

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR22LA284

COCKPIT VOICE RECORDER

Specialist's Factual Report

May 1, 2023

WARNING

The reader of this report is cautioned that the summary of a cockpit voice recorder audio recording is not a precise science but is the best product possible from a National Transportation Safety Board investigative effort. The summary or parts thereof, if taken out of context, could be misleading. The summary 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 summary as the sole source of information.

A. ACCIDENT

Location: San Francisco, California
Date: July 27, 2022
Time: 1240 Pacific daylight time (PDT)
1940 coordinated universal time (UTC)
Airplane: Bombardier Challenger 300 BD-100-1A10, XO Jet, N557XJ

B. COCKPIT VOICE RECORDER SPECIALIST

Specialist: Michael Portman
Aerospace Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

Per federal regulation, turbine multiengine aircraft with six or more passenger seats and requiring two pilots manufactured prior to April 7, 2010, and operated under Title 14 *Code of Federal Regulations* (CFR) Part 91, must be equipped with a cockpit voice recorder (CVR) that records a minimum of the last 30 minutes of aircraft operation; this is accomplished by recording over the oldest audio data. The accident aircraft was manufactured in 2005. When the CVR is deactivated or removed from the airplane, it retains only the most recent 2 hours of CVR operation.

D. DETAILS OF THE INVESTIGATION

A CVR group was not convened. The NTSB Vehicle Recorder Division received the following CVR:

Recorder Manufacturer/Model: L3/Fairchild FA2100-1020
Part Number: 2100-1020-00
Recorder Serial Number: 000289032

1.0 Recorder Description

This model CVR, the L3 FA2100-1020, is a solid state CVR that records 120 minutes of digital audio. Specifically, it contains a 2-channel recording of the last 120 minutes of operation and separately contains 4-channel recording of the last 30 minutes of operation. The 120-minute portion of the recording is comprised of one channel that combines three audio panels sources and a second channel that contains the cockpit area microphone (CAM) source. The 30-minute portion of the recording contains 4 channels of audio information: one channel for each flight crew, one channel for a cockpit observer, and one channel for the CAM.

1.1 Recorder Damage

Upon arrival at the laboratory, it was evident that the CVR had not sustained any heat or structural damage and the audio information was extracted from the recorder normally, without difficulty.

1.2 Audio Recording Description

Each channel's audio quality is indicated in Table 1.¹ Channel number three did not contain any audio information (nor was it required by federal regulations). The recording was partially overwritten. For the last, approximately, 1.5 hours of the recording, the aircraft sat powered and largely unoccupied, thus overwriting the 30-minute channels. As such, no accident pertinent audio data were recovered from these channels.

Table 1: Audio Quality.

Channel Number	Content/Source	Quality	Duration (hh:mm:ss)
1	Pilot	Good	00:31:03
2	Co-pilot	Good	00:31:03
3	Observer	N/A	N/A
4	CAM	Good	00:31:03
5	CAM 2-hour	Good	02:04:14
6	Combined Channels 1,2,3	Good	02:04:14

1.3 Timing and Correlation

Timing on the transcript was established by correlating the CVR events to common events on the flight data recorder (FDR). Specifically, the last five radio transmissions that the aircraft made were correlated to the radio transmit microphone key parameter from the FDR. Each of the five radio transmissions acted as an anchor point for a linear interpolation between the remaining CVR events. Once a correlation between the two recorders was established, a reference to local time was determined. The CVR and FDR times were offset to reflect the local Pacific daylight time of the accident.

¹ Appendix A comprises the CVR Quality Rating Scale.

1.4 Description of Audio Events

In agreement with the Investigator-In-Charge, a CVR group did not convene. A summary of events from the CVR follows.

Time PDT (hh:mm:ss)	Observation
12:41:10.9	The recording began after the event with the aircraft descending back towards San Francisco International Airport (SFO).
12:42:00.8	Air traffic control (ATC) instructed the crew to descend and maintain flight level 200 and fly direct to the airport, asked the crew to provide information about the injury, and subsequently advised the crew to turn left and fly direct to the airport, when able.
12:42:32.6	The crew read through a checklist addressing a display reversion.
12:43:40.6	The flight was handed to NorCal approach.
12:43:54.5	The crew had a conversation with the outgoing controller in which they described the nature of the event being an autopilot failure which caused the flight attendant to "twist her ankle." The crew further informed the controller that they do not have a functional autopilot and also lost a couple flight instruments.
12:44:33.3	The crew checked in with NorCal approach at flight level 220 descending to flight level 200. The crew additionally affirmed that they did not have an emergency. ATC cleared the flight to descend and maintain 9,000 feet (ft).
12:45:37.1	The crew were instructed to turn left to 180 degrees and fly direct to CEDES when able. Additionally, the crew declined emergency services on ground.
12:46:15.8	The crew discussed and walked through programming the flight computers for the ILS runway 28R approach.
12:46:54.8	The crew continued the descent checklist below the line.
12:47:36.4	The flight was handed to the next NorCal approach controller.
12:48:21.9	The crew checked in with approach at 15,000 ft descending to 9,000 ft.
12:48:34.4	The crew were instructed to expect the quiet bridge visual to runway 28R, but the crew requested the ILS to runway 28R instead.
12:49:06.1	The crew talked about the event, with the pilot mentioning that "that's exactly what that...checklist said to expect, but there's nothing I could do," and that it "waved" as soon as the autopilot was disconnected. The pilot asked the co-pilot to continue running appropriate arrival and descent checklists and mentioned difficulties in hand flying the aircraft. The co-pilot continued running checklists.
12:50:23.1	The crew briefed the visual approach, backed up by the ILS for runway 28R.

Time PDT (hh:mm:ss)	Observation
12:50:33.2	The flight was cleared direct to ARCHI.
12:51:15.9	The pilot called out 10,000 ft descending to 9,000 ft, and an automated altitude alert was noted.
12:51:51.9	The flight was cleared to descend to 8,000 ft.
12:52:08.8	The crew continued talking about the event including that nothing was mentioned about "going into secondary trim."
12:52:18.9	ATC instructed the crew, at ARCHI, to join the ILS course only.
12:52:28.1	An automated altitude alert was noted.
12:53:01.0	The crew were instructed to maintain 210 knots (kts) and to contact the next approach controller.
12:53:33.0	The crew checked in with the next approach controller, level at 8,000 ft and were instructed to maintain 230 kts or greater.
12:53:40.3	The crew discussed it being hard to fly the aircraft at 230 kts, especially because the trim is "janky."
12:54:08.0	The flight was cleared for the ILS runway 28R approach at ARCHI and instructed to maintain 230 kts.
12:55:08.2	ATC confirmed with the crew that they're on the ILS and descending, and again asked if they needed any special assistance, to which the crew replied that they are on the ILS and descending and did not need any special assistance.
12:55:40.3	The crew were instructed to maintain 210 kts when able.
12:55:47.0	The captain commented that the aircraft is difficult to hand-fly.
12:56:51.2	An automated altitude alert was noted, and the captain repeated that the aircraft is difficult to control.
12:56:56.3	The crew bugged 3,000 ft on the instruments.
12:57:12.4	The crew were instructed to maintain 180 kts until AXMUL and were instructed to contact SFO tower.
12:57:30.0	The crew checked in with SFO tower and were cleared to land runway 28R.
12:57:34.4	An automated altitude alert was noted.
12:57:49.5	The crew selected flaps 20.
12:58:15.2	The crew selected gear down.

Time PDT (hh:mm:ss)	Observation
12:58:39.8	An automated altitude alert was noted.
12:58:42.9	The crew discussed the glideslope and programmed the missed approach altitude into the instruments. The crew discussed that they "don't really have speeds in here," and that it "should be around 130."
12:58:46.3	An automated altitude alert was noted.
12:59:15.4	The co-pilot mentioned that the Vref would be 118 kts and asked the pilot if she should bug 128 kts. The pilot mentioned that he had 130 kts currently bugged.
12:59:29.0	The crew selected flaps 30.
12:59:33.1	The crew performed the before landing checklist.
13:00:25.6	The pilot was noted, off headset, checking in with the flight attendant, who gave an unintelligible response.
13:00:33.3	The co-pilot called out "1,000 stable."
13:01:57.8	An automated 100 ft EGPWS callout was noted.
13:02:02.0	An automated 50 ft EGPWS callout was noted.
13:02:03.1	An automated 40 ft EGPWS callout was noted.
13:02:04.2	An automated 30 ft EGPWS callout was noted.
13:02:05.5	An automated 20 ft EGPWS callout was noted.
13:02:07.0	An automated 10 ft EGPWS callout was noted.
13:02:13.2	Sounds consistent with touchdown were noted.
13:02:17.5	The co-pilot called out 100 kts.
13:02:19.0	The co-pilot called out 90 kts.
13:02:21.7	The co-pilot called out 80 kts.
13:02:27.2	The co-pilot called out 70 kts.
13:02:35.2	The crew were instructed to turn right on taxiway E and to contact ground control.
13:03:14.0	The crew checked in with ground control and were cleared to taxi to Signature via taxiway C.
13:03:28.3	The crew performed the after-landing checklist.

Time PDT (hh:mm:ss)	Observation
13:04:14.1	The flight attendant was noted in the background where they were. The pilot responded that they are taxiing into Signature at SFO.
13:04:26.7	The pilot engaged in an unintelligible conversation with the flight attendant.
13:05:26.3	The crew called the FBO but received no response.
13:06:17.0	The crew performed the parking/shutdown checklist. After shutting down, the crew exited the cockpit and they, the flight attendant, and paramedics could be heard in the background, intermittently, with prolonged spans of silence for the remainder of the recording.
14:04:49.9	The pilot was noted having a conversation with another individual about aircraft systems. The discussion was far from the cockpit and was therefore largely unintelligible.
14:19:18.9	The pilot was noted having a conversation, possibly on the phone, specifically mentioning that they didn't declare an emergency, and that he was told to "take care of your crew."
14:42:24.8	The pilot, in another conversation, again confirmed that they did not declare an emergency, that ATC asked about nature of problem, to which they reported a screen failure and a trim failure, but that the problem was under control, that the flight attendant twisted her ankle, that they were asked if they needed medical assistance, and that they said no.
14:45:25.6	The recording ended.

Submitted by:

Michael Portman
Aerospace Engineer - Recorder Specialist

APPENDIX A. 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.