

NATIONAL TRANSPORTATION SAFETY BOARD WASHINGTON, D.C.

ISSUED: May 1, 1979

Forwarded to:

Honorable Langhorne M. Bond
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)
A-79-27 through -30

On May 8, 1978, National Airlines Flight 193, a Boeing 727-235, crashed in Escambia Bay during its approach to the Pensacola Regional Airport at Pensacola, Florida. There were 52 passengers and a crew of 6 aboard; 3 passengers were drowned, and 9 passengers and 2 crewmembers were seriously injured.

As the aircraft descended through 500 feet altitude, its rate of descent had increased to about 2,000 feet per minute; the aircraft was also not configured for landing -- the flaps were set at 25°. At this point, the ground proximity warning system (GPWS) activated and continued for five cycles, or about 9 seconds.

The captain and first officer tried to determine the cause of the GPWS warning. The cockpit voice recorder tape indicated that the first officer said, "Descent rate's keepin' it up." The captain reportedly acknowledged this and shallowed the aircraft's descent. The flight engineer, who claimed to have had difficulty hearing the cockpit conversation because of the volume of the GPWS aural alert, believed that the captain had commanded him to turn off the GPWS. As a result, he inhibited the system without the captain's knowledge. The silencing of the GPWS erroneously convinced the captain that he had solved the problem; however, the aircraft continued to descend into the water.

The GPWS in this aircraft incorporated warning lights mounted on both instrument panels and a loudspeaker mounted in the ceiling of the cockpit. A guarded and safety-wired inhibit switch was located on the flight engineer's panel. The GPWS will activate automatically if the aircraft's flightpath penetrates one or more complex, multiparameter flight envelopes. The aural and visual warning will cease only when the aircraft's flightpath is corrected satisfactorily or when the aircraft is configured properly depending on the warning conditions. However, the inhibit switch, when activated, will disable the entire system. The Safety Board believes that, regardless of the safeguards

established by the applicable regulations to prevent inadvertent or voluntary deactivation of the system, the function of the inhibit switch should not cause an apparent but false problem-solving situation as it did in this accident.

The GPWS in this aircraft was only required to provide two messages --"pull up" and "glideslope." Thus, during this approach, the crew was required to determine mentally whether an excessive terrain closure rate or a nonlanding configuration caused the warning before they could take corrective action. Obviously, there was some uncertainty as to the cause of the warning; the crew decided that it was an excessive descent rate below 2,500 feet when, in fact, a non-landing configuration below 500 feet was also triggering the warning.

As you know, 14 CFR 37.201 (TSO-C92a) and Radio Technical Commission for Aeronautics Document No. DO-161A, "Minimum Performance Standards, Airborne Ground Proximity Warning System," do not require that the cause of an alert be identified. The technology exists, however, to provide individual warnings to the crew for each deviation. At least one manufacturer now offers a GPWS with features which specifically announce the reason for each triggered warning, such as "sink rate," "terrain," or "flaps." The Board believes that these features will eliminate ambiguity and will reduce considerably crew reaction time to the warning being given.

The crewmembers reported also that the sound of the GPWS was so loud and uncomfortable that it interfered with cockpit communication. At the Board's request, an FAA Civil Aeromedical Institute acoustics specialist measured the sound level of the GPWS in a National Airlines Boeing 727 aircraft, in a National simulator, and in an Eastern Airlines Boeing 727. Sound levels were above 103 decibel (dB) in the National simulator and in the National aircraft. These were generally several dB higher than in the Eastern aircraft.

The standards for GPWS output signals are specified electrically by Radio Technical Commission for Aeronautics Document No. DO-161A; however, because of variations in loudspeaker efficiency, baffling, and location, the level of the acoustical signals can vary widely in different areas of the cockpit. Informal information from the FAA, air carriers, and GPWS manufacturers indicates that currently acoustics levels are set subjectively by air carrier engineering personnel and are approved by FAA Principal Operations Inspectors usually without using sound level measuring instruments. The Safety Board is concerned that, by using this subjective method, the sound pressure levels for these warning systems can be set too high, thereby masking emergency

communications between the crewmembers. In this accident, verbal communications evidently were blocked by the high sound levels of the GPWS.

A 1977 study "Aircraft Alerting Systems Criteria Study," Report No. FAA-RD-76-222 recommended that the signal of an alerting system should be as loud as the masked threshold created by ambient noise plus 15 dB or should be halfway between the masking threshold and 110 dB, whichever is less. This study shows cockpit noise data for eight turbojet air carrier aircraft and presents a simple method for calculating the threshold values of alerting systems. The Safety Board believes that the FAA should require some form of standardization of GPWS aural warnings in different aircraft using the data presented in this report. This FAA guidance will permit engineering personnel to set sound levels objectively and will result in optimum signal strength in cockpits without unduly affecting necessary verbal communications between crewmembers.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Amend 14 CFR 37.201 to: (1) require that ground proximity warning systems identify with aural messages the cause of the warning being given; and (2) restrict the function of the deactivation switch (if utilized on such systems) to suppress only the aural alert, but not the warning lights. (Class II - Priority Action) (A-79-27)

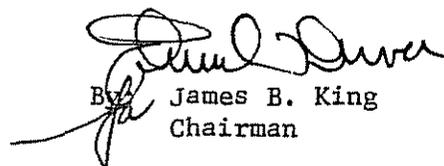
Amend 14 CFR 121.360 to require after an appropriate date that all newly manufactured aircraft be equipped with ground proximity warning systems that conform to the amended Technical Standard Order. (Class II - Priority Action) (A-79-28)

Define sound pressure levels and acoustical characteristics for ground proximity warning systems for each type of aircraft requiring these systems, consistent with ambient cockpit noise levels and with the requirements for emergency verbal communications between crewmembers. (Class II - Priority Action) (A-79-29)

Honorable Langhorne M. Bond - 4 -

Issue an Advisory Circular specifying ground proximity warning system sound pressure levels and acoustical characteristics for each type of aircraft requiring these systems. (Class II - Priority Action) (A-79-30)

KING, Chairman, DRIVER, Vice Chairman, McADAMS and HOGUE, Members, concurred in the above recommendations.


By James B. King
Chairman