SGL Carbon and Porsche collaborate on ceramic brakes

Series production has begun of Porsche's ceramic composite brake (PCCB) for the 911 Turbo. Details of the brakes, which use carbon-fiber-reinforced silicon carbide, were revealed by *AEI* earlier this year. They have been developed in collaboration with materials specialist SGL Carbon AG of Wiesbaden, Germany. At the Paris Motor Show, Porsche said the new brake disc had undergone an extensive test program at the SGL Carbon plant before the start of series production. Porsche expects that about 15% of all 911 Turbos that leave the plant in Zuffenhausen will be equipped with PCCB in the near future.

Fitted to all wheels, the PCCB is made from SIGRASIC, a ceramic material specially optimized for use on the 911. Life of the material is put typically at 300,000 km (186,000 mi). The PCCB is perforated and internally ventilated. Dimensions differ only marginally from regular discs, but the ceramic disc is more than 50% lighter to make a significant contribution to unsprung weight.

The 911 Turbo is the first Porsche sports car to be fitted with a ceramic composite brake disc.

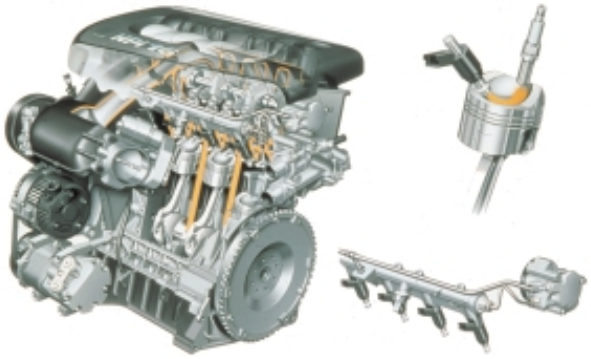
Porsche's ceramic composite brake (PCCB) is now in series production.

Stuart Birch

Interesting? Circle 172
Not interesting? Circle 173

High-pressure fuel injection by PSA

PSA Peugeot Citroen says its new high-pressure direct-injection gasoline engine, called the HPi, is the first in Europe to feature lean-burn, stratified-charge technology. The 2.0-L engine was developed in-house by the French company over a period of more than 30 months for about $62 million. It will be introduced in the second quarter of 2001 in the Peugot 406 and the Citroen Xantia.

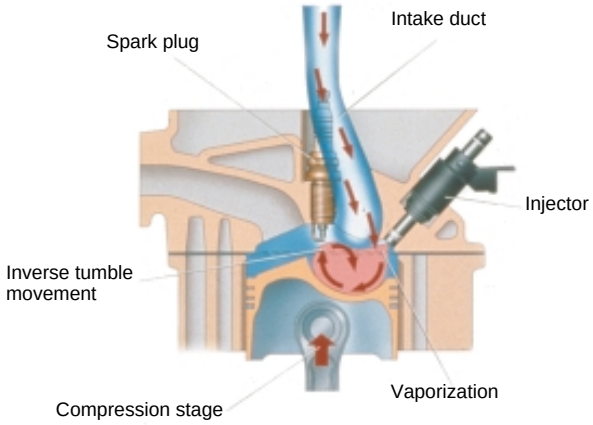


This cutaway of PSA Peugeot Citroen's HPi engine highlights its fuel-injection system components.

Lean stratified-charge mode operates at engine speeds of up to 3500 rpm — urban driving conditions or at moderate speeds on the open road. At high speeds, the engine runs in stoichiometric mode. Stratified-charge technology involves concentrating an inflammable air/gas mixture in the vicinity of the spark plug, then filling the rest of the combustion chamber with air. Intake must be closely matched to engine speed and requires precise fuel injection directly into the combustion chamber.

The high-pressure injection pump was developed through a joint venture with Siemens. The pump supplies an injection pressure between 3 and 10 MPa (435 and 1450 psi), compared with 350 kPa (51 psi) on a conventional gasoline engine.

The high injection pressure and lean fuel mix that can be used with a stratified charge substantially reduces the amount of fuel required for combustion and thus achieves significant fuel



This schematic illustrates the HPi engine's combustion process.

savings. Owing to the excess air in the combustion mix, however, the exhaust gas contains far more oxygen than found with a conventional engine. Special measures are required to reduce emissions of nitrogen oxides (NOx). PSA developed a sequential NOx treatment system based on a storage-release principle.

CO_2 emissions are reduced substantially, in proportion with the 19% fuel-consumption reduction (on the regulatory driving cycle test) over the previous-generation XU 2.0-L engine and a 10% reduction over the more recent DW 2.0-L indirect-injection engine. On an urban driving cycle, fuel economy is improved by 21 and 11%, respectively, over XU and DW figures.

The engine power rating is 103 kW (138 hp). With 170 N·m (125 lb·ft) of torque available at 2000 rpm, engine response at low speed is improved 9.6% over the XU and 3.6% over EW.

The HPi engine marks the latest step in an ambitious engine development program initiated by PSA in 1998 with the HDi high-pressure common-rail diesel engine. The HPi will be manufactured at the Tremery engine plant in eastern France's Moselle region at a rate of 200 units / day.

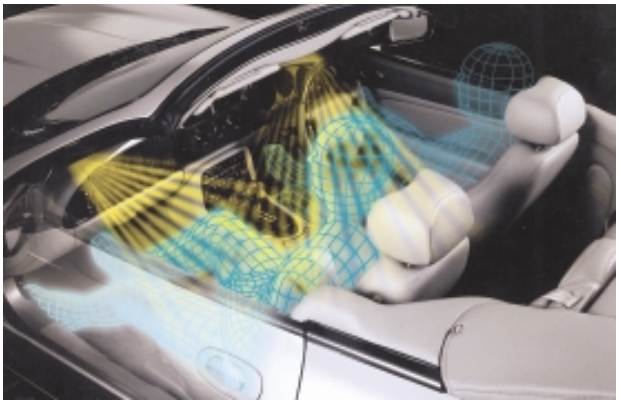
Patrick Ponticel

Interesting? Circle 174
Not interesting? Circle 175

Smarter airbags from Jaguar

Jaguar has introduced a new ultrasonic-based occupant sensing system to monitor the position of the front passenger in its 2001 XK Series sports models (unveiled at the Paris Motor Show) to reduce the risk of airbag-related injuries due to inappropriate deployment. Jaguar says the system benefits particularly smaller front-seat occupants who tend to run a high risk of airbag-related injury. It also senses whether a passenger is too close to the airbag deployment area because he or she is, perhaps, leaning forward to pick up an item from the floor or reaching inside the glove compartment. If that happens, a light on the dashboard warns that the airbag is inert. As soon as the passenger moves far enough away from the dashboard, the airbag becomes active again and the light extinguishes.

Called the Adaptive Restraint Technology System (ARTS), it not only uses ultrasonic sensors to monitor the position of the front passenger, but also incorporates other sensors to detect the passenger's weight, the position of the driver in relation to the steering wheel, seatbelt usage, and the severity of impact in the event of a crash. According to Jaguar, the system is tailored to the individual needs of each front-seat occupant and the specific characteristics of an impact. On the driver's side, a seat track position sensor provides information on how close the driver is to the steering wheel. From a financial angle, Jaguar says the system will reduce repair costs due to unnecessary airbag deployment, notably when the passenger seat is unoccupied, and also in low-impact collisions when the occupants are wearing seatbelts.



Jaguar's XK sports cars now have an Adaptive Restraint Technology System (ARTS).

Four ultrasonic sensors are positioned in the A- and B-pillars and in a roof console to determine the presence and position of the front-seat passenger's head and upper torso in relation to the passenger airbag deployment door. The ultrasonic sensors primarily monitor the position of the passenger's head and torso, rather than arms and hands, since their proximity to the airbag deployment door is the crucial factor to whether the airbag should be deployed.

A central processor that uses artificial neural network technology monitors and analyzes continuously information from the sensors about the position of people in the front seat of the vehicle. In the event of a crash it assesses, and decides, if airbag deployment is necessary, and if so, the energy needed to ensure protection.

Silicone is used for the weight sensor beneath the passenger seat. This detects distributed pressure and, together with the occupant sensing neural system, informs the processor of the approximate weight of the passenger. Seat-buckle switches inform the processor as to whether occupants are using seatbelts. This information is also crucial to decide what mode of airbag deployment is optimal.

The airbags have three parameters: no deployment, first stage, and second stage. The twin output inflator on the passenger side replaces traditional pyrotechnic systems and is a development of Jaguar's heated gas inflator technology. It uses nontoxic gas, the residue of which becomes mainly water vapor on release. The driver airbag is packed in a star pattern to provide radial deployment to help reduce injury

to those seated too near the steering wheel. Jaguar says the development of the ARTS system called for an advanced programming technique that tested more than half a million scenarios based on occupant position, seatbelt use, and impact severity. The XK's bodyshell has been modified with reinforced side members that give greater crash protection rigidity and also facilitate the positioning of crash sensors for faster impact detection.

Other changes for the 2001 XK Series include improved seatbelts. Both front seatbelts have an electrically operated, dual-stage spring system that reduces the force exerted on chest and shoulder during normal driving. The system contains both a "comfort" spring and a stronger "retraction" spring. When the seatbelt webbing is pulled out prior to buckling, the retraction spring operates. Once the buckle tongue is inserted in the buckle, an electrical circuit is completed, and a solenoid switch operates the comfort spring to reduce the amount of force on the webbing, which in turn allows the belt to rest more comfortably across the chest and shoulder. Releasing the buckle allows the retraction spring to operate.

The supercharged Jaguar XKR Coupe uses ARTS for added safety.

Stuart Birch

Interesting? Circle 176
Not interesting? Circle 177

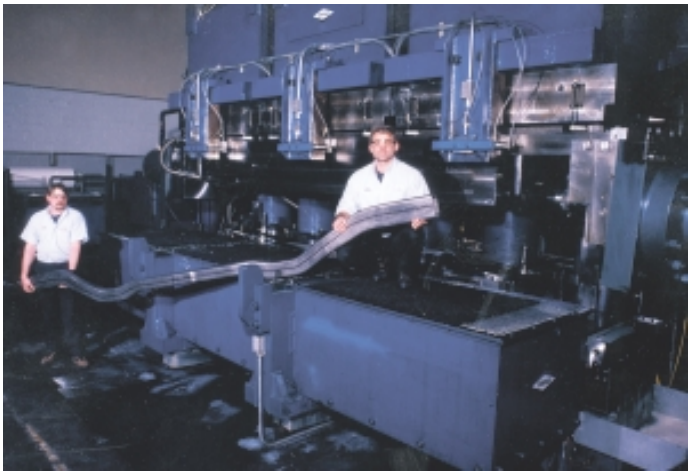
Dana's improved hydroforming technology

Dana Corp. has developed its own unique hydroform press, called RoboClamp, that enables the company to produce previously unmanufacturable designs. RoboClamp exerts twice the pressure of a typical hydroform press and was designed specifically for Dana's multi-pressure hydroforming process The result is lighter, stronger structural products, and new opportunities to develop further innovations in structural design and engineering.

Dana's Parish Structural Products Division developed the new press when it could not find one with all the desired capabilities it wanted. RoboClamp uses 10,000 t (11,000 ton) of force to shape metal tubes compared to most hydroform presses that exert 5000 t (5500 ton). RoboClamp also allows Dana to use its proprietary multi-pressure hydroforming process on a variety of structural products, including long side rails.

The hydroforming process was used with traditional hydroform presses at Dana's St Marys, Ontario, facility to create an engine cradle for the 1999 Ford Windstar. Hydroforming the engine cradle reduced component welds by 50% and component complexity by 30% compared to traditional stamped designs

"Dana's hydroforming offers a number of advantages to our customers," said Mike Greene, President of Structural Products. "In most cases, a single hydroformed part can be used to replace several stampings. The process also reduces weight, lowers manufacturing and maintenance costs, and optimizes strength and efficiency."



Dana's RoboClamp exerts twice the pressure of a typical hydroform press.

Dana has a working RoboClamp at its Reading, PA, facility and plans to build nearly a dozen others by 2003 for use in its structural facilities around the world. Dana has not announced on which vehicles the hydroforming technology will be used in the future, though it cites the spaceframe as a promising application. The spaceframe is a series of structural members assembled to create a skeletal system that supports interior systems as well as the exterior skin and driveline components of a vehicle.

Jean L. Broge

Interesting? Circle 178
Not interesting? Circle 179

Race engine revolution

Nearly nine hours of desert race time had elapsed at June's Baja 500 in Mexico. The modified 2001 Chevrolet TrailBlazer powered by an inline six-cylinder engine covered 709 km (441 mi). "It makes for a very long day," said Ed Keating, engine development engineer with GM Powertrain. But that seemingly endless day resulted in a victory.

A champion of every major off-road race in the U.S. and Mexico, veteran driver Larry Ragland dusted the V8-powered competitors from Ford, Toyota, and General Motors. (Private competitors entered GM V8-powered vehicles.) June's competition and July's Best In The Desert Nevada 2000 showed the durability of the new Vortec inline six-cylinder desert race engine.

"We've not had one minute of downtime with the vehicle because of the engine. Everything looked great. No wear issues. The thing was flawless," said Russ O'Blenes, program engineer for desert races.

The 5.0-L powerplant produces 447 kW (600 hp) at 7500 rpm and 610 N·m (450 lb·ft) of torque at 6000 rpm. In desert racing, the average vehicle speed is below 80 km/h (50 mph).

Speeds differ throughout the event from approximately 16 to 193 km/h (10 to 120 mph), according to Keating. "Drivers select the appropriate gear to keep the engine in an rpm range that provides the best opportunity for acceleration," he explained. "During much of this running below the top speed of the vehicle, the engine is at maximum power but cannot reach top speed due to the fact it is operating in deep sand. Under these conditions of wide-open throttle and full-power output, the engine will only propel the vehicle to a speed less than the maximum rpm allowable in top gear."

Modified Chevrolet Trailblazer Specifications

Structure:	Carbon-fiber body mounted on tube frame chassis
Engine:	Mid-engine 5.0-L inline six-cylinder built by Roush Industries
Transmission:	Hydra-Matic three-speed automatic
Suspension:	Dual wishbone (front), solid axle, trailing arm (rear)
Wheel travel:	660 mm (26 in) front/ 762 mm (30 in) rear
Shocks:	King Off Road Racing, one coil over and one external bypass per corner 457 mm (18 in) stroke
Springs:	Eibach
Brakes:	Brembo
Wheels:	Ultra 17 x 8
Tires:	BF Goodrich "Projects" 37 x 12.5-17
Steering:	GM Saginaw Recirculating Ball
Wheelbase:	3162 mm (124.5 in)
Track:	1873 mm (73.75 in) front/ 1797 mm (70.75 in) rear
Overall height:	1930 mm (76 in)
Overall width:	2260 mm (89 in)
Overall length:	5385 mm (212 in)
Weight:	2267 kg (5000 lb)

The Vortec off-road racing TrailBlazer, powered by a new inline six-cylinder engine, won the Baja 500 in Mexico. The new engine also powered a GMC Envoy to victory at the Pikes Peak International Hill Climb.

For the 5.0-L race engine, GM Powertrain modified the basic architecture of the all-new, all-aluminum Vortec 4200, the 4.2-L inline six-cylinder engine the company developed for three 2001 GM SUVs. The Vortec 4200 produces 200 kW (270 hp) at 6000 rpm and 373 N·m (275 lb·ft) of torque at 3600 rpm. "There's no single part that's applicable to both engines," said Keating, adding that "a good race engine would be a very poor production engine choice."

The engine's first prove-out beyond dynamometer tests happened during the race. Practice course runs are usually done in a substitute race vehicle equipped with a different engine and fitted with competition suspension. The vehicle driven in pre-runs has an enclosed, air-conditioned cockpit (race vehicles are windowless).

"The course is usually marked out about a month before the event, and the driver usually does pre-runs for three to five days, but you can't possibly pre-run enough to learn a 710-km (440-mi) course," said Keating in conveying the advantage of having a skilled driver.

"Our intent in the series was to prove that the basic inline six-cylinder dual-overhead camshaft engine configuration could compete and win against similarly modified V8s. We met every objective we had for this engine," Keating said, noting that the inline six excelled in four areas: fuel efficiency, power density (power per unit displacement), packaging, and smoothness. "We demonstrated those four things in the racing environment, and we'll do the same by demonstrating those four things in the production engine."

Kami Buchholz

Interesting? Circle 182
Not interesting? Circle 183

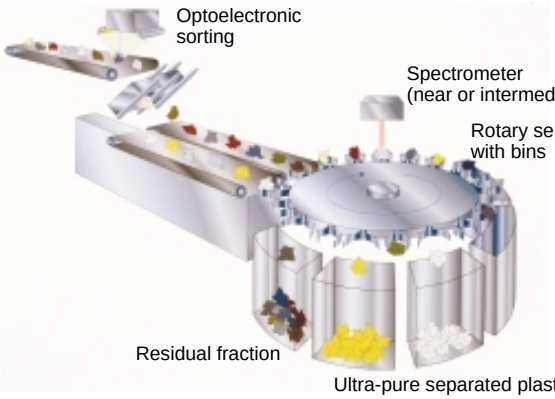
DC's separation and recovery

Recycling of materials is a continuing aim of auto manufacturers across the world, but it brings particular challenges. In Germany, DaimlerChrysler is developing a new process for the separation and recovery of the plastic content of end-of-life vehicles. The process uses infrared spectroscopy to identify and separate the various plastics in automotive shredder residue (ASR) with a degree of purity of over 99%. European Union law specifies that by 2015 at least 95% by weight of an end-of-life vehicle must be recoverable. According to DC, without an improvement in the recovery of plastics it would not be possible to meet that target using current processes alone.

Recycling plastics is not easy. At present, the "sink-float" process is used to separate different plastics by density. However, with very small densities it is extremely difficult to achieve the desired minimum separation target of 99% purity via density separation. DC says that while unalloyed plastics can be successfully separated, compounds and coatings present problems so serious that either incineration or placement in a landfill site are often the only solutions.

Because the proportion of plastics in vehicles is predicted to rise from the current average of 15% to about 25% by 2005, the situation presents major challenges. To meet them, DC and several other companies took part in a German government project to develop a new process for what it calls the "fractionation of the different plastics in ASR." The company reports that as a result of the new process, when the plastic content of end-of-life automobiles emerges from the shredder in what are commercially viable volumes, it can be sorted to a satisfactory level of purity. The design specifications for the process not only cover the ability to identify and separate the different types of plastic, but also set out the need for speed and reliability.

Concerning the recycling chain, the new process follows the dismantling of the vehicle and the shredding of the plastic content. The plastics are first pre-sorted by means of a special sensor. Two types of plastic are removed, and the blackened and non-blackened materials are separated. The two types are then segregated, using two spectrometers that can analyze plastics in the near- and intermediate-infrared spectra. By interconnecting the two spectrometers, the process becomes both effective and economical. DC says the process is based on the principle that each type of plastic has its own specific spectrum. This characteristic enables each to be analyzed accurately and assigned to the correct group. After the pre-sorting phase, the system decides automatically which plastics can be returned to the materials cycle and which are to be sent for thermal energy recovery.



DaimlerChrysler's new plastic sorting process for end-of-life cars.

Stuart Birch

Interesting? Circle 188
Not interesting? Circle 189

GM and ExxonMobil's fuel-cell collaboration

A gasoline fuel processor for fuel-cell vehicles has been developed through a joint venture between General Motors Corp. and Exxon Mobil Corp. The companies believe that the processor is a major breakthrough that will lead to greatly reduced emissions and improved fuel economy. GM plans a vehicle demonstration using this technology within 18 months.

The processor uses gasoline as a fuel to create a high-quality stream of hydrogen that powers a fuel cell. For consumers this means they will be able to fuel these new vehicles the same way they do for present cars. GM researchers and engineers believe that the gasoline processor is a key to achieving production fuel cells in this decade.

"The gasoline processor could be the bridge between today's conventional vehicles and tomorrow's hydrogen fuel-cell vehicles," said Harry J. Pearce, GM Vice Chairman. "While we view hydrogen as the future fuel for automotive applications, we have significant commercial challenges, such as designing and building a large number of hydrogen refueling stations, developing feasible onboard fuel tanks, and agreeing to industry-wide specifications."

GM and ExxonMobil said that the results of the three-year collaborative research program have allowed both companies' engineers to design, develop, build, and run a gasoline processor that exceeds 80% efficiency. By the end of this year, GM will demonstrate in a laboratory an integrated system with an advanced version of this processor and a GM fuel-cell stack producing 25 kW (34 hp).

GM selected the 25-kW (34-hp) system as a learning platform. The system approaches the overall efficiency requirements for automotive use and will foster development of future automotive and stationary fuel-cell systems. Peak fuel-cell-system efficiency is expected to achieve nearly 40% in this early generation design. As a reference, GM engineers cite this result as nearly twice the efficiency of today's vehicles for a typical drive cycle. The system will integrate GM's proprietary designs in gasoline processing and fuel-cell stacks.

"We've addressed an important technical challenge and accomplished what others thought wasn't possible," said Larry Burns, GM Vice President for Research & Development and Planning, in announcing the fuel-cell development in August at Traverse City, MI. "Consumers want practical solutions. Fuel cells based on gasoline make use of an existing infrastructure, and it means that cleaner, more efficient vehicles can be in consumers' hands within the next 10 years. This breakthrough demonstrates the power of collaboration between the petroleum and auto industries."

"Continuing to improve the performance of hydrocarbons in vehicle transportation systems is one of ExxonMobil's major business strategies and priorities," said Bill Innes, President of ExxonMobil Research and Engineering Company.

ExxonMobil and GM signed an agreement in 1998 to conduct research on hardware and fuel options for next-generation vehicles. The collaboration has resulted in several important breakthroughs to speed the development of a gasoline processor to provide hydrogen for a fuel-cell-powered vehicle. Other breakthroughs resulting from the ExxonMobil and GM research alliance include:

- A transient reactor unit that allows testing of gasoline processors from zero to full power and then test the quality of the generated hydrogen fuel.
- An advanced set of system dynamic models (computer code) to accelerate the development and testing of fuel-processor-system prototypes.
- Advanced models for coupling chemical kinetics and fluid dynamics that allow for detailed studies of processor / fuel interactions.
- Use of computational fluid dynamics (CFD) for the development and design of primary reactor inlet systems has resulted in significant improvements in reactor performance compared with early prototypes.
- ExxonMobil and GM have combined their knowledge of fuels and gasoline-processor-system design to accelerate prototype development, identify critical fuel properties, and aid in the selection of optimized combinations of fuel and processor that can increase efficiency and reduce size and complexity.

Burns said that the gasoline processor running today is GM's second-generation design, with a third planned shortly. With each generation, GM has reduced system size and weight while improving efficiency. The next generation GM fuel-cell system fueled by gasoline will be half the size and half the weight of the current generation.

Jean L. Broge

Interesting? Circle 192
Not interesting? Circle 193

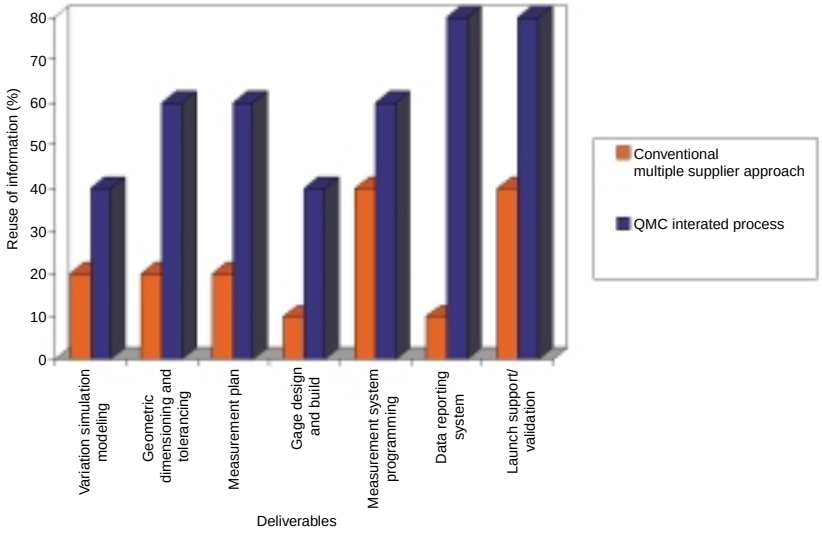
QMC quality checks

"CM4D allows engineers working on a common, global platform to immediately see and analyze dimensional information from their suppliers and communicate via the Web so that timely, judicious decisions can be made to shorten time to market and avoid costly assembly snafus," said Quality Measurement Control, Inc. (QMC) President Dale Mahrle.

DaimlerChrysler, General Motors, Honda, Jaguar, and Saab are among OEMs currently using CM4D software, according to Mahrle.

The process for collecting, analyzing, and displaying measurement data on demand provides a real-time method for tracking and correcting errors that otherwise can lead to fit and finish problems. Conventional quality collection methods use different types of measurement hardware with analysis work typically done off-line by engineers.

Traditional methods to monitor and alter vehicle-build instability can consume significant time and cost when errors require plant downtime to implement corrective measures or when substandard parts become warranty claims.



A shorter vehicle development process is achieved through the efficient reuse of information. QMC provides a complete turnkey solution versus the conventional multiple supplier approach.

"For every dollar that DC spends on graphical charting and analysis, CM4D allows us to save $6 on the back end, and the software reduces data collection and analysis time by about two-thirds," said Joe Fallert, general supervisor of vehicle and powertrain inspections, and vehicle operations at DC.

The Auburn Hills, MI-based provider of quality management products and services is working on its first total support package for a niche 2002 / 03 model year sports car. QMC's engineering consultants will develop geometric dimensional and tolerance parameters for the car and conduct variation analysis / modeling for interior, exterior, chassis, and powertrain components as well as the total vehicle. The QMC team also will use CM4D information to chart part-specific inspection points, do off-line coordinate measuring machine programming, design and build measurement gauges, and provide vehicle launch support.

"By providing the entire variation reduction strategy — from an intellectual as well as a physical perspective — the QMC system can provide cost and significant time savings in the vehicle development and production process," said Alan Corker, Director of Business Development for QMC.

Assembly work for the sports car will change from shim-build to net-build because the QMC measurement procedures enable precision body panel placements. "This system — managing of variation in the manufacturing process — lends itself well to what the market seems to be doing more of now, which is niche vehicles," Mahrle said.

Although much of QMC's consulting work deals with vehicle volumes of fewer than 50,000 units a year, the techniques are also applicable to large-volume programs.

Kami Buchholz

Interesting? Circle 198
Not interesting? Circle 199

More than tires from Continental

Continental's new North American headquarters symbolizes a new direction for the automotive supplier. "We are like no other company," said Continental AG Chairman of the Executive Board Stephan Kessel, noting that the company's expertise in multiple areas has positioned the supplier to become a chassis integrator. "We're the only automotive supplier that has combined its core competencies — brakes, brake systems, air suspension systems, and tires — to make mobility safer, more comfortable, and fun."

Continental's original-equipment Auburn Hills, MI, headquarters building doubles as a technical center. The two-story facility includes a vehicle development lab (with a 16-hoist garage area), a foundation brake lab, an instrumentation lab, a metrology lab, a sensors lab, an anti-lock brake system/actuation hydraulics test lab, and an NVH lab. In the coming months, the facility will add prototyping and component and system level testing. Adjacent to the technical center is a 230 x 20-m (750 x 65-ft) evaluation track.

"Our headquarters building creates a culture that enables us to design, manufacture, and market our tire, brake, and suspension systems into total chassis systems," Kessel said.

New Continental North American headquarters houses more than 500 employees.

During a dedication ceremony for the $40 million center, Continental executives talked about a few production-ready and under-development technologies:

• Deflation Detection System (DDS) — planned for the 2002 model year in North America, DDS is a software enhancement to an anti-lock braking system, or an electronic stability program, that detects tire deflation.

• Intelligent tire — expected to reach the European market in the 2004 model year, a smart tire uses sidewall sensors to deliver information about forces that act between road and tire to the electronic chassis management system. It is expected that sidewall torsion sensors will become integral components of anti-lock brakes, traction control, and electronic stability programs.

• Thirty-meter car — unites tire, brake, bearing, and electronic technologies to stop a car in 30 m (98 ft) from a speed of 100 km/h (62 mph). Depending on the vehicle, a typical braking distance is between 30 and 38 m (98 to 125 ft). Continental executives say automakers will witness technology demonstrations in December 2000.

"Continental has expanded its core business of tires and components to embrace the development and production of advanced electronic brake and chassis systems that help manage vehicle dynamics," Kessel said.

Kami Buchholz

Interesting? Circle 200
Not interesting? Circle 201

Automotive resolver systems

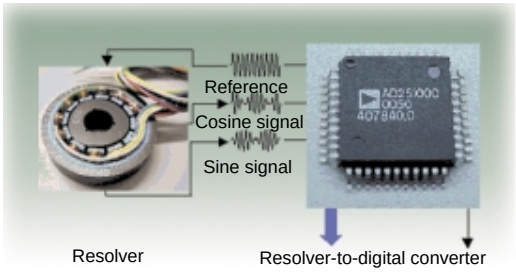
Analog Devices, Inc. (ADI) and Minebea Co., Ltd. of Japan are jointly high-performance resolver systems that will be offered at a lower price than commonly found in the automotive industry. According to the companies, the systems will be affordable and easy to use for high-volume applications such as electric power steering (EPS), starters/generators, and hybrid-electric vehicles. EPS systems have many benefits to consumers because they enable environmentally friendly vehicles and can save drivers up to 8% on gas mileage.

ADI will supply resolver-to-digital converter (RDC) integrated circuits to Minebea for use with its family of resolvers. Minebea will market and sell the solution. A resolver is a mechanical device mounted on a rotating shaft of a motor to give the exact position of the shaft in the form of sine and cosine signals. An RDC converts this information into digital signals for the controller. ADI's RDCs perform this conversion in hardware and also give velocity, direction outputs, as well as encoder emulation.

"We chose to partner with Analog Devices because the company has the integrated circuit expertise in resolver-to-digital converter technology, motor control, and DSP we were in search of," said Akihiro Hirao, Director, General Manager, Office of Engineering Department, Minebea.

"We believe that Minebea's experience in building quality, high-volume resolvers, combined with Analog Devices' record of delivering industry-leading resolver-to-digital converter technology, will result in the platform of choice in high-precision motor control," said Phil Davies, Director, Embedded Digital Signal Processor Division, Analog Devices

ADI is currently developing two versions of 12-bit RDCs to use with Minebea's resolvers. Both components will be rated for automotive temperature and environments ranging from -40 to +125°C (-40 to +257°F) for the highest levels of quality and reliability. The resolver system sends its position, velocity, and direction information via a parallel or serial port, resulting in easy adoption of the new technology to existing EPS systems and enabling much higher performance at lower costs. In addition, the resolver system will interface with microprocessor-based motor controllers, including ADI's families of embedded DSP motor controllers, such as the ADMCxxx and future ADMC5xx families.



ADI and Minebea have teamed to develop high-performance resolver systems for high-volume automotive applications.

Jean L. Broge

Interesting? Circle 204
Not interesting? Circle 205