

Rolls-Royce

Automated SPF coating application

Customer challenge

Boron nitride (BN) is a water-based coating commonly used to provide lubrication to Rolls-Royce fan blades during the superplastic forming (SPF) process.

BN is typically applied manually using a spray gun. This often results in variability in the thickness uniformity of the coating. This variability can cause issues in relation to the SPF process as parts that are not sprayed consistently can be susceptible to high temperature oxidation, die adhesion and surface finish issues which can ultimately lead to costly and time consuming part post-processing and die refurbishing operations.

How did the AFRC help?

To minimise the variability in application, the AFRC worked in collaboration with Rolls-Royce to develop, demonstrate and validate an automated method for the application of boron nitride (BN) to Trent 700 fan blades. The application of BN via an automated spray system is not common practice in the aerospace industry.

An automated spray system was installed onto one of the AFRC's FANUC robots to facilitate a series of spray trials. Rolls-Royce supplied a Trent 700 fan blade and an associated CAD model, allowing the AFRC to work with Core PD Ltd to design and manufacture an automatic blade manipulator. A simulation of the process was created to develop appropriate spray paths, which informed experimental trials aimed at mapping the key process variables of coating thickness and consistency.

After demonstrations were conducted, blades with a specific coating thickness were put through the SPF process using the AFRC's 1,200 tonne SPF press to demonstrate the benefits of consistent and accurate BN coating application.

Business impact

The demonstrated system was accurate to within $\pm 10 \mu\text{m}$ of the target coating thickness with full and even coverage of the fan blade. Process control benefits of using a spray robot for the application of BN to complex aero-components were confirmed.

The results of the investigation and the live demonstration helped re-affirm the business case to install a similar automated spraying system within Rolls-Royce's manufacturing facility.

The industrialisation of the automated spraying system is expected to bring about further benefits on die-life and rework costs in addition to reducing the need for post processing and potential waste.

"The AFRC's knowledge and experience from previous SPF related projects for Rolls-Royce was key in allowing them to understand the best approach to developing the automated BN application."

Dr Steven Halliday
Rolls-Royce Partnership Manager at AFRC

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