National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

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ONBOARD IMAGE RECORDER

Group Chair's Factual Report

January 22, 2024

TABLE OF CONTENTS

A. ACCIDENT 3
B. ONBOARD IMAGE RECORDER GROUP 3
C. DETAILS OF THE INVESTIGATION 4
1.0 DEVICE DESCRIPTION 4
1.1 Device Condition 4
1.2 Device Recording Description 5
2.0 IMAGE/VIDEO FILE INFORMATION 5
D. TRANSCRIPT 7
3.0 SUMMARY OF RECORDING CONTENTS 7

A. ACCIDENT

Location:	Croydon, New Hampshire
Date:	October 8, 2023
Time:	1932 eastern daylight time (EDT) 2332 coordinated universal time (UTC)
Helicopter:	Bell 407, N802JR

B. ONBOARD IMAGE RECORDER GROUP

Group Chair:	Gerald Kawamoto Electronics Engineer – Recorder Specialist National Transportation Safety Board (NTSB)
IIC:	Adam Gerhardt Investigator-In-Charge NTSB
Member:	Tom Hamilton Air Safety Investigator (ASI) - Rotorcraft Federal Aviation Administration (FAA)
Member:	Kurt West President JBI Helicopters
Member:	Matt McLuckie Air Safety Investigator Bell Helicopter
Member:	Jack Johnson Air Safety Investigator Rolls-Royce Corporation

C. DETAILS OF THE INVESTIGATION

An Onboard Image Recorder group was convened at the NTSB Vehicle Recorder Laboratory on November 16, 2023.

The NTSB Vehicle Recorder Division received the following onboard image recorder:

Device Manufacturer/Model:	Appareo Vision 1000
Device Serial Number:	Unknown

1.0 Device Description

The Appareo Vision 1000 is a self-contained image, audio, and data recorder. The unit is typically mounted in the overhead of aircraft cockpits and records cockpit images at a rate of four times per second. In addition to cockpit images, the device is capable of recording two tracks of audio that are synchronized with the image data. The unit also receives GPS satellite-based aircraft time, position, altitude and speed. A self-contained real-time inertial measuring unit provides 3-axis acceleration, aircraft pitch, roll, and yaw data.

1.1 Device Condition

The device was damaged in the event as shown in Figure 1. The internally mounted 16GB SD card was undamaged, and its contents were extracted normally using laboratory tools.

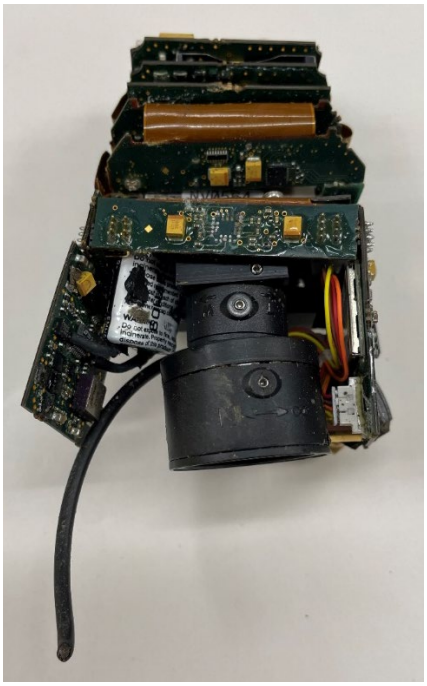


Figure 1. Appareo Vision 1000 as received.

1.2 Device Recording Description

Data were parsed out from the SD card using the manufacturer's procedures. Files included data from May 17, 2023, through October 8, 2023, Coordinated Universal Time (UTC). The accident event was the last session recorded. The device recorded time in UTC. An offset of 4 hours (14,400 seconds) was applied to the data such that all times are expressed in EDT (local time) from this point forward.

Parametric data from the accident flight started at 19:19:35.00 and ended at 19:32:03.00 EDT and is presented in the Electronic Device – Recorded Flight Data Specialist's Factual Report in the public docket. When viewed in the Appareo playback utility, image and audio stopped at approximately 19:28:36.25 EDT, approximately 3.5 minutes prior to the end of the recording. An additional 844 JPEG (.jpg) files (the equivalent of 3 minutes and 31 seconds of images played back at a 4 Hz rate) and corresponding audio data were recovered from the binary image of the SD card, however, these files did not contain timestamps (UTC time or elapsed milliseconds from power on). The timestamps assigned to the additional images were continued in 0.25 second increments from the last image file with an associated timestamp (19:23:36.25 EDT), resulting in the final image file with a timestamp of 19:32:07.00 EDT.

2.0 Image/Video File Information

The accident recording was made at a resolution of 1600x1200 pixels at a frame rate of 4 frames per second (fps). Both ambient and line-in audio were recorded. The camera was mounted in the overhead of the helicopter's cockpit and was oriented to show a forward-facing field of view (FOV) that included a view of the instrument panel, rudder pedals, and cyclic. The collective stick was not visible. Figure 2 is a still frame image showing the camera's FOV with select instruments and indicators labeled.

1. SkyTrac
2. Multi-function Display (MFD)
3. Primary Flight Display (PFD)
4. Garmin 696
5. HeliSAS Control Panel (HCP)
6. Garmin 530

Figure 2. Field of view identifying select instruments on the panel (pilot redacted in gray).

D. TRANSCRIPT

3.0 Summary of Recording Contents

The entire recording of images and audio was reviewed by the group, however, only a portion of the recording were transcribed in detail for this report. Notable still frame images identified by the group are included.

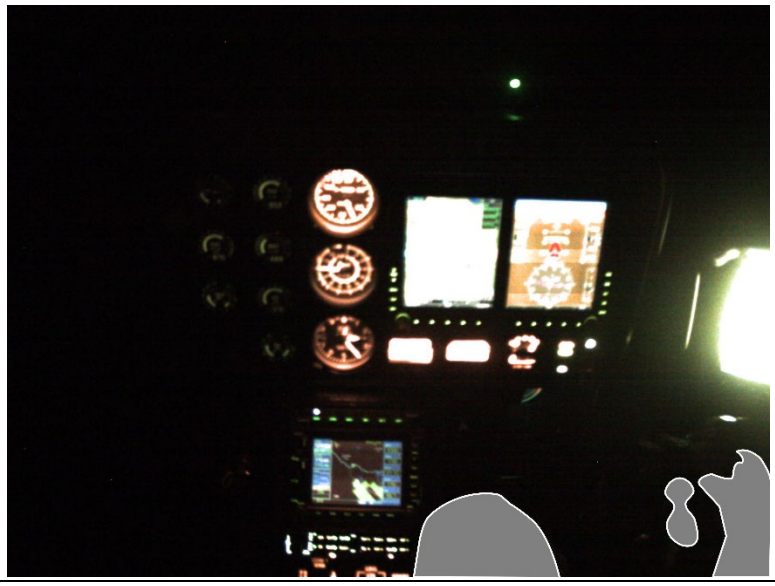
Time Start (EDT)	Time End (EDT)	Transcript
19:19:35		The video started. The instrument panel was visible and the following were noted: • Fuel gauge showed about 650 lbs of fuel. • Stability Augmentation System (SAS) LED indicator was illuminated white.[1] • The SkyTrac power light was on and remained illuminated for the duration of the recording. The helicopter was illuminated by exterior lighting. The pilot was wearing glasses.
19:19:45		The pilot reached his left hand up and appeared to increase the brightness on the instrument panel as there was a visible increase to all panel gauges. After this point, the pilot didn't appear to make any additional adjustments to the brightness level of the panel lighting.
19:21:25		The annunciator said, "Terrain test okay."
19:21:51		The pilot interfaced with the Garmin 696. This display appeared brighter than the remaining interior panel lighting.
19:23:39		The pilot entered a waypoint for Quonset State Airport on the Garmin 530.
19:25:04		The pilot exited the helicopter and was visible through the windshield walking from the right side of the FOV to the top center of the FOV until he was no longer visible.
19:25:49		The exterior lighting illuminating the helicopter appeared to be turned off.
19:27:05		The pilot re-entered the helicopter.
19:28:51		The pilot put on his helmet.
19:29:23	19:29:43	The engine ran-up. The engine out warning light on the annunciator panel extinguished.
19:30:11		The pilot said, "Okay, I've got everything on I need."

[1] SAS LED on HCP white indicates that SAS is in standby mode.

Time Start (EDT)	Time End (EDT)	Transcript
19:30:46		The helicopter took off. All values observed on the instrument panel appeared nominal: • The stand-by altimeter was about 1700 ft. • The stand-by airspeed was 0 kts.
19:31:01		A light from the barn was visible on the right side of the FOV.
19:31:07		A house was visible in the upper left of the FOV.
19:31:18		The altitude was about 1850 ft. The trim ball indicated full left deflection. The pilots said, "Ah [expletive], it's too dark."
19:31:33.75		The following were observed: • Altitude: 2200 ft • Airspeed: 0 kts The helicopter appeared to be in level uncoordinated flight. The turn coordinator showed right needle deflection and full left ball. 

Time Start (EDT)	Time End (EDT)	Transcript
19:31:42.75		The following were observed: • Altitude: 2450 ft • Airspeed: 20 kts The pilot said, "Ah [expletive], [pilot's name]." A red chevron indicating extreme nose down attitude appeared on the PFD.[2] The helicopter appeared to be in a right bank with full turn needle deflection and ball centered. 
19:31:46		The pilot said, "What am I doing?"

[2] Garmin G500 Pilot Guide, Section 2.3.1: 30 degrees pitch down.

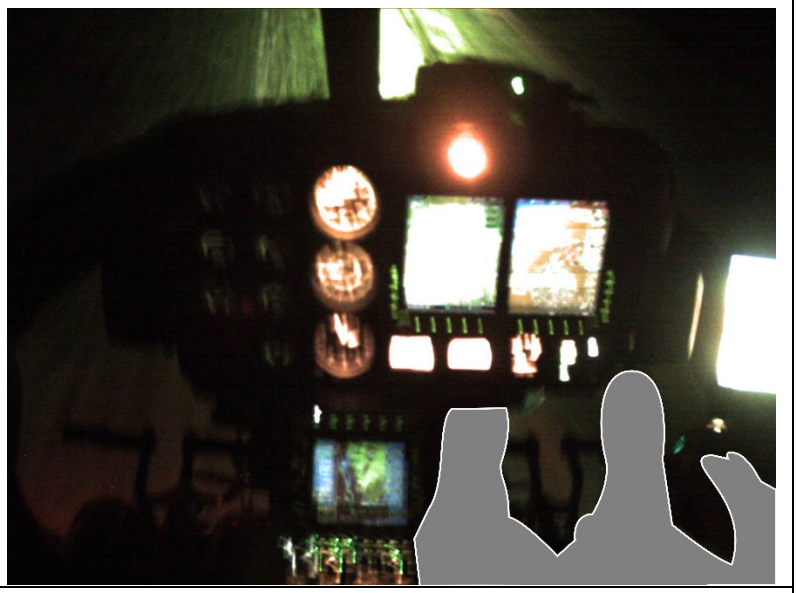
Time Start (EDT)	Time End (EDT)	Transcript
19:31:49.50		The following were observed: • Altitude: 2400 ft • Airspeed: 70 kts A double red chevron indicating extreme nose down attitude appeared on the PFD for approximately 3 seconds. The helicopter appeared to be in uncoordinated flight with full right needle deflection and full left ball. Large rapid cyclic movements were observed: predominantly forward and right cyclic inputs, which were followed by two full left cyclic inputs. 
19:31:51		Terrain warning inset appeared on the MFD.
19:31:52		The pilot said, "[expletive], [pilot's name]."
19:31:53		The annunciator said, "Warning, terrain, terrain." This announcement was heard 3 additional times until the end of the recording.
19:31:57		The check instrument annunciator light illuminated for approximately 2.75 seconds. The segmented Trend ARC display on the torque gauge flashed off and on, and the numeric display remained illuminated.[3]

[3] Bell 407 BHT-407-MD-1 pg 1-21:
To provide advance notice to the pilot that an exceedance is about to be recorded, these indicators also have other preprogrammed advisory points at which they will flash the Trend ARC display. The digital readout display will not flash.

When an advisory is displayed by the instrument, the instrument will also turn on the CHECK INSTR light on the caution panel.

Time Start (EDT)	Time End (EDT)	Transcript
19:32:00		The pilot momentarily reached his left arm across his body towards the Garmin 696.
19:32:03.25		The following were observed: • Altitude: 2100 ft • Airspeed: 120 kts A red chevron indicating extreme nose down attitude reappeared on the PFD. The helicopter appeared to be in uncoordinated flight, extreme right bank, with full right needle deflection and full left ball. The torque gauge appeared to be near the maximum allowable value. Large rapid cyclic movements continued. 

19:32:04.50	19:32:04.75	The following were observed: • Altitude: 2050 ft • Airspeed: 125 kts The red chevron indicating extreme nose down attitude remained on the PFD. The helicopter appeared to be in uncoordinated flight, extreme right bank, with full right needle deflection and full left ball. The segmented Trend ARC display on the torque gauge flashed off and on and the numeric display remained illuminated. The check instrument annunciator light illuminated for the second time and remained illuminated for the remainder of the recording. Large rapid cyclic movements continued.  

Time Start (EDT)	Time End (EDT)	Transcript
19:32:06.25		The gauges were blurred. The following were observed: • Altitude: about 1900 ft • Airspeed: about 125 kts Trees illuminated by the helicopter spotlight were visible in the pilot's windscreen. 
19:32:07.00		The video ended.

Submitted by:

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