

## Case Study

High Speed Inspection Improves Quality Control  
Data And Allows Process Trend Monitoring In  
Specialist Composite Material Production.



Red Composites has commissioned a high-speed inspection system from Scorpion Vision for use in the production of specially formulated carbon fibre and glass fibre towpregs. The vision system monitors the width of the impregnated ribbon as it is wound onto spools for customer use, providing valuable quality and process control data.

## Background

Red Composites is one of Europe's leading suppliers of towpregs, which are ribbons of carbon fibre or glass fibre pre-impregnated with an epoxy resin and wound onto a spool. Red Composite's towpregs are generally used in the winding of tubular components in a diverse range of industries.

Since the material does not harden until it has been heat-treated, the towpregs can be transported and stored for extended periods of time without refrigeration before they are used to form the final product.

The company has developed a range of primary high-performance thermoset epoxy resin matrices for use in the towpregs, with different formulations for different applications. They are used for the manufacture of products in industries such as fire fighting, European Space flight, performance marine (racing yachts), wind turbines and automotive.

For example in the fire fighting industry, towpregs from the company have been used to manufacture composite cylinders for Self Contained Breathing Apparatus, while in the automotive industry there is particular interest in the use of the composites in hydrogen powered vehicles.



Composite Over-wrapped Pressure Vessel (COPV) made from Carbon Fibre Towpreg





# 01 Challenges

Towpregs are manufactured by unwinding carbon fibre or glass fibre ribbon from spools and passing it at high speed through a chemical processing stage where it is impregnated with the required thermoset epoxy resin and curing agent. The ribbon is then wound back onto spools utilising the latest fibre winding technologies ready for dispatch to customers.

Ribbons are produced in a variety of widths from 1-12 mm with thousands of metres wound onto an individual spool. From both a quality control and process control viewpoint, it is important to monitor the width of the ribbon at multiple points along the entire length of the ribbon.

In order to maintain the necessary production throughput, the measurements need to be made without slowing or stopping the winding process (which would happen if measurements were made manually with calipers). In addition, the measurement system must be capable of measuring both black (carbon fibre) and lighter coloured (glass fibre) ribbons.



Spool of pre-impregnated carbon fibre ↑

# 02 Solution

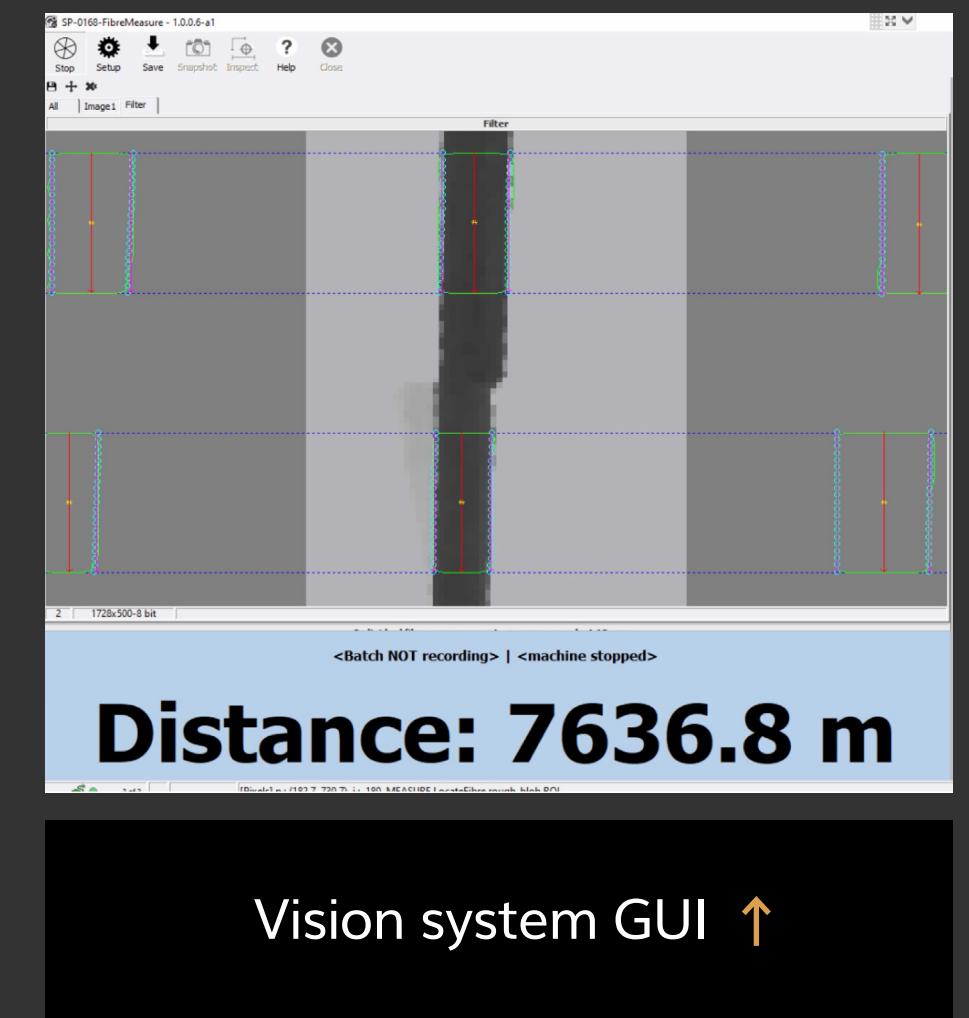
An automated vision system designed by Scorpion Vision provides real-time, high accuracy non-contact measurements of the fibre width from the entire length of the material as it is wound onto the spool.

The system consists of a box containing a high resolution camera to allow measurements to the micron level, if required, LED lighting, strobe controller and an industrial PC. It is controlled via a separate touch screen with a custom designed graphical user interface (GUI). High speed strobe lighting is used to eliminate motion blur and effectively 'freeze' the motion of the ribbon for measurement. A signal from an encoder on the spool equipment roller is used to trigger the lighting pulse and the camera exposure.

The encoder signal defines the interval between the image captures, and therefore the distance interval along the ribbon for the measurements. A white background is positioned below the ribbon for carbon fibre measurements and a dark background for glass fibre measurements.

This ensures optimum contrast in the images for edge detection. Several image processing tools within the Scorpion Vision Software are used to condition the image for measurement. The software locates the fibre in the field of view and automatically measures the width and other parameters.

The touch screen displays the current average width as well as the length of fibre processed so far. All results are saved locally in a CSV format and at the end of the run they are wirelessly uploaded to the company's servers.



## 03 Key Benefits

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The vision system generates thousands of data points for every spool and user defined tolerances can be set. **Jeremy Dolby, Managing Director at Red Composites, commented; "The vision system brings a number of key benefits".**

The large amounts of data generated not only help to further validate our quality assurance certification but also provide invaluable trend information on the impregnation processing process itself. Identifying process problems at an early stage minimises production downtimes. In addition it helps us evaluate any new impregnation processes before full scale production begins."

The formulation of different epoxy matrices and end-user cure schedules is a core element of **Red Composite's** product offerings. It is fundamental to meeting the needs of different market sectors. Currently available formulations include:

- **Toughened systems for dynamic composite structures.**
- **High strain versions for pressure vessels requiring high fibre translation properties.**
- **Elevated service temperature operation.**
- **Systems for use in a vacuum in space flight applications.**

As new formulations are developed, or custom formulations and engineering designed fibre/matrix ratios are requested, a comprehensive in-house mechanical testing, thermal analysis and analytical chemistry capability ensures evaluation of the cured composite, while data from the vision system helps monitor the effects of any modifications in the impregnation process.

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**The Vision System provides invaluable trend information on the impregnation processing process itself. Identifying process problems at an early stage minimises production downtimes."**

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Jeremy Dolby,  
Managing Director at  
Red Composites,



Thank you for reading.

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