

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



SPECIALIST'S SUMMARY REPORT OF INVESTIGATION

DCA16LA032

**By
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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 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.

NATIONAL TRANSPORTATION SAFETY BOARD
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July 28, 2016

Cockpit Voice Recorder

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1. EVENT SUMMARY

Location: Nashville, Tennessee
Date: December 16, 2015
Aircraft: Boeing 737-300, Registration N649SW
Operator: Southwest Airlines, Flight 031
NTSB Number: DCA16LA032

On Tuesday, December 15, 2015 at 1725 central standard time, Southwest Airlines flight 31, a Boeing 737-300, N649SW, departed taxiway T4 and came to rest in a ditch at the Nashville International Airport, (BNA), Nashville, Tennessee. The passengers evacuated via the emergency slides. The aircraft was substantially damaged and nine passengers sustained minor injuries. The flight was a regularly scheduled passenger flight from the William P Hobby Airport (HOU), Houston, Texas. Night visual meteorological conditions prevailed at the time of the accident.

A solid state cockpit voice recorder (CVR) was sent to the National Transportation Safety Board (NTSB) Vehicle Recorder Division for evaluation.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division received the following CVR:

Recorder Manufacturer/Model: **Honeywell 6022**
Recorder Serial Number: **14914**

3.1 CVR Carriage Requirements

Per federal regulation, turbine engine powered aircraft operating under 14 CFR Part 121 must be equipped with a CVR that records a minimum of the last 2 hours of aircraft operation; this is accomplished by recording over the oldest audio data. The accident aircraft was manufactured in 1997. When the CVR is deactivated or removed from the airplane, it retains only the most recent 2 hours of CVR operation.

3.2 Recorder Description

This model CVR, the Honeywell 6022, 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.

3.3 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.

3.4 Audio Recording Description

Each channel's audio quality is indicated in Table 1.¹

Table 1. Audio Quality

Channel Number	Content/Source	Quality	Duration
1	CAM	GOOD	120 min
2	Mixed	EXCELLENT	120 min
3	Captain	EXCELLENT	30
4	First Officer	EXCELLENT	30
5	Observer	EXCELLENT	30

3.5 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 three radio transmissions that the aircraft made were correlated to the radio transmit microphone key parameter from the FDR. Each of the three 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 central standard time of the accident.

3.6 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.

The recording began before takeoff when the aircraft was on the ground at HOU. The pertinent part of the recording for this investigation occurred after the aircraft landed at BNA.

At 17:21:20 CST, Southwest 31 contacted ground and requested taxi to Concourse C.

¹ See attached CVR Quality Rating Scale.

At 17:21:23 CST, ground delivered the following taxi information "Southwest 31 thirty one Nashville ground taxi to ramp via bravo cross three one tango three enter tango four." To which Southwest 31 read back the instructions.

From 17:21:42 to 17:22:06 CST, the Southwest 31 cockpit crew discussed between themselves the instructions the ground controller gave them.

At 17:22:22 CST, Southwest 31 contacted ramp control to notify them they were inbound to Concourse C.

At 17:23:16 CST, a cockpit crew member said "tango four" and at 17:23:26 CST, a crew member said "dark taxi light."

At 17:23:29 CST, sounds of impact were recorded and four seconds later a flight attendant was heard over the CAM telling passengers repeatedly "heads down stay down."

At 17:23:41 CST, a sound of a buzzer began and continued for the remainder of the recording.

At 17:24:05 CST, Southwest 31 contacted ground and notified them that "we've cut the corner here and are off in the grass" and proceeded to ask for the fire department.

At 17:24:38 CST, one of the pilots mentioned to the other pilots that the slides were being deployed and passengers were evacuating.

At 17:24:42 CST, one of the pilots said "okay don't evacuate flight attendants do not evacuate." to which the other pilot responded "oh they are already going."

From 17:25:28 to 17:26:03 CST, Southwest 31 completed the evacuation checklist in a challenge response manner which included the following items: parking brake, speed brake lever down, flap lever 40, standby power battery, pressurization manual, flow valve hold open, start levers cutoff, advise tower, engine apu fire switches override and pull, and no fire switches.

At 17:26:12 CST, the cockpit crew confirmed with each other if they were ready to evacuate. At 17:26:31 to 17:26:37 CST, the cockpit crew discussed the incident briefly where one pilot said that they didn't see the turn and the other pilot replied that he should've said something. At 17:26:35 CST, a crew member stated "I had the light on and."

At 17:26:51 CST, the cockpit crew contacted aircraft operations and notified them what happened.

At 17:27:58 CST, the cockpit crew discussed pulling the APU fire switches and determined they did not have to discharge anything.

At 17:28:26 CST, the crew mentioned the following items: APU one and two, battery two, and standby power and the CVR ended seven seconds later.

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.