



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** December 22, 2003

**In reply refer to:** A-03-62 through-65  
and A-99-59 (Reiteration)

Honorable Marion C. Blakey  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

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Since January 2000, the National Transportation Safety Board has investigated numerous accidents involving turbine-powered aircraft not required to operate with either a cockpit voice recorder (CVR) or a flight data recorder (FDR). These accidents involved aircraft operating under 14 *Code of Federal Regulations* (CFR) Parts 91 and 135. Included among these accidents was the October 25, 2002, accident involving a Raytheon (Beech) King Air that crashed on approach to Eveleth-Virginia Municipal Airport, Eveleth, Minnesota, killing all eight persons on board, including Senator Paul Wellstone. The airplane was not equipped with either a CVR or an FDR at the time of the accident, nor did Federal regulations require it to be so equipped.<sup>1</sup>

The Safety Board has investigated several cases in which the aircraft was not required to be equipped with a flight recorder,<sup>2</sup> but a CVR was installed voluntarily on the aircraft. The Board has found that data from these CVRs provided invaluable information during its investigations. Specifically, in the beginning phases of an investigation, CVR data may reveal operational issues that are not readily apparent from the physical evidence found at an accident site, enabling the Safety Board to immediately narrow the focus of its investigation and issue safety recommendations quickly to prevent similar accidents. In some instances, CVR data may be the sole source of evidence for a probable cause.

In addition, Safety Board investigators have repeatedly found that CVRs installed in conjunction with FDRs provide data instrumental in reconstructing events leading to the accidents. Specifically, CVRs have provided insight into the operational environment within the cockpit and FDRs have provided information regarding the aircraft's performance. Using data from both recorders, investigators have been able to determine the aircraft's motion and crewmember response to it, or conversely, how crewmember actions affected the airplane's

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<sup>1</sup> National Transportation Safety Board, *Loss of Control and Impact with Terrain, Aviation Charter, Inc., Raytheon (Beechcraft) King Air A100, N41BE, Eveleth, Minnesota, October 25, 2002 Aircraft Accident Report* NTSB/AAR-03/03 (Washington, D.C.: NTSB, 2003).

<sup>2</sup> For private operations, CVR and FDR requirements are in 14 CFR 91.609. For charter operations, CVR requirements are in 14 CFR 135.151, and FDR requirements are in 14 CFR 135.152. For scheduled transport operations, CVR requirements are in 14 CFR 121.359, and FDR requirements are in 14 CFR 121.343, 14 CFR 121.344, and 14 CFR 121.344a.

performance. The CVR and the FDR each provide a different but complementary perspective on the events leading to an accident.

Although CVRs and FDRs are required on most larger passenger-carrying aircraft,<sup>3</sup> the Safety Board is concerned that two categories of smaller aircraft that have experienced numerous accidents are excluded by the current regulations and are not required to be equipped with any crash-protected recorder: specifically, single-pilot certificated turbine-powered aircraft and dual-certificated cargo/passenger aircraft. When neither CVR nor FDR data are available, Safety Board investigators can sometimes compensate in part with radar data or air traffic control recordings. However, these data do not provide the same level of detail about the aircraft's flight path, flight conditions, or operations as that provided by CVR and FDR data. Furthermore, when accidents occur in areas outside radar coverage, these data are not available.

The two categories of aircraft that are not required by regulation to be equipped with a crash-protected recording system are detailed below.

### **Single-Pilot-Certificated Turbine-Powered Aircraft**

The first category of turbine-powered aircraft includes Beech King Air, Cessna Citation, Cessna Caravan, and Piper Cheyenne airplanes,<sup>4</sup> as well as Bell 407 and Bell 206L helicopters. These single-pilot-certificated aircraft are heavily used in Part 135 passenger charter and other commercial operations. Under 14 CFR Part 91 and 135 operations, a CVR is required only if the aircraft are certificated to operate with two pilots. Moreover, because these aircraft are configured for fewer than 10 passenger seats, they are not required to have an FDR installed on board. Although CVR data from single-pilot operations may not provide the same level of operational information as would be expected when two or more crewmembers are present, the recorder can capture events that are important to accident investigators. Specifically, investigators routinely extract aircraft event data from a CVR recording—some of which might have been available from an FDR, if one had been installed—such as warnings and alerts, engine power settings, and main rotor rotation speed. Significantly, despite their single-pilot certification, aircraft in this category are often operated with two pilots due to insurance requirements or for other reasons, such as safety-of-flight, making the presence of a CVR even more valuable to Safety Board investigations.

Aircraft in this category have been involved in more than 100 accidents investigated by the Safety Board since January 2000; the majority of these aircraft were not equipped with CVRs and in only one case was the CVR operating at the time of the accident. In particular, the Beech King Air has been involved in 45 of these investigations. Of those accidents, three of the accident aircraft were equipped with CVRs although they were not required by Federal regulation to be so

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<sup>3</sup> The Safety Board has previously addressed the issue of insufficient recorded data from larger aircraft (that are currently required to be equipped with both a CVR and an FDR) in Safety Recommendations A-00-30 and -31.

<sup>4</sup> The name "Beech King Air" includes the following aircraft models: Raytheon Beech 65-90, 65-A90 series, B90, C90 series, E90, H90, 100 series, 200 series, and 300 series. The name "Cessna Citation" includes the 501, 551, and 525 models. "Cessna Caravan" refers to the 208 series airplanes and "Piper Cheyenne" involves the PA-31T series airplanes.

equipped, but only one of these CVRs<sup>5</sup> was operational and provided data that aided in the investigation.<sup>6</sup>

Safety Board statistics also show that the Cessna Citation and the Piper Cheyenne have been involved in 18 accidents since January 2000.<sup>7</sup> CVRs were not installed on any of the Piper Cheyennes, and, although one Cessna Citation was equipped with a CVR, it did not contain any useful audio information.

The Safety Board has also investigated a significant number of rotorcraft accidents. For instance, Bell 407 and Bell 206L-series helicopters, certificated to operate with one pilot and carry at least six passengers, are often used in medical transport and oil platform operations; since January 2000, these helicopters have been involved in more than 50 accidents investigated by the Board, where almost half of the accident flights were operated under 14 CFR Part 135. None of these helicopters were equipped with CVRs.

It is significant to note that the aircraft in this category, specifically the Cessna Caravan, were previously addressed in Safety Board Recommendations A-99-59 and A-99-60,<sup>8</sup> which are on the Board's Most Wanted List of Transportation Safety Improvements and are discussed later in this letter. Safety Board accident statistics show that from September 1985 through January 2000, Cessna Caravans were involved in over 70 accidents. In the time since these recommendations were issued 3½ years ago, another 32 accidents involving the Caravan have occurred, two-thirds of which took place during commercial operations.<sup>9</sup>

Without data recorders, the Safety Board is disadvantaged in its ability to thoroughly investigate the large number of accidents occurring among these aircraft. The Safety Board notes that, had the FAA implemented the prior recommendations (A-99-59 and A-99-60) in a timely manner, a crash-protected recorder would have been required to be operating on the Beech King Air that crashed on October 25, 2002, killing Senator Wellstone.

Select accidents are detailed in the following table to show the range of operations encompassed by these aircraft and the number of passengers potentially at risk.

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<sup>5</sup> The CVRs in the other aircraft were not operating at the time of the accidents and therefore provided no data of use in the investigations.

<sup>6</sup> On August 9, 2001, about 0948 eastern daylight time, a Beech King Air B200, N899RW, registered to Warren Manufacturing, Inc., operating as a 14 CFR Part 91 corporate flight, crashed in the vicinity of Sandersville, Georgia. The two pilots and four passengers were injured. A CVR was operating on board the aircraft and was used in the investigation (NTSB ID #MIA01LA211).

<sup>7</sup> Eight of these accidents involved fatalities.

<sup>8</sup> Specifically, Recommendations A-99-59 and A-99-60 were issued with the report regarding the accident of N12022, a Cessna 208B, near Montrose, Colorado, on October 8, 1997, in which nine people were killed (NTSB ID #DCA98MA002).

<sup>9</sup> The Safety Board is concerned that the remaining U.S.-registered Cessna Caravans—717 according to the FAA's aircraft registry—are not required to be equipped with a crash-protected flight recorder.

Aircraft Type	Date	Location	Notes	NTSB ID
Beech King Air B200	4/4/2003	Leominster, Massachusetts	The airplane, registered as N257CG, crashed while on approach to Fitchburg Municipal Airport. The two pilots and four of the five passengers were killed. The fifth passenger received serious injuries. Although not required, a CVR was installed on board the airplane, but was not recording at the time of the accident.	IAD03FA043
Bell 407	3/27/2003	Broadus, Texas	The helicopter, N175PA, operated as a Public Use aircraft under contract to the U.S. Forest Service, was destroyed when it crashed into heavily wooded terrain while conducting low-level flight operations in support of an inter-agency effort to recover Columbia Shuttle debris. The pilot and one crewmember were fatally injured and three other crewmembers sustained serious injuries.	FTW03FA118
Cessna Citation 501	3/15/2003	Carey, Idaho	The airplane, registered as N70FJ, was destroyed after impacting terrain. The airline transport pilot and two passengers sustained fatal injuries.	SEA03FA045
Beech King Air A100	10/25/2002	Eveleth, Minnesota	The airplane, registered as N41BE, crashed on approach to Eveleth-Virginia Municipal Airport. The airplane was operating under 14 CFR Part 135 as a charter flight by Aviation Charter, Inc., when it crashed; all eight persons on board were killed, including Senator Paul Wellstone.	DCA03MA008
Cessna Caravan 208	10/10/2001	Dillingham, Alaska	The aircraft, N9530F, operated by Peninsula Airways, Inc., (PenAir) as flight 350, crashed shortly after takeoff from the Dillingham Airport. The pilot and nine passengers were killed, and the airplane was destroyed.	DCA02MA003
Beech King Air 200	1/27/2001	Strasburg, Colorado	The airplane, registered as N81PF, crashed into terrain, and the two pilots and eight passengers were killed. The airplane was operated under 14 CFR Part 91 and was returning to Stillwater, Oklahoma, with members of the Oklahoma State University basketball team.	DCA01MA017
Piper Cheyenne PA-31T3	9/18/2000	Nuiqsut, Alaska	The airplane, registered as N220CS, was destroyed after colliding with terrain near the Nuiqsut Airport. The airplane was operated by Cape Smythe Air Service, Inc., on a 14 CFR Part 135 flight. The pilot and four passengers received fatal injuries; the remaining five passengers received serious injuries.	ANC00MA125

### Dual-Certificated Cargo/Passenger Turbine-Powered Aircraft

The second category of aircraft, which includes the Dassault Falcon Jet<sup>10</sup> and Embraer 120, has dual certification for both passenger and cargo<sup>11</sup> use; when configured for six or more passengers, these aircraft are typically used in executive passenger charter operations. This dual certification allows the same model aircraft to operate either with or without a CVR or FDR depending on seating configuration. Specifically, the passenger/cargo certification allows the

<sup>10</sup> The name "Dassault Falcon Jet" includes the following aircraft models: Dassault-Breguet Falcon 10 and Mercure 100C, Dassault-Aviation Mystere-Falcon series (20 series, 50, 200, 900), Fan Jet Falcon series, and Falcon 900EX.

<sup>11</sup> The cargo configuration is one of several cabin configurations in which passenger-carrying aircraft have interior seating of fewer than six passenger seats; reduced seating configurations are used for such purposes as cargo operations, medical evacuation, and luxury seating.

operator to remove the FDR if the aircraft is configured for fewer than 10 passenger seats and to remove the CVR if the aircraft is configured for fewer than 6 passenger seats.

In practice, the Dassault aircraft, which have a maximum seating capacity of fewer than 10 passenger seats, are required to carry a CVR but not an FDR, even with a full complement of seats. The Embraer 120, however, can accommodate 30 passengers, and is therefore required to carry a CVR and FDR under its original passenger certification. The Safety Board is interested in preserving data from these cargo-configured aircraft because these data can be used to identify safety issues that may affect the entire fleet.

Since January 2000, the Dassault Falcon Jet and the Embraer 120 have been involved in 18 accidents<sup>12</sup> investigated by the Safety Board; one-third of these aircraft were being used for cargo operations and therefore, as described above, were not required to carry CVRs. One accident involved a cargo-configured Embraer 120 that was equipped with both an FDR and a CVR although neither was required because of the aircraft's type certification. Other accidents involved Dassault cargo aircraft that were not equipped nor required to be equipped with a CVR or an FDR.

The Safety Board has observed that the six-passenger requirement in the current CVR regulation may be unclear, leading operators to believe that if they remove the passenger seats from a two-pilot-certificated, multi-engine, turbine-powered aircraft, the aircraft is automatically exempted from the requirement to carry an operating CVR. This is not correct. For an aircraft to operate without an operating CVR, a cargo certification must exist for the aircraft type. Therefore, regardless of the number of seats that are installed for a particular flight, if the aircraft does not have a certification that explicitly allows it to operate with fewer than six passenger seats, it must be equipped with an operational CVR, at a minimum.

The Safety Board has investigated several accidents involving the Learjet (models 24, 25, and 35) in which the accident aircraft had been reconfigured from passenger service to cargo operations. With the removal of the seats from these cargo-configured Learjets, some operators removed the CVR or left the CVR on board but did not maintain it. However, because the Learjet's type certification does not contain a specific cargo configuration, it must be operated with an operational CVR, unless its supplemental type certificate contains specific provisions for removal of the CVR. Regardless, the Safety Board maintains that, at a minimum, a CVR should be installed on these aircraft.

### **Solutions for the Lack of Recorded Data**

Considering the number of accidents occurring among the aircraft cited previously, the Safety Board has identified the need to install crash-protected recording devices on all turbine-powered aircraft. The Board recognizes the economic impact of requiring both a CVR and an FDR on smaller aircraft and consequently proposes that all smaller turbine-powered aircraft be equipped with a single crash-protected recorder: the video image recorder. Such recorders obtain not only audio information like that from CVRs and event data like that from FDRs, but also information about the environment outside the cockpit window.

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<sup>12</sup> Of these accidents, eight resulted in fatalities.

An image recording system, estimated to cost less than \$8,000 installed, typically consists of a camera and microphone located in the cockpit to continuously record cockpit instrumentation, the outside viewing area, engine sounds, radio communications, and ambient cockpit noises. Like the data on conventional FDRs or CVRs, image recorder data can be stored in a crash-protected unit to ensure survivability.

Additionally, the Safety Board notes that Public Law 106-424, signed on November 1, 2000, provides for withholding from public disclosure voice and video recorder information for all modes of transportation. Specifically, Section 5(a) of the Public Law expanded upon 49 U.S.C. §1114(c) regarding the protection of cockpit voice recordings to include video recordings. This regulatory change emphasizes the importance of using recorded image data in investigations by requiring the Safety Board to protect both audio and image recordings from all modes of transportation.

The Safety Board recognizes that industry and the pilot community have raised important concerns regarding the privacy issues that are associated with the installation of video image recorders in turbine-powered aircraft. In that regard, the Board encourages the FAA to work with industry and representatives of the pilot community to constructively address and resolve these issues and incorporate the necessary provisions in its new requirements. The Board would be pleased to assist the FAA in pursuing such efforts.

The Safety Board previously addressed the need for video image recording systems in turbine-powered aircraft in Safety Recommendations A-99-59 and A-99-60, issued to the FAA on February 8, 2000:

Incorporate the European Organization for Civil Aviation Equipment's [EUROCAE] proposed standards for a crash-protective video recording system into a technical standards order [TSO]. (A-99-59)

Require, within 5 years of a technical standards order's issuance, the installation of a crash-protective video recording system on all turbine-powered nonexperimental, nonrestricted-category aircraft in 14 Code of Federal Regulations Part 135 Operations that are not currently required to be equipped with a crashworthy flight recorder device. (A-99-60)

In its recommendation letter, the Safety Board noted further that the EUROCAE was—

developing minimum manufacturing standards for the use of such video recording systems in aircraft. These standards will establish the unit's crash/fire survivability requirement, stipulate the recording duration and the video frame rate and resolution, and establish the minimum acceptable cockpit view. To facilitate the introduction of this new technology in commercial aviation, the Safety Board believes that the FAA should incorporate the EUROCAE's proposed standards for a crash-protective video recording system into a technical standard order.

In March 2003, EUROCAE issued its technical standards for video image recording systems: ED-112, *MOPS for Crash Protected Airborne Recorder Systems*. Despite the issuance of these standards, the FAA has taken no action, either to issue a TSO or to implement the standards proposed

in ED-112. Recommendation A-99-59 is currently classified “Open—Acceptable Response,” pending FAA action. However, in light of the number of accidents that have occurred over the last 3 years among aircraft like the Beech King Air, Cessna Caravan, Bell 206L, Dassault Falcon Jet, and other aircraft that are not required to be equipped with CVRs but would be covered by the TSO requested in Safety Recommendations A-99-59 and -60, the Safety Board is disappointed that the FAA has not yet implemented Safety Recommendation A-99-59 and therefore reiterates that recommendation in this letter.

Further, the Safety Board notes that 14 CFR 121.359(a), stated below, does not address turbine-powered rotorcraft or smaller turbine-powered airplanes. Title 14 CFR 121.359(a) states:

No certificate holder may operate a large turbine engine powered airplane or a large pressurized airplane with four reciprocating engines unless an approved cockpit voice recorder is installed in that airplane and is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight.

As noted above, this regulation does not encompass any turbine-powered rotorcraft or smaller turbine-powered airplanes like the Beech King Air, which can weigh less than 12,500 pounds (and therefore, by definition, are not large airplanes). Moreover, neither 14 CFR 135.151 nor 14 CFR 91.609 require aircraft like the Beech King Air, Cessna Caravan, or Bell 206L to carry a CVR. Because the retrieval of recorded data is critical for effective accident investigation regardless of the aircraft’s operation, the Safety Board is superseding Safety Recommendation A-99-60 to include Parts 91 and 121, as further discussed below.

Based on past retrofit history, it seems reasonable that image recording systems could be installed on aircraft within the next 3 years. Such image recording systems would have significantly aided investigators in documenting the facts associated with the accidents listed previously. For example, the Beech King Air, chartered by Senator Wellstone, that crashed on October 25, 2002, was certificated for single-pilot operation and was therefore not required to carry a CVR, even though two pilots were operating the airplane at the time of the accident. Although CVR data would have helped in the investigation, an image recorder would have provided, in addition to the cockpit audio, a point of reference for the crew’s comments, as well as a record of the data displayed on the aircraft instruments and the conditions visible outside the cockpit window.

## **Summary**

Given the number of accidents occurring among these aircraft, the Safety Board notes that retrieving valuable recorded data from turbine-powered aircraft during an accident investigation is essential—regardless of the aircraft’s type of operation or the number of engines, pilots, or passenger seats. The Safety Board therefore believes that the FAA should require the installation of a crash-protected image recording system on all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured after January 1, 2007, that are not equipped with an FDR, and that are operating under 14 CFR Parts 135 and 121 or that are being operated full-time or part-time for commercial or corporate purposes under Part 91. Safety Recommendation A-99-60 is therefore reclassified “Closed—Superseded.”

Although image recorder technology is well developed, the Safety Board recognizes that drafting image recorder certification standards and the corresponding regulations mandating their carriage will require work by the FAA. The Board proposes that such aircraft be equipped with at least a CVR, and, subsequently, with an image recorder when the devices are certified and appropriate regulations are issued. In the interim, the Safety Board believes that the FAA should amend the current regulations for 14 CFR Parts 91, 135, and 121 operations to require all turbine-powered, nonexperimental, nonrestricted-category aircraft that have the capability of seating six or more passengers to be equipped with an approved 2-hour CVR that is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight. The Safety Board is aware that retrofitting these aircraft with a crash-protected image recorder shortly after requiring a CVR installation would have an economic impact on the operator and, therefore, acknowledges that the FAA should allow for an appropriate period of time before requiring the image recorder retrofit.

However, upon the availability of crash-protected image recorders, it is reasonable to expect any turbine-powered aircraft that are not equipped with a CVR to be retrofitted with a crash-protected image recorder immediately upon the availability of such recorders. Accordingly, the Safety Board believes that the FAA should require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a CVR, and that are operating under 14 CFR Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording system by January 1, 2007.

As stated above, the Safety Board recognizes that it will take time to retrofit the rest of the turbine-powered fleet (which are currently required to be equipped with a CVR) with a crash-protected image recorder once it becomes available. However, recorder retrofits have historically been accomplished in a few years. Therefore, the Safety Board believes that the FAA should require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with an FDR, and that are operating under 14 CFR Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require the installation of a crash-protected image recording system on all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured after January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being operated full-time or part-time for commercial or corporate purposes under Part 91. (A-03-62)



Amend the current regulations for 14 *Code of Federal Regulations* Parts 91, 135, and 121 operations to require all turbine-powered, nonexperimental, nonrestricted-category aircraft that have the capability of seating six or more passengers to be equipped with an approved 2-hour cockpit voice recorder that is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight. (A-03-63)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a cockpit voice recorder, and that are operating under 14 *Code of Federal Regulations* Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording system by January 1, 2007. (A-03-64)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft, that are manufactured prior to January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (A-03-65)

The Safety Board is also reiterating A-99-59:

Incorporate the European Organization for Civil Aviation Equipment's proposed standards for a crash-protective video recording system into a technical standards order.

Please refer to Safety Recommendations A-03-62 through A-03-65 and A-99-59 in your reply. If you need additional information, please call (202) 314-6177.

Chairman ENGLEMAN CONNERS, Vice Chairman ROSENKER, and Members CARMODY and HEALING concurred with these recommendations. Member GOGLIA disapproved these recommendations but did not file a dissent.

By: Ellen Engleman Connors  
Chairman