Frankfurt preview

Maserati, **Smart**, **BMW**, and **Porsche** were among the companies raising the corner of the drapes around their new models prior to the Frankfurt Motor Show.

The Maserati Quattroporte (four door) has been styled by **Pininfarina** and will have a 400-hp (298-kW) V8 engine. Few details had been released as we closed for press, but length is 5052 mm (198.9 in), width 1895 mm (74.6 in), height 1438 mm (56.6 in), and the car is built on a 3064-mm (120.6-in) wheelbase. There is an aesthetic affinity with Maserati's coupe, but the new car has a distinctive, if restrained, style of its own. It is 40 years this year since Maserati created its first Quattroporte.

Maserati's new Quattroporte has a 400-hp (298-kW) V8.

Smart's new forfour shares its platform with Mitsubishi.

The BMW X3 has xDrive intelligent all-wheel drive and a wide choice of engines.

Another new four/five-door following on a two-door is the cleverly named Smart forfour. Electronic Stability Program and disc brakes to all wheels are standard. Mass is less than 1000 kg (2200 lb) for a 12.2-kg/kW (20-lb/hp) ratio similar to that of the Smart roadster. It has a conventional five-speed manual gearbox as standard, which should be a vast improvement over the robotized six-speed of the Smart city coupe and roadster, although that system is an option on the forfour. There is a choice of a plastic roof, a panorama glass type, or an electric glass sunroof. Built in collaboration with **Mitsubishi** off a common platform, it comes with a 1.1-1.5 L diesel and gasoline engine range, the former from **DaimlerChrysler**, the latter from Mitsubishi.

BMW's X3 has hardly been a best kept secret, but now it is official. It has "intelligent" all-wheel drive, hill descent control, optional trailer stability control, plus a wide choice of engines including a six-cylinder 3.0-L gasoline unit producing 231 hp (172 kW) and a 3.0-L turbodiesel with 204 hp (152 kW) and 410 N•m (302 lb•ft). Called xDrive, the car's electrohydraulically controlled all-wheel-drive system is described as being "fully adjustable and infinitely variable," feeding optimum torque to the axle that most requires it. It also counters understeer and oversteer on metalled surfaces. The X3 has DSC (Dynamic Stability Control), although the system is said to interfere much later and is required less frequently than earlier generations of the system. As with other new BMW arrivals, notably the Z4, the X3 uses concave and convex surfaces and "Hofmeister kink" styling for the rear side windows. The traditional double kidney grille gets a similar snarling look to that of the Z4.

Also making its debut is the new BMW 6 Series coupe, initially in 645Ci form. It is the first 6 Series since 1989. The styling is as distinctive as that of the

Thirty years after the first Porsche 911 RS comes the GT3 RS.

Distinctive styling marks BMW's new 6 Series.

latest 7 Series, 5 Series, and Z4, and there is a panorama roof option. Engine is a 4.4-L V8 using Valvetronic technology and producing 333 hp (248 kW) with 450 N•m (332 lb•ft) at 3600 rpm. Transmission choice includes a Sequential Manual Gearbox (SMG) with steering-wheel shift paddles. The car has a mass of 1600 kg (3520 lb) and incorporates a combination of materials, including aluminum (hood, doors, and the entire front body structure), synthetics (front fenders are thermoplastic and the trunk lid is sheet molding compound), and steel. Active steering uses a stepper motor to vary ratio according to speed. Run-flat tires are standard. A convertible 6 Series will follow next year.

Another new arrival timed for Frankfurt is the Porsche 911 GT3, a homologation model that will serve as the basis for motorsport. The classic RS was the 2.7-L introduced in 1972. The

Circle 310

mass-to-power ratio of the latest car is 4.86 kg/kW (7.98 lb/hp), a 4% improvement on the Club Sport version of the GT3. The new car is 50 kg (110 lb) lighter, having a mass of 1360 kg (2990 lb) with 90 L (23.8 gal) of fuel on board. Its 3.6-L engine develops 280 kW (375 hp) at 7300 rpm, but it can rev to 8200 rpm. An air collector positioned beneath the rear wing uses pressure buildup to supply extra intake air to the engine at high speeds, says Porsche. Performance figures include 0-100 km/h (0-62 mph) in 4.4 s, 0-200 km/h (0-124 mph) in 14 s, and a top speed of 306 km/h (190 mph). The car uses a single mass flywheel. A close-ratio six-speed gearbox is standard.

Stuart Birch

Driving Chrysler's concepts

There are times when automotive engineering moves in a direction that seems barely credible. What, you may wonder, is the point of investing research and development money in creating a four-wheel, single-seat motorcycle capable of reaching at least 250 mph (400 km/h)—and possibly more than 300 mph (480 km/h), powered by a V10 car engine producing 500 hp (373 kW), and that might sell for the best part of a quarter of a million dollars? **Chrysler** thinks there are some very good reasons for doing so, which is why it sanctioned the **Dodge** Tomahawk concept, one of the world's most outrageous vehicles.

Those reasons range from pushing the design envelope to achieving a public relations coup.

But as unlikely as this and some other Chrysler concept creations may seem, the company is sufficiently confident in its technological and aesthetic direction that each year it allows a small number

Tomahawk Product Designer, Mark Walters (left), describes the salient technology points of the four-wheel Dodge Tomahawk—an 8.3-L, 500-hp (373-kW) motorcycle—to AEI European Editor, Stuart Birch.

Could the Chrysler Airflite make it to production like the Crossfire two-seater?

of international journalists to drive them—some of which point the way to future production models. In addition to the Tomahawk, this year's lineup included the Dodge Avenger and Kahuna, the Chrysler California Cruiser and Airflite, the **Jeep** Grand Cherokee Concierge, and the Chrysler 300M IT-Edition technology demonstrator.

Sensibly, Chrysler did not allow journalists to wield the Tomahawk. "But you can sit astride it and get the feel of what it is all about," said Product Designer Mark Walters. It was about weight and power and sheer bravery on the part of the company to design and build it and anyone who might buy it if limited production (perhaps a run of 50 to 100 units) becomes a reality.

"We have seen about 85 mph from it," said Walters, who is based in **DaimlerChrysler**'s (DCX) Advanced Design studio in Auburn Hills, MI. The Tomahawk started life in the minds of two employees at DCX. They thought of using a Dodge Viper engine for a motorcycle and took the idea to Vice President level of the design department and said that such a vehicle would provide access to a new market. Chrysler agreed and the project went to **RM Motorsports**, a small company in Wixom, MI. "I went there, taking

along my computer, and together we created the Tomahawk. The sheer physical bulk of the Viper engine made packaging by far the greatest challenge. As a result, the Tomahawk has no chassis—it just uses the robustness of the Viper engine as a sort of backbone off which everything is hung," said Walters.

That engine displaces 8.3 L, and to match its 500 hp (373 kW), there is 525 lb•ft (712 N•m) of torque. For the Tomahawk, the powerplant has dry-sump lubrication to lower it, and the intake manifold and fuel-injection system have been moved outboard to accommodate radiators. The cooling system includes use of a **Porsche** 911 Turbo's fan, which is driven by a toothed belt at 1.5 times crankshaft speed. It draws air into what Walters describes as a "box" positioned where the gas tank of a regular motorcycle would normally be placed. The air is then forced around two aluminum radiators each measuring 8 x 18 in (200 x 460 mm), and arranged in a pent roof inverted V, between the two banks of cylinders. The air is diffused through the walls of the radiators and passes out beneath the rear tires.

The Dodge Kahuna has a "woody" image and a huge roof opening system.

The Tomahawk's exhaust system has no baffles and makes a raucous sound quite different from that of the Viper. The fuel tank holds 3.25 gal (12.3 L), and the Tomahawk will manage 18 mpg if driven gently; probably about 4 mpg if not, said Walters. Brakes use 16 pistons at the front, eight at the rear. Perimeter-mounted discs are used, with calipers mounted from the inside to maximize the overall mechanical advantage. Tires are by **Dunlop**, the tread of which imitates the appearance of a printed circuit board. Drive is via twin chains. There is a two-speed gearbox with straight-cut gears. Four-wheel independent suspension is fitted, with the wheels making a "scissor action" to allow lean through corners, although it is not a knee-down machine. Mass is 1490 lb (675 kg).

"At present, it is geared for 120 mph," said Walters. "With appropriate gearing, it might reach 250 mph." As for the possibility of achieving greater than

300 mph (480 km/h), I suspect that traveling by air might be a more sensible way to complete a journey.

Also more sensible is the Chrysler 300M-IT, a rolling technology demonstrator used to carry systems developed at Massachusetts Institute of Technology (**MIT**). Professor Ted Selker of MIT's Media Laboratory said that every six months a new student is allowed to use the car to test novel systems.

As tested by *AEI*, its technology included a sensor-driven system that gave the driver positive or negative reaction to driving techniques. Brake hard and the car's speaker system booms, "Brake gently." Jab the accelerator and the driver is told, "Easy on the gas." Warning vibrations are sent through steering wheel, pedals, and driver seat cushion. The system is called Car Coach (Coach as in trainer). Said Selker, "It is controlled by two levers: affirmation is green, criticism is red, and these control the frequency and intensity of the feedback to driving techniques." At the end of a journey, the driver may get a green or red light depending on graded behavior. This *AEI* editor got a red, which demonstrated my level of irritation. The concept is aimed at improving driving skills and safety; the subtle vibrations might be acceptable, the voice might not.

The Chrysler California Cruiser has a "chopped top" look.

Eye movements have long been an interesting line of automotive safety research into detecting the possible onset of sleep or the effects of alcohol. MIT knows all about that, but is doing some lateral thinking on positive application of blinking for a purpose; one possibility is for radio tuning—two blinks for a favorite news station, three for classic music, four for pop, *etc*. Another, perhaps more pragmatic system sets taillights flashing when the driver stops and is about to open an offside door; the flashing lights are to warn any overtaking cyclists or motorcyclists to beware.

The other Chrysler concepts were mainly demonstrators of styling and materials use. The Chrysler Airflite, which as revealed at this year's Geneva Motor Show, has clear visual cues to the Crossfire two-seat coupe, although Product Designer Greg Howell said there was actually little direct carry over. Airflite designers looked at 1940s air travel and **Riva** boats for themes. The car has a 116-in (2945-mm) wheelbase and uses an LX drivetrain with V6 engine and a very sporty exhaust note.

Large sunroofs were a distinct theme on the company's designs. On the Dodge Kahuna, the roof system opens from B-pillar to rear bumper. All exterior windows are frameless and retract totally into the doors. The chopped-top California Cruiser has a large sunroof and converts quickly for open-air motoring—"eight panels of glass lower or pivot," says Chrysler.

Stuart Birch

Seat builds a racer

The **Seat** Cupra GT racer prototype, unveiled at the Barcelona Motor Show as a technology demonstrator for the company's design and engineering capability, will be developed as a competition car, although a road-going version looks possible. Powered by a mid-mounted 3.0-L V6 **Audi**-based bi-turbo engine producing over 500 hp (373 kW), top speed is an estimated 295 km/h (183 mph), with a 0-100 km/h (0-62 mph) time of 4.2 s. Maximum torque is 600 N•m (443 lb•ft) at 5250 rpm. The car has a six-speed sequential gearbox and a suspension that includes **Ohlins** dampers. Body and chassis are carbon fiber, and light alloy tubing is used for enhanced rigidity. At the front, an arch formed by the dashboard beam and windshield frame reinforces the subframe. The car, which has gullwing doors, has some design cues from the Salsa concept seen at international motor shows and styled by Walter de'Silva.

Though slated for competition use, there could be a road-going version of the Seat Cupra GT.

Stuart Birch

Cranfield's "third way" car

A projected medium-volume car having ultra-low fuel consumption and emissions capabilities, mixing advanced materials with a conventional powertrain, has been built in prototype form by **Cranfield University** in the UK. Its name, Aerocarbon, indicates the two main technologies (aerodynamics and carbon fiber) that it incorporates. The design uses what the University's Associate Professor, Steve Cousins, calls the "third way," as an alternative to hydrogen fuel-cell or hybrid technologies, to achieve a step-change in passenger vehicle efficiency. The essence of the design is the combination of a very light yet strong structure with a low-drag shape.

Performance predictions for the Aerocarbon include a fuel consumption of about 2.8 L/100 km (84 mpg) and a 144-km/h (89-mph) top speed. It is powered by a three-cylinder 660-cm^3, 40-hp (30-kW) **Honda** engine driving through a five-speed manual gearbox. An exceptionally low drag coefficient of 0.23 has been confirmed by wind tunnel tests. Cousins believes it has potential for further development to below 0.20. Historically, 0.25 has been regarded as the lower limit for aesthetically acceptable production car designs. Studies show that this low-power route to affordable economy is desired by a significant proportion of the relevant consumer group in Europe, said Cousins.

Cranfield University's Aerocarbon is meant to be an alternative to fuel-cell or hybrid cars.

Cranfield's four-seat car is built on a structural frame of a new carbon-fiber-based material called Coretex. Although carbon fiber is still generally regarded as an exotic technology more suitable for racing and supercars, Cousins says that it is now becoming economically competitive for medium volume production of a road car. Increased supply has brought down the cost of the raw material, and researchers at Cranfield are developing a robotic assembly system for the Aerocarbon's spaceframe that will, they believe, allow manufacture in quantity at a competitive cost.

The Coretex spaceframe is very stiff (15,000 N•m/° [11,000 lb•ft/°]), said Cousins, and has good impact energy absorption characteristics. Its crashworthiness has been tested on rigs at Cranfield's Impact Center, which is regularly used by mainstream car manufacturers and the Formula One motor racing industry. Safety is further enhanced by its low flammability; the material is said to be "self-extinguishing" in the event of a fire.

Because it is so new, Cousins and his team are now working to fully assess the crashworthiness of Coretex and are developing repair techniques.

Planned European recycling legislation constrains the use of carbon materials to either the spaceframe or outer skin panels of a car, but not both on the same vehicle, he explained. The Aerocarbon's outer panels are therefore of recyclable plastics. The Coretex fibers can also be recycled using what Cousins described as "a special thermal process."

The spaceframe is made up of braided carbon fibers combined with "innovative core materials" in a matrix of epoxy resin that is infused under vacuum to form multicellular beams, which have "high impact absorption properties." The production process uses continuous feedstock, with additional reinforcement being added where required. The production rate is essentially limited by the cure.

"This stands to become quite a major manufacturing technology," said Cousins. "We are developing all the aspects involved in bringing it to market, including a manufacturing technology to mass-produce vehicle spaceframes in volumes of about 20,000 a year. This is a very scaleable concept that enables extra production units to be added very cheaply in response to growth in product demand."

An experimental "micro-factory" has been established in Cranfield's Center for Lightweight Composites. A robot supplied by one of the project's industrial partners has the potential to produce some 3000 Aerocarbon spaceframes a year.

The spaceframe has a mass of 80 kg (176 lb). The body mounted to this scales 140 kg (309 lb), and the total empty vehicle mass is 600 kg (1320 lb)—about half that of a steel equivalent. The Aerocarbon uses conventional running gear; the first prototype is based on **Lotus** Elise suspension. Because of its light weight, crosswind stability has been an important consideration, and the body incorporates aerodynamic features to reduce this, including roof edge strakes, hood air intakes, and a "perforated rear body." This work has been carried out in collaboration with UK aerodynamics specialist company **Apecs**.

The Aerocarbon car is the first concept vehicle to be produced under the UK government's Foresight Vehicle program. The overall program has involved most of the UK's major manufacturers and suppliers, plus many academic institutions and research organizations, in collaborative projects to develop future private transport technologies.

Stuart Birch