

# Carbon ThreeSixty

## ZAK Springs - Case Study

**Carbon ThreeSixty** is a leading innovator in composite technologies and manufacturing. Based in Chippenham, Wiltshire, UK, CTS recently relocated into a purpose designed 44,000 sq ft factory. Recent growth has led to the staff count reaching 35 employees working across Automotive, Aerospace, Defence and Engineering sectors.

CTS is at the forefront of manufacturing, specialising in Resin Transfer Moulding (RTM), Compression Moulding, Filament winding and Tailored Fibre Placement (TFP)

### Introduction:

Zak Mobility required lightweight, durable, and performance-tuned suspension springs for their innovative cargo bike wheel assembly. The springs were a critical component, with three integrated into each complete wheel assembly. The initial geometric and laminate design was developed in-house by Zak Mobility. They then needed a manufacturing partner capable of producing the complex composite spring element, incorporating specific features like an aluminium bearing seat and a location "lip", and ultimately tuning the spring stiffness for optimal performance.



### CTS Solution:

CTS partnered with Zak Mobility to design and manufacture the composite spring element, drawing on information from the previous iterations manufactured by Zak Mobility from 2020 to 2024.

**Expert Process Selection:** CTS evaluated different manufacturing methods, including wet press and Resin Transfer Moulding (RTM), factoring in future production rates. For prototyping, compression moulding of prepreg was chosen for its lower tooling cost and easier control of layers and fibre angles, CTS's analysis demonstrated a comprehensive understanding of composite manufacturing options.

**Advanced Design Integration:** CTS collaborated to modify the initial design to incorporate an aluminium bearing seat at one end and a molded lip on the other. These features were integrated directly into the composite part, reducing the overall number of components and leading to a more efficient assembly. This required altering the laminate design to include wrap-around plies around the bearing seat, a technical challenge where approximately 30% of the plies wrapped around the insert while the rest terminated.



**Precision Tooling Design:** To successfully mold the integrated features, a sophisticated multi-part aluminium mold was developed. This tooling precisely held the aluminium insert in position using two steel pins that also filled the insert's centre, preventing material ingress during molding. The tooling design facilitated extraction, particularly for the lip feature.

**Manufacturing Process Refinement:** CTS continuously refined the manufacturing process. A 3D printed insert was introduced into the preform near the aluminium bearing carrier, to reduce local stresses and ensure consistent material thickness and quality in this critical location. This highlights CTS's commitment to optimising lay-up procedures for complex geometries.

**Performance Tuning through Laminate Optimisation:** After producing the first set of springs, the project required adjusting the spring stiffness. With the geometry fixed, CTS leveraged laminate properties – volume fraction, material type, and fibre orientation – to tune performance. Using tools like Altair ESAComp to simulate structural properties, CTS successfully produced springs with high, medium, and low stiffness by adjusting the percentage of laminate placed in various orientations. The comparison between the high and medium stiffness laminates clearly shows how fibre orientation within a fixed volume can significantly influence mechanical properties to achieve the desired stiffness reduction.



## The Results:

CTS successfully manufactured and supplied three different stiffness specifications of the composite spring in glass fibre. Furthermore, demonstrating material flexibility and innovation, a fourth variant with a carbon outer layer was also produced.

## Partner with CTS:

This project showcases CTS's capability to act as a leading manufacturing partner for innovative composite solutions. From initial process selection and collaborative design modifications to precision tooling and sophisticated laminate optimization, CTS delivers high-performance, integrated composite components. Our expertise in manufacturing complex parts, incorporating integrated features, and tuning mechanical properties like stiffness provides clients like Zak Mobility with efficient, lightweight, and high-quality solutions. If you require a partner with the technical expertise and manufacturing capability to bring your complex composite designs to life, contact CTS today.