

**NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Vehicle Recorder Division
Washington, D.C. 20594**



GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION

CEN13FA192

By

Bill Tuccio, Ph.D.

WARNING

The reader of this report is cautioned that the transcription of a cockpit voice recorder audio recording is not a precise science but is the best product possible from a Safety Board group investigative effort. The transcript or parts thereof, if taken out of context, could be misleading. The transcript should be viewed as an accident investigation tool to be used in conjunction with other evidence gathered during the investigation. Conclusions or interpretations should not be made using the transcript as the sole source of information.

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August 8, 2014

Cockpit Voice Recorder

Specialist's Factual Report
By Bill Tuccio, Ph.D.

1. EVENT

Location: Grand Lake, Louisiana
Date: March 15, 2013
Aircraft: Sikorsky S-76A++ , N574EH
Operator: Era Helicopters LLC, Flight ERA 574
NTSB Number: CEN13FA192

2. GROUP

A group was convened on July 2, 2014.

Chairman: Dr. Bill Tuccio
Aerospace Engineer
National Transportation Safety Board

Member: Mike Folkerts
Air Safety Investigator
National Transportation Safety Board

Member: Ron Price
Air Safety Investigator
National Transportation Safety Board

Member: Tony James
Air Safety Investigator
Federal Aviation Administration

Member: Allan Clapp
Test Pilot
Sikorsky Aircraft Corporation

Member: Paolo Corradini
IFR Captain/Check Airman
Era Helicopters LLC

3. SUMMARY

On March 15, 2013, about 1147 central daylight time (CDT), a Sikorsky S-76A++ helicopter, N574EH, was substantially damaged after ground impact near Grand Lake, Louisiana. All three occupants onboard, the pilot and two maintenance personnel, were fatally injured. The helicopter was registered to Era Helicopters LLC and was operating under the provisions of 14 *Code of Federal Regulations* Part 91 as a post-maintenance check flight. Visual meteorological conditions prevailed for the local flight, which departed from Lake Charles Regional Airport (LCH), Lake Charles, Louisiana, at 1119. A solid-state cockpit voice recorder (CVR) was sent to the National Transportation Safety Board's Audio Laboratory for readout.

4. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division's Audio Laboratory received the following CVR:

Recorder Manufacturer/Model: **L-3/Fairchild FA2100-1020**
Recorder Serial Number: **UNKNOWN**

4.1. Recorder Description

Per federal regulation 14 CFR 91.609(b), a helicopter operating on a maintenance test flight to test electrical equipment is not required to be equipped with a CVR. However, this helicopter was equipped with a CVR that recorded the last 2 hours of aircraft operation; this is accomplished by recording over the oldest audio data. When the CVR is deactivated or removed from the aircraft, it retains only the most recent 2 hours of CVR operation. This model CVR, the L-3/Fairchild FA2100-1020, is a solid-state CVR that records 2 hours of digital cockpit audio. Specifically, it contains a 2-channel recording of the last 2 hours of operation and separately contains a 4-channel recording of the last 30 minutes of operation. The 2-hour portion of the recording is comprised of one channel of audio information from the cockpit area microphone (CAM) and one channel from the intercom communication system. The 30-minute portion of the recording contains 4 channels of audio data only two of which are used; one channel for the intercom communication system, and the other channel for the CAM.

4.2. Recorder Damage

Upon arrival at the audio laboratory, it was evident that the CVR had sustained significant heat and structural damage, as shown in figure 1. The crash survivable memory unit (CSMU) was removed from the CVR assembly, as shown in figure 2. The CSMU was disassembled and the memory "puck" was

retrieved from the CSMU, as shown in figure 3. The memory puck showed signs of thermal exposure in excess of its designed limits. The memory puck was removed from its container, as shown in figure 4. The memory puck was disassembled, inspected, and reassembled as outlined in the L-3 Accident Investigator Kit. The memory was then downloaded using an NTSB surrogate recorder.

Figure 1. CVR as received.



Figure 2. CSMU removed from CVR assembly.



Figure 3. Memory puck retrieved from CSMU.

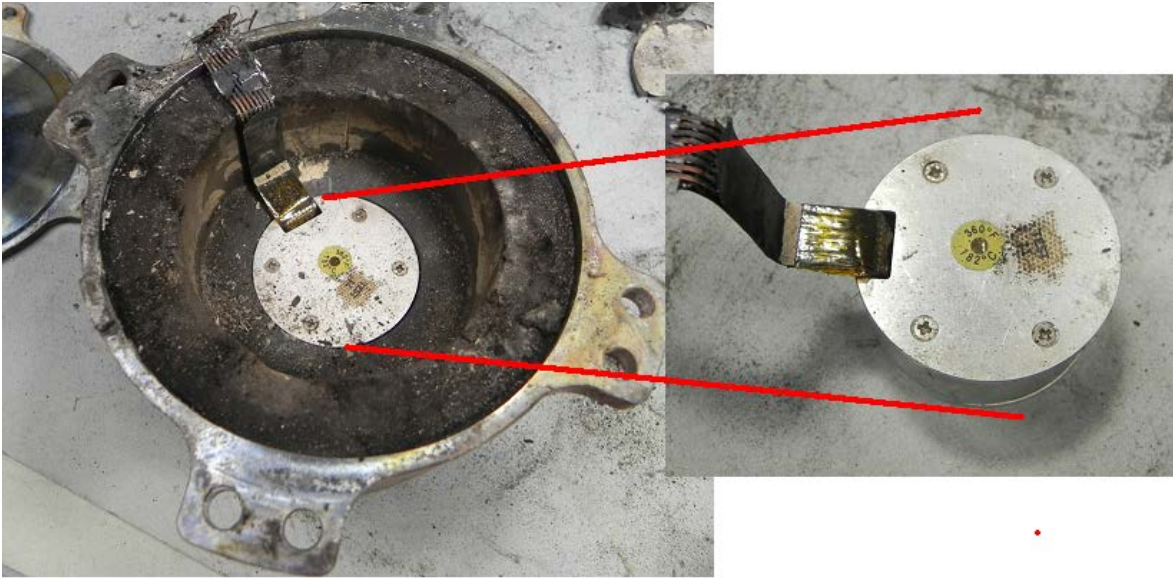


Figure 4. Memory puck removed from container.



4.3. CVR Channels

The recording consisted of two channels of audio information. One of the channels contained audio information from the intercom communication system. The quality of this channel was excellent.¹ One channel contained the cockpit area microphone (CAM) audio information. The quality of this channel was good.

4.4. Timing and Correlation

The two hour recording contained a number of power cycles prior to the accident flight. The dates and times of the events prior to the accident flight were not investigated for this report; accordingly events prior to the accident flight are reported as CVR Elapsed Time (time from the beginning of the CVR recording).

The times used for the accident flight are expressed as local time of the accident (CDT). The accident flight recording began at about 0130:00 CVR Elapsed Time on the 2-hour recording portion (about 0000 on the 30-minute recording portion).

Timing of the accident flight CVR recording was aligned with timing information provided by a time-encoded air traffic control (ATC) recording. A radio transmission starting at 0021:23.797 CVR Elapsed Time (on the 30-minute portion) was aligned with the same transmission on a time encoded ATC recording at 1634:33.5 universal coordinated time (UTC). Subtracting 5 hours to convert from UTC to CDT, resulted in the ATC time of the transmission being 1134:33.5 CDT. Other transmissions in the recording were used to validate the alignment of the recording.

Accordingly, for the 30-minute recording portion, 1113:09.703 was added to all CVR Elapsed Times of the accident flight to convert to CDT.

4.5. CVR Power System Logic

According to the operator, the helicopter CVR power circuit was configured with an inertia/impact switch. The purpose of the switch was to immediately remove power from the CVR when a certain load level was attained. Once the switch was activated by reaching the load level, power remained removed from the CVR until the switch was manually reset.

The installed switch was an Inertia Switch, Inc., part number 3LO-871/6. According to the manufacturer, the "/6" in the part number means the switch was factory preset to a 6 g load threshold, with a +/-15% tolerance. The manufacturer also indicated this model was a hemispherical sensitive switch. This means when the switch was properly installed, it would sense the load limit in all directions of the forward facing hemisphere of the switch, e.g., vertical, lateral, or longitudinal.

The switch had no continued airworthiness requirements for maintenance according to the manufacturer.

¹ See Attachment I for the CVR Quality Rating Scale

4.6. Summary of Recording Contents

The recording began at 0000 CVR Elapsed Time when the helicopter was on the ground and mechanics were on the helicopter discussing a computer menu screen.

After a power cycle to the CVR, at about 0013 CVR Elapsed Time, the helicopter engines started for the maintenance test flight that occurred before the accident test flight (herein, the "First Maintenance Test Flight"). The First Maintenance Test Flight recording continued until about 0057 CVR Elapsed Time.

From about 0013 through 0020 CVR Elapsed Time, the pilot and the mechanic discussed the flight on the intercom. The mechanic noted a "new guy" was one of the passengers on board. The pilot discussed the flight management system (FMS) and the need for an engine power check with the mechanic.

From about 0021 through 0025 CVR Elapsed Time, the pilot performed power checks on each engine. The pilot read off engine parameter values and asked the mechanic to record the values.

At 0026 CVR Elapsed Time, the 1435 UTC ATIS information "Kilo" was recorded.

At 0028 CVR Elapsed Time, the pilot called operations with flight following information. The pilot said there were four people on board, provided fuel information, off time, and estimated time enroute. Operations referred to the pilot as "Bill."

At 0029 CVR Elapsed Time, the helicopter was cleared for takeoff by Lake Charles Tower.

At 0031 CVR Elapsed Time, the mechanic noted, "same thing on that door." At about this time, the pilot noted they were passing through 600 feet for 1,500 feet.

From about 0032 through 0047 CVR Elapsed Time, the pilot flew the helicopter on the First Maintenance Test Flight, testing functions related to the flight management system and autopilot. The pilot and mechanic discussed items such as the ability of the helicopter to capture heading, altitude, airspeed, and track navigation facilities. The pilot and mechanic agreed one of the two FMS systems was not "capturing" properly.

At about 0052 CVR Elapsed Time, the pilot told Lake Charles Tower they were returning to the airport, descending through 1,200 feet. The mechanic noted to the pilot there were one or two problems remaining to be fixed, including "the door."

At about 0056 CVR Elapsed Time, the pilot radioed operations and reported a landing time of "thirty." Shortly thereafter, as the engine was winding down, the mechanic noted the remaining item to fix was a coupling problem related to the FMS and flight controls.

For the remainder of the recording prior to the accident flight, there were about six power cycles to the CVR. During this time period, mostly unintelligible voices of mechanics could be heard amidst occasional snaps, clicks, thunks, and drill like sounds. At about 0124 CVR Elapsed Time, a mechanic stated a series

of numbers, followed by “twenty four volts,” such as “fifty six, twenty four volts.” Mechanics were also heard about this time reading numbers, followed by “is done,” such as “ninety eight is done.”

At about 0130 CVR Elapsed Time, the accident flight recording began, corresponding to about 1113 CDT. The recording began with a sound similar to the engine starting.

At about 1115 CDT, the pilot and mechanic noted that the automatic flight control system (AFCS) test passed with no faults. Thereafter, part of ATIS information “Charlie” was recorded. The pilot then radioed Lake Charles Tower requesting a local area maintenance flight at 1,000 feet. The pilot then radioed operations, reporting an off time of 15 “until about” 45, 3 persons on board, and 2 hours of fuel. Operations referred to the pilot as “Bill.” The helicopter then departed.

At about 1120 CDT, the mechanic noted they needed to do a power check when they returned. The pilot agreed.

At about 1121 CDT, the pilot noted, “well...let’s see if she levels off...”

At about 1124 CDT, the mechanic noted, “that damn door is back again.”

At about 1127 CDT, the mechanic asked if he could fly a “victory lap” after the maintenance checks.

From about 1127 through 1142 CDT, the pilot performed a number of turns, climbs, and descents to check the avionics, flight directors (F/D), and autopilot systems. The pilot and mechanic discussed the various tests, observations, and outcomes. The pilot and mechanic agreed the F/D on the mechanic’s side may have had a remaining problem.

At about 1142 CDT, the pilot asked the mechanic if he wanted to fly the helicopter. The mechanic agreed, and the pilot said he would set the helicopter up for the mechanic on a heading of 150 degrees at an altitude of 1,000 feet. The mechanic noted the helicopter was not like the Cessna 172 he had flown 15 years prior.

At about 1143 CDT, the pilot said to the mechanic, “it is all yours Tim.” Adding with laughter, “do anything you want with it, gun runs...”

At 1143:06 CDT, the mechanic asked if he needed to use the pedals. The pilot said only during power changes.

At 1143:17 CDT, two high pitched tones, each about 2 seconds in length were recorded, similar to an altitude alert, with a 1 second pause between each tone.

At 1143:42 CDT, the mechanic said, “not not quite as touchy as I thought it would be.”

At 1143:45 CDT, the pilot said, “oh that’s cause I’ve got everything turned on.”

At 1143:55 CDT, the pilot said, “what we’ll do we’ll take these autopilots off. take our forced trim off.”

At 1144:04 CDT, the mechanic said, “oh yeah there we go. now I’m flying something. okay.” The pilot and mechanic both laughed.

At 1144:10 CDT, the mechanic said, “okay you got her.”

At 1144:12 CDT, two or three snapping sounds were recorded on the intercom, at the same time the CAM recorded a sound similar to the rotor or engine RPM increasing. The two or three snapping sounds, about .25 seconds in length, may have been a virtual artifact of the power removal from the CVR and not a physical sound that existed in the aircraft. See the Sound Spectrum Study in the docket for this accident investigation for further information.

The CVR recording ended at 1144:13 CDT.

The ATC recording contained additional communications from the aircraft until about 1147 CDT. The ATC information may be found in the docket for this accident investigation.

Attachment I

CVR Quality Rating Scale

The levels of recording quality are characterized by the following traits of the cockpit voice recorder information:

- Excellent Quality** Virtually all of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.
- Good Quality** Most of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate several words or phrases that were not intelligible. Any loss in the transcript can be attributed to minor technical deficiencies or momentary dropouts in the recording system or to a large number of simultaneous cockpit/radio transmissions that obscure each other.
- Fair Quality** The majority of the crew conversations were intelligible. The transcript that was developed may indicate passages where conversations were unintelligible or fragmented. This type of recording is usually caused by cockpit noise that obscures portions of the voice signals or by a minor electrical or mechanical failure of the CVR system that distorts or obscures the audio information.
- Poor Quality** Extraordinary means had to be used to make some of the crew conversations intelligible. The transcript that was developed may indicate fragmented phrases and conversations and may indicate extensive passages where conversations were missing or unintelligible. This type of recording is usually caused by a combination of a high cockpit noise level with a low voice signal (poor signal-to-noise ratio) or by a mechanical or electrical failure of the CVR system that severely distorts or obscures the audio information.
- Unusable** Crew conversations may be discerned, but neither ordinary nor extraordinary means made it possible to develop a meaningful transcript of the conversations. This type of recording is usually caused by an almost total mechanical or electrical failure of the CVR system.