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## HYUNDAI AND GE PLASTICS UNVEIL QARMAQ ADVANCED TECHNOLOGY DEMONSTRATION VEHICLE AT 77TH GENEVA INTERNATIONAL MOTOR SHOW



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- ***Sporty Crossover Coupé makes debut in Europe***
- ***Elastic Front™ safety system reduces pedestrian injury***
- ***Eco-focused technologies lower weight, fuel consumption and CO<sub>2</sub>***

**GENEVA, Mar. 6, 2007** - At the Geneva International Motor Show today, Hyundai Motor Co. and GE Plastics presented QarmaQ, a first in the Crossover Coupe segment. QarmaQ is Hyundai's Advanced Technology Demonstration Vehicle (ATDV) that showcases over 30 different environmentally progressive technologies led by the innovative "Elastic Front™", an innovative solution that can help reduce the risk of severe injuries in Crossover Utility Vehicles (CUV) pedestrian collisions.

Designed at Hyundai Motor Europe's Design and Technical Center in Russelsheim and engineered in close cooperation with GE Plastics, QarmaQ develops and validates over 30 key technologies, which will be selectively incorporated into Hyundai's new models to be rolled out from 2008-2014.

"At Hyundai, we believe in innovation for humanity, and QarmaQ demonstrates our commitment to safety innovation and our determination to bring more environmentally responsible technologies to the market," said Dr. Kwon Moon-Shik, Hyundai Motor's vice president of advanced technology. "We chose to partner with GE Plastics because of their commitment to the environment and their wide range of innovative materials and technical capabilities. Technologies from QarmaQ will provide Hyundai owners with a safer, more environmentally responsible car and a better driving experience."

QarmaQ is lighter, stronger and more economical than any current production CUV in its class. It also offers significant recycling advantages both in construction and eventual disassembly. In short, it is a viable and realistic glimpse of the future potential of personal automotive transport.

### **Pedestrian Safety**

The issue of pedestrian safety is a growing one. In the EU, one-fifth of all traffic fatalities – 7,000 people per year – are pedestrians hit by a vehicle. In densely populated Korea, the rate is as high as 39 percent. QarmaQ's Elastic Front™ safety system, which encompasses the whole front end of the vehicle, is arguably the world's first global pedestrian protection solution on a CUV. Three energy-absorbing structures are fully integrated underneath the futuristic styling of QarmaQ and this system takes advantage of several advanced materials that offer inherent energy absorbing properties. QarmaQ's body panels have been designed to work in concert with energy-absorbing systems on the underside of these panels to manage and dissipate the force of a pedestrian/CUV collision. The Elastic Front™ has been engineered to meet EEVC WG17 Phase2, Euro NCAP, and JNCA pedestrian impact requirements and is currently undergoing testing for final validation.

### **A totally relevant concept**

The Hyundai QarmaQ concept car is the result of the fusion of exceptional expertise and engineering foresight from Hyundai and GE Plastics. More than a design concept, QarmaQ illustrates that environmentally responsible solutions can be elegantly incorporated to enhance safety, design and performance.

"GE Plastics is committed to developing greener, lighter and aesthetically pleasing solutions to support our customers in creating vehicles with reduced environmental impact," said Gregory A. Adams, vice president and general manager, GE Plastics – Automotive. "We are delighted to have collaborated with Hyundai and we believe that working together we helped them develop an exciting new CUV that demonstrates greater environmental responsibility as well as improved safety, dramatic design, and high performance."

Firmly positioned as a crossover Coupe/CUV, the QarmaQ derives its name from traditional Inuit dwellings, constructed from earth, whalebone and animal skins. Like them, QarmaQ challenges conventional ideas on construction methods and materials. Also in common with the original structures, it boasts unusual strength, resilience and protection.

By combining leading edge design, advanced engineering techniques and the benefits of GE materials technology, the QarmaQ demonstrates the ability to meet necessary, but problematic areas of legislation dealing with pedestrian safety and eco-responsibility.

The choice of a crossover coupe/CUV format for QarmaQ underlines the commitment of Hyundai to design innovation in this market sector. With Santa Fe, Tucson, and Veracruz, Hyundai created pioneering vehicles.

This 2+2 vehicle targets the important empty nest baby boomers demographic, who are rediscovering a new-found freedom while remaining the wealthiest demographic in history. Today, this key group of consumers is beginning to spend their nest egg and enjoy the fruits of their labour, not on material possessions, but on experiences. QarmaQ soulfully blends the driving experience of a Coupe with the ability to manage multi-terrain driving of a CUV, providing empty nesters with effortless access to their outdoor playground.

#### **Design: Freedom of shape**

As a joint project with GE Plastics, QarmaQ endowed designers with greater expressive freedom to create complex three-dimensional shapes that could not have been achieved with conventional production methods and materials such as metal and glass.

"The powerful profile and stance of the design incorporates dynamic, sculptural qualities and elegant sportiness on one hand, with smooth refined surfaces on the other," said Thomas Bürkle, chief designer, Hyundai Motor Europe. "Moreover, the various properties of the GE materials allowed more freedom in meeting or even exceeding safety requirements. The result is a uniquely balanced and harmonic design both inside and out," he added.

Departing from conventional car design that combines a lower body and a glass cabin on top, QarmaQ blazes a new trail with panoramic wrap-around glazing area using GE's Lexan™ polycarbonate resin. This part sits between the two pronounced "muscles" above the front and rear wheels. The C-shaped side window enables innovative helicopter-like downward visibility and is a key design feature demonstrating the new glazing technology.

#### **Exterior: Fluidity of line**

Connected by unique glazed surfaces, the exterior design relates strongly to, and interacts effortlessly with the interior. The unique division between the solid bodywork and transparent glazed areas creates a new perspective, whether viewed from inside or from the pedestrian standpoint.

The exterior contours and fluidity of line have been refined to give an immediate impression of movement frozen in motion. This aesthetic is mirrored in the interior, so that the fusion and merging of the perceptual boundaries between inside and out delivers a feeling of integration and synchronization to the overall appearance.

Although QarmaQ does not have a high waistline or small window area (conventional methods to convey a feeling of protection), the exterior design still communicates a commanding presence and a feeling of protection to the occupants.

"The QarmaQ's exterior design communicates a commanding presence and a feeling of protection to the occupants," said Robert Butterfield, global market director, GE Plastics. "The twin domes on the sunroof, facilitated by the new glazing technology, increases the inner space for the rear passengers and creates a unique design feature." The wrap-around windscreen, in combination with the elongated bonnet delivers dramatic, almost classic, proportions and gives the car a unique sporty feeling. Finally, the contrast of the strong dark coloured areas to the lighter tonal areas emphasizes QarmaQ's off-road DNA.

#### **Interior**

In response to shrinking family sizes and emergent customer preferences, QarmaQ is specifically designed to carry four people in

above average comfort. The extensive use of new materials and techniques has resulted in a more fluid, more unified interior, by allowing seamless integration of otherwise intrusive elements.

As the sporting exterior proportions suggest, the QarmaQ is primarily a driver's car. Within its unique interior architecture the cockpit is isolated in an active, yet protective pod structure. This helps promote a sensorial and highly self-indulgent driving experience.

One of the main aims of the interior design was to develop a practical and interactive space, which wraps around the occupants. The driver-oriented cockpit, which combines functionality with organic sculpted shapes, creates an attractive, fun-to-drive atmosphere. This is further underlined by:

- Inclusion of smooth surfaces embedded with discrete or hidden touch activated sensors
- "Floating" elements pulsating and glowing with tinted ambient lighting

The interior is brought alive by a variety of technologies, effects and surfaces, including:

- Thoughtful ambient LED lighting by Lumination, LLC glows through ceramic components
- Silicone applied next to leather, to give a pleasing tactile and visual experience

The colour harmony of the interior has been designed to enhance the feeling of serenity and spaciousness, which in turn relates directly to the high level of comfort enjoyed by the passengers. The mixed effects, textures and colours add sophistication to the dynamic forms and strong presence of the car. Functional elements made from aluminium emphasise the more technical aspects, contrasting with and highlighting the softness of the interior materials.

#### **New materials, new directions in comfort and safety**

Current composite technology is usually thought too expensive and too difficult to fabricate to be of use anywhere but the aerospace and motor racing industries. The QarmaQ is physical proof that this need not be so.

The wrap-around GE Lexan™ windscreen and extensive use of GE polycarbonate glazing materials provides a weight saving of up to 50 percent in relation to glass, while simultaneously allowing more adventurous shapes than flat glass. The glazing features a unique technology from Exatec™ which deposits a thin protective layer of glass on the Lexan™ to add protection from scratching and the effects of weathering.

QarmaQ also introduces new curved and moving side glazing in Lexan. As well as allowing such advanced applications, the impact resistance and other properties of this material also helps increase both occupant and pedestrian safety.

Exatec™ infrared coatings on the whole transparent areas reflect heat, helping cool the interior and reducing the power demands upon the infrared regulated air conditioning. Lighting is achieved by incorporating mood illumination into the actual material, delivering a unique interior ambience. The material also facilitates a perfectly flat, fully integrated fractal radio antenna within the roof structure.

Among other milestones in the construction of QarmaQ, the front wings were designed from the beginning to be one very large single injection moulded component. Together with the deformable bonnet and precise bumper mouldings, these also form a major addition to pedestrian impact safety. The sophistication of the material and manufacturing technique also played a major part in the ability to fully encapsulate the complex headlight shape into the whole frontal styling.

At the other end, the tailgate breaks new ground by bonding different materials, including the glazing and rear light assemblies, to create a one-piece component structure. This increases the integral strength, while at the same time simplifying vehicle assembly and reducing weight.

Another major safety advance is the use of sensors to detect vehicle presence in the blind spots of the rear view mirrors when pulling out or overtaking, and audio-visually alert the driver.

#### **Euro5 diesel engine**

QarmaQ's 2-liter diesel engine is fully compliant with EURO5 emission regulations. It features the very latest technologies such as high pressure fuel injection and fine fuel spray atomization for higher torque and better power output. Regulated emissions such as CO, THC, NOx and PM, were reduced drastically while a Catalyzed Particulate Filter system, CPF, is capable of cleaning about 90 percent of the particulate matter from the diesel emissions. Furthermore, by switching the position of CPF from the under-floor area to a location more closely coupled to the exhaust manifold, it was possible to minimize the catalytic light-off time and to enhance the

naturally regenerative characteristics of the CPF.

### **A greener future**

Thanks to extensive use of advanced materials, QarmaQ is 60 kg lighter than a comparable vehicle made with traditional materials.

GreenOrder, an environmental strategy firm based in New York, N.Y. that audited the QarmaQ estimated that the 60 kg. that have been taken out of the QarmaQ, means the vehicle would require about 80 fewer litres of diesel per year, and would cut annual greenhouse gas emissions by more than 200 kg. Furthermore, if every new vehicle registered in the European Union (EU-15) in 2006 had reduced fuel consumption by the same amount, the result would have been an annual savings of more than 7.4 million barrels of diesel fuel -- or enough to sustain the European Union (EU-15) diesel demand for three days.

As a result, the greenhouse gas savings would equal approximately 3.1 million metric tons of carbon dioxide. According to Joseph Malcoun, an Associate with GreenOrder, cutting edge material technologies are expected to make a major contribution to increasing the fuel economy of tomorrow's passenger vehicles. "As consumer demand for more fuel efficient vehicles continues to grow, we expect the use of advanced materials to play an increasing role in reducing the greenhouse gas footprint of the cars we drive."

HPPC composites for horizontal body panels significantly reduce part weight - up to 50 percent per part - while maintaining strength equal to that of steel. This lighter-weight cladding contributes to better fuel efficiency and improved power-to-weight ratio for drivers and its energy absorbing qualities are harnessed to create the Elastic Front™ safety system.

QarmaQ's body panels use an environmental responsible plastic, Xenoy iQ™ and Valox iQ developed as part of GE's ecomagination™ initiative to address three critical environmental concerns: conserving energy, lowering greenhouse gas emissions, and up-cycling or re-using materials such as PET plastic bottles. QarmaQ re -uses approximately 900 PET bottles that would otherwise become landfill.

Another environmentally progressive aspect of the QarmaQ's design is the use of GE paint replacement technologies, including Visualfx™ resins with Lexan™ films, to replace painting operations that can release toxic and greenhouse gases.

To eliminate dependency on PVC in the wiring, GE's Noryl™ resin technology was used for wire and cable coating. Replacing PVC, these ultra-thin coatings can reduce cable weight by up to 25 percent.

### **About GE Plastics**

GE Plastics ([www.geplastics.com](http://www.geplastics.com)) is a global supplier of plastic resins widely used in automotive, healthcare, consumer electronics, transportation, performance packaging, building & construction, telecommunications, and optical media applications. The company manufactures and compounds polycarbonate, ABS, SAN, ASA, PPE, PC/ABS, PBT and PEI resins, as well as the LNP\* line of high-performance specialty compounds. GE Plastics, Specialty Film & Sheet manufactures high-performance Lexan\* sheet and film products used in thousands of demanding applications worldwide. In addition, GE Plastics' dedicated Automotive organization is an experienced, world-wide competitor, offering leading plastics solutions for five key automotive segments: body panels and glazing; under the hood applications; component; structures and interiors; and lighting. As a Worldwide Partner of the Olympic Games, GE is the exclusive provider of a wide range of innovative products and services that are integral to a successful Games. For more information on GE's materials for automotive applications, please go to [www.geplastics.com](http://www.geplastics.com).

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