

## 2004 Paris Motor Show highlights

by **Stuart Birch**

Most international motor shows have themes. There may be a plethora of both likely and unlikely concepts, of technologies enhancing environmental responsibility, of safety systems...or performance cars. At Paris this year, though, themes were distinctly elusive. Instead, there was on display the whole glittering gamut of the international motor industry at its best, showing what it could do across a broad spectrum of technology, design, and styling, while bringing out evolutionary and revolutionary solutions to challenges real and imagined. Despite the endless pursuit of low emissions, economy, and practical, value-for-money vehicles, kilowatts still figured prominently. And glamour, that essential ingredient for success, was on almost every stand. The car, it seems, is still a long way from becoming the purely functional mechanical device that is its basis, and the words "automotive engineering" will continue to mean a great deal more than four wheels, an engine—and a hunk of metal to keep out the rain.



Following are highlights of the Paris show from Europe-based automakers.

**Aston Martin**—The motor show pursuit of power and glory was graphically demonstrated by the Vanquish S V12, the fastest production model ever to be built by Aston Martin. Top speed is rated in excess of 321 km/h (199 mph), made possible by a 6.0-L engine producing 520 bhp (388 kW) at 7000 rpm, complemented by what Aston describes as subtle suspension and steering changes.

Compared to the regular Vanquish, external modifications are minimal, although there is a different radiator grille for more efficient cooling and an aerodynamic splitter is fitted to improve high-speed stability. The trunk lid has also been re-shaped for added downforce. The Cd figure is 0.32.

Engine modifications, which have boosted power by 60 bhp (45 kW) over the regular Vanquish's 460 bhp (343 kW), include new cylinder heads with fully machined inlet ports and combustion chambers to improve breathing, revised engine mapping, and newly designed fuel injectors. Maximum torque of 577 N·m (426 lb-ft) is generated at 5800 rpm. The car's 0-100 km/h (0-62 mph) time is 4.8 s and curb mass is 1875 kg (4135 lb).

The steering changes bring a 20% quicker response. The car has shorter steering arms plus stiffer springs and dampers. Six-piston caliper brakes are fitted, with larger grooved and ventilated designs at the front, while rear discs are a couple of millimeters wider to aid heat dissipation. Floating discs are fitted to provide consistent pedal feel, and a new brake assembly is said to reduce travel.

Aston's Chief Executive, Dr. Ulrich Bez, never a man to undersell the product, stated, "The Vanquish S V12 is a combination of state-of-the-art aerospace technology and hand craftsmanship." And at Paris he added for good measure that Aston is determined to make the most technologically modern sports cars in the world.

**Audi**—To keep its A4 sedan and Avant (station wagon) stylistically in step with the rest of its range, Audi has carried out major changes to the model barely four years after its introduction. Although most of the changes are aesthetic, there are some mechanical modifications too. With the exception of the roof, all exterior panels have been changed, the most significant being the adoption of what the company describes as its "new corporate single-frame grille." This is large and prominent, and has been designed to provide a corporate identity as clear as the front ends of a **BMW**, **Mercedes-Benz**, or **Rolls-Royce**. In



Audi A4



BMW H2R

Europe, reactions to Audi's corporate grille have been mixed; it can make a car look narrower and higher. But the new A4 has undeniably gained more road presence.

The body shell has improved side-impact protection via strengthening forward of the B-pillar. It meets future standards for passive safety including the "fast rear crash" test FMVSS 301. At Paris, Audi enthusiastically described the car as being "dynamically transformed," although physical changes are relatively few. The revised four-link front suspension has a new guide link mounting at the lower link level, and link mounts and track rods are adopted from the powerful S4 quattro at the upper link level. Damper settings have been optimized "to give a more sporting feel without sacrificing ride comfort." The rear suspension has a new asymmetric mounting for the trapezoidal link plus larger dampers based on the type used for the A6.

Most A4s get Servotronic speed-dependent rack-and-pinion power steering modified to complement the suspension changes. These changes include its steering valve characteristics and stiffer track rods, again from the S4 quattro.

Brakes share A6 and A8 technology with floating-frame **Continental-Teves** 16-in (406-mm) discs at the front and a **TRW** floating caliper setup at the rear, again based on the system found in the S4 quattro. The latest **Bosch** Electronic Stability Program, generation 8, features "major revisions to the understeer control function." There is a hydraulic fading compensation (HFC) function integrated with brake assist and a new brake-disc-cleaning module. In wet weather, very gentle intermittent brake pad pressure is applied to keep the discs dry, the

system taking data from windshield wiper application.

There is a choice of 10 EU-4 compliant engines, four new to the A4 including a 2.0-L FSI (direct gasoline injection) turbo producing 200 PS (147 kW). A 3.0-L diesel TDI V6 produces 204 PS (150 kW) and 450 N·m (332 lb·ft) to give a 0-100 km/h (0-62 mph) time of 7.2 s, top speed of 146 mph (235 km/h), and fuel consumption of 7.7 L/100 km, a remarkable combination. The S4 with V8 4.2-L engine produces 344 bhp (257 kW). Transmission choice differs with variant and includes five- and six-speed ML (Manual Longitudinal), six-speed Tiptronic auto, and a CVT (continuously variable transmission) with seven "speeds" in manual mode.

The A4 interior is much as before with a very high quality finish and great attention paid to ergonomics. Optional equipment includes swiveling adaptive cornering lights if specifications include xenon-plus headlights, which react to steering input and speed data.

Audi's planned SUV, the production version of the Pike's Peak quattro concept, will be called Q7 when it hits the market in 2006. Q denotes a new type of vehicle for Audi and the 7 designation places it between the A6 and A8. It will be a five-door, seven-seater with particular focus on cabin packaging.

**BMW**—With a timely piece of publicity, BMW set up new speed records with its V12 H2R hydrogen-powered car just a few days before the Paris Motor Show. At the Miramas Proving Ground in the South of France, using an adapted version of the 6.0-L BMW 760i's engine tucked inside the highly aerodynamic, carbon-fiber body of the H2R, it set nine world records for a hydrogen-powered car including a top speed of 187.62 mph (301.95 km/h). BMW described the record attempt as a major hurdle to overcome before a production version of a hydrogen-powered car could be offered for sale, believing the H2R was the ideal testbed for the forthcoming hydrogen-powered 7 Series as it pushed the envelope of what had previously been thought possible with such a dual-fuel vehicle. The longest distance covered was 10 mi (16 km) at 163.81 mph (263.63 km/h), which may not over-impress an established high-speed user of the autobahn, although a long distance record might.

The hybrid (gasoline/hydrogen) engine

was kept in hydrogen-only mode throughout the establishment of the nine records. Unlike a gasoline engine with fuel injected directly into the combustion chambers, the injection valves on the hybrid are integrated into the inlet manifolds. The engine also has special valves. An air cooling process for each cylinder designed to prevent the next injection of hydrogen/air mix from igniting too soon in the combustion process (because of the higher temperature generated by burning hydrogen) was also devised. Power output of the record car's engine was 232 bhp (173 kW). The H2R was developed in 10 months. BMW's hydrogen-powered vehicle program has now extended over 26 years. Four years ago the company said that it was the first motor manufacturer in the world to run a demonstration fleet of 15 hydrogen-powered 750iL sedans.

**Citroën**—Citroën's new C4 was one of the more attractive new arrivals at Paris, and it contained some interesting technology. As well as a fixed steering-wheel hub with centered controls, it has as options a lane-departure-warning system (produced by **Valeo**, using infrared beams linked to an ECU and vibrating the driving seat, the vibration being to right or left to indicate which way the car is straying), and directional xenon headlights which swing up to 15° on both high and low beams. The two C4 body styles, a five-door hatchback (Citroën calls it a sedan) and three-door coupe, each has an exceptionally low Cd of 0.29 and 0.28, respectively. Citroën states that the coupe's profile "reflects the quest for optimized aerodynamics," which would seem to indicate technology dictating styling. Despite very different styles, both C4 variants have the same interior space. The dashboard is strikingly designed with a high-level, centrally mounted, translucent strip for main information and a multifunction screen at a lower level. Five gasoline and three diesel engines are offered. The most powerful diesel, the HDi 138 with 100 kW (134 hp) and 350 N·m (258 lb·ft), also gets a six-speed gearbox.

The fixed steering wheel uses a multiplex connection designed and manufactured by Valeo. Secondary controls usually set in the dashboard or above the central console are grouped together at the edge of the fixed steering wheel hub. The standard top-column module and the controls set in the fixed panel of the steering



Citroën C4



Ford Focus



wheel are linked using a LIN/CAN multiplexed connection proposed by Valeo in the early stages of design in liaison with other suppliers.

Citroën also took along to Paris what it termed its "new look" C5. Although spacious and comfortable, the original C5 was hardly an aesthetic delight, but styling changes have brought improvements and the car looks better balanced. At the front it features Citroën's distinctive "boomerang" headlamp design and a prominent double chevron badge in the grille. Many of the innovations featured on the C4 are also to be found on the

new C5 including a speed limiter, laminated glass for the side windows, and tire-pressure-warning system.

Also significant technologically is the availability of a Valeo-based "stop and start" system on the Citroën C3, which cuts the engine at idle. It combines the Sensodrive paddle-shift robotized manual gearbox with an electronically controlled alternator; fuel consumption and CO<sub>2</sub> emissions in heavy traffic may be reduced by up to 15%. The car's 1.4-L gasoline engine produces 90 bhp (67 kW). Valeo has also designed an air conditioning system that functions when the engine is

off. The cooling function is achieved via an A/C evaporator that stores cold energy. It contains a material which accumulates cold energy while the engine is running. When the stop-start system is triggered, the A/C fan continues to operate, directing air through the evaporator, which cools it before releasing it into the cabin. In cold weather, the cabin is heated using an additional electric pump, which continues to circulate water between the engine, which remains hot, and the heater radiator.

**Ford**—The big problem with the creation of a highly successful product is its follow-up. When Ford introduced the Focus at the 1998 Paris Motor Show, it replaced the Escort, a worthy car of little aesthetic or dynamic distinction (except in high performance form) but strong sales. To some extent the Focus was a gamble; it had avant-garde styling that might have shocked the traditionalist, conservative Escort buyer. In fact, it proved to be immensely popular and was to result in the production of more than four million units into 80 countries.

But its popularity was not just down to its looks. The Focus demonstrated, perhaps more than any other car in its class since the original **Volkswagen** Golf, that sharp dynamics and strong performance, allied to efficient packaging together with distinctive styling, could bring enormous commercial success and the accolade on both sides of the Atlantic of "Car of the Year." Aesthetics and technology had come together, and for once the market-speak dithyrambs were justified.

But that was six years ago; now it is time for change—and at this year's Paris Motor Show the new Focus was unveiled. Its antecedence is clear both stylistically and mechanically. The car will be built at Saarlouis, Germany, and Valencia, Spain; at present, it is not planned to be sold in the United States. It is slightly larger, with 25 mm (1-in) longer wheelbase and 40 mm (1.6 in) wider track, and about 10% stiffer than the original, particularly in "local" areas such as the links between subframes and body. It also uses Ford's Global Shared Technologies (GST) which represent a philosophy of shared engineering and components, making for R&D and production savings via economies of scale without, says Ford, risking a dilution of brand identity. GST has been applied to the Ford C-Max multi-activity vehicle, **Mazda3**, and **Volvo** S40 sedan

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Ford Focus Duratec Ti-VCT and CVT detail



Ford Focus Vignale concept



sponsive handling allied to improved ride quality. It continues to use the successful Control Blade rear suspension, which provides lateral stiffness, controlled flexibility, "and a contribution to steering efforts under cornering forces plus improved compliance level." The chassis uses a new, stiffer front subframe.

As well as maintaining or enhancing the original car's dynamics, the new Focus's chassis has been designed to contribute to the reduction of cabin noise levels by some 20%.

To better control initial roll, the Focus has an improved rear anti-roll bar drop link with low-friction double ball joints originally developed for the high-performance Focus RS.

The chassis incorporates a new MacPherson strut design, larger front dampers, and gas-filled twin-tube struts. The front lower control arms are mounted to the subframe by two horizontal bushes which, *inter alia*, have been tuned to support low lateral compliance, which is said to be important for high levels of steering precision and to allow for good impact absorption. The new front subframe design provides a "significant" increase in stiffness at the attachment points.

Electric hydraulic power steering (EHPAS) from the C-Max is offered on a majority of models and lightens low-speed maneuvering. An electric-motor-driven pump uses vehicle speed and steering wheel inputs to calculate optimum powered support. The system provides a fuel saving of up to 0.2 L/100 km.

Brakes are of larger diameter than before. The car has a **Continental-Teves** 60 ABS with analog valve operation together with EBD (electronic brake force

and V50 station wagon. Overall length and wheelbase of the new Focus are the same as those of the C-Max.

Available initially in three-door, five-door, and station wagon forms, a four-door Focus sedan will follow later in 2005. The three-door has a sporty, coupe-style, with steeply sloping windshield—the A-pillars are moved forward 100 mm (3.9 in)—and sloping C-pillars and tail; the five-door has similar treatment.

One of the most important elements of the original Focus that separated it from its rivals was its fine driving dynamics; the Focus handled and steered more like a taut sports car than a mass-market family model. The new car has been designed to mature this approach, with re-

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Mercedes-Benz CLS



distribution). ESP (Electronic Stability Program) is an option.

Packaging of the new car is improved over the original model. Despite its falling rear roofline, rear-seat headroom reaches 978 mm (38.5 in); there is 8 mm (0.3 in) more knee room and a 10% increase in trunk capacity. Driver comfort is improved by optional pedal adjustment.

The Focus's added length facilitated the coupe-like roofline, particularly for the three-door, with rear lamp clusters placed high and a rear spoiler fitted. Laser sighting and welding is used in the car's construction, and X-ray technology is applied to weld checking. Panel gaps have been reduced to 3.5 mm (0.14 in) throughout the vehicle, with tolerances down by a third to 1 mm (0.04 in). Crash load paths through the body have been optimized and more crush space achieved via a controlled detaching of stiff chassis components from the body structure underfloor, allowing impact energy to pass beneath the rigid passenger cell. This reduces deceleration values for the occupants and avoids deformation of the underfloor structure. New compression members inside the door waist are designed to reduce A-pillar and instrument-panel-beam deformation, and there is a new crossbar beam bolted between the A-pillars to stabilize the body side structure and minimize intrusion of steering column and pedals.

Ease of repair has also been improved, an example being the boron radiator-grille-opening reinforcement beam. Previously, separate components were mounted to a wide variety of points, making it "exceptionally hard" to ensure consistency with regard to alignment and gaps, says Ford. The new design eliminates variations in lines or gaps by being mounted to fixed points. If damaged in an accident, it can be replaced to fit as the vehicle left the production line. The interior has a more up-market look and

feel, continuing a philosophy introduced with the C-Max. The manual shift lever is 30 mm (1.2 in) higher, which Ford has adopted on other models.

A significant powertrain development across the Focus range sees the introduction of a new 1.6-L Duratec gasoline engine with twin variable camshaft timing (VCT). Designated Duratec Ti-VCT, it has improved torque characteristics compared to the basic 1.6-L unit, plus an extra 15 PS (11 kW) but around 5% better average fuel consumption. A redesigned cam cover houses Ford's VCT bridge, which is mounted to the front assembly. The vane-type variable cam system enables oil pressure to be optimized at all engine speeds. It has a shifting range of 50° on the intake side and 45° on the exhaust side. At low revs, the engine control unit leaves the cams in their default position. As engine speed increases, two oil-flow control valves adjust the cam timing for higher airflow. Torque is improved at high engine speeds, with a maximum of 155 N·m (114 lb·ft) achieved at 4150 rpm. At low engine speeds, the intake and exhaust valves are timed with small—at times even negative—overlap.

Other gasoline engines are a 1.4 L, the regular 1.6 L, and a 2.0 L with 145 PS (107 kW). There are two diesel engines with the option of a particulate filter. A Durashift CVT (continuously variable transmission) developed by Ford and ZF is offered on the 1.6-L TDCi (turbodiesel) engine and can be switched from fully automatic to "seven-speed manual" operation. It is also offered on the C-Max. Further transmission choices according to model are five- and six-speed manual and four-speed Durashift auto. The more powerful 136-PS (100-kW) 2.0-L TDCi engine gets the six-speed manual, the first Ford-manufactured six-speed transmission.

Ford not only had its new Focus at Paris but also sprang a surprise in the

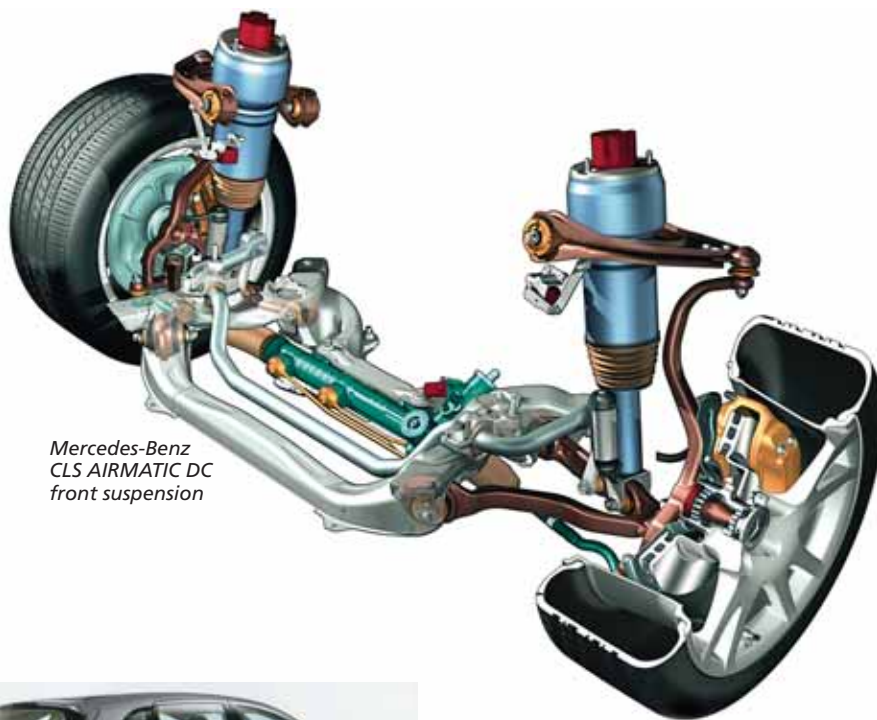
shape of the retractable hardtop Focus Vignale Concept with retractable hardtop. No confirmation was given that it might reach production, but at present it looks likely. (There was a cabriolet version of the Focus's predecessor, the long-running Escort.) Derrick Kuzack, Ford's European Vice President for Product Development, said at Paris that the new Focus "offers tremendous promise from which we can develop additional models." The Vignale may be one of them. Retractable hardtops have become *de rigueur* following the success of the two-seat Mercedes-Benz SLK introduced in 1996, but four-seat versions do bring their own challenges in terms of roof stowage and cost.

The Focus Vignale has a new-look radiator grille that may appear on other Ford models. Wheels are 20-in and the A-pillar angle is slightly steeper than that of the regular Focus hatchback, but the windshield is a carry-over item. The interior has been given leather and suede surfaces, while the seat backs have a ribbed effect that echoes mid-1960s American car designs. The car was designed at Ford's Dunton, UK facility and built by Stola in Italy.

"We want to show a hint of what direction Ford might go in terms of aesthetics; people want to see a car pass by and turn to look," said Ehab Kaoud, Chief Designer of the Vignale. The concept's wheelbase is the same as the regular Focus's. The front end is little changed apart from some work on headlamps and the new grille.

"So many cars that have a folding hardtop look clumsy because everything revolves around the base of the C-pillar," said Kaoud. "The whole roof has to disappear inside that area somehow, so mechanical elements and electronics have to be just right. What was important for us, was to make the car look as good as a coupe with the top up as it does with the top down. We are thinking Italian sports cars with this design, but with the structure of a German product. We started work on it in May." Ford owns the right to the Vignale name.

**Mercedes-Benz**—As a conflict in terms, the phrase "four-door coupe" is a classic example. But never let it be said that the international motor industry can be daunted by a dictionary definition that states that a coupe has only two doors. So Mercedes-Benz has not only founded



*Mercedes-Benz CLS AIRMATIC DC front suspension*



*Mercedes-Benz Vision B concept*



*European version of Mercedes-Benz Vision R*

a new model line with its four-door coupe CLS Class, but has also given the lexicologists something to ponder. What does not need any pondering is the likely success of the CLS, production of which is scheduled to reach at least 30,000 units next year. Shown as a concept at Frankfurt in 2003, it took less than a year from then to see it into production, which says much for Mercedes' adroit development but also underlines the fact that the company was convinced of its potential well before Frankfurt. Making extensive use of E-Class mechanicals worked wonders for the reduced lead time.

The CLS is really about aesthetics, despite the fact that it is equipped with most of Mercedes' latest technology and that a 5.5-L high-performance **AMG** ver-

sion is already in place. The car synthesizes sedan and coupe styling, but in general terms rear-seat space is reasonable and the car can justifiably claim to be a full four-seater. Front-seat space is abundant. The distance between front and rear seats is 829 mm (32.6 in), rear seat shoulder width is 1422 mm (56.0 in), and rear-seat elbow-level width is 1464 mm (57.6 in). Trunk space totals 505 L (17.8 ft<sup>3</sup>) by VDA measurements. The CLS is slightly larger than an E-Class—95 mm (3.7 in) longer and 51 mm (2.0 in) wider—with both cars having a wheelbase of 2854 mm (112.4 in). The CLS is 4913 mm (193.4 in) long, 1873 mm (73.7 in) wide, and 1381 mm (54.4 in) tall. Airmatic DC air suspension is standard on the CLS 500, optional on the 350. The CLS has a four-link suspension system at the front, a multilink at the rear.

Front and rear overhangs are pronounced, the windows are frameless, the waistline high, and shoulder line strong. The C-pillar blends into the rear quarters and trunk, giving the car an almost fast-back look when viewed from the front three-quarter position. The body shell is steel, with aluminum used for the front-end module, parcel shelf, and the panel behind the rear seats. Front- and rear-end modules are bolted to the structure, facilitating ease of replacement in the event of an accident without the need for ex-

tensive welding. High-strength steel makes up 47.5% by weight of the body shell. A dual-phase steel with two-phase microstructure is used for parts of the underbody and reinforcements around the bumpers and springs to provide high dynamic strength and resistance to "extremely high" loading forces.

A scratch-resistant clearcoat "based on nano-technology" is standard on the CLS, applied to both metallic and nonmetallic surfaces. The production system on the CLS integrates ceramic particles measuring less than a millionth of a millimeter into the molecular structure of the paint binder. They form a network during the drying phase, creating a very dense regular structure on the surface of the paintwork. The result is a three-fold increase in scratch resistance, claims Mercedes. The best CLS aerodynamic drag coefficient of 0.30 compares with an E-Class best of 0.26.

Initially, the regular CLS is available with two gasoline engines: a 3.5-L V6 with 200 kW (268 hp) giving 0-100 km/h (0-62 mph) in 7 s, and a 225-kW (302-hp) 5.0-L V8 with 0-100 km/h (0-62 mph) in 6.1 s. Both engines drive through Mercedes' 7G-TRONIC seven-speed gearbox. The CLS 55 AMG version has a supercharged 5.5-L V8 engine producing 350 kW (469 hp); AIRMATIC DC suspension tuned by AMG; AMG SPEEDSHIFT (with gear changes up to 35% quicker than standard) five-speed automatic transmission with steering wheel shift buttons; more powerful brakes; 18-in wheels; styling changes; and AMG sports seats. The CLS 55 AMG's performance potential includes 0-100 km/h (0-62 mph) in 4.7 s and 0-200 km/h (0-124 mph) in 16.1 s.

The CLS rack-and-pinion steering is higher geared than that of the E-Class, is positioned ahead of the center axis of the wheels, and helps to reduce any tendency to understeer. Electronic Stability Program (ESP) and Sensotronic Brake Control (SBC) are standard.

Safety elements of the CLS include bi-xenon headlights with a cornering light function and steering-dependent lighting. Other technology will include PRE-SAFE, a "precautionary" safety system that activates in anticipation of an impact, including moving the front seats to a safer position and tensioning the seatbelts. The windshield wiper system is unusual: The arm on the driver's side moves around a



*John Cooper Works Mini*



*Opel/Vauxhall  
Astra Sport Hatch  
Panorama*

fixed axis while the passenger side wiper executes an "additional lifting movement" to wipe an even larger area of the windshield. The system is described as using a reversing motor that periodically changes its direction of rotation, so driving the wipers on the reverse sweep. This means that the wiping frequency and intervals can be continuously varied according to need, either manually or with the help of the standard rain sensor. The wipers comprise a one-piece rubber section with an integral spoiler and externally mounted spring rails. Mercedes says this configuration brings better wiping quality and reduced noise.

Mercedes-Benz has extended its Sports Tourer family, revealing at the Paris Motor Show the Vision B Compact Sports Tourer based on A-Class technology, including its sandwich chassis construction with the engine positioned partially beneath the passenger cell. It joins the Vision R Grand Sports Tourer, the European version of which also appeared at Paris. Both cars have turbodiesel engines, the Vision R's a newly developed V6 with particulate filter putting out 160 kW (215 hp) with 510 N·m (376 lb·ft) from 1800 rpm. Combined fuel consumption is 9.0 L/100 km. The Compact Sports Tourer has a four-cylinder also with a particulate filter producing 103 kW (138 hp) and 300 N·m (221 lb·ft), with combined fuel consumption of less than 6.0 L/100 km.

The "Euro Vision" R differs from the U.S. version in having a 235 mm (9.3 in)

shorter wheelbase at 2980 mm (117.3 in), with other variations including the seating. The Euro version is a 4+2 configuration rather than the full six seats in the car designated for the U.S. Passengers have single, individual seats. The car has all-wheel drive and air suspension and its gearbox is Mercedes' 7G-TRONIC.

Mercedes' Sports Tourer concept show cars were finished in a new type of exterior paint. The extremely shiny, high luminance finish is the result of a newly developed and highly sophisticated process that the Stuttgart brand intends to develop to series production. Called ALU-BEAM, Mercedes explains that, although conventional metallic paints have 100 to 300 nm (12 µin) pigments to create the metallic effect, the newly developed finish has only 30 to 50. This is said to help the pigments integrate with the surface more evenly, resulting in more light reflection and a more "glossy" effect.

**Mini**—BMW's supercharged Mini Cooper S is now available with more power via a new John Cooper Works tuning kit, which ups the output of the car's 1.6-L power unit to 154 kW (207 hp), providing a 0-100 km/h (0-62 mph) time of 6.6 s and a top speed of 230 km/h (143 mph). The kit, unveiled at the Paris Motor Show, is to be made available in all the markets into which the Cooper S is sold and is suitable for both hatchback and convertible versions.

Main improvements are gained by improving the engine's breathing above 4500 rpm, which involves the use of an extra air intake flap to reduce pressure losses in the intake system. New fuel injectors and engine management calibration are also part of the package. The kit complements improvements to the regular Cooper S introduced earlier this year including changes to the gear ratios of the car's **Getrag** gearbox. In-gear acceleration times for the Works kit include 5.4 s from 50 to 75 mph (121 km/h) in fourth. CO<sub>2</sub> emissions are 207 g/km. The Cooper S with the latest Works Kit has undergone a 150,000-mi (240,000-km) test program. Cars fitted with an earlier Cooper Works kit can be upgraded to the latest specification. Both the new kit and the upgrade are fully approved by Mini, with warranty and "tlc" service pack unaffected.

Also announced at Paris was a new John Cooper sports suspension using



*Peugeot 907*



*Peugeot 1007 RC  
design study*

shorter and stiffer coil springs to lower ride height, with a new cross-brace in the engine compartment to reduce body vibration. A sports brake system includes larger discs. All accessories have been fully developed jointly by Cooper and Mini engineers. Cosmetic options include carbon-fiber interior trim items.

**Opel/Vauxhall**—The trend towards three-door cars achieving coupe-like profiles was continued at the Paris Motor Show by the Opel/Vauxhall Astra Sport Hatch (and to a lesser degree by the Ford Focus three-door). The most significant styling element is an optional "panoramic windshield," which extends from the trailing edge of the hood over the front seating position to the B-pillars with no header rail/crossbeam. "This makes driving through beautiful scenery or a brightly-lit city at night a really special experience," said designer Matthias Hallik.

Opel/Vauxhall says that the panorama windshield maintains the standards of the Astra's safety record, thanks to strong A- and B-pillars, an additional crossmember in the middle of the roof, and a sturdy floor assembly. The system adds some 10 kg (22 lb) to overall mass. The 1.8-m<sup>2</sup> (19.4-ft<sup>2</sup>) windshield uses 6 mm (0.2 in) thick laminated safety glass and is said to be shaped by an innovative gravity bending process. Selective points on the glass panel are heated so strongly in a special oven that gravity pulls it into the pre-defined shape. The glass is heat-absorbing and the car has two foldout sunblinds.

The Astra Sport Hatch will be available with a choice of four gasoline and three common-rail diesel engines with power outputs ranging from 90 to 170 bhp (67 to 127 kW). A 230-bhp (172-kW) VXR variant will follow soon. Options include a networked chassis with electronic



Porsche Boxster



Renault Modus



Porsche Boxster S  
3.2-L engine

Continuous Damping Control (CDC) and steering-linked AFL (Adaptive Forward Lighting) headlamps.

The Astra Sport Hatch is built in Opel's Antwerp, Belgium facility, alongside five-door and wagon variants. Planned annual capacity of the three-door is 70,000 units.

**Peugeot**—Peugeot may not be immediately associated with supercars, but at the Paris Motor Show it unveiled its 907 GT concept with 6.0-L V12 engine putting out 500 bhp (373 kW). Like other

manufacturers anxious to achieve greater product identification and not concerned about flouting general European tastes for understatement, Peugeot is playing the radiator grille game. Its 407 has an enormous intake and the 907 enlarges on the theme. The car's mighty engine is placed longitudinally behind the front axle and its sequentially controlled six-speed gearbox ahead of the rear axle. Like those of other supercars including the Mercedes-McClaren SLR, the exhausts exit behind the front wheels. Bodywork is

carbon-fiber composite on a 2.5-m (8.2-ft) wheelbase. The cockpit is all luxury, with extensive use of leather. The steering wheel is wood-rimmed. Nose treatment apart, the car has distinctive styling echoes of exotic 1960s GTs that were not entirely French.

Peugeot also took along its 1007 city car to Paris. Derived from detailed analysis of customer demands and expectations, says the company, the car incorporates innovation only where it has a positive contribution to make including electric sliding doors and an interchangeable interior. Peugeot had 16 1007s on its stand at Paris, including a 140-bhp (104 kW) 1007 RC with 18-in wheels described as a "study in style."

Another Peugeot concept was the Quark, which even Peugeot admits "looks like a work of science fiction." It has fuel-cell technology driving an electric motor in each wheel. It is 2.38 m (7.8 ft) long, 1.5 m (4.9 ft) wide, and has a range of 80 mi (130 km).

**Porsche**—It may not look greatly different from its predecessor, but the new Porsche Boxster shown at Paris demonstrates the meaning of the phrase "automotive evolution." Although about 80% of the car is new or revised, Porsche said it saw no need to change the looks of the Boxster, which has been in production for eight years. But its styling has now undergone subtle changes with different lights, large frontal intakes, more "muscular" wheel arches, larger wheels, and a reshaped folding roof. The car's aerodynamic drag coefficient is improved by 0.02 to achieve 0.29.

The 2.7-L engine's output has been upped 8 kW (11 hp) to 176 kW (236 hp) for a 0-100 km/h (0-62 mph) time of 6.2 s and a top speed of 256 km/h (159 mph). Its five-speed gearbox has shorter throws and better synchromesh. The 3.2-L Boxster S's power rises from 191 to 206 kW (256 to 276 hp); this version gets to 100 km/h in 5.5 s and top speed is 268 km/h (167 mph).

Chassis changes include a wider track and larger wheels. Porsche Active Suspension Management (PASM) is an option and Porsche Stability Management (PSM) standard. The cross-drilled and inner-vented brake discs are enlarged, with ceramic brake discs of 350-mm (13.8-in) diameter on each wheel an option for the S. Variable-ratio rack-and-pinion steering is fitted, and the steering wheel is



Volvo XC90 and V8 engine

adjustable for height and reach. A little more space has been found in the cockpit, and taller drivers will now find sufficient adjustment.

Safety aspects include what Porsche is claiming as the world's first roadster to protect driver and passenger against side impact via a head airbag. Combined with a thorax airbag housed on the outer side of the seat backrest, the airbag comes out of the door sill. The interior uses slush technology to soften its feel, and there is extensive use of leather and aluminum. Seats are new and include an adaptive sports design with individual adjustment of the side supports of the cushion and backrest.

**Renault**—Renault's little Modus supermini hatchback has received a five star rating from Euro NCAP crash tests, making it Renault's seventh vehicle to achieve the top rating. The car is described as a higher-range alternative to the Twingo and Clio. It was designed to give the space efficiency of an MPV but within modest overall dimensions. It is 3792 mm (149.3 in) long; 1960 mm (77.2 in) wide including door mirrors; and 1589 mm tall (62.6 in). Its wheelbase is 2482 mm (97.7 in). It has a sliding back seat and specially designed cycle rack, which can be mounted or removed quickly by sliding its fixtures into, or out of, forks screwed into the rear chassis. It can carry two-adult-size bicycles but allows access to the trunk. When folded, the rack fits into the luggage compartment.

Modus is the first Renault to use Alliance platform B jointly developed by Renault and **Nissan**. Suspension is a development of that fitted to the Megane II. There are MacPherson struts at the front with L-shaped lower arms. The front suspension is mounted on a "filtered" sub-

frame, which is designed to reduce vibration. The Nissan Micra has something similar. Rear suspension includes a programmed-deflection torsion beam, coil springs, and an anti-roll bar. Electric variable-powered steering is fitted, with a turning circle between curbs of 9.9 m (32.5 ft).

Renault says that resonance has been reduced by stiffening the junction between the nose structure and the cabin by using two crossmembers. With the same objective, the front longerons terminate in a scuttle crossmember connecting the front pillars, and the cabin structure is further stabilized by additional crossmembers. Electronic technology includes **Bosch** 8.0 ABS-EBD, and the car is available with new-generation ESP with understeer control and a tire-pressure-monitoring system. Options include cornering lights, a first in this class. It has six airbags.

A choice of gasoline and diesel engines is offered for the Modus. Gearboxes are five-speed types with cable shifting adapted from the Megane II. A four-speed auto is an option with a 1.6-L gasoline engine. Service intervals are up to 18,000 mi (29,000 km) or two years, and 95% of the car by weight can be recycled.

The Modus can be specified with a large, twin-panel glass sunroof or a detachable double roof with side-by-side panels.

**Volvo**—Volvo unveiled its first V8 model at the Paris Motor Show. The XC90 SUV gets a 232-kW (311-hp) 4.4-L engine built by **Yamaha** specifically for the car. It is a narrow-angle (60°), balance-shafted transversely installed unit that fits the original car's crumple-zone configuration. The engine—which is likely

to be used in future Volvos, notably the S80—produces 440 N·m (325 lb·ft) at 3900 rpm. It is claimed to be the first launch of a gasoline V8 meeting ULEV II levels.

Contributing to the compact packaging is the fitting of ancillary units, including alternator, directly to the engine. The starter motor is fitted above the transmission. Secondary chains running off the inlet camshafts drive the exhaust camshafts, a configuration which also saves space. The left-hand cylinder bank is offset half a cylinder ahead of the right bank—contradicting normal practice in the automotive world—so that the engine can slot neatly into the structural beam network of the XC90 and thus enhance collision safety. The variable-valve-timed aluminum engine is 754 mm (29.7 in) long and 635 mm (25.0 in) wide, and has a mass of 190 kg (420 lb). It has four catalytic converters, two close-coupled (one to each exhaust manifold) and two fitted under the floor. To enhance low-end torque, a valve fitted in the inlet manifold is closed below 3200 rpm to cut off airflow between the two cylinder banks to support a broader and more even torque curve.

Performance figures include a 0-100 km/h (0-62 mph) time of 7.3 s and a top speed of 210 km/h (130 mph). Preliminary figures indicate a composite fuel consumption of about 13 L/100 km. The engine is said to have a "charismatic off-beat burble."

The engine drives through a six-speed **Aisin Warner** automatic transmission and has all-wheel drive (AWD) with Instant Traction—also said to be a world-first. The six-speed Geartronic transmission has a manual mode. The car's Instant Traction system, developed by **Haldex**, is designed to improve quick stepoffs and enhances traction on slippery surfaces.

"A nonreturn valve allows us to use software to control the base torque that is programmed into the AWD system," stated Jörgen Svensson, Chief Program Engineer. "When starting off, 80 N·m of torque is precharged in the system since the nonreturn valve prevents the unit from becoming totally drained of hydraulic fluid. This reduces the usual wheel spin of about one-seventh of a turn that the current system permits before the power is delivered to the rear wheels."