

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA22FA257

ONBOARD IMAGE AND PARAMETRIC DATA RECORDER

Specialist's Factual Report

October 6, 2022

A. ACCIDENT

Location: Fairfield, NJ
Date: June 4, 2022
Time: 12:01 EDT
Helicopter: Bell Helicopter B407, N98ZA

B. ONBOARD IMAGE AND PARAMETRIC DATA RECORDER GROUP

Group Chairman: Sean Payne
Sr. Engineer
National Transportation Safety Board (NTSB)

Member: Brian Rayner
Investigator-In-Charge (IIC)
NTSB

Member: Steve Smith
Engineer
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Member: Gary Howe
Air Safety Investigator
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C. DETAILS OF THE INVESTIGATION

In agreement with the Investigator-In-Charge, an Onboard Image and Parametric Data Recorder group was convened on October 4, 2022, and a summary was prepared.

The NTSB Vehicle Recorder Division received the following onboard recorder:

Device Manufacturer/Model: Appareo Vision 1000
Device Serial Number: N/A (Memory Card Only)

1.0 Device Description

The Appareo Vision 1000 device is a small self-contained image, audio, and data recorder. The unit is typically mounted in the overhead of aircraft's cockpit and records a cockpit image at a rate of four times per second. In addition to cockpit images, the device is also capable of recording two tracks of audio that are synchronized with the image data. The unit also contains a GPS receiver that receives

GPS satellite-based aircraft time, position, altitude, and speed. In addition to the GPS position, the Appareo unit also has a self-contained real-time inertial measuring unit that provides 3-axis accelerations as well as aircraft pitch, roll and yaw data.

The two recorded audio tracks can be wired to record the following inputs: an external audio source such as the aircraft's intercom or radios and audio picked up by a microphone mounted internal to the Vision 1000 unit. In this installation no external aircraft audio was connected to track one and the track two microphone only picked up very loud engine and/or transmission sounds from the helicopter.

The Appareo unit records the image, audio and parametric data on a removable SD1 memory card that is inserted into the unit. Depending on card size, this removable memory retains approximately the last two hours of image and audio data and about the last 100 hours of parametric data. In addition to the removable memory the Vision 1000 is also equipped with a memory module that is mounted internal to the unit. This internal memory contains an exact duplicate of the data stored on the removable card.

The Appareo unit on this aircraft was connected to the aircraft's electrical bus. Any time the battery switch is turned on the Appareo unit will start to record audio, images and data. The Vision 1000 unit creates a new file for every electrical power application and can create multiple files for the same power cycle if the recording time exceeds a certain time limit.

2.0 Data Recovery

The device contained an internally mounted 16 GB SD card. The SD card was in good condition and is shown in Figure 1.



Figure 1. The device's internally mounted, externally removable SD card.

¹ SD - Secure Digital - A type of nonvolatile memory card used extensively in portable devices.

The device was downloaded using the manufacturer's procedures. This resulted in a successful retrieval of flight data that captured the accident. Only flight data pertinent to the investigation is discussed in this report.

3.0 Timing and Correlation

The times used in this report are expressed as eastern daylight time (EDT).

The recovered flight data files from the Vision 1000 unit were recorded in UTC using the device's internal GPS. These times were assumed to be valid. The times were offset to the local time of the accident, EDT, which is how the timing appears in this report.

4.0 Summary of Recording Contents

The Vision 1000 recorder captured a field of view represented in Figure 2. Figure 2 is a screen capture from the device while no personnel was present in the image. The recorder also captured a two-channel audio recording of the helicopter's operations. One audio channel recorded sounds from the device's internal cockpit area mic, which was a record of the ambient sounds of the helicopter operating. The second audio channel recorded wired audio from the helicopter's audio panel. This included the pilot's comments when they reached the audio panel's squelch threshold, as well as air traffic control (ATC) communications that were passed through the helicopter's audio panel. Commentary transcribed from personnel onboard the accident aircraft are transcribed below in **bold font**.



Figure 2. The field of view of the Appareo Vision 1000 device, as installed on the accident helicopter N98ZA.

Previous Flights

Previous power cycles from the Vision 1000 were reviewed to determine if there were events pertinent to the accident investigation. In this case, previous power cycles captured maintenance operations prior to the accident flight. A summary of these operations appears below, listed in chronological order leading up to the accident flight.

Fifth Previous to the Accident Flight - June 3, 2022 - 05:28:21 EDT

A 46 second recording taken in a hangar. Nothing pertinent to the accident was noted. Flights prior to this contained only parametric data and were not reviewed.

Fourth Previous to the Accident Flight - June 4, 2022 - 04:09:00 EDT

A 4 minute and 53 second recording taken in a hangar. Nothing pertinent to the accident was noted.

Third Previous to the Accident Flight - June 4, 2022 - 07:09:01 EDT

A 5 minute and 41 second recording in the morning. An unidentified person was in the right seat in a pilot's uniform and a second voice was also audible but the individual was not visible. The helicopter was started and brought up to 100 % Nr. The helicopter was then shut down. The operation appeared to be part of a track and balance maintenance operation for the tail rotor.

Second Previous to the Accident Flight - June 4, 2022 - 07:26:45 EDT

A 6 minute and 27 second recording in the morning. An unidentified person was in the right seat in a pilot's uniform and a second voice was also audible but the individual was not visible. The person in the right seat stated, **"here we go feels smoother if I had to guess, but you know better with equipment, so I'll just shut my mouth. Or not."** The second voice then instructed the right seat occupant to shut down the helicopter. The second voice stated, **"we're going to do 14 grams."** The helicopter was shut down by the right seat occupant and nothing else pertinent was noted.

First Previous Recording to the Accident Flight - June 4, 2022 - 07:43:14 EDT

A 6 minute and 42 second recording in the morning. An unidentified person was in the right seat in a pilot's uniform. The right seat occupant started the helicopter. The right seat occupant stated, **"there ya go. I'm just gunna center the cyclic hang on."** Another voice stated, **"Its at a hundred."** The pilot stated, **"it's at a hundred and cyclic is centered."** The other voice stated, **"cool, uh @[Right Seat Occupant]² tiny bit of left pedal, like just keep your foot on it."** The right seat occupant stated, **"ok, uhh there you go. tiny bit more. Left pedal. Uhhh right pedal tiny bit. That feels pretty good. Oh yeah."** The other voice stated, **"we got a point two we'll call it a night, we'll come back main rotor call it a day."** The right seat occupant remarked, **"Good bye. Good job."** The helicopter was shut down uneventfully.

Accident Recording

Note, that only comments from air traffic control (ATC) and the pilot that were pertinent to the investigation were transcribed.

11:39:31.5 - The accident flight recording began. The helicopter was stationary on a tarmac area adjacent to the Essex County Airport (CDW), Caldwell, NJ, tower and a hangar area. The pilot was in the right seat. A shoulder harness was visible over the pilot's left shoulder. The PFD and MFD were already on. There were several caution and warning lights illuminated on the MFD consistent with pre-engine start. The pilot had his finger on the "TEST - PEDAL STOP" button at this time.

11:40:07.0 - The pilot initiated a start procedure. The start procedure was reviewed and nothing anomalous regarding the pilot's actions or the helicopter's behavior was noted. The engine start procedure was completed uneventfully. During

² Names of personnel are redacted and the person's position is instead shown in brackets.

the startup procedure, the pilot verbalized, **"the #³ frictions are on,"** and had an action consistent with loosening the helicopter's control frictions. The pilot produced an iPad that showed a digital sectional and appeared to put it aside.

11:45:14.0 - The pilot increased throttle.

11:46:50 - The pilot called CDW tower and requested an eastbound departure. CDW tower issued the altimeter setting (which the pilot had previously confirmed) and issued an east departure via taxiways A and N and to "stay east of runway 22 at all times." The pilot read back the clearance.

11:47:22 - As the pilot completed the route and clearance read back to CDW tower, the helicopter ascended vertically, the pilot introduced forward pitch and forward motion, and performed a pedal turn to the right along taxiways N and later A. There was no hover check. The helicopter climbed via the takeoff instructions issued by CDW tower. At no time was the helicopter required to make a left turn via the departure instructions. Around 11:47:50, the helicopter's indicated airspeed was above 55 knots and the helicopter was performing a departure climb on nearly a straight heading.

The helicopter continued flying eastbound, climbed to approximately 1100 feet indicated. Nothing anomalous was noted.

11:49:05 - CDW tower issued a frequency change to Teterboro Tower (TEB), Teterboro, NJ, tower. The pilot acknowledged. The pilot waited for other radio calls on frequency and checked in stating, **"Great Notch crossing Route 3 for * *."**⁴ TEB issued "as requested" and clarified to the pilot to remain at or below 1000 feet. The pilot confirmed, **"at or below. zip four zero [call sign of the accident helicopter]."**

11:50:30 - The pilot commented, **"let's get some power,"** to himself. The helicopter was still in a descent trend and was descending out of 900 feet at the time of this statement.

11:50:34 - The pilot commented, **"left pedal and (ya/yaw)."**⁵ At this time, the helicopter's track came back slightly to the left, the helicopter was crossing the intersection of the Garden State Parkway and Route 3. The helicopter was following Route 3 eastbound. The airspeed was 125 knots indicated.

The helicopter continued descending.

³ Expletives are represented as a #.

⁴ Asterisks indicate unintelligible words.

⁵ Parenthesis indicated transcriptions in which the group was uncertain.

11:51:05 - The pilot remarked to himself, **"okay,"** as the helicopter had to track back to the left to follow Route 3 as it turned left past the Upper Montclair Country Club. At this time, the pilot changed the MFD screen from the Power Situation Indicator Gauge and Dual Tachometer Gauge screen to a map screen, and then quickly back to the Power Situation Indicator Gauge and Dual Tachometer Gauge screen. Around this time the TAWS warning issued audibly, "500."

11:51:21 - The pilot remarked to himself, **"left pedal (in yeah)."** The helicopter's altitude was around 600 feet MSL at this time.

11:51:30 - As the pilot tracked Route 3 eastbound, it was apparent that the helicopter was yawing a bit right and left, and there were some mild perturbations in pitch as the helicopter traveled forward at approximately 130 knots indicated.⁶

11:51:50 - TEB tower issued the pilot a traffic warning for multiple other traffic targets in the vicinity of his route. TEB tower stated, "zip forty use caution multiple targets north bound and southbound on the river from * range from two thousand to eight hundred. Traffic at your- you're at direct conflict right now * about a mile south of the tunnel northbound altitude indicates one thousand two hundred." The pilot reported, **"I have that traffic in sight. zip four zero."** The helicopter was crossing the Passaic River and still heading eastbound at this time.

11:52:15 - The pilot remarked, **"what is going on here?"** as the helicopter continued to track east on Route 3, just east of the Passaic River. The pilot then remarked **"#."** The turn slip indicator showed the ball approximately 2 ball widths to the left of center.

11:52:33 - TEB tower gave the pilot a VFR squawk code and issued, "use caution." Around this time, the airspeed indicated showed the helicopter had slowed to 100 knots. The pilot read back, **"squawk V-F-R, approved, Zip four zero."**

11:53:05 - The pilot stated, **"Teterboro tower zip four zero needs to turn around back to Caldwell."** TEB tower stated, "roger zip four zero stay in the code, proceed as requested, do you require any assistance?" The pilot responded back, **"not at this moment. Zip four zero."** At this time, the helicopter was just south of the Meadowlands sports complex.

The helicopter performed a left turn, airspeed was about 85 knots indicated. The helicopter picked up a track westbound on Route 3.

⁶ Section 3 "Emergency and Malfunction Procedures" of the Pilot's Operating Handbook for this helicopter, specifically 3-5 TAIL ROTOR describes the indications of a loss of tail rotor thrust as the following: "This a situation involving a break in drive system, wherein tail rotor stops turning and delivers no thrust. 1) Uncontrollable yawing to the right (left slip) 2) Nose down tucking 3) Possible roll of fuselage." This portion of the POH is attached to this report as Attachment 1.

11:54:37 - While tracking west bound near Route 3 and the intersection of the Passaic River, the pilot made a radio call, **"@{Unidentified Personnel} you up?"** The radio call went unanswered.

11:54:58 - TEB tower stated, "zip forty make sure you continue your climb to meet the height restrictions you're approaching." The pilot responded, **"yes ma'am I'm climbing."** The indicated altitude was just over 400 feet and now indicated a climb trend. The TEB controller then gave the pilot a frequency change to CDW which he immediately acknowledged.

11:55:40 - The pilot checked in with CDW tower and stated, **"back inbound on Route 3 I may need the runway."** CDW tower stated, "Zip forty roger continue inbound report 2 miles and uh expect runway 28." The pilot stated, **"expect two eight call two out."** The helicopter was just east of the Montclair Country Club Golf course westbound on Route 3.

11:56:28 - The master caution for "PEDAL STOP" CAS message was displayed along with a CAS tone. Indicated airspeed at this time was 110 knots. There were several other traffic calls on the CDW tower frequency at this time. The CDW controller appeared to be handling at least four other aircraft.

11:57:06 - The pilot remarked to himself, **"which way is two eight?"** The helicopter was heading around 345 degrees magnetic.

11:58:48 - The pilot called CDW and stated, **"Caldwell tower zip four zero two out."** The controller read back "Zip four zero wind one eight zero at six, runway two eight cleared to land on the numbers." The pilot acknowledged, **"land on the numbers two eight zip four zero."** At this time, the helicopter continued inbound to CDW at 95 knots.

11:59:45 - The pilot banked the helicopter left to track inbound to CDW off Route 46. The indicated airspeed was 85 knots.

12:00:21 - CDW was in sight ahead of the aircraft, specifically the threshold area of runway 28. Indicated airspeed was approximately 95 knots.

12:00:34 - Indicated airspeed began decreasing. The helicopter took a track to the right to intercept an approach course near runway 28.

12:00:44 - The helicopter was 45 degrees to the north of the runway 28 threshold, nearly over CDW airport property. The indicated airspeed was decreasing below 65 knots. The helicopter's nose was pitched slightly nose up, consistent with the helicopter decreasing in indicated airspeed.

12:00:52 - The helicopter started a right turn near the final approach course to runway 28 (just to the north). Indicated airspeed at this time was 55 knots.

12:01:01 - The helicopter was tracking toward the runway 28 numbers, pitch was slightly positive, indicated airspeed was decreasing below 45 knots. Altitude was also decreasing below 280 feet indicated.

12:01:04 - The runway was visible in the left chin bubble below the helicopter, as airspeed decreased, the helicopter began yawing to the right. The altitude was 250 feet MSL. The helicopter stated tracking parallel to runway 28 (on the north side of 28 over a grassy area on airport property). The indicated airspeed was now falling below 35 knots.

12:01:09 - The indicated airspeed fell below 30 knots, the helicopter's yaw increased to the right drastically. The helicopter was north of runway 28 over the grassy area on airport property, adjacent to a tree line and structures.

12:01:14 - Around tree top level, the helicopter ceased its yaw to the right and began a yaw to left. Indicated airspeed now showed 0 knots. There was slight left roll component as well.

12:01:17 - The helicopter yawed again hard right, indicated airspeed was still zero knots. The aircraft was carrying energy/motion to the west (north of runway 28).

12:01:20 - The helicopter started a rapid right yaw, appeared to pitch forward, a house and more trees came into view. The helicopter completed one quick right yaw (360 degrees) the pilot remarked **"holy #."** Pitch was changing from positive to negative as the right yaw continued to develop. The helicopter completed nearly two 360 degree rotations to the right, the pilot was audible grunting. In this sequence, the panel displayed the low RPM light.

12:01:29.250 - The last frame of the recording indicated severe vibration indicating impact was occurring and some view of vegetation. The recording ceased playback.

Note that in high impact scenarios, additional video information can exist in a state that is not immediately retrievable using the manufacturer's normal download process. A forensic search for additional video information was not conducted for this accident.

Figure 3 is a KML of the aircraft's departure and arrival route shown in a 3-D representation on Google Earth. Note that weather and lighting conditions may not be accurately depicted in Google Earth imagery.

For other depictions of the helicopter's route during the accident flight, refer to the Cockpit Displays – Specialist's Factual Report, which can be found in the public docket for this accident.

Attachment 1 is Section 3 "Emergency and Malfunction Procedures" of the Pilot's Operating Handbook for this helicopter, specifically the page for procedures involving loss of tail rotor thrust, 3-5 TAIL ROTOR, and the indications listed for such a scenario.

5.0 Surviving Flight Crew Review

As part of this investigation, surviving flight crew were invited to review the recording of the accident after the group met and developed the report. There was no response from the surviving crew or his representatives.

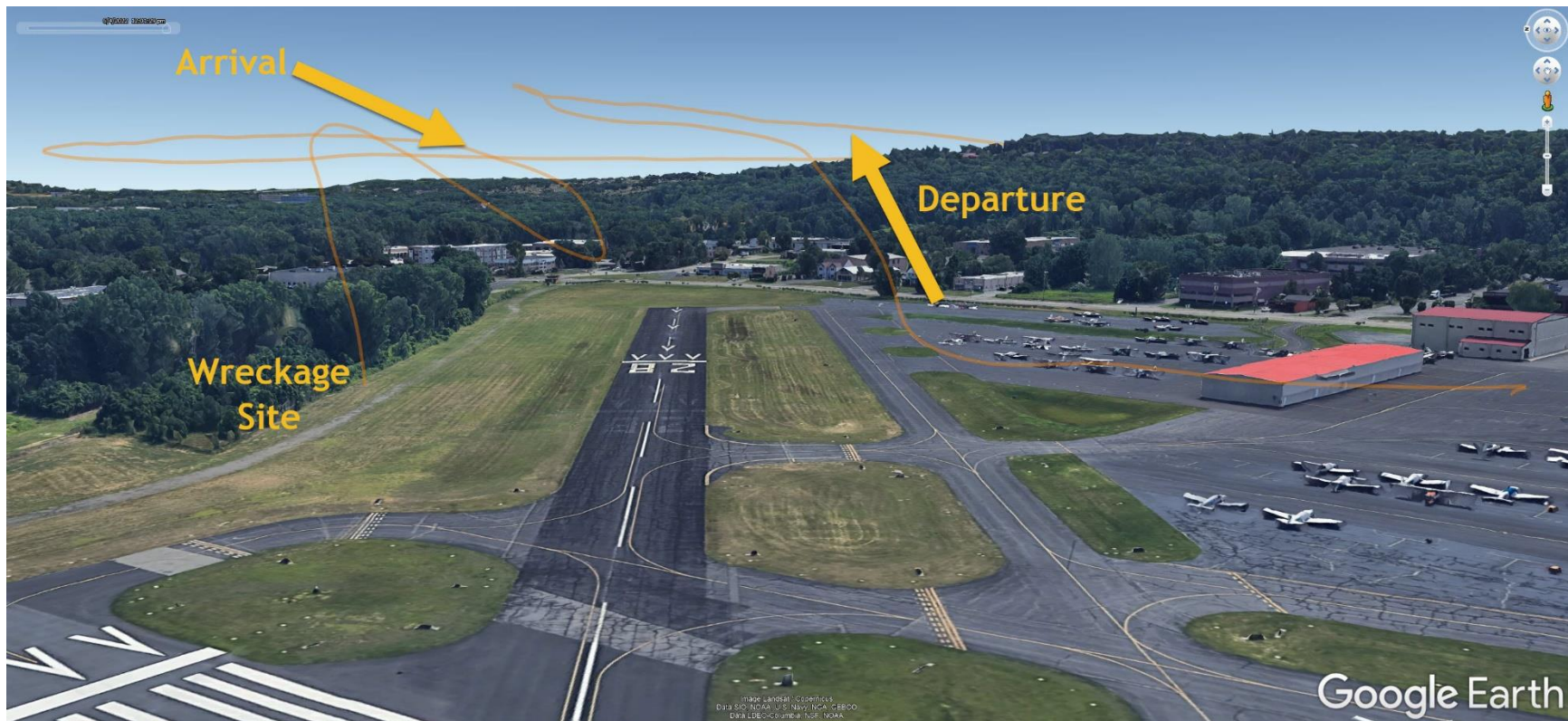


Figure 3. A Google Earth overlay of the helicopter's departure and arrival sequence. The approximate site of the wreckage is shown.

Submitted by:

Sean Payne
Sr. Engineer

Attachment 1

TC APPROVED

BHT-407-FM-2

NOTE

With battery and generator OFF, an 80% charged battery will operate left fuel boost pump and left fuel transfer pump for approximately 1.7 hours (2.8 hours with optional 28 amp-hour battery).

NOTE

Pedal stop disengages with loss of electrical power.

When throttle is repositioned to the idle stop (during engine shutdown), the PMA will go offline and the engine may flame out.

3-5. TAIL ROTOR

There is no single emergency procedure for all types of anti-torque malfunctions. One key to a pilot successfully handling a tail rotor emergency lies in the ability to quickly recognize the type of malfunction that has occurred.

3-5-A. COMPLETE LOSS OF TAIL ROTOR THRUST

This is a situation involving a break in drive system (e.g., severed driveshaft), wherein tail rotor stops turning and delivers no thrust.

• INDICATIONS:

1. Uncontrollable yawing to right (left side slip).
2. Nose down tucking.
3. Possible roll of fuselage.

NOTE

Severity of initial reaction of helicopter will be affected by AIRSPEED, CG, power being used, and H_D .

• PROCEDURE:

3-5-A-1. HOVERING

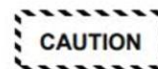
Close throttle and perform a hovering autorotation landing. A slight rotation can be expected on touchdown.

3-5-A-2. IN FLIGHT

Reduce throttle to idle, immediately enter autorotation, and maintain a minimum airspeed of 55 KIAS during descent.

NOTE

When a suitable landing site is not available, vertical fin may permit controlled flight at low power levels and sufficient airspeed. During final stages of approach, a mild flare should be executed, making sure all power to rotor is off. Maintain helicopter in a slight flare and smoothly use collective to execute a soft, slightly nose-high landing. Landing on aft portion of skids will tend to correct side drift. This technique will, in most cases, result in a run-on type landing.



IN A RUN-ON TYPE LANDING AFTER TOUCHING DOWN, DO NOT USE CYCLIC TO REDUCE FORWARD SPEED.

3-5-B. FIXED PITCH FAILURES

This is a situation involving inability to change tail rotor thrust (blade angle) with anti-torque pedals.

• INDICATIONS:

1. Lack of directional response.
2. Locked pedals.

Export Classification C, ECCN EAR99

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