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Introducing Delta's Revolutionary E-4 Coupé Constructed from ACG's Innovative Prepreg Systems

Introducing Delta's E-4 Coupé & ACG's Innovative Materials

Designed and built by Delta Motorsport Ltd. at their Silverstone facility, the exciting new E-4 Coupé electric car has been developed exclusively in the UK by Delta in collaboration with some of the country's most innovative companies. Delta worked with Derbyshire based Advanced Composites Group Ltd. on the carbon fibre integrated chassis and bodywork construction to generate a class-leading, low-mass vehicle together with a clear road map towards effective medium-volume production.

Delta, a finalist in "The Engineer Technology & Innovation Awards" for the E4-Coupe project in 2010 and recipient of the "MIA Small Business of the Year Award for 2009", was keen to demonstrate its skills on a project firmly based in the automotive sector, where the pace of change and innovation, driven by reducing carbon dioxide limits, has never been greater. The project is a seedbed for new ideas and technologies which can be licensed or sold to larger vehicle manufacturers and tier 1 suppliers to the automotive industry.

Delta is a design and engineering consultancy operating in motorsport and niche sectors of the automotive industry. From a vision and concept developed in late 2006, detailed work on the E4-Coupé commenced in December 2008.

The company carries out concept studies together with detailed design and styling programmes. Prototype construction and low volume vehicle builds are also within the company's scope. Delta specialises in working with novel vehicle architectures requiring a broad holistic understanding of all the factors which influence the solution – as with the E4-Coupé.

The four-seater road car has been developed using a combination of ACG's DForm® Deformable Composites System (DCS) and next generation Body Panel System (BPS). To achieve maximum weight reduction compared with traditional materials, the car has been engineered with a high level of parts integration. The Body in White (BIW) is manufactured from just fifteen bonded major composite panels and weighs only 85Kg, including the front and rear aluminium sub-frames, and crash structures.

Closures have been manufactured using carbon DForm for the internal panels and either glass or carbon BPS for the outer skins. This approach dispensed with the need to attach additional trim covers, which would have added weight to the vehicle and reduced that all-important mileage range.

To enable Penso, Delta's partnering design consultants, to undertake a structural analysis of the vehicle, a materials test programme and initial design data set for the materials was generated by ACG at its Heanor Technology Centre. ACG's DForm was chosen for the structural chassis components because it retains the benefits of directional continuous fibre composites whilst greatly reducing production cycle-times. Time savings are achieved due to DForm's ability to conform to moulded shapes, all with significantly reduced operator input.

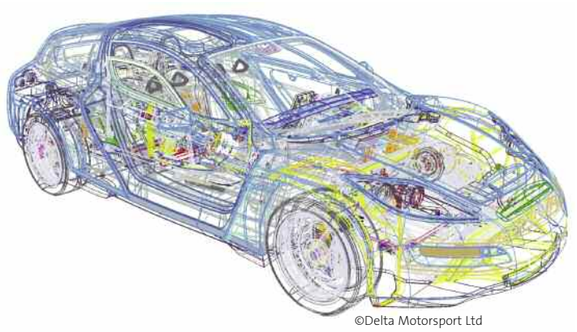
ACG's in-house moulding facility and KS Composites, Delta's moulding partner, manufactured the prototype parts using ACG's single-sided DForm tooling, a product which is custom-formatted to produce the optimum surface finish for automotive paint processes. Pre-production panels were produced using conventional vacuum bag moulding techniques with a view to switching to compression/press moulding for higher volume production - without the need to change either the construction materials or the vehicle design.

External body panels have been manufactured using ACG's latest glass and carbon body panel systems, which utilise unidirectional fibres in their construction to eliminate the fibre print-through associated with other woven-fabric based products. These materials have the ability to produce exceptionally flat external surfaces ready for painting with a minimum of surface preparation, and provide a desirable 65% mass saving compared with conventional steel body panels.

The low weight of the vehicle and exceptionally low centre of gravity, coupled with the potential of high torque electric propulsion, makes the E-4 Coupé a stunning combination of engineering and environmental awareness with the potential for head turning performance figures.

The first five cars will be on the road over the course of 2011 as part of a Government supported low carbon vehicle demonstrator programme. Delta will use this experience to learn more about low carbon emission vehicles and how they are used.

Delta will also be developing further ideas, particularly in the fields of low cost composite structures, torque vectoring systems and range extension, together with the integration of all these systems.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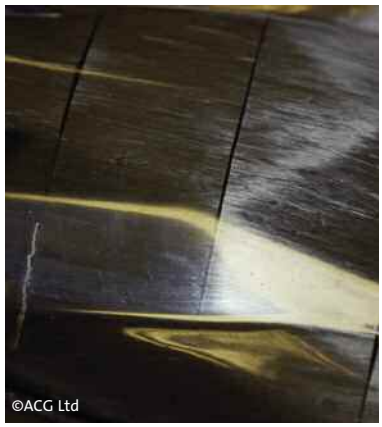
For more information regarding the project and the car, please contact Simon Dowson (simon@delta-motorsport.com) at Delta Motorsport Ltd.

For information about the materials and moulding processes and techniques used, please contact Steve Cope (scope@acg.co.uk) or Mike Millward (mmillward@acg.co.uk) at ACG.

DForm for Tooling

ACG TB750 tooling block master model used to manufacture the bulkhead tool for the E-4 Coupé.

ACG DForm tool, created from the master model, used to manufacture the bulkhead the for E-4 Coupé.



Close-up showing DForm conformability.

ACG's DForm® is ideally suited to the manufacture of composite tooling, offering a number of advantages over standard long fibre woven fabric prepreg, and random short fibre and infusion tooling systems.

DForm can offer considerable savings of up to 25 to 30% in lay-up time. Its unidirectional fibre structure maintains dimensional accuracy and performance predictability. DForm creates an extremely flat, print-through-free surface profile with no local thinning, no loss of fibre orientation or variation in resin content.

Technical Data - Delta E-4 Coupé	
Vehicle Type	All-electric, road-going 2+2 coupé.
Transmission	Two or four wheel direct drive.
Chassis & Body Shell	ACG DForm® and Body Panel System (BPS) carbon and glass composite.
BIW Weight	85kg, including sub-frames and crash structures.
Curb Weight	• 970kg with 2WD and 32kWh battery • 1220kg with 4WD and 48kWh battery
Driver Controls	Touch screen interface featuring speed and charge display, satnav, DAB radio, heating and air-conditioning plus bluetooth connectivity. Conventional electric power steering.
Range	• 130 miles (32kWh pack) • 180 miles (48kWh pack)
Performance	• 2WD 0-60mph = 6.5 seconds • 4WD 0-60mph = 4.5 seconds
Charge Time	Twin chargers for 48kWh pack = 8 hours from a fully discharged battery pack

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