REASSESSMENT OF THE RESPONSE TO AVIATION SAFETY RECOMMENDATION A96-13

Engine malfunction recognition

Background

On 19 October 1995, Canadian Airlines International Flight 17 was on a scheduled flight from Vancouver International Airport to Taipei, Taiwan. On board were 4 flight crew, 8 cabin crew, 2 interpreters, and 243 passengers. During the take-off on Runway 26 and approximately 2 seconds after the V1 call, the crew heard a loud bang and felt an airframe shudder and considerable vibration, later attributed to an engine stall. The captain called for and initiated a rejected take-off. The aircraft could not be stopped on the remaining runway and the nose-wheel gear collapsed as the aircraft rolled through the soft ground beyond the end of the runway. The aircraft came to rest in a nose-down attitude approximately 400 feet off the declared end of the runway. Six passengers were slightly injured during the emergency evacuation of the aircraft.

The Transportation Safety Board of Canada (TSB) determined that engine number 1 lost power at a critical point in the take-off and that the rejected take-off was initiated at a point and speed where there was insufficient runway remaining to stop the aircraft on the runway. Contributing to this occurrence were the misidentification of the cause of the loud bang and the lack of knowledge regarding the characteristics of engine compressor stalls. Contributing to the engine power loss was a delay between the collection and analysis of the engine monitoring data.

On October 18, 1996, the TSB issued one Aviation Safety Recommendation to Transport Canada as a result of its investigation into this accident.

The Board concluded its investigation and released Aviation Investigation Report A95H0015 on 18 October 1996.

Board Recommendation A96-13 (October 1996)

The captain did not recognize the loud bang as a symptom of a high bypass ratio engine compressor stall and thought that the noise might have been caused by a bomb. Consequently, he decided to reject the take-off even though the speed was above V1. Although the flight crew members were all very experienced pilots and had taken simulator and ground training throughout their careers, they had not been trained to recognize a loud bang as a symptom of a high bypass ratio engine compressor stall, and none of the crew members noticed the cockpit indications of power loss.

Rejecting a take-off at a speed above V1 during a field-length-limited take-off places an aircraft at more risk than continuing the take-off, and should not be attempted unless the pilot has reason to conclude that the airplane is unsafe or unable to fly. The FAA's Takeoff Safety

Training Aid states that "in order to eliminate unnecessary RTOs, the crew must differentiate between situations that are detrimental to a safe take-off, and those that are not." Also, a Boeing report entitled Engine Plus Crew Error Events indicates that positive recognition and correct identification of engine malfunctions appear to be significant contributors to the outcome of engine-plus-crew-error events. If pilots do not consider a loud bang as a symptom of a possible compressor stall, they may assume that the noise was caused by a bomb (a much less likely event) and unnecessarily reject the take-off.

Crew errors are often associated with engine failures that create loud noises. The Boeing report indicates that the majority of engine-plus-crew-error events involved engine malfunctions that generated loud noise. The report further indicated that the number of such events involving high bypass powered aircraft had steadily increased over the last five years covered by the study.

Few resources are available to flight crews to aid in the quick identification of engine failure conditions. Neither engine manufacturers nor aircraft manufacturers have specific information available on the characteristics of high bypass ratio engine compressor stalls. The Boeing report observes that there is currently no flight crew training for positive recognition and correct identification of engine failure conditions; the noises, vibration, and other "cues" of real engine failures are not simulated in the vast majority of flight crew training simulators. In light of the risks associated with unnecessary rejected take-offs, the Board recommends that:

> The Department of Transport ensure that flight crews operating high bypass ratio engines can correctly identify and respond to compressor stalls or surges.
>
> **TSB Recommendation A96-13**

Transport Canada's response to Recommendation A96-13 (January 1997)

Flight crew training encompassing recognition and response to engine malfunctions is a part of initial and recurrent training. All flight crews that operate high bypass ratio engines accomplish this training in approved simulators. Although there are varying levels of simulator sophistication, most generate representative sounds that are as real as empirical data permits. Until such time that engine and airframe manufacturers develop parameters for all the different types of compressor stalls, Transport Canada considers this training to be both reasonable and adequate.

Transport Canada is currently following the work of the Aerospace Industries Association (AIA) propulsion committee which has been formed to address issues related to "Propulsion System Malfunctions Plus Inappropriate Crew Responses" and Transport Canada has been invited to help form the focus of the group. Based on the results of these initiatives, Transport Canada will ensure improvements are made to better enable flight crews to properly identity and respond to compressor stalls or surges.

Additionally, Transport Canada will feature this occurrence in its "Aviation Safety Letter", which is distributed to all licensed pilots. The recognition of high bypass ratio engine compressor stalls will be among the items discussed.

Board assessment of the response to Recommendation A96-13 (January 1997)

In reply, Transport Canada (TC) indicates that current training practices are considered adequate until such time that engine and airframe manufacturers develop parameters for all the different types of compressor stalls. In this vein, TC will ensure that improvements are made following the results of the U.S. Aerospace Industries Association (AIA) propulsion committee's "Propulsion System Malfunction Plus Inappropriate Crew Responses" initiative. [Of note, the first meeting of the AIA's committee took place following TC's response (TSB staff attended; TC was not present). At the meeting, representatives of engine manufacturers indicated that they currently have the data (in digital format) required to simulate various engine failure conditions, including compressor stalls and surges, in flight simulators.]

Also in reply to the recommendation, TC indicated that the TC Aviation Safety Letter (ASL) will have a feature of this occurrence. [The DC-10 occurrence has subsequently been the feature article in ASL - Issue 1/97].

For the short term, increased awareness of the symptoms of malfunctions in high bypass ratio engines (as well as, thought-provoking discussion regarding rejected take-offs) has probably resulted from the recent ASL article. In the long term, appropriate TC follow-up to the AIA's initiatives could address the deficiency with respect to realistic simulation of engine compressor stalls and surges.

Therefore, the response to Recommendation A96-13 is assessed as **Satisfactory Intent**.

Board review of Recommendation A96-13 deficiency file status (April 2014)

The Board requested that Recommendation A96-13 be reviewed to determine if the deficiency file status was appropriate. After an initial evaluation, it was determined that the safety deficiency addressed by Recommendation A96-13 needed to be reassessed.

A request for further information was sent to Transport Canada and a reassessment will be conducted upon receipt of Transport Canada's response.

Therefore, the assessment remains **Satisfactory Intent**.

Consequently, the status of Recommendation A96-13 is changed to **Active.**

Transport Canada's response to Recommendation A96-13 (July 2015)

This training requirement has been addressed in guidance material Standard 725.124 (50) Engine Failure/Malfunction Recognition Training.

Board reassessment of the response to Recommendation A96-13 (March 2016)

In its response, Transport Canada has indicated that training requirements in Commercial Air Service Standard (CASS) 725.124 (50) address this issue. The training requirements identified in the CASS should substantially reduce or eliminate the safety deficiency identified in Recommendation A96-13.

Therefore, the response to Recommendation A96-13 is assessed as **Fully Satisfactory**.

Next TSB action

No further action is required.

This deficiency file is **Closed**.