

# Continuous Preforming System for Curved Composite Profiles

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## ABSTRACT

A closing of the gap between the unit costs of composite parts and those of the competing metal parts as demanded by the market for years can best be achieved through use of automated systems. A unique automation solution for the production of composite parts is the Continuous Composite Preforming System (CCPS) by BROETJE-Automation (BA). This system permits the automated, continuous production of 3D shaped and curved composite profiles such as those required for the frames and stringers of modern aircraft. At present such components can only be produced in a very time-intensive sequential manual or semi-automated process. The newly developed system provides a fully automated preforming process for curved profiles to ensure a cost efficient solution for composite frame production.

## INTRODUCTION

The Continuous Composite Preforming System (CCPS) introduces automatic and continuous manufacturing of 3D-formed and curved composite profiles. Previously, such components could only be manufactured using costly manual or semi-automatic procedures. The textile fibre material semi-finished products, from which the profiles are built-up in layers, thereby go through an extensive preforming process. Complex, multi-layer individual sub-preforms can be manufactured in parallel using the Composite Handling System Technology and joined together to the final preform. Subsequent consolidation of the composite components is carried out in a separate RTM-tool.

In this project a high quality and efficient process technology has been developed.

The main objectives of the development were:

- 3D-profile production by continuous preform forming and fixing
- Production of dry textile carbon fiber preforms
- Bonded composite materials or binder-ply for preform fixing

The technology distinguishes itself inasmuch that, for the first time, intensely curved preforms can be manufactured by fully-automatic means at a high process speed.

Within the framework of this year's JEC Composites Show 2011 in Paris, BROETJE-Automation GmbH presented their award-winning Continuous Composite Preforming System. This presently unique automation solution for manufacturing composite components has been awarded the internationally significant "JEC Innovation Award 2011".

## PROCESS CONCEPT

A so called LCF-profile was selected as a possible target component for the CCPS. This profile could be used as a frame in future passenger aircrafts. It is an assembly in which the overall or final profile (LCF profile) is composed of three individual profiles. These are a C-Profile, a small S-Profile and a large S-Profile. The scope of function of the system engineering presented here is the production of these individual profiles, forming in the transverse direction (cross section forming) and longitudinal direction (curvature forming), as well as combining the complete final profile.

The individual profiles of the LCF profile are produced from planar, reeled semi-finished dry fibre materials, which must be accordingly transported, contoured and compressed. These process steps in the production of dry fibre components are called "preforming". Once the individual profiles have passed the preforming, they are also designated sub-preforms. After



**Figure 1. “JEC Innovation Award 2011” winning Continuous Composite Preforming System (CCPS)**

joining the sub-preforms, the assembly is designated “final-preform”.

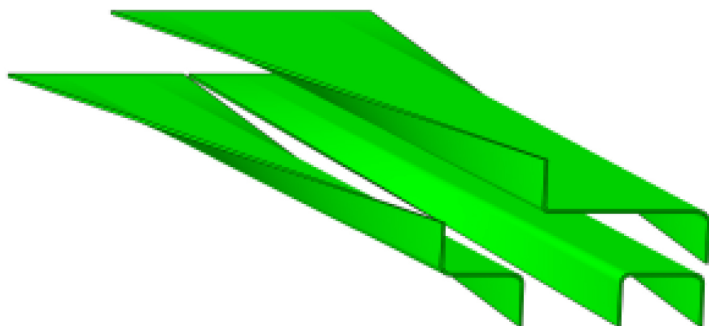


**Figure 2. Sub-preforms (source: BROETJE-Automation)**

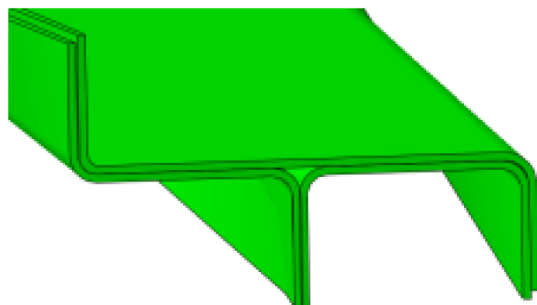


**Figure 3. Final-preform (source: BROETJE-Automation)**

Based on the process chain above, the following operational steps have been defined for the preforming process within the CCPS:

1. Unreeling material storage onto creels
2. Stacking of Sub-preform lay-ups
3. Local Pre-fixing of Sub-preform stacks
4. Cross-section forming of Sub-preform
5. Curvature forming of Sub-preform
6. Fixing of Sub-preform
7. Cutting of Sub-preform
8. Handling and positioning of Sub-preforms with a Composite Handling System in the mounting tool
9. Mounting and fixing Final-preform

## TECHNOLOGY CONCEPT

For continuous production of the LCF-profiles, BROETJE-Automation has designed and implemented the corresponding system engineering components. Subsequently, the complete CCPS has been built-up and installed in-house.

The design of the overall system is represented in [Figure 5](#).

The CCPS is divided into three levels for production of the three sub-preforms. After production of the individual sub-preform, the assembly is carried out in a mounting tool for the final-preform. A robot handling system takes the sub-preform and places it in the mounting tool.

The process sequence within the system engineering is represented as a schematically process chain in [Figure 4](#).

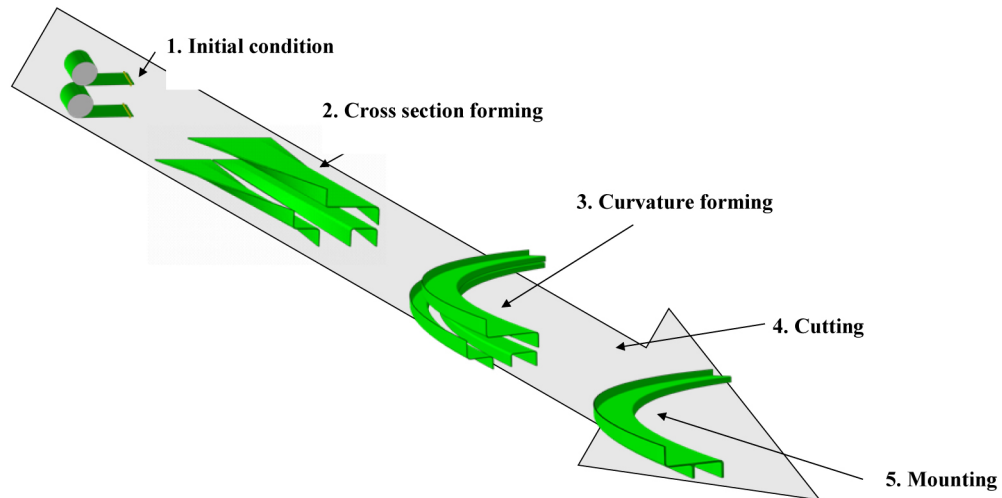


**Figure 4. Process chain (source: BROETJE-Automation)**



**Figure 5. CCPS as CAD model (source: BROETJE-Automation)**