



REASSESSMENT OF THE RESPONSES FROM THE FEDERAL AVIATION ADMINISTRATION TO AVIATION SAFETY RECOMMENDATION A04-03

AIRCRAFT FITTED WITH CFM56-5 SERIES JET ENGINES: CONTINUING AIRWORTHINESS

Background

On 20 October 2002, a Cathay Pacific Airways Airbus A340-300 (CPA829), B-HXN, departed Toronto/Lester B. Pearson International Airport, Ontario, at 2352 eastern standard time on a scheduled flight to Hong Kong, China, with a planned refuelling stop in Anchorage, Alaska. There were 249 passengers and 13 crew members on board. One hour and nine minutes into the flight, while cruising at flight level 350, the pilots felt an airframe vibration and observed the number 1 engine shut down spontaneously. All cockpit indications leading up to the engine power loss were apparently normal. The pilots secured the number 1 engine in accordance with the quick reference handbook, continued flight on three engines, and diverted to Vancouver International Airport, British Columbia. CPA829 landed at Vancouver at 0105 Pacific standard time without further incident.

The Transportation Safety Board of Canada (TSB) investigation revealed that an intermittent short circuit occurred in the permanent magnet alternator (PMA) when failure of the ball bearing caused the rotor to contact the stator. The PMA was then unable to generate reliable electrical power for the electronic control unit (ECU). The ECU continuously monitors the PMA, and, if the PMA no longer generates the required electrical power, the ECU will switch to other aircraft electrical power sources. The switch to other electrical sources, when it occurs, is rapid, usually with no significant change in engine performance. In this incident, the ECU became stuck in an endless loop of re-acquiring and losing PMA power due to the intermittent nature of the PMA failure. With no reliable or consistent source of electrical power, the engine eventually shut itself down. Without electrical power to the ECU, engine conditions were not transmitted to the cockpit instruments or centralized fault display system (CFDS), thus leading the pilots to assess that the engine had seized. CFM International (CFM) subsequently identified a problem with software version C.3.G, in the ECU, that prevented the switch-over to other sources of aircraft electrical power. The CFM document, entitled *CFM56-5 Fleet Highlights* (publication 00-01-7263-07), indicates that CFM has been aware of this deficiency since November 1999.

CFM issued Service Bulletin (SB) 73-0126 (published as CFM56-5C SB 73-0126, dated 13 November 2003). The SB changes the ECU software version from C.3.G to C.3.J and ensures that ECU electrical power successfully reverts to aircraft power in the event of a complete or partial PMA failure.



This SB applies only to the Airbus A340 aircraft, and, although CFM recommends implementation within six months, the actual timeframe for accomplishing this SB is at the discretion of the operator. Additionally, Airbus advises that it has launched similar initiatives to incorporate software updates on CFM56-5A and -5B engines used on its A319, A320, and A321 family of aircraft. It is anticipated that compliance for these SBs will likewise be at the discretion of the operator.

The Board concluded its investigation and released report A02P0261 on 20 December 2004.

Board Recommendation A04-03 (20 December 2004)

Given the number of aircraft affected, the known problem with PMA bearing failures, the critical function that the ECU software provides in ensuring engine reliability, and the discretionary nature of the proposed software updates, the Board is concerned that, without regulatory intervention, this known unsafe condition will remain in service well beyond the manufacturer's recommended six-month timeframe for the implementation of SB 73-0126. The Board therefore recommended that:

The Direction Générale de l'Aviation Civile and the Federal Aviation Administration issue airworthiness directives to require the implementation of all CFM56-5 series jet engine service bulletins whose purpose is to incorporate software updates designed to ensure that, in the event of a permanent magnet alternator failure, the electronic control unit will revert to aircraft power.

A04-03

Response to A04-03 (25 May 2005)

On 29 August 2005, the TSB received a letter dated 25 May 2005 in which the Federal Aviation Administration (FAA) responded to Recommendation A04-03. The response stated that C.3.J version software has been incorporated by over 90 per cent of the affected worldwide operators; the remaining CFM56-5C operators are complying voluntarily. The software has been provided to all operators. All other engine models with the same alternator design have similar software logic in place.

The FAA also reported that there has not been an alternator failure due to the identified cause (bearing failure) in over 20 months. In total, there have been 29 alternator failures due to this cause. CFM is currently pursuing root cause and corrective action for this failure, and intends to report its progress to the FAA.

The FAA has determined that an airworthiness directive is not necessary due to the absence of an unsafe condition.

Board Assessment of the Response to A04-03 (25 October 2005)

The response from the FAA dealt primarily with the CFM56-5C engine and the associated SB that incorporates software revision C.3.J. While the information provided by the FAA regarding compliance and the absence of alternator failures in the past 20 months is encouraging, the

response did not include similar information on other CFM56-5 series engines. Action taken by the FAA will reduce, but not substantially reduce or eliminate, the deficiency raised in Board Recommendation A04-03.

The response is assessed as **Satisfactory in Part**.

Next TSB Action (25 October 2005)

The Board will follow up the FAA response to determine what action is being implemented and the rate of compliance on the remaining CFM56-5 series engines.

This deficiency file is assigned an **Active** status.

Response to A04-03 (24 July 2007)

The FAA advises that the information provided in its previous response, dated 25 May 2005, is equally applicable to the CFM56-5/-7 series engines, which can experience the same PMA failure mode and for which similar service bulletins have been issued. Additionally, the FAA stated that, because voluntary compliance is widespread in the industry, there is no intention to issue Airworthiness Directives.

Board Reassessment of the Response to A04-03 (24 July 2007)

The Board is satisfied that the deficiency identified by Recommendation A04-03 has been substantially reduced by the voluntary compliance with all applicable CFM56 service bulletins.

The response is assessed as **Fully Satisfactory**.

Next TSB Action (24 July 2007)

Further action is unwarranted because the residual risk is relatively low.

The deficiency file is assigned an **Inactive** status.