



1000

Trent newsletter May 2006



Even though the higher thrusts are not needed for service until 2010 the Trent 1000 will be cleared for 75,000 lb from the outset in 2008. Coincident with the higher thrust requirements the engine will also incorporate performance improvements to the turbines, giving an extra 1% of fuel efficiency and enhancing operating margins and maintenance costs. These improvements will be retrofitable to earlier engines, and a single bill-of-material will be maintained, powering all aircraft models.

Trent engines coming down the line

A view of the build line shows the next two Trent 1000 engines being prepared for test-bed running. The first engine was tested on time on February 14th and during its month-long programme accumulated operating experience of all its systems from fast-start schedules through to the high power offtake. The first test has given us data from LP turbine aerofoil strain-gauge instrumentation, and also useful measurements from around the oil, air and fuel systems to confirm our understanding of their correct operation.

Highest thrust demonstration

On March 10th the engine showed its high-power capability, producing over 83,500 lbs of thrust – well above the 70,000 lb needed at EIS and the 74,000 lb thrust required for the Boeing 787-9 launch in 2010.

Test details and targets

The next engine on test, Engine 10002 (known as Engine 2) is instrumented to collect strain-gauge information from the Intermediate Pressure (IP) compressor and turbine aerofoils to pick up stress levels and sensitivity to vibration of the various stages, throughout the engine running range. This is to confirm the successful design of the aerofoils to avoid resonance in various modes of vibration such as flap or torsion. Extra sensitivity from fast-response transducers is needed to ensure that aerofoils do not suffer from aerodynamically induced flutter. All the rotor strain-gauge signals are collected from the rotating system via a state-of-the-art digital radio telemetry system that transmits the data to receivers for recording with all the other engine data, throughout and beyond the full engine operating range of conditions.



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In addition the engine is fitted with tri-axis accelerometers on various external units such as the HMU (Hydro-Mechanical Unit), and some solenoids and bleed valves. This instrumentation will provide valuable, detailed vibration characteristics of the units. It is always vital to know that the engine-mounted accessories do not have unacceptable levels of vibration that may impair their operation or reliability. It is equally important to ensure that pipes and wiring looms are well supported and do not vibrate, chafe in their fixings or contact each other during running. Extensive engine testing and detailed inspections will give that confidence, ensuring trouble-free operation in service.

Engine 2 started first time and quickly executed runs up to high IP shaft speed, successfully obtaining strain-gauge data on compressor and turbine aerofoils, clearing their capability for the ongoing development test programme.

The high power running was conducted with special VSV scheduling to obtain high IP shaft speeds, well beyond redline conditions. **The thrusts achieved were equivalent to around 87,000 lb**, beyond even the levels demonstrated by Engine 1.

Meanwhile, Engine 1 continues to run through the next phase of its test schedule. It has been passed to our outdoor test facility at Hucknall, about 20 miles northeast of Derby, for testing with strain-gauged fan

blades. This test will include simulated crosswind to evaluate the fan's tolerance to instability of intake flow, and its margins to avoid flutter.



Engine 1 on test at Hucknall

A drumbeat of testing

The engine development programme is starting to build up quickly now – new engines will be coming on-line about every 3 weeks, and the drum-beat of testing will increase in pace until all 7 ground-test engines are operating. This high rate of testing will be sustained through to engine certification in mid 2007 and beyond, embracing all the key operational, integrity and endurance testing to ensure maturity for the flight-test programme and on into service.

The Trent 1000 remains on track to be the first engine for the 787 to be certified and to enter service, justifying its position as launch engine on all current members of the aircraft family (787-3, -8, -9).