



2023 Capital Markets Day

Expo Transcript: Increase Time on Wing

Tuesday, 28th November 2023

Here in Civil Aerospace, we are laser-focused on improving our financial performance. One of the strategic initiatives we have, which will improve both operating margin and cash flow, is keeping our engines 'on wing' for longer. We can do this whilst maintaining excellent safety, performance and operational availability. Extending Time On Wing is very much like Formula One racing. To win, your aim is to keep the car on the track and operating at its peak performance for as long as possible and to minimise the number of pit stops needed.

This means you're constantly assessing and improving all the factors that would require a pit stop. Our engines are complex precision-engineered machines that have many different removal drivers, and our job is to always keep ahead of the next pacing item to maximise the time the engine stays on wing and generates revenue. Our ambition is to improve the average Time On Wing for modern Trent engines by at least 40% over the medium term.

To put that into context, this means relative to today's engine standard, we will extend time to overhaul by almost two years on average from around three years to more than five years. We will significantly improve our performance through pulling three key levers.

The first of those is improving our product durability. Again, in Formula 1 terms, we could liken this to improving parts that see a lot of wear during a race, such as the tyres, so that they can last longer.

Similarly, we are continuing to prove the durability of some of our components in our new modern generation engines. For example, we have developed a state-of-the-art High Pressure Turbine Blade which has improved durability, and at least doubled the blade's time on wing. This advanced technology has been in service since September 2022 on the Trent 7000 and is now the production standard.

More than 20% of the in-service Trent 7000 fleet has this High Pressure Turbine Blade incorporated, and we are upgrading all engines at their next refurbishment. That same blade will be available next year for the Trent 1000-TEN and will also be retrofitted across the existing fleet. Our second major lever is extending life and component limits. Engines are typically removed from aircraft for three reasons: either life limited part expiry, component condition or temperature margin.

And we've been working on all three of these. Let's take the first one, life limited part expiry. Engines have several components that must be replaced after a certain duration or a certain number of cycles. These are called Life Limited Parts. In line with standard industry practice, Life Limited Parts are intentionally certified with a relatively low life when an engine first enters service.

To extend this life, we used in-service sampling data and digital twin modelling to enable an extension of the life limit, which helps reduce the frequency of shop visits, without impacting safety. We have also developed an approach for counting cyclic usage, which uses the specific operator profile to calculate the life of components. For example, we've safely achieved up to 40% more flight cycles for some of our engine components.

In terms of component condition, we also look to extend individual component condition limits. To do this, we are investing in new capabilities that combine in-service data with manufacturing data to deliver improved high pressure turbine blade lives.

Lastly, temperature margin. We can also extend engine temperature limits through further testing. This involves material testing and development-engine testing to certify increased temperature limits that the engine can operate at before performance restoration is required through a shop visit. We've recently completed this type test on the Trent 1000 and 7000 and successfully unlocked an 8% time on wing improvement. Our teams are accelerating the fleet incorporation of these life extensions through new ways of working through digital and lean methods. Working closely with our regulators, this improved approach has resulted in a higher confidence and a 30% reduction in approval times.

Our third lever is around optimising aircraft operation and maintenance. To improve the efficiency and effectiveness of the engine, we've introduced a novel core wash technology that restores engine performance through more effective washing. Through this new technology, which can be carried out on-wing and at an airport gate, we are targeting up to 10% improvement Time On Wing. We have now validated it for use on the Trent 1000 and the Trent XWB and have trial units with two customers. Our intention is to place these in hubs around the world so that we can maximise the benefits to the Trent fleets.

Finally, we are also influencing how the aircraft is operated. Coming back to the Formula 1 analogy, this is like the Formula 1 team using their engine data to guide the Formula 1 driver on how best to handle the race. Similarly, we use our advanced IntelligentEngine digital twin to guide customers on how to optimise the aircraft's operation and minimise engine wear and environmental impacts. We've had great success with this already. For example, we identified that wear on a specific Trent 1000 part could be reduced by 40% through a small change in operational behaviors. Operators who adopted this advice secured, on average, 20% more flying time. We are now taking this even further by working with airframers to optimise at whole aircraft level, and early indications are very encouraging.

So extending Time On Wing is pulling on all these different levers to reach our goal. We are making good progress across multiple fronts, but we recognise we have much to do. But we are energised and committed to succeed.