midlands aerospace alliance

MIDLANDS AEROSPACE MAGAZINE

ISSUE 44. SUMMER 2017

2017 PARIS AIRSHOW ISSUE

MIDLANDS FLYING HIGH WITH A350

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Combined conference, B2B event rated success – page 2

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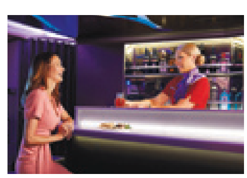


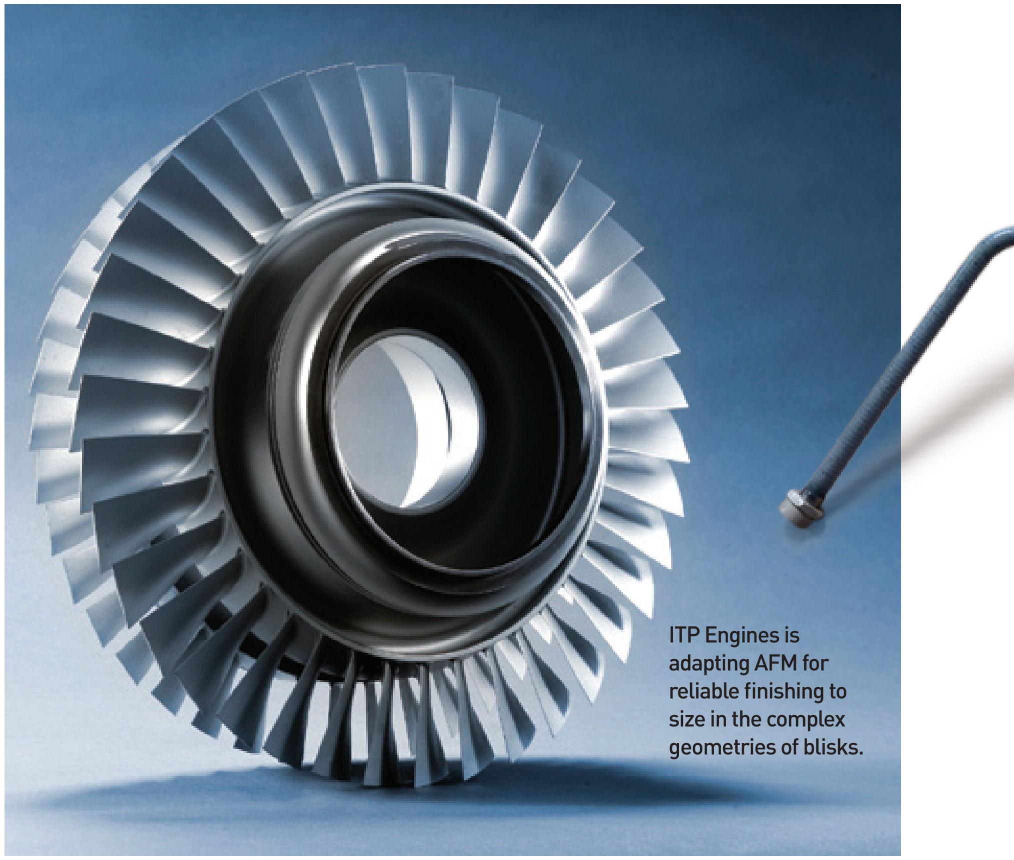
NATEP INNOVATIONS HEAD FOR MARKET

Project results underscore value of SME research – pages 12-13

NATEP

OUTSIDE THE BOX

Four NATEP projects led by members of the Midlands Aerospace Alliance underline the big long-term benefits of the programme.



ITP Engines is adapting AFM for reliable finishing to size in the complex geometries of blisks.

Updating old abrasion process

In this two-year NATEP project, Leicester-based ITP Engines UK and partners Extrude Hone and Brunel University are getting to grips with the science behind a 50-year-old process used extensively to improve the surface finish on metallic parts after machining.

ITP uses abrasive flow machining (AFM) to finish integrally-bladed rotors for aero engines, often referred to as bladed disks, or blisks. These high-value blisks are manufactured from aerospace alloy forgings using expensive 5-axis milling machines on which time is always at a premium.

During AFM, a viscous abrasive paste is forced under pressure across the surfaces of parts to smooth out surface irregularities such as machining marks.

Despite being deceptively simple in concept, the process has always been largely empirical because the underlying physics and chemistry are not fully understood.

As airfoil shapes become more sophisticated, the inability to accurately predict and control the AFM process means that it is becoming increasingly difficult to preserve key features. Caution dictates that some parts need to be subjected to interim measurement on CMM machines, thereby significantly increasing the manufacturing time.

During this project, Brunel University has been constructing a mathematical model of the AFM process and validating it through a series of tests on material coupons and blisk segments carried out by Extrude Hone and ITP.

Although this project still has a little way to go, the results to date are extremely encouraging.

ITP hopes it will be possible to fully integrate AFM into the manufacturing cycle as a controlled process, and that it may even be possible to reduce milling time, safe in the knowledge that reliable finishing to size can be achieved using AFM.

Adapting pipe-bending technology

Carbon fibre reinforced thermoplastic pipes offer potential weight reductions for aircraft because they are durable, strong and light. The problem with airframe and aero-engine pipes, however, is that they are seldom if ever straight and more usually have bends in complicated 3D geometries.

Traditional manufacture of thermoset composite parts, which involves laying the fibres in a mould replicating the final shape required, is problematic for pipes which can have many different shapes.

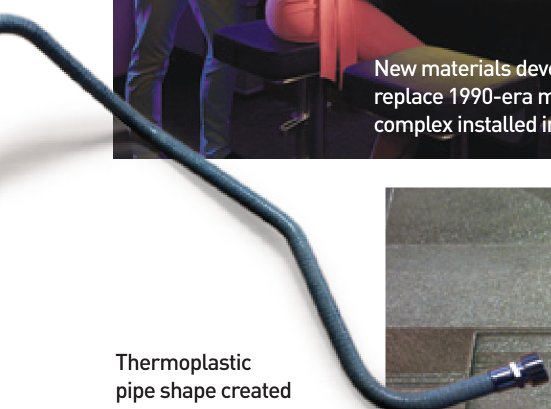
Warwickshire-based Sigma Precision Components, a leading supplier of metallic pipes, considered the traditional thermoset method neither a sensible nor cost-effective approach for composite pipes. Sigma proposed a novel alternative which NATEP has been able to help turn into a reality.

In this 12-month project, Sigma and partner e-Mould UK have developed a process to bend pre-made Sigma composite pipe into the desired form under computer control.

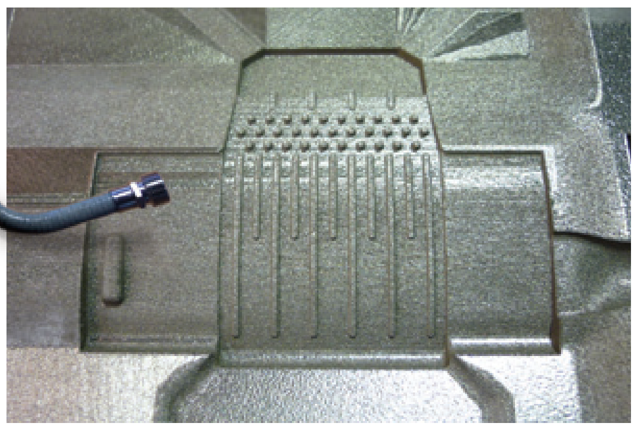
To achieve this, it was necessary to design and manufacture special tools which are heated and cooled during a precisely controlled, automated forming cycle. The bent pipes have been subjected to a range of tests and have been shown to meet performance requirements.

Composite pipe is a disruptive technology which offers up to 50 per cent weight reduction compared to stainless steel and 15 per cent reduction compared to titanium. Owing to temperature constraints of the thermoplastic material, only a proportion of aerospace

New materials developed by SHD Composites are designed to replace 1990-era materials used by AIM Altitude for a Door 2 bar complex installed in Virgin Australia Boeing 777-300 aircraft.



Thermoplastic pipe shape created by Sigma using its novel bending technique.



One-half of a new ceramic core die block, produced using AM.

applications would be eligible for a composite pipe solution, but this is still a very large potential global market.

With its experience in metallic pipes, Sigma is in a good position to exploit the market potential. Aside from aerospace, there is also interest from other sectors such as automotive for lightweight composite tube in applications other than conveying fluids.

New approach to ceramic cores

An 18-month NATEP project led by Gardner BTC features the use of additive manufacturing (AM) to help improve the yield from one of the many complex manufacturing steps in making modern gas turbine blades.

Turbine blades for aero engines are usually manufactured by investment casting (or lost-wax processing). This process involves making a precise negative die of the blade shape and filling it with wax to form a wax blade. If the blade has internal cooling channels, a ceramic core in the shape of these channels is inserted in the wax blade before it is coated with a heat-resistant material to make a metal casting shell. The core remains embedded in the blade alloy that replaces the wax until it is dissolved, leaving the blade channels hollow.

These cooling channels within the blade can be extremely narrow and convoluted, and for the ceramic cores which will eventually form these channels, this can pose a real problem for their manufacturer, Gardner. The thin 'fingers' of these ceramic blade cores are extremely fragile and prone to breakage as a result of thermal stresses during cooling.

Gardner, with 3D printing partner Material Solutions, has redesigned the ceramic core manufacturing dies to introduce optimised thermal control within the die block during injection. Cooling channels are designed and positioned with the aid of computer thermal analyses to give greater control over the injection process and minimise residual stresses in the injected core.

By using AM, it has been possible to make far more complicated internal pathways than have previously been achieved through conventional machining. In addition to improving the quality of ceramic cores, Gardner predicts that core manufacturing yield improvements will be realised, allowing more difficult core geometry to be more easily made.

Sugar cane to composite material

For Lincolnshire-based prepreg manufacturer SHD Composites, a new material set to revolutionise aircraft interiors has been developed using an unlikely biomass waste product.

Under this 18-month NATEP project, SHD – with its partner, AIM Aviation – has developed a new composite material in which the phenolic resin that is traditionally used has been replaced by a furfuryl alcohol resin derived from the inedible part of sugar cane after it is processed. This new material has demonstrated great fire-resistance properties compliant with aerospace standards (CS 25.853) and mechanical properties which are as good as or better than current materials.

However, project leader Nick Smith emphasises that there are other benefits likely to be at least as interesting to the aerospace industry, concerning the health and safety of production workers and the environment. The material is much safer to handle as manufacture does not involve any hazardous volatile organic compounds (VOCs) and the hot melt manufacturing is less energy-intensive and solvent-free, leading to reduced emissions.

Equally important, the material's raw organic matter cannot be used to feed people and its production is sustainable.

SHD has acquired a new factory which will be used to manufacture the new prepreg material after it is certified. Samples are currently being produced for evaluation in uses such as galleys, storage and partitions in cabin interiors – anywhere phenolic material is currently used.

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