



Case study: Metisse Motorcycle Demonstrator

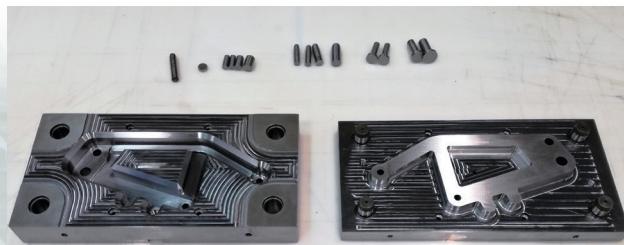
Metisse Motorcycle demonstrator created with Hexcel's latest CFRP technology.

Hexcel's HexMC®-i molding compound and HexPly® carbon fiber prepgs selected for innovative high rate manufacturing process demonstrator produced with Cranfield University and Metisse Motorcycles.

Project displays new rapid production process for the high rate manufacturing of structural components.

Between 2014 and 2016 Aurele Bras and Andrew Mills of Cranfield University developed and optimized a new process for the rapid production of lightweight carbon fiber parts as part of an EPSRC funded project, MultiComp funded through CIMComp, the Centre for Innovative Manufacturing in Composites.

In order to demonstrate this unique process, for which Hexcel's HexMC®-i molding compounds with HexPly® carbon fiber UD prepgs were specifically selected, the Cranfield team needed a suitable development partner and component to showcase the extensive benefits within high rate manufacturing applications such as automotive. In late 2016, Metisse Motorcycles, the UK-based manufacturer of retro style motorcycles, joined the project and a component design process was initiated between Cranfield, Hexcel and Metisse.

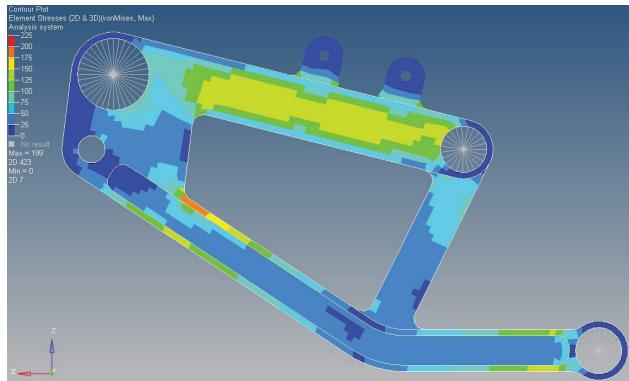


Press tool for composite bracket

Combining the latest CFRP technology with classic design

With a heritage born in motocross and road racing in the 1950's and '60's, Metisse Motorcycles has always produced classically styled motorcycles that blend superb handling with innovative design and engineering excellence. Founded in 1959, Metisse quickly built a loyal following with riders all around the world including racers and celebrities. The legendary Hollywood star and top amateur racer Steve McQueen described his Metisse Mk3 as the "best handling bike I've ever owned", and the company still produces a limited-edition version of his favorite desert racing motorcycle today. Despite their classic appearance, Metisse bikes incorporate many modern mechanical technologies with the current owner, Gerry Lisi, commenting that 'this new cutting-edge Hexcel carbon fiber part is most definitely in the spirit of the Metisse brand'.

Cranfield and Metisse selected an aluminum footrest bracket to optimize and began to re-design the part for composite production, carrying out a detailed stress analysis, steel tooling design and fabrication before arriving at an initial prototype part in March 2017.



Stress analysis of final part design

Further optimization of the design - made by adjusting the position and orientation of the UD carbon fiber - produced an even stiffer finished part in the summer of 2017 resulting in a massive 50% weight saving over the original component.

For alternative applications, metallic inserts can be incorporated directly in the molding process though this was not required in the Metisse bracket. Instead, all mounting holes and attachment points were molded in their final shape and position, with the demolded part ready to use with no secondary machining steps.

As a result, overall production time for the composite bracket was just under 3 minutes in a lab environment, with a complete cycle time of less than 2 minutes being deliverable with an automated production cell.

Lightweight benefits with consistent performance

Lightweighting is a clear benefit of composites over some metallic technologies, but a key feature of this hybrid HexMC®-i and HexPly® UD co-molding process is the ability to selectively place the UD elements and keep them highly aligned without compromising the curing time. This allows both the optimization of the material usage (critical when replacing relatively low-cost metals with carbon composites) and increases the predictability of the

part's performance versus design. By demonstrating a finished part that is within 3-5% of the weight of a fully optimized prepreg solution, the Cranfield team has shown that this Hexcel material combination delivers a massive performance versus weight improvement over traditional SMC solutions that may be considered too heavy for key composite structural parts. Hexcel's snap-cure HexPly® M77 resin, used in both the HexMC®-i and HexPly® UD prepreg, delivers reliable and consistent rapid curing with a common resin matrix throughout the part.

Hybrid lay-ups in high rate manufacturing

While Metisse Motorcycles intends to keep production volumes low, with a team of craftsmen hand-building bikes to order, this Hexcel – Cranfield collaboration has validated the use of a HexMC®-i and HexPly® UD hybrid part design in replacing complex cast, machined or forged metallic parts that could not previously be formed with composites in a cost effective high rate production process.

Both parties are now actively developing other industrial applications, particularly in the automotive sector, where components such as battery boxes, brackets, enclosures and even suspension or steering components could be made lighter and more rapidly with this production ready process.



Combining the latest CFRP technology with classic design

“This new cutting edge Hexcel carbon fiber part is most definitely in the spirit of the Metisse brand” *Gerry Lisi, Metisse Motorcycles*

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