

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

May 14, 2014

Cockpit Voice Recorder

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

1. EVENT

Location: Newark, New Jersey
Date: May 1, 2013

Aircraft: Embraer E-145, N17560 Operated by
ExpressJet Airlines as Flight 4226
and
Airbus A330-300, LN-RKO Operated by
Scandinavian (SAS) as Flight 908

NTSB Number: DCA13FA082

2. GROUP

A group was not convened.

3. SUMMARY

On May 1, 2013, at Newark Liberty International airport (EWR), at about 7:24 pm eastern daylight time (EDT) an ExpressJet Airlines Embraer E-145, flight number 4226 was taxiing northbound on taxiway Romeo (R) for departure to Nashville, Tennessee (BNA) from runway 22R and was stationary on Taxiway R between the intersections of taxiways Mike (M) and Yankee (Y) in sequence for departure. Taxiing behind the ExpressJet was a Scandinavian (SAS) Airbus A330-300, flight number 908, awaiting departure to Oslo, Norway (OSL). SAS was subject to a departure flow restriction and was advised to turn right at taxiway M and hold short of runway 22R at taxiway M. As SAS made the right turn onto taxiway M the left wing struck the horizontal and vertical stabilizer of the ExpressJet. The SAS airplane received minor damage and the ExpressJet airplane received substantial damage. There were no reported injuries. Two solid-state cockpit voice recorders (CVRs) were sent to the National Transportation Safety Board's Audio Laboratory for readout: one from ExpressJet N17560 and one from SAS LN-RKO.

4. DETAILS OF INVESTIGATION

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

Aircraft: **ExpressJet, N17560**
Recorder Manufacturer/Model: **Honeywell 6022**
Recorder Serial Number: **05078**

Aircraft: **SAS, LN-RKO**
Recorder Manufacturer/Model: **Honeywell 6022**
Recorder Serial Number: **04269**

4.1. Recorder Descriptions

Per applicable regulations, aircraft 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. When the CVR is deactivated or removed from the airplane, it retains only the most recent 2 hours of CVR operation. The CVR models on each aircraft, the Honeywell 6022, were solid-state CVRs that record 2 hours of digital cockpit audio. The recorded audio data is separated by the Honeywell download software into 2 sets of audio data files: a) a 2-channel recording containing the last 2 hours of recorded events and b) a 4-channel recording containing the last 30 minutes of recorded events. During the 2-hour portion of the recording, one channel contains audio information from the cockpit area microphone (CAM) and the other channel contains a mixture of two audio sources: the captain's audio panel information and the first officer's audio panel information. The 30-minute portion of the recording contains 4 channels of audio data; one channel for each flight crew and one channel for the CAM audio information.

4.1.1. Recorder Damage

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

4.1.2. CVR Channels

Each recording consisted of four channels of audio information. Two of the channels contained audio information from the captain's and first officer's audio panels. The quality of these two channels was excellent¹. One channel contained the CAM audio information. The quality of this channel was good. The fourth channel contained audio information from the passenger address system. The quality of this channel was excellent.

¹ See Attachment I for the CVR Quality Rating Scale

4.1.3. ExpressJet, N17560 Timing and Correlation

The times used in this report are expressed as local time of the accident, EDT.

Timing of the transcript was established by correlating the ExpressJet CVR events to common events on the ExpressJet FDR. Specifically, CVR transmissions at 4496.6, 4512.4, 4532.2, and 4540.7 CVR Elapsed Time (time from the beginning of the 120-minute recording) were correlated to the same microphone keying on the FDR at 95155.1, 95171.1, 95191.1, and 95199.1 FDR Subframe Reference Number (SRN). Further, FDR SRN of 95155.0 = 23:22:55 Greenwich Mean Time (GMT).

Therefore, a relationship between FDR SRN to GMT to CVR Elapsed Time can be developed.

Specifically for the ExpressJet CVR, it is assumed that FDR SRN 95155.0 = 23:22:55 GMT = 4496.6 CVR Elapsed Time. GMT was then offset 4 hours to reflect the local EDT of the accident. Combining this information, EDT = 18:07:58.4 + ExpressJet CVR 120-minute Recording Elapsed Time.

4.1.4. SAS, LN-RKO Timing and Correlation

The times used in this report are expressed as local time of the accident, EDT.

Timing of the transcript was established by correlating the SAS CVR events to common events on the SAS FDR. Specifically, CVR transmissions at 50.6, 62.4, and 117.8 CVR Elapsed Time (time from the beginning of the 30-minute recording) were correlated to the same microphone keying on the FDR at 96162.7, 96174.7, and 96229.7 FDR SRN. Further, based on a common radio transmission at 23:15:56.4 GMT recorded by the ExpressJet CVR and the SAS CVR, FDR SRN of 95781.8 = 23:15:56.4 GMT.

Therefore, a relationship between FDR SRN to GMT to CVR Elapsed Time can be developed.

Specifically for the SAS CVR, it is assumed that FDR SRN 96162.7 = 23:22:17.3 GMT = 51.2 CVR Elapsed Time. GMT was then offset 4 hours to reflect the local EDT of the accident. Combining this information, EDT = 19:21:26.0 + SAS CVR 30-minute Elapsed Time.

4.2. Summary of Recording Contents

In agreement with the Investigator-In-Charge, a CVR group did not convene and only this summary report was prepared. The two aircraft were occasionally on different radio frequencies; as a result, radio transmissions recorded on each CVR at any given time were not necessarily the same.

Events as Recorded on the ExpressJet CVR

The recording began when a prior flight, ExpressJet 4312, was landing at EWR. At about 18:36 EDT, the CVR began recording the crew of the event flight, ExpressJet 4226, as they entered the cockpit.

At about 18:59 EDT, ExpressJet 4226 pushed off the gate and then started engine number 2. At about 19:03 EDT, ExpressJet 4226 disconnected from the tug and the crew performed the after start checklist.

At about 19:04 EDT, ExpressJet 4226's first officer called EWR Ground for taxi. EWR Ground provided taxi instructions to runway 22 right's Whiskey intersection via Bravo, Romeo, and hold short of Juliet. The first officer read back the instruction to EWR Ground and the captain repeated the instruction to the first officer.

Sounds similar to the aircraft in motion were recorded on the CAM as the crew engaged in non-pertinent conversation.

At about 19:09 EDT, SAS 908 called EWR Ground ready for taxi from "Romeo-Fox." EWR Ground provided SAS 908 taxi instructions to runway 22 right's Whiskey intersection; instructing the aircraft to pull up to the Bravo taxiway and then follow the regional jet from right to left. SAS 908 read back the instructions as "behind the regional jet to Bravo."

At about 19:10 EDT, ExpressJet 4226's crew made a passenger announcement informing the passengers it would be about 15 minutes before take-off. The crew then continued to engage in non-pertinent conversation.

At about 19:14 EDT, EWR Ground instructed ExpressJet 4226 to follow Southwest all the way down to Yankee, then follow the first United 737 that "gets in front of you from the left," advising them they were number 12 for departure and to monitor tower. The first officer read back, "roger, will do." The crew then discussed the instructions and the aircraft mentioned in the taxi instructions.

At 19:14:56 EDT, EWR Ground told SAS 908 they were "number fifteen" and then instructed them to continue straight ahead, and at taxiway Yankee, follow the United 737 from the left at Yankee, concluding that SAS 908 was now "number fourteen." SAS 908 did not acknowledge the instruction.

At 19:15:24 EDT, EWR Ground said, "Scandy nine oh eight heavy." SAS 908 replied "go ahead." EWR Ground instructed SAS 908 to taxi ahead and hold short of Yankee. SAS 908 acknowledged, saying they would taxi ahead and hold short of Yankee.

At 19:17:49 EDT, EWR Ground instructed SAS 908 at Yankee to follow a United Boeing 737 from the left, advising they were number 12 and monitor tower. SAS 908 read back the instructions.

At 19:18:07 EDT, ExpressJet 4226's radio switched from EWR Ground to EWR Tower frequency. EWR Tower was instructing a number of aircraft to cross runway 22R and "pull up to Papa Alpha" and then contact ground.

At 19:20:12 EDT, EWR Tower instructed SAS 908 to contact EWR Ground. SAS 908 acknowledged.

At 19:21:26 EDT, ExpressJet 4226's crew discussed and confirmed amongst themselves that they were short of Yankee and which aircraft they were following. The crew then engaged in non-pertinent conversation.

At 19:22:26 EDT, the sound of rumbling similar to a collision was recorded on the CAM of ExpressJet 4226 and the crew commented with an expletive. At 19:22:31 EDT, the crew confirmed amongst themselves they were "hit," as another aircraft on the frequency reported observing the collision to EWR Tower.

At 19:22:40 EDT, the ExpressJet 4226's crew called the flight attendant advising her of the problem and telling her to remain seated. The aforementioned other aircraft continued advising EWR Tower, saying the SAS plane "just about" took the empennage off the "commuter." The crew of ExpressJet 4226 replied amongst themselves, "took the empennage off?" After trying to communicate with EWR Tower, the crew again commented amongst themselves, "okay took the empennage off."

At 19:23:05 EDT, ExpressJet 4226 's captain told the first officer he was shutting down the engines. The captain then made a passenger announcement. The first officer again tried to call EWR Tower.

At 19:23:24 EDT, ExpressJet 4226's crew changed to EWR Ground frequency as SAS 908 was completing an acknowledgement to hold short of Whiskey.

At 19:23:28 EDT, ExpressJet 4226 called EWR Ground. EWR Ground responded, "stand by," and then asked if ExpressJet 4226 was the one who got hit. The first officer said they had been hit and asked for a report on the tail. EWR Ground replied trucks were on the way to assist. ExpressJet 4226's first officer asked if they needed to evacuate. EWR Ground asked United Airlines flight 22 for a condition report on ExpressJet 4226, asking if there were any flames. The United flight responded there were no flames, but there was serious damage to the tail.

For the remainder of the recording, ExpressJet 4226's crew coordinated the response to the collision with EWR Ground, EWR Airport Rescue and Firefighting, ExpressJet Operations, and the flight attendant.

After the aircraft was towed to the gate, the recording ended at 20:13:02 EDT, as the B-31 CVR circuit breaker was pulled.

Events as Recorded on the SAS CVR

Part of the intracockpit communications of SAS 908 were in Norwegian. In agreement with the Investigator-in-Charge, no translation or summary of Norwegian was performed.

The recording began when a prior flight, SAS 903, was landing at Newark. At about 18:51 EDT, SAS 908 called EWR Clearance Delivery for their clearance to Oslo.

At about 19:05 EDT, SAS 908 began to push back from the gate and then started their first engine. After starting the engine, the crew performed the after first engine start checklist.

At about 19:09 EDT, SAS 908 called EWR Ground reporting they were ready for taxi from "Romeo-Fox." EWR Ground provided SAS 908 taxi instructions to runway 22 right's Whiskey intersection; instructing the aircraft to pull up to the Bravo taxiway and then follow the regional jet from right to left. SAS 908 read back the instructions as "behind the regional jet to Bravo." The crew then checked the brakes.

At about 19:14 EDT, EWR Ground instructed ExpressJet 4226 to follow Southwest all the way down to Yankee, then follow the first United 737 that "gets

in front of you from the left,” advising them they were number 12 for departure and to monitor tower. ExpressJet 4226 read back, “roger, will do.”

At 19:14:56 EDT, EWR Ground told SAS 908 they were “number fifteen” and then instructed them to continue straight ahead, and at taxiway Yankee, follow the United 737 from the left at Yankee, concluding that SAS 908 was now “number fourteen.” While EWR Ground was making this transmission, SAS 908’s crew were speaking in Norwegian in the cockpit; they did not respond to EWR Ground’s instructions.

At 19:15:24 EDT, EWR Ground said, “Scandy nine oh eight heavy.” SAS 908 replied “go ahead.” EWR Ground instructed SAS 908 to taxi ahead and hold short of Yankee. SAS 908 acknowledged, saying they would taxi ahead and hold short of Yankee. SAS 908’s crew then spoke in Norwegian, mentioning “Yankee.”

At 19:16:31 EDT, SAS 908’s crew engaged in Norwegian intracockpit discussion, mentioning “Yankee,” “Kilo,” “Mike,” and “Romeo.”

At 19:17:49 EDT, EWR Ground instructed SAS 908 at Yankee to follow a United Boeing 737 from the left, advising they were number 12 and monitor tower. SAS 908 read back the instructions. SAS 908’s crew then engaged in English discussion, confirming tower frequency was 118.3 and “airborne frequency” was on “nineteen point two.”

At 19:18:15 EDT, United 22 informed EWR Tower, “Scandinavian didn't stop so we can't get out.”

At 19:18:18 EDT, SAS 908 switched to EWR Tower frequency.

At 19:20:12 EDT, EWR Tower instructed SAS 908 to contact EWR Ground. SAS 908 acknowledged.

At 19:20:29 EDT, SAS 908 switched to EWR Ground frequency.

At 19:20:34 EDT, SAS 908 told EWR Ground they were “back with you.” EWR Ground replied, “Scandy nine oh eight heavy, Newark Ground, I ah erred in my sequencing here. Is it possible for you to make that hard left turn on Mike off your left?” SAS 908’s crew began an intracockpit Norwegian discussion when EWR Ground said, “You know what Scandy nine oh eight heavy let's do this. I want you to turn right on Mike. But hold short of runway two two right. Remain with me.” SAS 908 acknowledged the instructions. EWR Ground then apologized to United 22, saying he was getting “Scandy” out of the way.

At 19:21:25 EDT, SAS 908’s crew engaged in Norwegian intracockpit discussion, with an English portion of “Scandanavian didn't stop for us...he made an error...he sure did.” The discussion continued in Norwegian, including laughter.

At 19:22:06 EDT, EWR Ground instructed SAS 908 to turn right on Yankee, cross runway 22 right, left on Papa, then hold short of runway 22 right on Whiskey between the runways. As EWR Ground was talking, SAS 908’s aircraft background sound increased, similar to engine power increase. SAS 908 replied, “roger ah we'll cross ah two two right now and take Papa ahhh and then ah Yankee between the runways and hold short on the other side. Scandinavian nine zero eight.” EWR Ground replied, correcting SAS 908 to hold short on Whiskey. SAS 908 acknowledged the correction. While EWR Ground was

correcting the hold short instructions, a member of SAS 908's crew said "crossing runway."

At 19:22:31 EDT, SAS 908's crew engaged in English intracockpit discourse saying clear right, clear left, strobes on, and then confirming the taxi instructions.

At 19:22:57 EDT, SAS 908's crew engaged in English intracockpit discourse saying the runway was crossed, strobes should come off, and concluding "turning left here on Papa to hold short runway at Whiskey."

At 19:23:08 EDT, EWR Ground called SAS 908 and informed them they had hit another aircraft. SAS 908 acknowledged EWR Ground. SAS 908's crew then engaged in Norwegian intracockpit discussion.

At 19:23:28 EDT, ExpressJet 4226 called EWR Ground. EWR Ground responded, "stand by," and then asked if ExpressJet 4226 was the one who got hit.

For the remainder of the recording, SAS 908's crew coordinated the response to the collision with EWR Ground, EWR Airport Rescue and Firefighting, SAS Operations, and the flight attendants.

At about 19:38:48 EDT, SAS 908 began to taxi back to gate.

The recording ended at about 19:51 EDT, when SAS 908 was shut down at the gate and Newark Port Authority personnel began talking to the crew in the cockpit.

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.