The CF6-80E1

The CF6-80E1 engine model was developed for the A330 family and represents the highest thrust and most modern version of the CF6-80 family of civil engines by General Electric.

Engine Model	Thrust Rating (lb)	Number of Engines	Number of Aircraft	Types of Aircraft
CF6-80E1A2	68,000	42	21	A330-300
CF6-80E1A3	72,000	62	31	A330-200/-300
CF6-80E1A4	70,000	48	24	A330-300/-200
CF6-80E1A4B	70,000	4	2	A330-300/-200

Technical Development

The engine design is very similar to the CF6-80C2 engine model, with which it shares 60% of the parts. The increased thrust is provided by the increased front fan section – increased to 96″ – and longer fan blades. The additional differences are the booster, with 4 stages, the high pressure compressor (HPC) with 14 stages and the low pressure turbine (LPT) with 5 stages. The engine is equipped with a second generation full authority digital electronic control (FADEC II) controller.

The first version produced was the -E1A2 variant, which was installed on the A330-300 aircraft. The second version was the -E1A4 variant, while the -E1A3 model was launched in 2002.

In 2004, the -E1A4B model was proposed to customers, which addressed many of the technical issues experienced over the last five years.

The launch operator was French carrier Air Inter, with an order for 19 aircraft. In the end only four aircraft were delivered to Air Inter. Over the years, this engine model has been showing some of the same problems as the CF6-80C2 model: HPC Spool cracking, NGV cracking and sagging and HPT Disk cracking. The early CF6-80E1 engines have been showing the following issues:

1 Low pressure turbine vibrations – leading to engine changes and engine low pressure turbine balancing;
2 Stage 2 nozzle sag – causing HPT Stage 2 blades contact and failures;
3 Harness chafing – leading to harness replacement and scrappage.

While the above problems are almost completely solved or in any case handled, the following are representing actual concerns for engines currently in service:

1 Variable stator vanes lever arms wear and fracture, leading to operational disruptions and engine catastrophic failures;
2 Fan mid shaft teflon seal deterioration, causing oil leakage and possible oil in the cabin events;
3 TRF cracking.

Application and operators

The -E1 engine model can be installed on the Airbus A330-200 and -300 aircraft.

More than 15 airlines are currently operating the -E1 engine model. The biggest operators currently include Air France/KLM, Qatar Airways and Qantas. Based on a study by IASG, if the orders and options are converted to orders, the biggest operators (Qatar, Air France/KLM and Qantas) will operate 48% of the total fleet. The engine model has accumulated over 2.5 million hours with a 12-month rolling engine caused reliability rate of 99.774% as at February 2006.

Maintenance Costs

GE Caledonian, EVA Air engine shop and KLM are currently certified to overhaul this engine model. GE West Coast Operation was repairing the last engines at the time of this issue and will then be used only for engine testing. IASG's experience is that first production engines first run was 1,300 cycles/5,200 hours. Thanks to the improvements provided by GE to the operators, the engine is now showing an on wing life of 2,500 cycles on average subject to flight hours to cycle ratio. The main reason for removals is performance deterioration.

IASG notes that the typical cost of a shop visit for this engine model is 10% higher than a -C2 version, in the region of $2.2m to $2.4m depending on sector lengths, thrust derate policy, operating weights and operating environment. The flight hour costs are in the region of $180 to $220 per hour plus $300 to $350 per cycle. There are no significant airworthiness directives or repetitive maintenance burdens afflicting the -E1 variant.

Spare / Lease Engine

The current engine market is a natural monopoly. Spare engines are owned only by big operators and by GECAS. It is understood that no other leasing company has an -E1 variant in its portfolio. The cost of a new engine is around $12m, thus small A330 fleet airlines cannot normally afford to carry the capital costs. There have been a few attempts to create pools on this model, but these have been generally unsuccessful. Lease rate data is scarce but believed to be in the range of $100,000 to $150,000 per month.

Despite the fact that the number of operators will be increasing over the years, the fleet sizes and addressable operator base will be inherently small. This is not an engine that IASG would advise lessors to invest in unless on a full payout basis with a view to part out values at the end of a long-lease term. However, it does make a good portfolio diversification engine, which requires infrequent technical management due to the length of the lease terms and quality of operator.

In the future, IASG forecasts an increase of pooling of spare engines if airlines/alliances can get their acts together to agree common ground. As it can be determined from the deliveries to date and future deliveries, the -E1 is still in the first part of its product life cycle event, though it may be half way through its technical life cycle.

This article is an abbreviated version from Paolo Lironi of IASG Powerplant Support Service.