the valve timing adjuster keeps the exhaust valves open as the intake valves are opening, using this valve overlap for internal exhaust gas recirculation, reducing exhaust emissions and improving fuel economy. However, approaching full throttle, the camshaft adjustment optimizes valve timing for maximum power.

To minimize disturbing air flow through the ports, valve stems are only six millimeters or about 1/4 inch in diameter (most valves have 7 or 8 mm stems), and the valves are angled at 28.5 degrees to optimize the combustion chamber shape.

Tumble Flaps Improve Fuel Efficiency

The V8 engine is equipped with tumble flaps in the intake passages near the combustion chamber. The tumble flaps pivot open under part load, improving combustion by creating additional turbulence around the intake valve and in the combustion chamber. During higher engine loads such as full throttle, the tumble flaps are completely recessed in the wall of the intake manifold.

Better combustion helps improve engine torque, but the primary purpose of the tumble flaps is to further increase fuel economy, and tests show that the tumble flaps boost gas mileage by about two percent.

Two-Stage Intake Manifold Fattens the Torque Curve

While variable valve timing gets a lot of credit for the engine's unusually broad torque curve, a two-stage magnesium intake manifold plays a key role as well. At relatively low engine speeds, a set of flaps in the manifold close off short intake passages, forcing intake air to take a much longer route into the engine. This creates pressure waves that help the intake process and improve torque at lower engine speeds. Above about 3,500 rpm, the flaps open and intake air flows the shortest distance to the combustion chambers, helping to make more horsepower, especially at higher speeds.

Assembling the New V8

First, a forged crankshaft with five main bearings is placed into an all-aluminum engine block that features wide main-bearing saddles and transverse bearing supports to minimize vibration.

The engine block is cast around Silitek cylinder liners that provide a long-life, low-friction silicon-aluminum running surface for the piston rings. In addition, the block is nearly seven pounds lighter than if it was fitted with conventional cylinder sleeves. Aluminum pistons are pinned onto forged steel connecting rods that are 20 percent lighter than comparable engines. The pistons slide into the cylinders, and the connecting rods are clamped around the crankshaft journals.

The two cylinder heads are bolted onto the block, and twin camshafts are installed in each head. The intake cams are driven by a double chain from the crankshaft, and small gears on both cams in turn drive the exhaust cams.

Double-wall exhaust piping is used to keep the exhaust air as hot as possible leading down to twin catalytic converters. With the help of secondary air injection, the catalysts promote additional downstream conversion of pollutants into carbon dioxide and water vapor, and two oxygen sensors for each catalyst monitor and help manage the entire process.

E63 AMG Sedan

A Balanced Package

The new-generation Mercedes-Benz E63 AMG is much more than another competent E-Class sedan with a more powerful engine. The entire car is upgraded by AMG, the high-performance division of Mercedes-Benz, and is loaded with features that complement its powerful 6.3-liter AMG V8 engine. In addition to the larger brakes and staggered 18-inch wheels and tires described earlier, the E63 AMG boasts a seven-speed MCT

transmission with AMG Speedshift.

No Torque Converter with Multi-Clutch Technology

Providing the direct feedback of a manual transmission with the total convenience of an automatic, the MCT transmission features a special start-up clutch, which runs in an oil bath and replaces a conventional torque converter. The low-mass start-up clutch helps the transmission respond instantaneously with no slip. The transmission is equipped with four driving modes: "C" (Controlled Efficiency), "S" (Sport), "S+" (Sport plus) and "M" (Manual), which can be selected using a rotary electronic switch in the AMG DRIVE UNIT. Partial suppression of individual cylinders by interrupting ignition and injection during gearshifts under full load contributes to considerably faster shift times. In "M" mode the AMG SPEEDSHIFT MCT 7-speed sports transmission allows gearshifts to be performed in 100 milliseconds.

In the even more fuel-efficient driving mode Controlled Efficiency, the transmission shifts the gears with deliberate smoothness, and the transmission control unit is programmed to perform early upshifts to keep engine speeds as low as possible. At the same time, the AMG SPEEDSHIFT MCT 7-speed sports transmission met the most demanding requirements where driving dynamics are concerned: fast and precise multiple downshifts ensure first-class agility in conjunction with the automatic rev-matching and RACE START function: this enables the E63 AMG driver to call on the maximum acceleration potential automatically.

Wider Body, Unique Suspension

The new E63 AMG body is fitted with flared front fenders that allow a 2.2-inch wider track, as well as an AMG front apron, side skirts and a rear apron with a black diffuser insert. While new coil-spring struts and special control arms are used in front, the E63 AMG suspension features AMG-specific air springs in the rear, ensuring an unprecedented balance between handling sensitivity and automatic load-leveling. With a ratio of 14:1, its speed-sensitive power rack-and-pinion steering is 22 percent quicker than other E-Class models.

A High-Performance Interior

The E63 AMG interior includes high-bolster leather sport seats, an AMG instrument cluster and four-spoke sport steering wheel as well as brushed stainless door sills and sport pedal cluster. Its AMG "Drive Unit" includes one-touch shifting logic with controls for four shift modes, three suspension modes and three levels of ESP stability control as well as the "RACESTART" function.

The First Engine Developed Entirely by AMG

The E63 AMG is powered by the first engine developed from the ground up by AMG - a 6.3-liter V8 producing 518 horsepower and 465 lb.-ft. of torque. One of the most powerful naturally aspirated production V8s ever, the AMG engine revs freely to over 7,000 rpm, yet already produces nearly 90 percent of its peak torque at only 2,000 rpm. The engine shares no parts with Mercedes-Benz V8 engines. In combination with the new MCT transmission, the new E63 AMG accelerates from zero to 60 miles per hour in an astounding 4.4 seconds.

AMG Racing Success Spawns High-Power Production Engine

The 6.3-liter V8 boasts a wealth of exciting features derived from AMG's highly successful racing efforts. Built almost completely from a high-strength silicon-aluminum alloy, the new 6.3-liter features four valves per cylinder, double overhead camshafts with variable valve timing, bucket tappets (rather than rocker arms), an 11.3-to 1 compression ratio and a variable intake manifold. A first for a production engine, the cylinder bores feature a twin-wire-arc-sprayed (TWAS) coating, a new process that results in impressively low friction and running surfaces that are twice as hard as conventional cast-iron cylinders.

Crankcase Bedplate Instead of Main Bearing Caps

For greater strength and reliability, the AMG engine uses a rigid one-piece bedplate at the bottom of the engine block instead of individual main bearing caps that can distort or loosen at high RPM. With cast-in steel inserts for greater strength, the aluminum bedplate essentially sandwiches the crankshaft between two sections of the sturdy engine block.

A Racing Crankshaft

Made of high-quality 42CrMo4V forged steel alloy, a finely balanced crankshaft with six counterweights spins in five main crankshaft bearings. The crankshaft counterweights feature heavy metal plugs - a detail usually found only in racing engines - which means the counter-weights can be significantly smaller, increasing power by reducing rotational inertia and oil drag.

Each forged connecting rod is precisely "cracked" with the help of a laser beam, so the irregular fracture contributes to its strength when the two halves are clamped around the crankshaft. The connecting rods and lightweight pistons are matched for extremely close weight tolerances that contribute to smooth running at high speeds. Small nozzles in the engine block spray cooling oil onto the underside of each piston crown.

TWAS Twin-Wire-Arc-Sprayed Cylinder Bores

A first for a production engine, the cylinder bores feature a twin-wire-arc-sprayed (TWAS) coating, a new process that results in impressively low friction and running surfaces that are twice as hard as conventional cast-iron cylinders. The engine block and cylinder heads are made of cast aluminum silicon alloys (AlSi7 and AlSi17), which represent state-of-the-art strength, light-weight and thermal benefits. First, a high-pressure water jet roughens the cylinder bores. Then, two electrode wires and an atomizing gas form plasma under high voltage. In essence, the atomizing gas sprays molten metal from the wires onto the cylinder walls, where it solidifies, forming an extremely hard coating. A honing process finishes the cylinder bores, exposing micro-pores in the hard coating that will retain oil and ensure good lubrication of the pistons and piston rings.

Vertical Intake and Exhaust Ports

Adapted from racing designs, air passing through the engine follows a straight line down through the intake manifold into its hemispherical combustion chambers and out the exhaust passages. A patented dual-length intake manifold is part of the vertical intake and exhaust system.

Operated by the Bosch 9.7 engine management system, two electrically-operated internal flaps control air flow through a variable-length magnesium manifold. At relatively low engine speeds, intake air flows through long

runners, which helps to maximize engine torque. At higher engine speeds, the flaps direct intake air through shorter pipes for maximum high-speed horsepower.

"Bucket" Followers Instead of Rocker Arms

The AMG-designed engine also features a sophisticated valve train, also adapted from the AMG racing engines. Each intake valve is 40 millimeters in diameter, while the exhaust valves measure 34 mm. Twin overhead camshafts in each cylinder bank open the 32 valves via bucket-type followers. In other words, instead of rocker arms, the cam lobes sweep across flat top of the buckets, which sit directly on top of the valve stems. This space-saving design provides a very stiff valve train that allows for large valve openings and dependable high-speed operation for maximum horsepower and torque. However, in contrast to racing engines, each bucket incorporates a hydraulic lifter that automatically maintains valve clearance, which allows for long service intervals and low operating costs.

Variable Valve Timing

The AMG V8 makes use of variable intake and exhaust valve timing to maximize efficiency and torque over a wide RPM range. Valve timing can be automatically adjusted within a range of 40 degrees using electro-hydraulic vane-type adjusters on each camshaft. At part throttle, the valve timing adjuster keeps the exhaust valves open as the intake valves are opening, using this valve overlap for internal exhaust gas recirculation, reducing exhaust emissions and improving fuel economy. However, approaching full throttle, the camshaft adjustment optimizes valve timing for maximum power. The intake cams are driven by a double chain from the crankshaft, and small gears on the intake cams in turn drive the exhaust cams.

Two integral hot film air mass sensors behind the air cleaners provide the engine electronics with information about the density and temperature of the incoming air.

SEVEN-SPEED TRANSMISSION

All 2010-model E-Class sedans and coupes are equipped with the Mercedes-Benz seven-speed automatic transmission. When compared to other transmission designs, the seven-speed makes the vehicle faster and more economical while providing smooth, barely noticeable gearshifts. Seven gear ratios provide a wider spread of ratios between first gear and top gear and, at the same time, allow smaller increases in engine speed as the vehicle accelerates through the gears. This gives the electronic control unit more flexibility to maximize fuel economy and make the transmission's reaction time faster.

Skip a Gear When You Need To

Unlike most transmissions, the seven-speed transmission will skip up to three gear ratios if necessary when it downshifts, shifting directly from seventh to fifth, for example, or even sixth to second. This helps the transmission choose the best gear for quick acceleration and ensure smooth, almost imperceptible shifts in the process.

Lock It Up for Better Fuel Mileage

The Mercedes-Benz seven-speed uses a refined, proven hydrody¬namic torque converter with a special lock-up clutch inside the converter for maximum fuel efficien¬cy. The clutch eliminates the usual torque converter "slippage," providing the direct connection and fuel efficiency of a manual transmission when the clutch is engaged. In the seven-speed, the clutch engages in all seven gears. (To put that into perspective, many cars lock the converter only in top gear.) The Mercedes-Benz lock-up clutch is submerged in oil and uses special long-life friction materials.

Direct Select

The E350 and E550 sedans now come with a small stalk on the right side of the steering column that serves as the gear selector, freeing up valuable real estate on the center console between the seats. The column-mounted "Direct Select" lever electronically controls the seven-speed automatic - just lift the stalk up for reverse, push down for drive, and push a button on the end for park. Once underway, pushing one of the paddles on the "back" of the steering wheel provides manual gear changes.

Console Shift for E-Class Coupes and E63 AMG Sedan

Coupe models and the E63 AMG sedan retain a console shifter. In these models, the Mercedes-Benz Touch Shift feature provides manual shifting simply by tapping the lever for upshifts or downshifts. In other words, it's not necessary to move the lever to another gate to make gear changes, and an in-dash gear indicator shows the selected gear. Though all forward speeds can be selected, computer control prevents downshifts that would cause the engine to over-rev.

When not shifting manually, Mercedes automatic transmissions not only adapt to changes in road grade (delaying upshifts on hills for climbing power and hastening downshifts on descents for engine braking), but also to an individual's driving style. The transmission computer adjusts shifting logic for leisurely driving with smooth upshifts for the best fuel efficiency. A driver who does frequent highway merging will find each gear is held longer for quicker acceleration.

Sport and Comfort Modes

A button on the center console allows the driver to select two different shifting modes - Sport or Comfort. The Comfort setting is used for normal driving, which involves smooth, nearly imperceptible shifts and relatively low-speed shift points. When the Sport mode is selected, shift points occur at higher engine speeds, and shifts are faster and crisper.

4MATIC ALL-WHEEL DRIVE

Shortly after its U.S. retail launch, the new E-Class sedan will also become available with a new version of its popular 4MATIC all-wheel-drive system. As modern all-wheel-drive systems become even more refined, they are becoming increasingly popular, especially in the luxury car market. With negligible weight and fuel-efficiency tradeoffs, full-time four-wheel-drive systems provide year-round traction and stability benefits on both wet and dry roads. Overall, Mercedes-Benz has sold more than 1.2 million full-time 4MATIC cars and sport utilities, and in Europe, the all-wheel-drive segment of the high luxury market has increased 50 percent

in recent years.