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# National Transportation Safety Board

Washington, D.C. 20594  
Safety Recommendation

**Date:** March 19, 1987

**In reply refer to:** A-87-8 through -10

Honorable Donald D. Engen  
Administrator  
Federal Aviation Administration  
Washington, DC 20591

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At 1521 c.d.t. on September 6, 1985, Midwest Express Airlines, Inc. (Midwest Express), Flight 105, a McDonnell-Douglas DC-9-14 airplane, crashed into an open field at the edge of a wooded area about 1,680 feet southwest of the departure end of runway 19R shortly after taking off from General Billy Mitchell Field, Milwaukee, Wisconsin. The weather was clear with visibility 10 miles. During the initial climb, about 450 feet above ground level (a.g.l.), there was a loud noise and a loss of power associated with an uncontained failure of the 9th to 10th stage high pressure compressor spacer of the right engine. Flight 105 continued to climb to about 700 feet a.g.l. and then rolled to the right until the wings were observed in a near vertical, approximately right 90° banked turn. During the roll, the airplane entered an accelerated stall, control was lost, and the airplane crashed. The aircraft was destroyed by impact forces and postcrash fire. The pilot, the first officer, both flight attendants, and all 27 passengers were fatally injured. 1/

Much of the Midwest Express required flight training was performed in an approved, 3 degree of freedom (dof) visual flight simulator. The Safety Board found that visual flight simulators have limitations in reproducing the engine failure emergency as it would be experienced in an airplane since peripheral visual cues, certain onset motion cues, and aural cues were absent in the simulator. This characteristic is common to all visual flight simulators. The pilots of flight 105 may not have experienced the exact kinesthetic and visual cues on the accident flight which they had in their simulator training. However, the Safety Board believes that they should have been able to recognize and analyze the emergency based on the cues which were present.

The Safety Board cannot disregard the possibility that the type of training given in the simulator, rather than the limitations of cues provided in the simulator, could have been a factor in the flightcrew's performance. In particular, the Safety Board is concerned that the takeoff engine failure training involving a loss of thrust as the airplane approaches or passes V1 speed may have been a factor.

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1/ For more detailed information, read Aircraft Accident Report--"Midwest Express Airlines, Inc., DC-9-14, N100ME, General Billy Mitchell Field, Milwaukee, Wisconsin, September 6, 1985" (NTSB/AAR-87/1).

In the V1 engine failure, external visual information alone is generally sufficient to inform the pilot of the occurrence since the airplane is either on, or only slightly above, the runway and the movement of the nose of the airplane relative to the runway centerline provides adequate information that an engine has failed. As a result, training in recovery from engine failure at or just after V1 might lead pilots to rely extensively on forward external visual cues, even if peripheral visual cues are present. If the peripheral information is absent, as it is in the visual simulator, then repeated training in V1 failures in the simulator can result in exclusive use by the pilots of visual information that is presented straight ahead, outside the cockpit.

In this accident, there were no forward external visual references since the sky was clear. At the time the engine failed, the airplane would have been in a nose-up attitude of about 12° and the pilots would have been looking at the sky, if they were looking outside the cockpit. In the absence of clouds, there would have been no visual cues straight ahead that could have provided the pilots with the information needed to perceive the airplane's immediate yaw to the right following failure of the right engine. Consequently, the only external visual cues indicating a yaw that would have been available to the pilots would have been ground-based information that was presented peripherally, or the flight instruments. However, peripheral visual cues are of relatively little use for the detection of airplane yaw because the angular rates of stimuli in the periphery are generally too low to be readily apparent.

The Safety Board does not consider the limitations of the visual 3 dof simulator to have been a factor affecting the flightcrew's recognition of the engine failure since pilot training, in general, stresses to pilots the importance of confirming engine and flight control status through the interpretation of cockpit instruments. The simulator is fully adequate in the presentation of these instruments. The training records of the flightcrew of flight 105, as well as the statements and testimony of their instructor, indicated that they were so instructed. Thus, the engine instruments should have confirmed the engine failure, and the flight instruments should have confirmed the airplane's attitude, airspeed, altitude, and heading.

Nevertheless, questions asked by the captain and his failure to maintain control of the airplane confirm that he did not correctly interpret the sounds, motion, and other available information. Therefore, the Safety Board believes that the captain reacted primarily to other than visual and flight instrument references, such as kinesthetic cues. He apparently misinterpreted those cues and applied the flight controls incorrectly.

The Safety Board believes that infrequent training for an engine failure at low altitude in the initial climb phase of flight could have left the flightcrew ill-prepared to cope with the emergency. Although analyzing abnormal or emergency situations and maintaining control of the airplane by reference to flight instruments are basic elements of airmanship, the Safety Board believes that the Federal Aviation Administration (FAA) and the airline industry should consider the circumstances of this accident with a view toward including scenarios of engine failures after establishment of the takeoff climb in training programs to better prepare pilots for such emergencies. Consideration should be given to reducing pilot reliance on external visual cues during "V1 cut" training by making greater use of simulated low visibility situations during such training.

The Safety Board believes that the FAA oversight of Midwest Express procedures and training during certification and ongoing day-to-day activity in the carrier's first 2 years of operation was less than optimum and probably suffered as a direct result of the inexperience of the Principal Operations Inspector (POI). The POI testified that she devoted only 20 percent of her worktime to Midwest Express, her only FAR 121 scheduled

passenger airline, and that she was still obligated to perform routine general aviation duties. The Safety Board noted that the POI had no previous FAR 121 air carrier experience, that she was not rated in a turbojet of the category and class used by the airline, and that she had not received any formal training in the DC-9 airplane used by the certificate holder for which she was responsible. In fact, she had no turbojet pilot experience. Neither did the POI have available for consultation or assistance air carrier inspectors or DC-9 rated pilots in her own office. Although the POI used the services of air carrier inspectors assigned to other offices to fulfill her responsibilities, it is apparent that this practice reduced her exposure to the operation of the airline. Apparently, she had become so dependent on other inspectors in surveilling Midwest Express that her own role was reduced primarily to administrative matters. The absence of first-hand knowledge of the carrier and her lack of experience in turbojet air carrier operations severely handicapped her ability to perform the quality of surveillance required to detect shortcomings of an FAR 121 airline operation. The Safety Board believes that the experience level of the POI was inappropriate for her assignment as the POI of a new air carrier operating turbojet equipment.

Also, the Safety Board is concerned that the POI's lack of proper experience may have been a factor which allowed a "silent cockpit" <sup>2/</sup> concept to be taught in training which was contrary to the approved practice that required any crewmember noting a potential or actual emergency situation to call it to the captain's attention. The Safety Board believes that the latter concept is sound and assures that all flight crewmembers are provided the opportunity to coordinate their activities to assure the proper resolution of an emergency condition consistent with the practices of most operators of turbojet equipment. Midwest Express employees had discussed the silent cockpit concept with the POI but had not put it in writing or requested her approval of the concept. The Safety Board believes that if the POI had been more experienced she might have recognized the flaws in such a concept, and perhaps she might have recognized that the airline was already teaching the concept in its pilot training program.

The Safety Board supports the latest efforts of the FAA through Project SAFE (Safety Activity Functional Evaluation) to alleviate substandard surveillance of the airline industry. Project SAFE will revise the position description and qualification criteria for prospective air carrier inspector personnel to insure that the ability of the inspector personnel who would be assigned to an FAR 121 certificate holder matches the job requirements. The FAA target date for implementation of this plan is fiscal year 1988. The Safety Board believes that the FAA should, as an interim measure, discontinue the practice of assigning FAR 121 air carrier operating certificates to POIs without the training and experience commensurate with the POI role and without a type rating in a comparable (i.e., turbojet-powered transport category) aircraft in the category and class used by the certificate holder. The Safety Board trusts that if the FAA has not already done so, a review will be undertaken to require that all FAR 121 certificates are overseen by FAA personnel thoroughly knowledgeable in FAR 121 operations.

Therefore, as a result of its investigation, the Safety Board recommended that the Federal Aviation Administration:

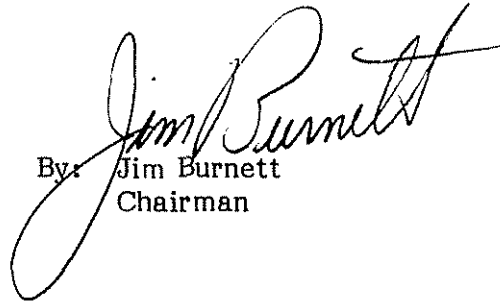
<sup>2/</sup> "Silent cockpit"--a term coined at the Safety Board public hearing to describe a period during which Midwest Express pilots were taught that it was unnecessary to verbalize callouts or to identify the nature of emergency or abnormal situations which might occur during certain phases of flight.

Issue an air carrier operations bulletin directing Principal Operations Inspectors to review their respective air carrier's flightcrew training programs to ensure the existence of new coordination procedures that, notwithstanding a policy endorsing nonessential conversation during an emergency condition, require any crewmember who observes a potential or actual emergency situation to verbally call it to the captain's attention. (Class II, Priority Action) (A-87-8)

Issue an air carrier operations bulletin directing Principal Operations Inspectors to review their respective air carrier's simulator training programs to verify that engine failures in the posttakeoff climb are frequently given with particular emphasis on the use of engine and flight instruments as the primary source of information for airplane control and on the need for deliberate actions based on flight and engine instrument analysis rather than hasty action based on kinesthetic cues. (Class II, Priority Action) (A-87-9)

Require Principal Operations Inspectors of 14 CFR 121 certificate holders to have training and experience commensurate with the air carrier involved, including a comparable type rating (e.g., turbojet-powered transport category) in the category and class of aircraft to be used by the certificate holder. (Class II, Priority Action) (A-87-10)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.

  
By: Jim Burnett  
Chairman