

TABLE 1—Continued

Date occurred	EE-1 #	Engine type	Affected system	Event description
7/1/1998	G-110	GE	ENGINE	IFSD—Uncommanded engine inflight shutdown during cruise at flight level 370. Flight crew noted a rapid loss of oil pressure and N2. Root cause was a Number 3 bearing failure.
7/22/1998	G-112	GE	ENGINE	IFSD—During cruise, EICAS indication of low oil quantity. Pilot shut down the engine. Oil filter housing cover bolts were over-torqued resulting in stripped threads in the oil filter housing inserts.
11/20/1998 ..	G-120	GE	IDG Installation	IFSD—Crew started return to departure airport due to indication of complete oil loss. Engine was subsequently shut down when oil pressure dropped to 10 psi. The integrated drive generator (IDG) packing was damaged during installation.
10/11/1996 ..	R-63	RR	ENGINE—RADIAL DRIVE SHROUD.	Flight diverted after crew observed right engine oil quantity loss approx. 5 hours into flight. Found cracked upper radial drive shroud.
10/11/1996 ..	R-64	RR	ENGINE—FUEL NOZZLE	Fuel found leaking from Zone 2 during investigation of R-63 oil loss. Source of fuel leak was a cracked weld on the No. 24 fuel nozzle (top dead center).
10/25/1996 ..	R-65	RR	ENGINE—RADIAL DRIVE SHROUD.	After engine shutdown at the gate, the right engine oil quantity indicated 9 qts. Upper radial drive shroud found cracked.
11/12/1996 ..	R-67	RR	ENGINE	“ENGINE OIL PRESS R” EICAS message displayed after landing. Engine shut down. Oil pump drive shaft found sheared.
1/26/1997	R-91	RR	ENGINE—STEP ASIDE GEARBOX	Low oil quantity caused by crack in step aside gearbox housing approximately 4 to 5 inches long.
5/24/1997	R-109	RR	ENGINE	Engine was shut down on takeoff following high power surge. Subsequent borescope inspection revealed HPC rotor 1 blade failure caused by foreign object damage that was consistent with blade damage noted on 5/20/97 inspection.
7/7/1997	R-112	RR	ENGINE	Aircraft diversion caused by excessive oil leakage due to incorrectly installed lower bevel box O-ring seal following radial drive shaft replacement.
7/26/1997		RR	ENGINE	Aircraft diversion due to high oil consumption. Not related to step aside gearbox housing cracking problem.
9/16/1997	R-113	RR	ENGINE	IFSD—Engine shutdown at 400 feet after takeoff due to high-pressure compressor failure.

Reliability of 737 Next Generation (737NG)

As part of the process of reviewing existing methods for ETOPS approval, the FAA also analyzed data from the initial in-service period for Boeing Model 737-600, 737-700, and 737-800 airplanes powered by CFM56-7 engines. As a group, these variants of the Model 737 were referred to as the 737 Next Generation, or “737NG.” Even though early ETOPS special conditions were not issued, the 737NG was chosen for this analysis because it followed an ETOPS approval process program that was very similar to what Boeing is proposing for the Model 777-300ER airplane. Several months after entry into service, however, the 737NG did not exhibit an acceptable level of propulsion system reliability for ETOPS approval. Early ETOPS special conditions were intended to identify a design not suitable for ETOPS approval prior to type certification.

Boeing proposed in 1994, prior to the Model 777’s type certification, that the 737NG be certified as an early ETOPS airplane in a manner similar to the Model 777, but without all of the testing required in the Model 777 special

conditions. Since the success of the Model 777 program was still an unknown at the time of Boeing’s request for the 737NG, the FAA did not agree to Boeing’s proposed changes to the airplane demonstration test requirement. Early ETOPS special conditions for the 737NG were never issued. Even so, Boeing proceeded with those elements of the Model 777 special conditions that the company had proposed to accomplish. These included the relevant experience assessment, design requirements assessment, 3000-cycle propulsion system ground test, and enhanced problem reporting and resolution.

Although the FAA never issued special conditions for the 737NG program, we agreed that the elements from the Model 777 special conditions that Boeing did accomplish justified a reduction in the service experience normally required for ETOPS type design approval, as outlined in AC 120-42A. Boeing presented the following information in support of its request for a reduction in service experience required for ETOPS certification.

- “Design involved lessons learned, similar to 777 Early ETOPS process.

- “APU most thoroughly tested in Allied Signal history—more than 3000-cycle ground test, including hot/cold exposure.

- “Propulsion system subjected to 3000-cycle ground test, intentionally unbalanced, with three 180-minute diversion cycles.

- “Flight testing included a Southwest Airlines 50-cycle demonstration, using airline crews and maintenance. During the Function and Reliability testing, 61 ETOPS cycles were conducted with three single engine 180-minute diversions.

- “A proposed ETOPS problem tracking and resolution system, similar to that used on the 777 that will remain in effect until the fleet attains 250,000 engine fleet hours.”

In its analysis of the 737NG approval process, the FAA noted that these program elements, at the time, had been accomplished with good results. The engines and airplane system had performed well during the test programs, with results comparable to the Model 777 test fleet (all engines). The in-service 737NG airplanes had achieved a 98.96% dispatch reliability rate after 45 days in service, better than any previous Boeing airplane. Boeing’s