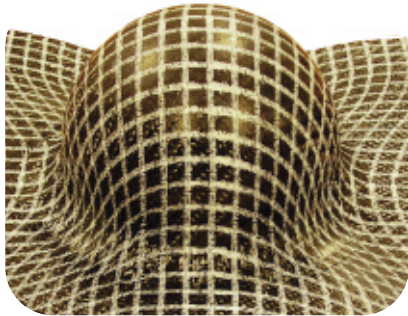
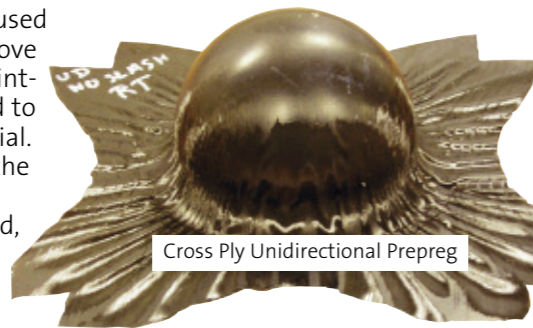


# Technical Report - ACG DForm - Tooling



# DForm DEFORMABLE COMPOSITE SYSTEM (DCS) TECHNOLOGY - TOOLING MANUFACTURING POSSIBILITIES

Short chopped fibres are often used in the composites world to remove 'architecture' and associated print-through from the structure, and to create a readily formable material. These are usually presented in the form of random mats which, although being readily deformed, offer poor translation of fibre properties and can only be considered, at best, to be semi-structural materials.



## Mechanical Properties of DForm

The mechanical performance of DForm is dictated not only by directionality and fibre volume fraction but also by fibre length.

The DForm format addresses a number of processing and surface quality issues, but the reduction in fibre length will influence material properties.

A programme of testing has been carried out to evaluate this. A series of samples were made using a standard unidirectional carbon prepreg.

DForm formats were made with effective fibre lengths of 20, 40 and 60mm and compared with cross-ply unidirectional and woven fabric-based prepreps processed under similar conditions.

The results showed that the slitting of the fibre inter-layers had minimal effect on the tensile modulus of the laminates, but, as might be expected, the tensile strength showed a drop-off. However, when compared to the properties of a woven fabric laminate, this drop-off in strength did not appear to be severe. Graphs can be made available to support these findings.

Comparisons of compressive and inter-laminar performance showed a similar pattern, but the relative differences were less significant.

## DForm Tooling Application

The results of the mechanical testing demonstrated that, as might be expected, there is some drop-off in mechanical performance due to the fibre slitting process. However, the laminate stiffness showed minimal variation in fibre length.

DForm is particularly suited to composite tooling manufacture, where it offers a number of advantages over standard long-fibre woven fabric prepreg, random short-fibre and infusion tooling systems.

When compared to a standard fabric-based tooling system, DForm offers considerable savings, typically in the region of 20 - 30% reduction,

in lay-up time. Furthermore, the directional nature of a DForm's unidirectional fibre structure maintains dimensional accuracy and performance predictability.

DForm is capable of creating an extremely flat, print-through-free surface profile with no local thinning, loss of fibre orientation or variation in resin content, all of which are the issues that can compromise random short fibre, wet lay-up and resin infusion tooling systems.

A DForm tool face is shown in the accompanying diagram (DForm Mould Tool).

Note that woven fabric strips can be laminated around the periphery to stop break-out of the unidirectional fibre. Alternatively, if a tool face is prone to surface damage, a standard surface ply can be used.

Interested parties are advised to contact Dr. John Nixon, ACG's Technical Marketing Manager, who will access DForm's suitability for purpose on a case-by-case basis, providing expert guidance where required.

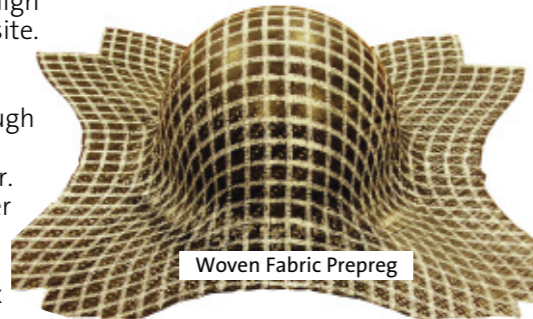
To achieve high performance from a readily formable composite without the print-through issues, fibre directionality and packing (fibre volume fraction) must be maintained.

If this exercise is repeated with the unidirectional (UD) fibres selectively slit, the plies can 'flow' and conform to the requisite shape as the slits open. Each slit only opens by a relatively small amount, but the sum of each of these movements allows the multi-ply material to deform around complex shapes.

The degree of conformability can be further modified by changing the cut density within each UD layer, thus changing the fibre length between cuts.

ACG's DForm Deformable Composite System (DCS), for which patents have been lodged, is an advanced, labour-saving prepreg technology that combines the conformability of a short fibre moulding compound with the directional characteristics of a high performance, long fibre composite.

This unique combination of characteristics is achieved through selective fibre slitting of a unidirectional prepreg precursor. This is presented in a multi-layer format that will flow under press or autoclave pressure, and readily conform to complex shapes.

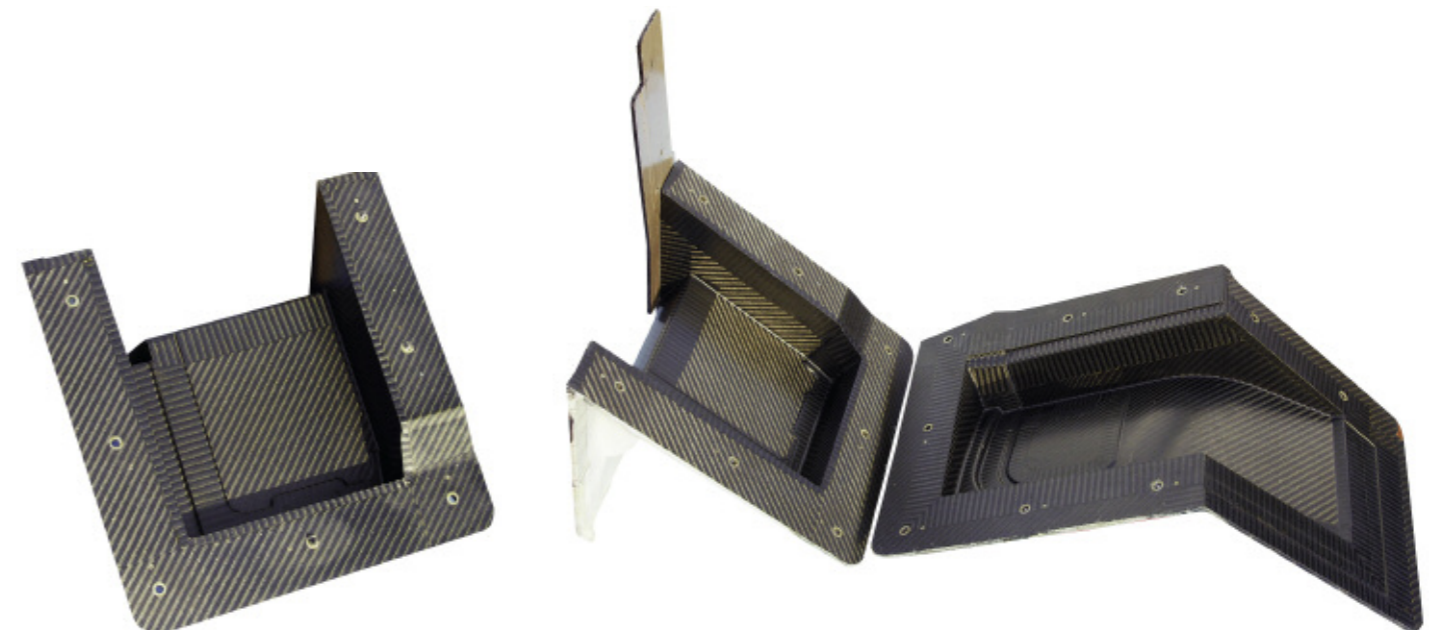
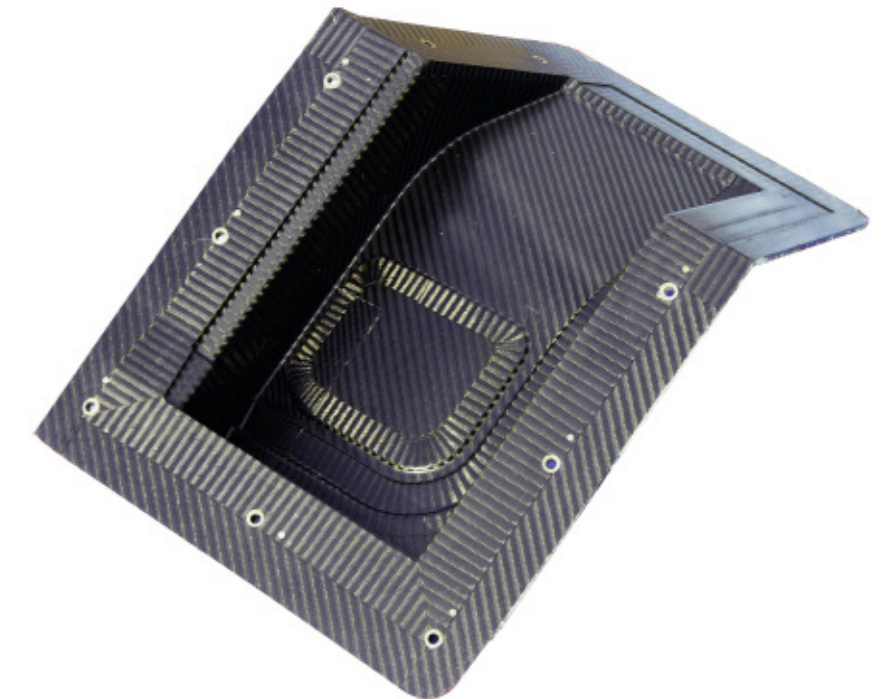
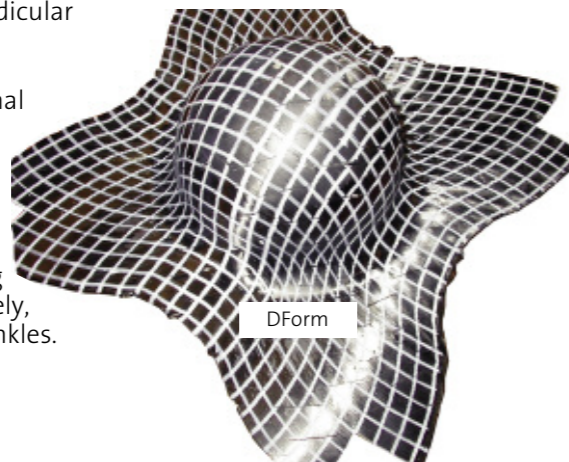


## How does it Work?

A woven, fabric-based composite, particularly one based on a twill or satin weave style, will readily deform around a complex shape. However, because conventional unidirectional prepreps are made-up of continuous fibres, they cannot stretch, and have a tendency to tear and, ultimately, split perpendicular to the fibre direction.

This format has created a short fibre composite material retaining the fibre alignment and packing properties of a high performance material, but with drape and handling characteristics approaching those of a woven fabric prepreg. However, it achieves this without the issue of the 'architecture' creating print-through.

Cross-plying the unidirectional material will help overcome the splitting problem simply because the plies can support each other. However, the continuous fibres prevent any stretching of the material and, ultimately, lead to the formation of wrinkles.



**Advanced Composites Group Inc**

5350 South, 129th East Avenue  
Tulsa, Oklahoma 74134, USA  
Tel: +1 918 252 3922  
Fax: +1 918 252 7371  
email: sales@acg-us.com



**Advanced Composites Group Ltd**

Composites House, Sinclair Close  
Heanor, Derbyshire, DE75 7SP, UK  
Tel: +44 (0)1773 766200  
Fax: +44 (0)1773 530245  
email: sales@acg.co.uk