AFRC

ADVANCED FORMING RESEARCH CENTRE

UNIVERSITY OF STRATHCLYDE

University of Strathclyde Glasgow

Advanced Forming Research Centre

Rolls-Royce

Project Background

Flow forming or tube spinning, as it's more commonly known, is an incremental process using cold forming methods, whereby the pre-formed material is placed on a cylindrical mandrel and compressed and elongated across a number of rollers to create different outer profiles. The technique is closely calculated and monitored to produce precise wall thicknesses and accurate profiles of the final component.

Part of the Rolls-Royce led SAMULET (Strategic Affordable Manufacturing in the UK through Leading Environmental Technologies) research programme, this project involved the core capabilities of the AFRC to examine and enhance current knowledge on the applications, limitations and advantages of the flow forming process using super steel alloys. The goal was to recommend the best strategy to form a full-scale, high strength steel component based on Rolls-Royce's future engine designs for aerospace. The result will also be used to improve knowledge of the key process variables for Rolls-Royce's supply chain.

Shaping the future
Forging partnerships

CATAPULT High Value Manufacturing

Problem

Flow forming of mild steel and aluminium alloys is well established. However, there is currently limited knowledge of flow forming super steel alloys due to its superior mechanical strength and resistance to deformation and loading.

Though the AFRC has a wide range of equipment, facilities, and industrial expertise to support partners and collaborators, it had to acquire and install a flow former machine, the WF-STR-600/3, specifically for the project.

The main challenge was to not only understand the characteristics, properties, and behaviour of the material, but to also identify the operating parameters of the machine in relation to forming super steel alloys.

What we did

The project aimed to address this gap in understanding through in-depth research and a series of small and full-scale forming trials into its material formability, achievable reduction rates, forming forces, and material characteristics, to counter potential cracking and breaking issues.

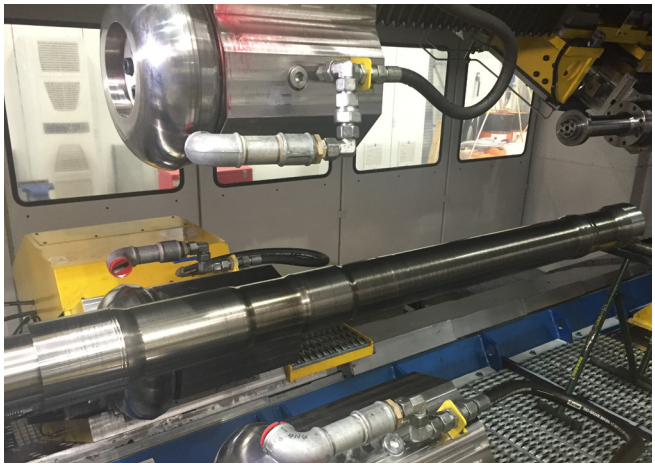
It involved close collaboration and knowledge transfer between the AFRC and Rolls-Royce's Materials Processing Technology team and its supply chain, to demonstrate the applications of the flow forming process and the formability of the super steel alloy.

A representative small-scale part was then produced and results used to replicate a larger, demonstrator piece.

Result

This project was successful in demonstrating the possibilities for flow forming for aerospace engine applications, and producing recommendations to showcase the benefits of this process in future Rolls-Royce projects. From a technical aspect, the material properties achieved exceeded expectations.

The final component was three times its original pre-form length. The project concluded that flow forming produces high precision cylindrical components at a fraction of the time, energy and waste generated using conventional methods.



> We have generated invaluable information on the applications, limitations, and benefits of flow forming which can be transferred to other materials and industries. This project will aid in building a business case for the use of flow forming for Rolls-Royce components in a production environment.
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> Jill Miscandlon, Research Associate, AFRC

> Extending the applications that flow forming can be applied to is a key element to our strategy to increase material utilisation rates and reduce costs. SAMULET 2 demonstrated that a pre-form can be cylindrically flow formed to 3X its original length - representative of geometry required for full scale engine component and demonstrating a threefold improvement on material utilisation. The work has highlighted geometrical and microstructural changes that occur as a function of varying input parameters and this has generated key understanding on the process capability for flow forming.
>
> Martin Tuffs, Global Process Owner, Cold Forming, Rolls-Royce

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