NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

January 25, 2013

On Board Image Recorder

Specialist's Factual Report
By Bill Tuccio

1. EVENT

Location:	Borrego Springs, California
Date:	September 8, 2012
Aircraft:	Edward R. Moore MXS, N21MX
Operator:	Private
NTSB Number:	WPR12LA407

2. GROUP

A group was not convened.

3. SUMMARY

On September 8, 2012, about 1235 Pacific daylight time (PDT), an experimental Edward R. Moore MXS, N21MX, departed controlled flight and impacted terrain near Borrego Valley Airport (L08), Borrego Springs, California. The pilot was operating the airplane under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The commercial pilot was fatally injured; the airplane sustained substantial damage by impact forces. The local personal aerobatic flight departed L08, about 1225. Visual meteorological conditions prevailed, and no flight plan had been filed. A GoPro HD2-14 video recorder was sent to the National Transportation Safety Board's Image Laboratory for readout.

4. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division's Image Laboratory received the following device:

Recorder Manufacturer/Model: **GoPro HD2-14**
Recorder Serial Number: **H214A0312042521**

4.1. Recorder Description

The GoPro HD2-14 "Hero2" camera is a self-contained high definition, portable video recorder. The camera contains a rechargeable Lithium-ion battery

and a 170 degree field of view lens. The camera can record up to 1920x1080 high definition video at 30 frames per second, and mono audio with its built in internal microphone, or stereo via an external microphone. The camera can also take still images of up to 11 megapixels resolution. All storage is on a removable SD card, supporting cards up to 32GB of capacity.

4.2. Recorder Damage

Upon arrival at the audio laboratory, it was evident that the camera had sustained minor damage, as shown in figure 1. The Lithium-ion battery was missing from the camera, as shown in figure 2. The removable 32 GB SD card is shown in figure 3. The video information was copied from the SD card normally, without difficulty.

Figure 1. GoPro HD2-14 - front.

Figure 2. GoPro HD2-14 - back.

Figure 3. SD card from HD2-14.

4.2.1. Video Files

There were a total of 13 video files on the SD card. Only the last file on the SD card was determined to be pertinent to this investigation. The video was recorded at 1280x960 resolution, at 30 frames per second. The video was 16 minutes 17.1 seconds in length.

4.3. Timing and Correlation

The times used in this report are expressed as Local Time of the accident (PST).

Timing of the summary was established by aligning the GPS position as recorded by the Garmin GPS 496 with video imagery of the take-off[1]. Specifically, at 1926:12 UTC the aircraft position was at 33.25888 north latitude, and 116.3283 west longitude. The Video Elapsed Time (time from the beginning of the recording) at this same position was 0006:40.1. UTC was then offset by 7 hours to reflect the local PDT time of the accident. Using this information, a relationship between Video Elapsed Time and PDT can be established. Specifically, for this report, PDT = Video Elapsed Time + 12:19:31.9.

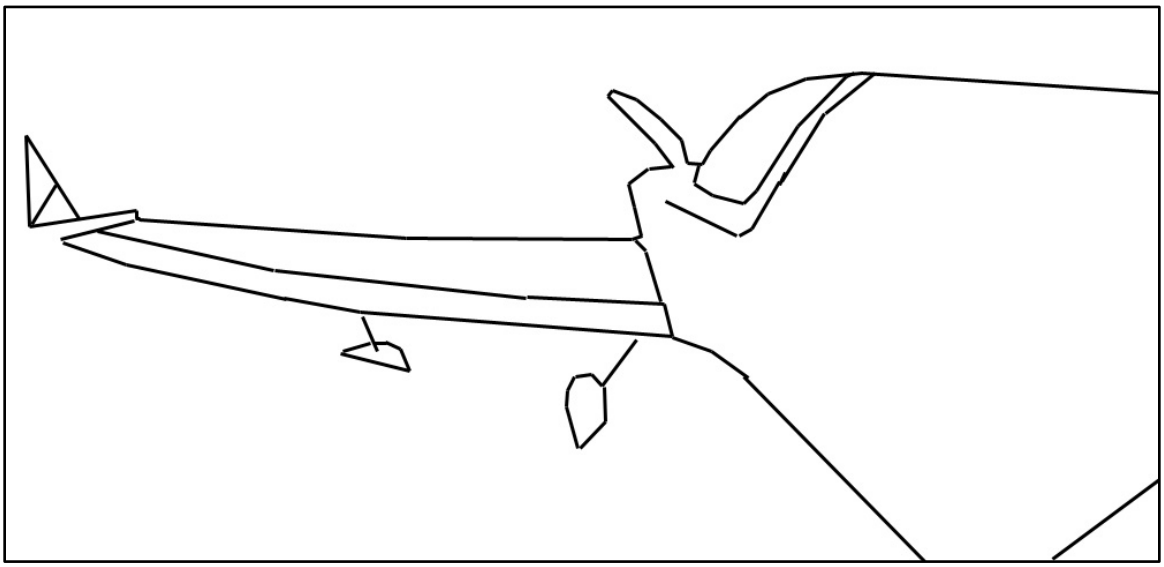
4.4. Summary of Recording Contents

In agreement with the Investigator-In-Charge, a video group did not convene and only this summary report was prepared.

The video was recorded from a fixed position on the rear of the aircraft. Figure 4 shows a wireframe representation of the camera field of view. An aerobatic sight gauge was installed on the left wingtip, with a small piece of yarn attached to the aft portion of the sight gauge.

[1] See “Electronic Devices Factual Report” in the public docket for this investigation.

Figure 4. Wireframe representation of field of view.



The video began at 1219, as a man with a straw hat was turning the camera on. The sky condition in the background was scattered, high cirrus-like clouds and unrestricted visibility. The pilot was in the cockpit, with the canopy closed.

The man with the straw hat exited the video to the left, and at 1220 re-entered the video from the left, walking behind the trailing edge of the wing to the closed canopy. The pilot and straw hat man nodded heads, and may have exchanged a few words through the closed canopy, but no discourse was recorded on the audio.

While the man with the straw hat moved aft of the fuselage, standing against the left horizontal stabilizer, the pilot started the engine at 1220:08. The man with the straw hat exited the video to the left, and the aircraft began to taxi at 1220:29. The man with the straw hat entered a golf cart with another man and drove out of the field of view of the camera.

The aircraft taxied to runway 8, stopping short of the runway at 1224:06. The pilot looked left and right while the left aileron was moved up and down. At 1224:21, the engine sound increased while the aircraft remained stationary. The higher engine sound decreased momentarily twice, similar to the propeller being cycled to low RPM. The engine then twice ran rough, similar to the magnetos being checked during an aircraft runup. At 1225:02, the engine sound decreased.

At 1225:30, the aircraft began to move forward onto runway 8. The aircraft began its take-off roll and was airborne at 1226:18.4.

The aircraft climbed in the vicinity of the L08 airport. At 1227, the aircraft began a turn to the right, followed by a turn to the left.

The aircraft began a series of aerobatic maneuvers at 1228:10, which continued until the end of the recording. The maneuvers included: a climbing

half loop to inverted flight, followed by a left turning hesitation roll to horizontal upright flight; a left roll to inverted flight; a descending half loop to horizontal upright flight; a half outside loop (negative loading); a barrel roll to the left; and two, 2-revolution spins to the left. During all these maneuvers, the power varied, and the left aileron was observed to move up and down consistent with the flight maneuvers.

At 1235:26, the aircraft nosed up from level upright flight and the left aileron began to deflect up, as the aircraft rolled rapidly to the left. The left aileron deflection achieved its full upward deflection before 90 degrees of bank. After the aircraft had rolled through inverted to about a 60 degree right bank, the left aileron deflection began to decrease. By 1235:28, the aircraft was in level flight, and the left aileron was neutral again.

At 1235:30.9, the aircraft began another pitch up, similar to that at 1235:26. The left aileron began a downward displacement, and the aircraft began to roll rapidly to the right, similar to the prior roll to the left. After the aircraft passed inverted flight by about 45 degrees and was in about a 135 degree left bank, the left aileron displacement reduced. By the time the aircraft rolled to about 120 degree left bank, the left aileron was about to neutral and the aircraft rolling motion stopped. The nose began to drop towards the horizon at 1235:32.7, as the pilot could be seen moving his head in either direction in the cockpit. The nose continued to drop below the horizon, the aircraft in about a 120 degree, left bank turn and the aircraft facing runway 8 at L08, at about 1235:35.

At about 1235:43, the pilot's hand moved towards the left side of the cockpit, as the nose was still below the horizon and the left bank angle had reduced to about 90 degrees. The left aileron was still about neutral and not moving.

At about 1235:44, the canopy began to crack open, and then quickly opened towards the right and separated from the aircraft and moved back along the fuselage. Within about 1 second, the canopy left the field of view of the camera to the aft. While the canopy was visible, pieces of materials, similar to Plexiglas, were observed, as was some insulation-like material. As the canopy was separating, the left aileron deflected momentarily sharply up and then back to neutral.

From about 1235:45 until the end of the recording at 1235:49, the pilot's head was visible and moving forward in the wind stream; the bank angle decreased to about a 60 degree left bank, the pitch attitude became less nose down, though still slightly below the horizon; and the needle on the airspeed indicator moved from about the 8 o'clock position on the indicator to about the 4 o'clock position.

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