OEM Quality CFRP Parts

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Our Materials Technology

Gurit’s patented structural SPRINT® technology can be used for all structurally loaded components including chassis.

Benefits include:-

- Very low void content, typically 0 – 0.5 %
- Minimal surface porosity
- Increased drape characteristics
- Reduced lay-up times
- High quality laminates without the need for expensive autoclaves
Body Panel Evolution

SPRINT + Syntactic Core = Car Body Sheet (CBS)
# Body Panel Evolution

**SPRINT + Syntactic Core = Car Body Sheet (CBS)**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>RC300 2x2 Twill weave</td>
</tr>
<tr>
<td>1.0</td>
<td>Syntactic Core (1.0)</td>
</tr>
<tr>
<td>0.1</td>
<td>RC300 2x2 Twill weave</td>
</tr>
<tr>
<td>0.0</td>
<td>Glass Surfacing film SF95/700g</td>
</tr>
</tbody>
</table>

*Courtesy of Nottingham University*
CBS – What does the syntactic core do?

Low density syntactic core retains the flexural stiffness of a monolithic panel but also benefits from being

- Lower cost
- Reduced lay-up times (only one ply required)
- Paintable to Class-A quality*

*when used with an in-mould surface film.
CBS – What does the surface film do?

Class-A surfaces were traditionally not achievable with composite parts due to ‘print through’ of the carbon fibres caused by the differing Coefficient of Thermal Expansion (CTE) of carbon and epoxy resin.

Gurit’s patented Surface Film is an epoxy resin layer sandwiched between a glass and a thermoplastic scrim, which upon curing forms a homogeneous surface layer.
CBS – How does it work?

Additives in the Surface Film reduce it’s CTE and acts as a middle point and link between the differing CTE’s of carbon and epoxy resin.
CFRP – Barriers to OEM Entry

CFRP Automotive panel technology has been available now for many years and many solutions have been developed to expand their use into a broader market.

Although occasionally used on OEM programs they remain restricted to mainly the most niche supercars.

The perceived barriers to entry for many OEM’s are:-

- High Part Costs
- Low Productivity (Long Cycle Times)
- Dimensional Repeatability (Tool life / Stability)
- Consistency through paint (No paint pops, single pass primers)
- Surface Quality (Initial and Long Term Class A)
Project ALBOS (Affordable Light BOdy Structures)

- Funded by the DTI, the DfT and industrial partners and coordinated by Aston Martin Lagonda Ltd.

- Project partners include automotive and aerospace manufacturers, tier 1 suppliers, resin and fibre materials manufacturers and the University of Nottingham.

ALBOS sets out to exploit low-cost carbon fibres to produce a composite material for the manufacture of lightweight vehicle structures with high specific structural properties, Class A surface finish and low component cost.
Selected Component and Deliverables

ALBOS Development Platform – DB9

Gurit nominated component – Hood Assembly
ALBOS Hood – Key Deliverables

After an initial consultation with AML (Aston Martin Lagonda Ltd) a brief was constructed detailing the performance that was required to meet the ALBOS targets.

The key deliverables of the project was:-

- Single tool solution capable of 1000 parts with no degradation.
- Component cycle time of <90 minutes
- Single primer pass with no rework, no paint pops
- Class A surface after paint and environmental exposure
- Appropriate tooling costs, reduced part costs
Characterisation of CBS Materials

The first stage was to establish the suitability of CBS in producing a component of the required quality.
AML in co-operation with Nottingham University conducted a number of experiments to evaluate and characterise composite technologies and their performance as a Class A substrate.

Extract from :- 'Surface analysis of “Class A” polymer composite substrates for the automotive industry’;
Nottingham University
Developing a CBS Material ‘Charge’

With the surface quality independently accredited it was important to develop a way to introduce the materials to the tool in the most efficient manner.

Using in house CNC nesting and cutting technology a process was developed that allowed for the generation of highly accurate 2D preforms.

All materials were pre cut and consolidated off line thus reducing the number of plies to be introduced into the tool to a minimum.
Developing a CBS Material ‘Charge’

FEA Software drapes the component based on shear characteristics of the fabric and builds up a 2D image. These are converted into a kit concept.

Kits nested, cut and labelled before consolidation and despatch.
Tooling Solution

With the components material and format selected the key technology driver became the tool in which the materials were to be cured.

To fulfill the requirements of the ALBOS and work with our CBS system it would need to be durable, thermally conductive, dimensionally stable and cost effective.

These requirements quickly eliminated composite, aluminium, Invar and steel tooling.

Work was carried out to look at tooling solutions for other technologies.
Tooling Solution

Nickel electroform tooling has become well established in aerospace as a composite compatible tooling however this is an autoclave prepreg process.

Nickel electroform has also been used in simple slush moulding process. Here the tool is heated through simple heat exchanger technology.

By combining these systems, a tooling technology was developed that as capable of meeting the ALBOS requirements while suiting the cure requirements of CBS.
Creating the Nickel Electroform Tool

Machined bath master ready to be electroplated

Bath master after nickel has been deposited and copper heating system in place

Completed tool
**ALBOS Process**

With the tool completed a suitable heating system was commissioned. This worked on a pressurised recirculating water system which allowed through the use of heat exchangers to rapidly heat or cool the thin nickel tool.

A suitable release system was applied to the tool and trials were undertaken to optimise the stages of the process:-

- Application of the kit to the tool
- Applying the consumables and additional loose tooling
- Curing and cooling
- Demoulding and re-releasing
ALBOS Process

Kit Application

22 mins
ALBOS Process
ALBOS Process

Cure

Time (Minutes)

Temperature (°C)

22 mins

38 mins

20 mins
ALBOS Process

Demould & Re-release
SPRINT Inner Structure

To allow the composite CBS outer to be assessed as a hood assembly a more conventional composite inner tool was fabricated.
Again from this tool a kit was developed and a 2D preform cut.
The part was processed in a conventional oven cure format
Final DB9 Hood Assembly

The inner and outer components were then assembled in the Nickel Shell before demoulding and inspection.

The hood was then transferred to AML where it was fitted to the ALBOS donor vehicle for final inspection.
Paint Evaluation at AML

To complete the ALBOS brief the panel would have to pass through the AML standard low bake paint process.

Light Prep

After Primer

After Colour and Clear Coat
The original ALBOS brief was addressed as follows:

- Nickel Electroform showed no distortion/degradation through the program and has been used in RTM programs producing in excess of 18000 components.
- The final part cycle time for the hood outer fell within the 90 minute cycle time.
- The paint trials undertaken AML showed the ability for CBS parts to be integrated alongside conventional metal components and achieve equivalent surface quality with no rework.
- Work carried out by Nottingham University confirms that the Gurit CBS materials exceed current OEM Class A requirements. Environmental test data from DuPont shows a consistent quality through vehicle life.
- Models of the amortised part costs shows significant savings over existing CFRP technologies.
Nickel tooling investment and 2D CBS preforms equate to a lower ultimate part cost.

For carbon fibre parts this can be cost effective for quantities up to 5000 parts a year.
Future Opportunities for CBS Systems

For parts to meet the requirements of these higher volume opportunities, the CBS system must be capable, where required, to meet the demands of high volume paint processes.

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<th>Cars/annum</th>
<th>Paint Process</th>
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<tbody>
<tr>
<td>0-500</td>
<td>Off-line</td>
</tr>
<tr>
<td>500-5000</td>
<td>In-line/On-Line</td>
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To meet these demands Gurit have developed CBS and Surface Film to withstand the higher temperatures associated with in-line & on-line painting.
Future Opportunities for CBS Systems

Resin system developed to withstand the high temperatures experienced during OEM inline & online painting

- Materials cured at 150°C
- Cured parts function in temperatures up to 230°C (450 °F)
- Suitable for in-line & on-line painting
- Surface flatness characterised at < 4 μM after E-Coat (KTL)
Special Thanks and References

Many thanks to Dr. Ken Kendall (Head of New Technologies - Aston Martin Lagonda Ltd; Demonstration Manager ALBOS) for his assistance in compiling this presentation.

'Surface analysis of “Class A” polymer composite substrates for the automotive industry',
P J Schubel, L T Harper, T A Turner, N A Warrior, C D Rudd, K N Kendall

‘Affordable lightweight body structures (ALBOS)’,
N A Warrior, L T Harper, T A Turner, P J Schubel, C D Rudd, K N Kendall
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