LOG 1289

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 12, 1981

Forwarded to:

Mr. Charles E. Weithoner
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-24 and -25

On July 21, 1980, Scenic Airlines Flight 306, a Cessna 404, N26835, crashed during takeoff from the Grand Canyon National Park Airport, Tusayan, Arizona. The left engine turbocharger failed after takeoff causing a substantial power loss. The aircraft was not able to climb or maintain altitude because the pilot failed to establish immediately a minimum drag configuration which further degraded the aircraft's performance significantly. The aircraft was 856 lbs below its certificated maximum gross takeoff weight and was within c.g. limits; however, the density altitude at the time of the takeoff was 10,000 ft m.s.l. The pilot and six of the seven passengers were killed. One passenger survived the accident but died 5 days later because of thermal injuries. Except for the postcrash fire, the accident was survivable.

AAR-81-2

Based on the aircraft flight manual, the aircraft should have had a best single-engine rate of climb of 160 fpm at a speed (Vyse) of 99 knots indicated airspeed (KIAS). This performance is predicated on the use of takeoff power on the operating engine with the landing gear and wing flaps up, the propeller on the inoperative engine feathered, a 5° angle of bank into the operative engine, and a 1/2-ball width slip deflection on the turn and bank indicator. The 160 fpm rate of climb, which was established under optimum flight test conditions, is barely discernible on the vertical climb indicator. Additionally, the manufacturer's data indicated that the climb performance of the Cessna 404 will be adversely affected by certain pilot actions. For example, a 5° bank into the inoperative engine will decrease the climb performance by 100 to 150 fpm, while a wings-level attitude would cause a 20 to 30 fpm decrease in climb performance. A 10° bank into the operative engine will decrease the climb capability by 150 to 200 fpm. Since the capability of the aircraft to climb in a single-engine configuration can be degraded by small increments of bank angle in either direction, the pilot must exercise exceptional skill to achieve the airplane's maximum performance under single-engine emergency circumstances. This fact was underscored in the Safety Board's special study 1/ on light twin-engine aircraft (nine passengers or less), wherein the Board stated "the ability to fly the aircraft in precisely the proper attitude and single-engine configuration to achieve maximum climb performance is difficult, and highly dependent on the knowledge of, and proficiency in, emergency situations."

1/ Special Study --"Light Twin-Engine Aircraft Accidents Following Engine Failures, 1972-1976" (NTSB-AAS-79-2).

AAR-81-2
AAR-81-4 3191A

A second similar accident occurred on March 21, 1980, when an Eagle Commuter Airlines, Inc., Piper PA-31-350, crashed after the takeoff. The accident occurred following a power loss in the right engine during a night departure. The pilot, who had considerable experience in the PA-31-350, the copilot, and five of the eight passengers were killed. The investigation revealed that the aircraft was about 90 ft above the runway and at, or just below, Vyse when power was lost. From the point where the power was lost, sufficient runway and clear zone remained to make a survivable emergency landing. However, the pilot elected to continue single-engine flight, although he did not raise the wing flaps or feather the propeller. As a result, he lost control of the aircraft, and it crashed 90° off the runway heading.

The foregoing accidents involved a critical emergency in these types of aircraft of a partial power loss at low altitude resulting in an extremely short period of time in which a pilot must decide whether or not to feather the propeller of the malfunctioning engine and take other immediate corrective actions. Pilots in this situation have allowed their aircraft to decelerate to dangerously slow speeds. Pilots, degrading the marginal single-engine performance by attempting to increase the climb of their aircraft, have lost control of the aircraft when the only realistic alternative was a controlled, straight-ahead emergency landing. The Safety Board believes that these pilots have responded improperly to single-engine emergencies because they have not prepared themselves for a power loss on takeoff. In part, this is because the performance data upon which a decision to continue the takeoff or make an emergency landing must be made has not been adequately defined or adequately understood by pilots. Additionally, some pilots apparently have not understood the necessity of establishing a zero sideslip attitude, and have exhibited difficulty controlling the yaw and roll associated with a sudden power loss.

The Safety Board believes that critical information relating to a power loss on takeoff in light, twin-engine aircraft is not stressed sufficiently in aircraft flight manuals or in pilot training programs. These manuals and programs should emphasize that a light, twin-engine aircraft which loses power on an engine shortly after takeoff will not have the capability to continue the takeoff climb unless the pilot analyzes the emergency correctly and responds immediately. The pilot must also be prepared to accept the possibility that continued single-engine flight is not possible and that a controlled emergency landing is the safest option available to him. Further, we believe it imperative that the pilots of these aircraft have complete knowledge of the critical performance data of the aircraft to enable them to determine quickly whether the aircraft has the capability to continue a single-engine climb or whether a controlled emergency landing is the safest option.

The Safety Board believes that emergency training must stress that most light, twin-engine aircraft, even when properly configured for a single-engine climb, have a marginal capability to maintain level flight at speeds below Vyse and very limited capability to climb even at airspeeds of Vyse. A pilot whose aircraft loses power on takeoff must raise the landing gear and flaps, identify and feather the propeller on the inoperative engine, and establish a 5° bank into the operative engine before the airspeed falls below Vyse. Concurrently, he will probably have to lower the nose of the aircraft to a level flight attitude, or a slightly nosedown attitude, to maintain the airspeed. Finally, each of these actions must be precise and timely because the available time, altitude, and aircraft performance leave little or no margin for error.

Realistically, a pilot needs 3 to 8 seconds to determine and accomplish the proper emergency response, during which time the aircraft can decelerate as much as 3 kns per second. Therefore, the aircraft should be accelerated to an airspeed greater than Vyse as soon as possible in order to provide the pilot with the opportunity to configure the aircraft properly and still maintain Vyse. The FAA, in Advisory Circular 61-21A, "Flight Training Handbook," recognizes the need for the posttakeoff attainment of an airspeed above Vyse and concludes that, ". . .the initial climb speed for a normal takeoff with both engines operating should permit the attainment of a safe single-engine maneuvering altitude as quickly as possible; it should provide for good control capabilities in the event of a sudden power loss on one engine; and it should be a speed sufficiently above Vyse to permit attainment of that speed quickly and easily in the event power is suddenly lost on one engine. The only speed that meets all of these requirements for a normal takeoff is the best rate-of-climb speed with both engines operating (Vy)."

As a result of the Safety Board's accident investigation experience and the special study on commuter airlines, we believe that the current training programs for 14 CFR 135 certificate holders do not discuss adequately the issue of emergency response to an engine loss on takeoff, or the marginal single-engine performance of light twin-engine aircraft. Furthermore, the training programs do not address adequately the specific capabilities of the aircraft used by the individual airlines. Finally, the Safety Board believes that most training programs and aircraft flight manuals do not contain sufficient data to inform the pilot of the marginal capability of many light twin-engine aircraft to maintain level flight, in a single-engine configuration, at airspeeds below Vyse.

On December 31, 1979, the Safety Board issued Safety Recommendation A-79-95, requesting that the FAA periodically disseminate additional information concerning how to manage engine failures in light twin-engine aircraft. Although the FAA responded by publishing three articles on light twin-engine operational safety, and accident prevention coordinators had conducted safety meetings with air taxi operators, it appears that the actions taken may not be sufficient. Therefore, the Safety Board reiterates the following recommendation:

> Periodically disseminate to pilots, certificated flight instructors, and FAA inspectors and their designees, additional information on how to manage light twin-engine aircraft following an engine failure, using advisory circulars, safety seminars, or other means at its disposal. (Class II, Priority Action) (A-79-95)

The Safety Board recognizes that more comprehensive aircraft flight manuals and improved pilot training and proficiency, while essential elements in a strategy to minimize accidents involving light twin-engine aircraft which experience an engine power loss during the critical takeoff regime, are not the ultimate solution to the prevention of these accidents. Therefore, the Board intends to conduct a more comprehensive investigation during which manufacturers, operators, and pilots will be solicited to assist the Board in identifying other possible and feasible corrective measures. Such measures could include standardized training, making more explicit performance data available to the pilot, and modifications of operational procedures.

As an interim measure the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that pilot training programs for 14 CFR 135 certificate holders which operate light twin-engine aircraft include specific ground and flight training in: (1) the factors related to achieving and maintaining Vyse; (2) the capability of company aircraft to maintain level flight at airspeeds below Vyse while in a single-engine configuration; (3) the capability of company aircraft to accelerate to Vyse while in a single-engine configuration; and (4) rapid appraisal of those situations in which a controlled, straight-ahead emergency landing is the safest or only option available. (Class II, Priority Action) (A-81-24)

Require that aircraft flight manuals for light twin-engine aircraft used in 14 CFR 135 operations contain data related to those conditions in which the aircraft, in a single-engine configuration and at airspeeds between Vmc and Vyse, has the capability to maintain level flight. (Class II, Priority Action) (A-81-25)

KING, Chairman, DRIVER, Vice Chairman, McADAMS and BURSLEY, Members, concurred in these recommendations. GOLDMAN, Member, did not participate.

By: James B. King
Chairman