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

GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION

ERA21FA346

By
Sean Payne

WARNING

The reader of this report is cautioned that the transcript 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.

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division

August 1, 2023

Cockpit Voice Recorder

Group Chairman's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location:	Farmington, CT
Date:	September 2, 2021
Aircraft:	Cessna 560, N560AR
Operator:	Brookhaven Properties, LLC.
NTSB Number:	ERA21FA346

2. GROUP

A group was convened on September 15, 2021, at the NTSB's Vehicle Recorder Division laboratory in Washington, D.C. The group consisted of the following individuals:

Chairman:	Sean Payne Branch Chief – Vehicle Recorder Division National Transportation Safety Board
Member:	Timothy Monville Investigator-In-Charge (IIC) National Transportation Safety Board
Member:	David Case Computer Scientist/Investigator National Transportation Safety Board
Member:	Todd Gentry Sr. Accident Investigator Federal Aviation Administration
Member:	Dan Morris Sr. Manager/Chief Pilot, Engineering Flight Test Textron Aviation

3. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division received the following CVR:

Recorder Manufacturer/Model: **L3 FA-2100-1020**
Recorder Serial Number: **000322527**

3.1 CVR Carriage Requirements

Per federal regulation, turbine engine powered aircraft that require two pilots and are operating under 14 *CFR* Part 91, must be equipped with a CVR. For aircraft with an initial certificate of airworthiness issued prior to April 6, 2021, the minimum CVR record length is 30 minutes.

3.2 Recorder Description

This model CVR, the L-3/Fairchild FA-2100-1020, records a minimum of 120 minutes of digital audio stored on solid state memory modules. Specifically, it contains a 2-channel recording of the last 120 minutes of operation and separately contains 3-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 panel sources and a second channel that contains the cockpit area microphone (CAM) source. The 30-minute portion of the recording contains 3 channels of audio information: one channel for the captain's hot-mic, one channel for the first officer's hot-mic and one channel for a cockpit observer. When the 30-minute portion of the CVR is downloaded, the same two-hour CAM channel is also recovered. This two-hour CAM channel is the same CAM channel that is recorded on the two-hour portion of the recorder.

3.3 Recorder Damage

The recorder did not show obvious signs of deformation damage. The recorder was filled with earthen material in some areas, particularly around protruding hardware. The recorder showed some evidence of heat damage. The recorder's crash survivable memory unit (CSMU) appeared undamaged and was still affixed to the recorder's chassis. Figure 1 shows the condition of the recorder upon arrival to the NTSB laboratory. Note that the recorder's Underwater Locator Beacon (ULB) had been removed from the device for shipping.

Figure 1. The arrival condition of the CVR from N560AR.

Figure 2 shows the internal condition of the CSMU when removed from the chassis. The CSMU appeared undamaged, and the internal non-volatile memory (NVM) chip stack also appeared undamaged.

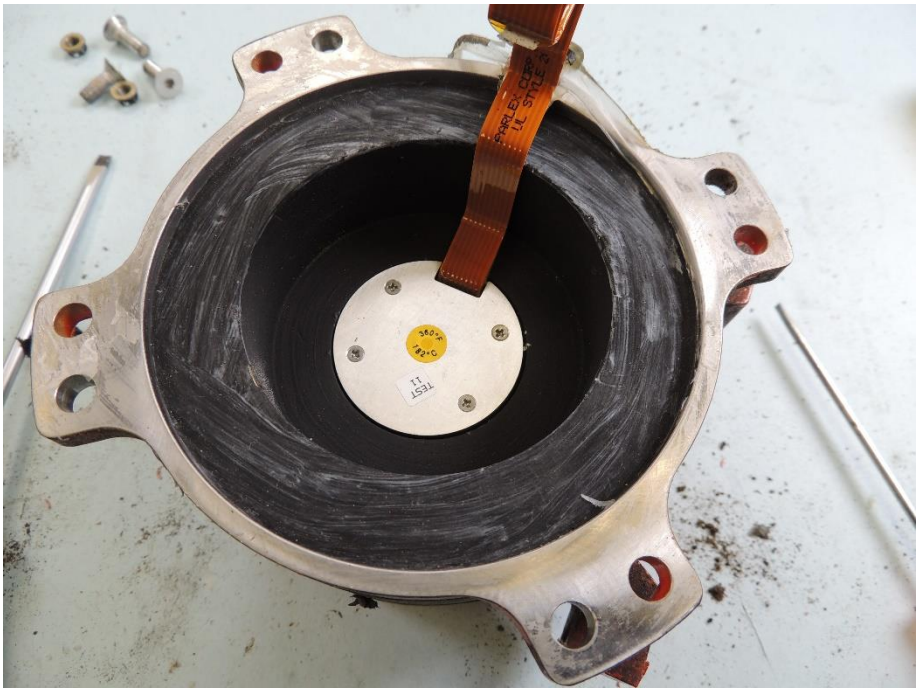

Figure 2. The condition of the CSMU and associated NVM chip stack.

Figure 3 shows the NVM chip stack removed from the CSMU. The chip stack and associated ribbon cable were in good condition and were read out normally using an NTSB owned L3 FA-2100 surrogate.

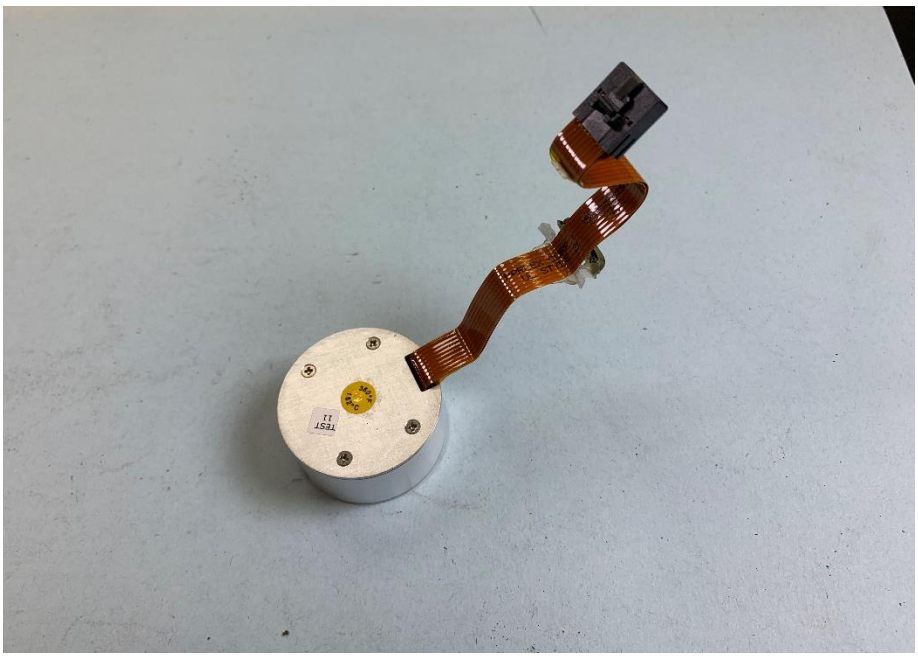

Figure 3. The NVM chip stack and ribbon cable shown in good condition.

3.4 Audio Recording Description

The data downloaded normally from the CVR and produced files consistent with the logic of a 2-hour CVR. The audio quality for all channels was characterized as "good." Attachment 1 to this report, which follows the CVR transcript and summary, describes the NTSB's CVR rating scale.

For the 30-minute portion of the recording, each channel's audio quality is indicated in Table 1.

For the two-hour portion of the recording, each channel's audio quality is indicated in Table 2.

Table 1. Audio Quality for 30 minute portion.

Channel Number	Content/Source	Quality	Duration
1	Cockpit Observer (un-used)	Good	31m03s
2	First Officer	Good	31m03s
3	Captain	Good	31m03s

Table 2. Audio Quality for two-hour portion

Channel Number	Content/Source	Quality	Duration
1	Captain, First Officer, and Cockpit Observer	Good	2h04m41s
2	Cockpit Area Microphone (CAM)	Good	2h04m41s

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 last four radio transmissions that the aircraft made were correlated to the radio transmit microphone key parameter from the FDR. Each of the four radio transmissions acted as an anchor point for a linear interpolation between the remaining CVR events. Once a correlation between the recorders were established, a reference to the local eastern daylight time (EDT) was determined using additional timing information from the FDR. The sample rate of the recorded mic keys on the FDR was 1 Hz.

Because the CVR recording contained multiple power disconnects, radio transmissions for other portions of the recording were separately aligned with mic key information from the FDR for other portions of the recording.

For one area of CVR recording, no FDR timing information was available, and thus a time correlation could not be performed. Timing information from the FDR comes from the GPS system. If the aircraft is in a hangar (or the GPS antenna is not visible to the sky), it is possible that the system will not record timing information. As such, the first portion of the transcript uses recorder elapsed time, as no FDR timing information was available.

All other times are referenced in EDT.

3.6 Description of Audio Events

In agreement with the Investigator-In-Charge, a CVR group was convened.

The CVR recording contained multiple power disconnects during the approximately two-hour long recording. Power disconnects can be a result of the flight crew cycling the master battery switch, or the recorders becoming depowered if certain criteria is not met.

According to Textron, the 560XL utilizes a CVR shutdown sequence that will remove power from the CVR according to the following logic:

The CVR will be powered on when the battery power (BATT ON) is selected. The CVR will remain powered on for only 9 minutes if the avionics system does not detect a valid oil pressure signal of at least 10 psi from the LH or RH engine. If the flight crew turns on battery power but does not start at least one of the main engines (APU does not apply) the avionics system will automatically remove power from the CVR after 9 minutes. This logic is intended to recognize that a flight has ended and then preserve the CVR recording.

Note: The FDR uses shutdown logic that is the same as the CVR with minor exceptions related to the power source being AVIONICS power rather than BATT power.

The transcribed portion (attached below) describes events relevant to the accident investigation and were broken into three sections according to power disconnects present on the recording, they are as follows:

- The aircraft on the ground where the captain was present discussing fuel load with a ramp employee.
- The captain and first officer were discussing flight planning and FMS entry procedures.
- The portion of the recording that contained engine start and the accident sequence.

Following the transcript, previous flights that were available on the two-hour segment were summarized. The summary discusses the nature of the previous flights captured on the two-hour segment in section 3.6.1.

Transcript of a L3 FA-2100-1020 solid-state cockpit voice recorder, serial number 000322527, installed on a Cessna Citation 560 (N560AR), which crashed in Farmington, CT on September 2, 2021.

LEGEND

APP	Approach Controller
CAM	Cockpit Area Microphone
EGPWS	Enhanced Ground Proximity Warning System
HOT	Voice captured on flight crew headset boom mic
RAMP	Voice identified as ramp (FBO) employee
RDO	Outgoing transmission over Very High Frequency (VHF) radio
-1	Voice identified as the captain
-2	Voice identified as the first officer
-?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in Eastern Daylight Time.
Note 2: Generally, only radio transmissions to and from the incident aircraft were transcribed.
Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.
Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control, or condition of the aircraft.

00:00:00.0 **START OF RECORDING**

DUE TO LACK OF TIMING INFORMATION FROM THE FDR FOR THIS POWER CYCLE, TIMING INFORMATION IS UNAVAILABLE FOR THIS PORTION OF THE TRANSCRIPT. SEE SECTION 3.6 OF THIS REPORT FOR AN EXPLAINATION. TIMING IN THIS SECTION IS PRESENTED IN ELAPSED TIME OF THE 30 MINUTE CVR PORTION.

00:07:07.9
CAM **START OF TRANSCRIPT**

00:07:07.9
CAM [sound of electronic chime.]

00:08:21.4
CAM [sound of rustling and click.]

00:08:36.1
CAM [sound of click.]

00:09:09.6
CAM-1 hello @[RAMP EMPLOYEE].

00:09:11.0
RAMP uhhh I'm not gunna get in there but uhh how much fuel are you guys gunna hold?

00:09:16.8
CAM-1 uhhh.

00:09:20.3
RAMP like uhhh seven hundred gallons?

00:09:22.9
CAM-1 nah maybe five six hundred.

00:09:25.2
RAMP oh really?

Intra-Aircraft Communication		Over-the-Air Communications
00:09:26.4 **CAM-1**	yeah. whatever. I # up last time and had a lot of extra fuel.	
00:09:30.1 **RAMP**	nice.	
00:09:32.6 **CAM-1**	ummm yeah so I'll probably take - let's see. thirty four—	
00:09:39.0 **RAMP**	yeah if that's what you think uhhh I'll fuel it up with a different truck and then we'll see uhhh if we need to top it off again (or whatever).	
00:09:49.8 **CAM-1**	three and three hundred— yeah it's not gunna be much— it's not gunna be too much more than— it won't be more than six hundred for sure.	
00:09:56.5 **RAMP**	okay.	
00:09:57.6 **CAM-1**	alright.	
00:09:59.4 **RAMP**	alright (there).	
00:10:00.2 **CAM-1**	thank you.	

A POWER DISCONNECT OCCURRED HERE. TIMING INFORMATION BECAME AVAILBLE FROM THE FDR FOR THE FOLLOWING TRANSCRIBED SEGMENT. TIMES ARE PRESENTED IN EDT ON THE DAY OF THE ACCIDENT, SEPTEMBER 2, 2021.

13:10:24.0 **CAM-2**	A-P-U test.	

Intra-Aircraft Communication		Over-the-Air Communications
13:10:24.2 **CAM**	[sound of electronic chime.]	
13:10:25.1 **CAM-1**	the master battery for the— for the on the A-P-U as a battery.	
13:10:28.9 **CAM-2**	uh okay (connecting) * the master on let it finish its test.	
13:10:35.4 **CAM-1**	and then you gotta test it— you gotta push it.	
13:10:37.1 **CAM-2**	alright here we go.	
13:10:37.8 **CAM**	[automated voice] A-P-U fire.	
13:10:41.0 **CAM**	[automated voice] A-P-U fire.	
13:10:46.6 **CAM-2**	that's it?	
13:10:47.3 **CAM-1**	yuhhh there she goes just hit the start button.	
13:10:49.6 **CAM-2**	alright that's good let's hit the start.	
13:10:51.4 **CAM**	[sound similar to power driven device changing lower in frequency, consistent with a battery voltage drop.]	
13:10:55.7 **CAM-2**	(normal) * * check *.	

Intra-Aircraft Communication		Over-the-Air Communications
13:11:10.4		
CAM	[sound of APU starting]	
13:11:17.5		
CAM-2	ready to load alright— gen first?	
13:11:20.0		
CAM-1	yeah just the generator I don't need the air on *.	
13:11:26.3		
CAM-2	alright.	
13:11:30.5		
CAM	[sound of mid-frequency clicks]	
13:11:37.0		
CAM-2	alright let's see.	
13:11:38.9		
CAM-2	which is it? the top antenna's two?	
13:11:42.2		
CAM-1	um yeah you might hafta use one. maybe that's why it didn’t work last time.	
13:11:45.2		
CAM-2	oh okay.	
13:11:45.6		
CAM-1	ohhh I don't know.	
13:11:47.9		
CAM-2	alright I dunno why (it didn’t work). alright let's see let it start up a sec.	
13:11:55.9		
CAM	[sound of click]	

Intra-Aircraft Communication		Over-the-Air Communications	
		13:13:12.8 **RDO-2**	Hartford clearance citation five six zero alpha romeo.
		13:13:22.0 **APP**	citation five six zero alpha romeo Bradley approach I have your clearance advise when ready to copy.
		13:13:26.0 **RDO-2**	rrready to copy.
		13:13:27.9 **APP**	zero alpha romeo you are cleared to mike quebec india airport from the Robertson airport via radar vectors to Hartford then as filed. departure maintain three thousand expect flight level three six zero one zero minutes after departure. departure frequency one two three point niner five. code is two zero three seven. call for release.
		13:13:50.5 **RDO-2**	yeah five six zero alpha romeo were cleared to mike quebec india airport uhh vectors to Hartford then as filed three thousand initial three six zero in ten and uh twenty three ninety five two zero three seven and we'll hold.
		13:14:06.9 **APP**	citation zero alpha romeo read back is correct just advise when you're ready number one in the runway.
		13:14:11.4 **RDO-2**	will do no passengers here yet it'll be a bit.
		13:14:13.9 **APP**	'kay
13:14:27.0 **CAM-2**	[unintelligible mumbling. The identifier “4B8” was detected.]		

Intra-Aircraft Communication		Over-the-Air Communications
13:16:02.0		
CAM-2	uhhh. * *.	
13:16:02.7		
CAM-1	were you able to get 'em?	
13:16:03.9		
CAM-2	yeah I got 'em. it's as filed. T-H-U-M-B. T-H-U-M-B.	
13:16:11.3		
CAM-2	[low voice comments consistent with using the aircraft's FMS system. some waypoints detected in conversation were THUMB, YODER, CCC [Calverton VOR], GEDIC.]	
13:16:26.9		
CAM	[sound of click.]	
13:17:14.5		
HOT-2	yes. [sound of quick laugh.] alright. let's see.	
13:17:19.4		
HOT-2	(performance) * *. ummm fuel.	
13:17:26.6		
CAM-1	we should be reading alright.	
13:17:27.9		
CAM-2	uhhh daaa-daaa-daaa okay we got it. we got– so what do you got. two passengers only?	
13:17:33.5		
CAM-1	yup.	
13:17:37.4		
CAM-2	two passengers— cargo— 'bout wha' hundred and fifty maybe?	

Intra-Aircraft Communication		Over-the-Air Communications
13:17:40.8 **CAM-1**	yeah I mean they're probably not even that much but that's fine.	
13:17:44.9 **CAM-2**	alright cruise altitude is thirty-six.	
13:17:52.1 **CAM-2**	[sound of mumbling] * * uhhh alright aaand exxxecute. takeoff. we're gunna takeoff to the north?	
13:18:05.4 **CAM-1**	yeah— yuuup.	
13:18:07.9 **CAM-2**	uhhh and that's runway what? two?	
13:18:09.1 **CAM-1**	(two) (two) yup.	
13:18:11.1 **CAM-2**	uhhh zero two.	
13:18:17.5 **CAM-2**	(alright).	
13:18:20.7 **CAM-2**	huh?	
13:18:41.0 **CAM-2**	that's not good.	
13:19:21.7 **CAM-2**	why did that come up?	

A POWER DISCONNECT OCCURRED IN THIS AREA. THIS POWER DISCONNECT WAS LIKELY CAUSED BY CVR/FDR RECORDING PRESERVATION LOGIC DISCUSSED IN SECTION 3.6 OF THIS REPORT. TIMING INFORMATION BECAME AVAILBLE FROM THE FDR FOR THE FOLLOWING TRANSCRIBED SEGMENT. TIMES ARE PRESENTED IN EDT ON THE DAY OF THE ACCIDENT, SEPTEMBER 2, 2021.

Intra-Aircraft Communication		Over-the-Air Communications
13:45:09.8		
CAM	[sound of turbine engine starting]	
13:45:32.5		
CAM	[sound of click]	
13:45:43.1		
CAM	[sound of second turbine engine starting]	
13:46:03.6		
HOT-2	alright. air onnn.	
13:46:05.3		
CAM	[sound similar to rudder bias check operation]	
13:46:14.3		
HOT-2	just to do a sanity check. four twenty-five–- four twenty-six– on the flight plan.	
13:46:18.7		
HOT-1	okay.	
13:46:25.0		
HOT-2	alright uhhh let's see uhh twenty-two point eight.	
13:46:25.8		
CAM	[sound of passenger safety alert.]	
13:46:39.4		
HOT-2	they said to call 'em when we're uh number one.	
13:46:42.1		
HOT-1	yup.	
13:46:42.6		
HOT-2	so wait till on the (that) side—	
13:46:43.9		
HOT-1	yeah wait down on the other end.	

Intra-Aircraft Communication		Over-the-Air Communications
13:46:44.8 **HOT-2**	alright.	
13:46:45.8 **HOT-2**	take a quick look and see if they changed anything on us.	
13:46:46.3 **HOT-1**	(see if I—)	
13:47:05.3 **HOT-2**	(boy/whyyy) it's a narrow taxiway for this huh—	
13:47:07.2 **HOT-1**	yeah I don't know why they did this when they repaved it.	
13:47:12.9 **CAM**	[sound of two quick clunks]	
13:47:14.2 **HOT-2**	alright. (what's that) looks good. come onnn.	
13:47:20.6 **CAM**	[sound of single click and two thuds, similar to thrust reverser emergency stow check]	
13:47:34.7 **CAM**	[sound of two light thuds]	
13:47:35.4 **HOT-2**	I'll give it a sec.	
13:47:38.5 **HOT-2**	so uhh vectors to Hartford was the clearance. initial three thousand three-six- zero in ten. three thousand's in the box.	

Intra-Aircraft Communication		Over-the-Air Communications	
13:47:45.7			
HOT-2	uhhh I'll get departure in there when we get- after we get our clearance.		
13:47:52.1			
HOT-1	you can tell 'em we're ready we're close enough.		
13:47:53.9			
HOT-2	alright.		
		13:47:56.0	
		RDO-2	aaand Hartford citation five six zero alpha romeo we are taxiing out at Robertson uh we'll be ready in about a minute.
		13:48:04.3	
		APP	'kay five six zero alpha romeo roger hold for release.
		13:48:07.9	
		RDO-2	five six zero alpha romeo.
13:48:10.0			
HOT-2	alright hold for release. alright.		
		13:48:16.1	
		APP	zero alpha romeo release for departure— (hold on) standby.
13:48:19.5			
HOT-2	huh. [spoken like a quick laugh]		
		13:48:20.8	
		APP	zero alpha romeo release for departure enter controlled airspace heading zero-two-zero clearance void if not off innn five minutes.
		13:48:28.3	
		RDO-2	zero two zero on the heading and then we got five minutes for zero alpha romeo talk to ya in a bit.

Intra-Aircraft Communication		Over-the-Air Communications	
13:48:34.6 **HOT-2**	alright so now we need twenty-three ninety fiveee actually we're gunna need that first.		
13:48:37.0 **CAM**	[sound similar to low vibration repeating tone pattern, similar to a vibrating Personal Electronic Device (PED)]		
13:48:41.7 **HOT-2**	oops * two three nine fiveeee and the squawk two oh three seven. two oh * *.		
13:48:52.2 **HOT-2**	twenty thirty-seven on the squawk is there and we're good.		
13:49:08.5 **HOT-1**	'kay flaps. trim three times. pitot heat on.		
13:49:13.3 **HOT-2**	aaand pitot static's coming on aaan I'll give a call.		
		13:49:18.5 **RDO-2**	Robertson traffic citation uhh takin' off runway two straight out.
13:49:28.1 **HOT-1**	is your button in the middle?		
13:49:29.7 **HOT-2**	nopppe [sound of quick laugh] there we go.		
13:49:31.6 **HOT-1**	[sound of quick laugh]		
13:49:32.1 **HOT-2**	better.		
13:49:37.7 **HOT-2**	alright final looks clear nobody on the bases.		

Intra-Aircraft Communication		Over-the-Air Communications
13:49:43.7		
HOT-2	oh here's a little bit of water.	
13:49:45.6		
HOT-1	whoaaa #.	
13:49:47.1		
HOT-2	it’s good that you guys are up high huh?	
13:49:48.7		
HOT-1	wow I haven't seen it that high in a long time.	
13:49:54.6		
HOT-2	wow.	
13:49:56.6		
HOT-1	* can shut the uhhh A-P—	
13:49:58.1		
HOT-2	the A-P-U off. here I'll unload the generator first. right? offf offf and stop.	
13:50:10.0		
HOT-2	alright I'm goin’ over to departure here we go.	
13:50:11.2		
CAM	[sound similar to toggle switch operation]	
13:50:15.9		
CAM	[sound similar to power advancing. sound tops out shortly thereafter]	
13:50:26.4		
HOT-2	uhhh 'kay power is set.	
13:50:31.2		
HOT-2	airspeed's alive.	

Intra-Aircraft Communication		Over-the-Air Communications
13:50:39.0 **HOT-2**	eighty knots cross check.	
13:50:42.7 **HOT-2**	v one.	
13:50:44.5 **HOT-2**	rrrotate.	
13:50:45.2 **CAM**	[sound similar to loud thunk]	
13:50:47.5 **HOT-2**	oht oht 'sa matter?	
13:50:48.9 **CAM**	[sound of multiple low frequency thunks until end of recording]	
13:50:49.2 **HOT-1**	[sound of heavy strain] it's not # rotating.	
13:50:50.7 **HOT-2**	'kay 'kay.	
13:50:51.6 **HOT-1**	[sound of physical strain/grunt]	
13:50:52.8 **HOT-2**	# # # #.	
13:50:53.7 **HOT-?**	[sound of strain/heavy breathing]	
13:50:54.9 **CAM-?**	[sound of electronic stall warning]	
13:50:55.0 **CAM**	[sound of stick shaker activation]	

Intra-Aircraft Communication		Over-the-Air Communications
13:50:57.0 **EGPWS**	[automated voice] bank angle.	
13:50:57.3 **CAM-1**	#. [sound of strain]	
13:50:58.0 **HOT-2**	ohhh #. [sound of strained voice]	
13:50:58.1 **EGPWS**	[automated voice] bank angle.	
13:50:59.0 **HOT-?**	[sound of strain]	
13:50:59.3 **END OF TRANSCRIPT** **END OF RECORDING**		

3.6.1. Summary of Previous Flights

Previous flights that were recorded on the 2-hour segment of the CVR were reviewed. The previous flights included the following:

August 13, 2021 – The descent portion of a 33-minute flight from 4B8 to KACK. The audio indicated the accident captain was acting as SIC.

August 13, 2021 – The entire 22-minute flight from KACK to KGON. The audio indicated the accident captain was acting as PIC.

August 13, 2021 – The entire 13-minute flight from KGON to 4B8. The audio indicated the accident captain was acting as PIC.

With the exception of rote callout items, such as calling for gear and flaps, there was no verbalized checklist usage noted. Additionally, there were no crew briefings noted, including takeoff and landing briefings, and no discussion of aircraft performance or takeoff/landing distance calculations. Overall, there were no obvious indications from the recorded audio during the previous flights that the flight crews followed any conventional standard operating procedures.

Much of the conversations reviewed were unrelated to the operation of the aircraft in all phases of flight.

In review of the audio as it relates to instructions issued by air traffic control, there were no indications that the flight crews on any of the recorded audio missed any ATC instruction or required responses.

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.