ALL THE SEVENS 700 & 7000

Lucky number seven could apply to developments in the Rolls-Royce Trent civil aero-engine family.

There are now seven Trent marques following the announcement last year of the latest version to be launched, the Trent 7000 for the Airbus A330neo.

And which Trent engine is currently the most successful in terms of the largest fleet in service? Why the Trent 700 of course. This is the engine that powers the Airbus A330 flying today, now re-designated the A330ceo or 'current engine option'.

The Trent 700 celebrates 20 years in service this month (March). It entered service with Cathay Pacific – a big operator of the aircraft/engine combination – and the airline continues to accept new A330/Trent 700s into its fleet today.

There are now around 1,600 Trent 700 engines in service around the world, the 1,500th having been delivered last year and it remains the most popular engine on the A330 with 64 per cent of the airframe operators choosing it as their engine option.

It is the only engine that was specifically designed for the A330. Average time on wing is now circa 5,000 cycles with the lead engine currently heading towards 40,000 hours without being removed. It has an enviable reputation for reliability in the market – causing least disruption for A330 operators.

"It holds its head high amongst its peer group," says Ashley Owen, Chief Engineer Trent 700. "Its market share position has been developed over the years because it is just better integrated with the aircraft. It also has the highest thrust rating. That's important in markets like China where there are routes such as in and out of Lhasa, Tibet. Here, hot and high performance is vital and the Trent 700 scores really well over the competition. Most A330s flying in China use Trent 700s."

Ashley and his team continue to work on new developments for the Trent 700 engine. "We are designing a new fan blade and making some modifications to the containment system. We are also designing a new electronic engine control (EEC) system which is a major project.

"The developments in electronics and processor capability have been extraordinary in the past 20 years. We want to bring our EEC up-to-date so that we can continue to upload software improvements that improve safety or reliability throughout the life of the programme.

"Our agreement with Airbus is to certify the new EEC as 'equivalent' to the existing system so that there is no disruption in introducing it. In other words it can replicate the current EEC perfectly. Thereafter, we will have the capacity to load new software as and when we need to. Customers expect to see continuous improvement. It's important in keeping the engine competitive for the future."

The new EEC is being developed by Controls and Data Services, a wholly-owned subsidiary of the Rolls-Royce Group.

Over 60 airlines currently operate the A330/Trent 700 combination. Even though production of new Trent 700 engines for airlines will cease in the next two-three years (as the A330neo/Trent 7000 assumes the

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Ashley Owen and Jon Wandless (front) Chief Engineers for the Trent 700 and Trent 7000 respectively.

mantle), Ashley is quick to point out that the fleet is still young. "We are only about 20 per cent through the expected flying hours for the Trent 700 fleet – we have done 30 million so far – there is a lot more to do," he says.

The engine will still be produced for air freight and military air-tanker applications.

The Trent 700 engineering team is very aware of their responsibility in terms of the reputation of the Trent and of Rolls-Royce. Almost all of the 60 airlines who fly the Trent 700 are widebody operators who have, or are likely, to buy the Trent XWB, Trent 1000 or Trent 7000 for the A350 XWB, Boeing 787 and A330neo respectively.

"Customers need to feel good about Rolls-Royce and what we demonstrate on Trent 700 performance can influence their decision making for the future," says Ashley. "It's a good motivator for the Trent 700 engineering team, they know that the work they are doing is important for the future development of the Trent family and of the civil engine business for Rolls-Royce."

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That future business on the A330 family is now embedded with the Trent 7000 programme for the new A330neo. Rolls-Royce was selected by Airbus at last year's Farnborough International Air Show as the sole engine provider.

At present Rolls-Royce is in the design phase for the engine, with the first test runs due to take place in October this year.

Modifications

That is remarkably quick for designing and developing a large civil aero engine but this is an interesting programme, not just in terms of the speed at which it is being done, but also in its heritage. The Trent 7000 is not, as you might think, a development of the Trent 700, it is in fact a Trent 1000TEN engine (originally developed for the Boeing 787) with some modifications. As a latest generation engine, the Trent 1000TEN is not even scheduled to enter service on the Boeing 787 until 2016.

All the major machinery of the Trent 7000 will be that of the -1000TEN, however, it will have a new nacelle and will be modified to provide bleed air for the cabin. The 787 is an all-electric aircraft and does not require air to be drawn from the engine. The change from all-electric also leads to other engineering differences to make it applicable to the A330neo, including the fact that the Trent 7000 will require a new gearbox and will have an air, not electric, starter mechanism.

A new EEC providing the communication between airframe and engine will also be developed and again it is being produced by Rolls-Royce Controls and Data Services.

"We are using the Rolls-Royce philosophy of 'invent once and reuse many times' as far

The Trent 700 is the market leader on the A330.

as this engine is concerned," says Jon Wandless, Chief Engineer Trent 7000. "The innovation in this programme is in taking the technology we have already proven on the Trent 1000TEN and re-purposing it for the -7000. I am not aware of us ever doing this before on a civil large engine, although the company has plenty of experience of doing so on other programmes."

Trent 7000 development is scheduled to be completed in just 42 months as opposed to the normal schedule of six to eight years for a new civil engine.

There are four development engines in the test programme, the first two of which are effectively Trent 1000TENs but with the key aspects such as the cabin bleed modification incorporated. Although the -7000 will be required to clear all its type-tests on parameters such as speeds, pressures and temperatures, it will not be required to complete major engine tests such as blade-off, ice, water and bird ingestion, as these have already been confirmed by the -1000TEN.

Composite

The new engine will produce 72,000lb thrust just as the Trent 700 does now – but at a far greater efficiency.

First flight of the Trent 7000 will be on an A330neo in February 2017 and the first aircraft is scheduled to enter service in late 2017, ramping rapidly to full rate production shortly afterwards. So far, 240 engines are on order.

According to Airbus itself: 'aerodynamic improvements for the aircraft include composite A350 XWB-style winglets and 3.7 metre increased wing span. As a result of these upgrades, the A330neo delivers fuel savings of 14 per cent per seat compared to the in-production A330, while also providing even quieter operations, a range increase of approximately 400 miles, additional payload capability, decreased maintenance costs and superior passenger comfort.'

Two versions of the new aircraft will be produced and they will have 95 per cent spares commonality with A330ceo aircraft.

The A330-800neo retains the current-production A330-200's fuselage length, while the A330-900neo uses the A330-300's longer fuselage. The A330-800neo will offer up to ten extra seats for a capacity of 252 passengers, with the A330-900neo accommodating as many as ten additional seats and 310 travellers, at a comfort standard of 18-inch wide seats in economy class.

For crew, the familiarity to the A330ceo is a benefit as pilot training is straightforward. Drawing on the full Airbus family concept, the A330neo will share the same pilot-type rating as current-production A330 aircraft, a common type rating with the A350 XWB.

For passengers, new cabin features such as full LED mood lighting and Wi-fi connectivity will be available as well as new comfort standards derived from the A350 programme.

"Airbus has seen a sweet spot in the market that it wants to secure with the A330neo. The Boeing 787 is a thoroughbred aircraft which is all new-technology and composite materials but consequently priced appropriately. It is also simply not available for airlines to buy and receive between 2017 and 2021 as the Boeing production line is full," says Jon.

"The A330neo provides a great, modern and economic aircraft option for airlines and has the advantage of commonality with the A330ceo, which is very popular. The bulk of the fuel saving benefit will be derived from our Trent 7000 engines.

"Our biggest challenge in the development of the Trent 7000 engine is the speed of the programme. It is not that we need to do anything radical or novel. We understand the technology and the work we need to undertake but it has to be done at a pace that will allow Airbus and ourselves to hit that window of opportunity in the market.

"It is essential that we work in very close association with Airbus. It is that close co-operation and understanding that will be the key to success on a programme of this scale and speed," he adds. ℝ

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