

## FDM Empowers Champion Motorsport to Create Strong, Beautiful Parts for Porsche

*“Soluble cores allow me to design and make parts that I previously wouldn’t have considered because of the difficulty involved in creating them.”*

— Chris Lyew, Lead Mechanical Engineer, Champion Motorsport

### SITUATION

Champion Motorsport’s legacy in auto racing includes a win at the prestigious 24 Hours of Le Mans and five straight American Le Mans Series LMP1 championships: two as a private team and three as an Audi Sport North America factory team. In the past decade, the company has leveraged the technology they developed, perfected and proved on the racetrack to create a very successful line of aftermarket performance products for Porsche vehicles.

An example of these products is Champion’s carbon fiber turbo inlet duct for the Porsche 997 Turbo. By constructing the duct from carbon fiber, Champion was able to increase the duct’s interior dimensions while keeping the outer diameter at factory specifications. The result is better airflow through the duct, leading to improved engine performance. The new design is also lighter than the original part which further enhances overall performance.

“Producing complex tubular composite components, such as the turbo inlet duct, is very challenging,” said Chris Lyew, lead mechanical engineer, Champion Motorsport. “The performance of the vehicle depends on a smooth internal surface while the customer expects a beautiful external surface. The part also needs to be very strong to last the life of the vehicle.”

Achieving a smooth interior and exterior surface finish with tubular composite components is almost impossible using conventional tooling methods. If the part is molded in a single piece, the interior core can be trapped inside the tube, unless it is made of a material that can later be washed away like a sacrificial sand core. An alternative is to mold the tube in two halves. The disadvantage of this approach is that the two halves must be bonded together after molding, resulting in a part that’s not as strong as one with single-piece construction. In both cases, good surface finish is only obtained on one side of the part.

Over time, Champion tried different methods for producing inlet ducts but was unable to attain a seam-free part with high quality surface finish on both the outer and inner surfaces.

### SOLUTION

Champion Motorsport had traditionally used its Fortus<sup>®</sup> 3D Production System to make conceptual and functional prototypes during the design process. Later, they discovered that using it to make FDM soluble cores was the ideal solution for manufacturing the company’s high performance turbo inlet ducts, as well as a number of other tubes and pipes for the Porsche engine.

Champion could now make its ducts in a single piece by laying up carbon fiber on an FDM printed soluble core. An excellent external surface finish was achieved by combining the



High performance car utilizing FDM-enabled components.



FDM soluble core-enabled components on a turbocharged engine.



Composite turbo inlet duct (black) made using FDM soluble core (white).

soluble core with an external clamshell mold. The core could then be easily dissolved away in a solution bath after the carbon fiber resin was cured.

## RESULTS

FDM technology not only improved the performance of the carbon fiber part, but it also improved the consistency and production yield by providing a reliable, automated process.

“We substantially improved the quality of our carbon fiber turbo inlet ducts and other aftermarket parts by making them with FDM soluble cores,” Lyew said. “It’s now possible to mold the inlet duct in a single piece that is much stronger than parts produced by bonding. Every FDM soluble core is exactly the same so it’s easy to maintain the internal finish of the duct as well.”

FDM soluble cores have also opened up new design possibilities and knocked down the barriers that have traditionally gotten in the way of improving design and manufacturing capabilities. As Chris Lyew puts it, “Soluble cores allow me to design and make parts that I previously wouldn’t have considered because of the difficulty involved in creating them.”

For Louis Milone, Technical Director of Champion Motorsport, the benefits are clear: “There’s really no downside to this technology for us.”



An array of complex, composite ducts made using FDM soluble cores.

<b>Challenge</b>	Inability to make carbon fiber tubes and ducts that met consistent quality and performance requirements using conventional layup tools and methods.
<b>Solution</b>	FDM soluble core molds allow parts to be fabricated with desired interior and exterior surface finishes without the need for two-piece molds or sand cores.
<b>Benefits</b>	Creation of high performance automotive parts with excellent finish and strength, which was previously unattainable or impractical before via a streamlined and consistent manufacturing process.

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