

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



GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION

CEN16FA307

**By
Sean Payne**

WARNING

The reader of this report is cautioned that the transcription of a cockpit image and 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

Washington, D.C. 20594

October 12, 2017

Onboard Image Recorder

Group Chairman's Factual Report

by Sean Payne

1. EVENT

Location: Burns Flat, Oklahoma
Date: August 6, 2016
Aircraft: Bugatti-Demonge 100P
Registration: N110PX
Operator: Private
NTSB Number: CEN16FA307

2. SUMMARY

On August 6, 2016, about 0820 central daylight time, an experimental amateur-built Wilson Bugatti-DeMonge 100P airplane, N110PX, impacted terrain during takeoff from runway 35L at the Clinton-Sherman Airport (CSM), near Burns Flat, Oklahoma. A subsequent ground fire occurred. The airline transport rated pilot was fatally injured. The airplane was destroyed during the impact and ground fire. The airplane was registered to Le Reve Bleu LLC and operated by the pilot as a 14 *Code of Federal Regulations* 91 test flight. Day visual meteorological conditions prevailed in the area about the time of the accident, and the flight was not operated on a flight plan. The local flight was originating from CSM at the time of the accident.

3. GROUP

On February 2, 2017, a video group was convened at the National Transportation Safety Board (NTSB) Vehicle Recorder Laboratory.

Chairman: Sean Payne
Mechanical Engineer
National Transportation Safety Board (NTSB)

Member: Ed Malinowski
Investigator-In-Charge
NTSB

Member: Timothy Burtch
Aerospace Engineer
NTSB

Member: Clint Crookshanks
Aerospace Engineer
NTSB

Member: James Wirt
Aviation Safety Inspector
Federal Aviation Administration

Member: Stan Shumway
Groundcrew
Bugatti 100P Project (Le Reve Bleu)

4. DETAILS OF INVESTIGATION

On August 12, 2016, the NTSB's Vehicle Recorder Laboratory received the following devices:

Recorder Model: GoPro Hero 4 Session
Recorder Serial Number: C3141325521689

Recorder Model: GoPro Hero 4 Session
Recorder Serial Number: C3141325519201

Recorder Model: GoPro Hero 3+
Recorder Serial Number: H3S+A0814AE89C8

Recorder Model: GoPro Hero 4
Recorder Serial Number: C3121124674630

Recorder Model: GoPro Hero 4
Recorder Serial Number: C3121124915669

Recorder Model: GoPro Hero 4
Recorder Serial Number: C3121124781888

4.1. GoPro HERO Device Description

The GoPro HERO is a compact, lightweight, POV¹ digital camera enclosed in a ruggedized housing that allows the camera to be mounted in a variety of positions using an array of supported accessories. The device is capable of recording a maximum of 4K² resolution video at frame rate of 15 frames per second (FPS). The camera supports 1080 HD³ as well as other lower quality recording resolutions at higher frame rates. The camera can be set to record still images simultaneously or independently of a video stream at a resolution of up to 12 megapixels⁴. The camera includes a wide angle aspherical f/2.8 glass lens that provides a maximum of 170 degrees viewing angle. The camera supports recording to microSD⁵ cards up to 64 GB in size. A built in Wi-Fi⁶ module allows users to connect to the camera either via an accessory remote control or via a smart phone app that permits camera control and image transfer.

4.2. Recorder Damage

Figure 1 shows the condition of the six GoPro cameras upon receipt by the NTSB Vehicle Recorders laboratory. The six cameras had various states of mechanical damage ranging from light, to an entirely displaced rear camera frame (top right). The cameras were shipped with their associated microSD cards seated in the camera's chassis. All microSD cards were present and appeared undamaged.



Figure 1. The condition of the GoPro Cameras

¹ POV – Point of View Shot – A photography technique that records the character's viewpoint from a singular camera location mounted in a manner that represents the character's field of view.

² 4K Resolution – A resolution consisting of a horizontal pixel count of around 4,000 pixels.

³ HD – High Definition – A resolution generally consisting of greater than 480 lines of horizontal resolution.

⁴ Megapixel – (MP) – A count of a million pixels in an image or used to express the number of individual image sensor elements on a digital camera image sensor.

⁵ SD – Secure Digital – a standard for nonvolatile memory card used in portable devices.

⁶ Wi-Fi – A local area wireless technology that allows electronic devices to exchange data over a network.

4.3. Video File Recovery

All six of the GoPro's associated microSD cards were read normally in a Windows file system. Five of the six microSD cards contained data that lasted up to and through the aircraft's impact with the ground. Only one microSD card contained data that stopped a few moments short of the aircraft's impact with the ground⁷. This camera provided a view from above and behind the aircraft's canopy. The missing portion of the recording would not have shown a view of the aircraft or instrument panel that would have been useful to the investigation, and the last moments of the aircraft's flight as observed by that camera were not recovered.

4.4. Timing and Correlation

Timing for the report was established by using the most relevant video recording obtained from the six GoPros and was baselined to the elapsed time of that particular camera during its final recorded file. The GoPro mounted inside the aircraft's cockpit which provided a view of the instrument panel shot from over the right shoulder of the pilot was determined to be the most critical field of view that captured the accident. The GoPro offering that field of view produced three video files, the last of which captured the accident sequence. Times in this report represent the elapsed time of the critical camera's elapsed time during the final file it recorded. When the final recorded file began, elapsed time was set to zero. All other cameras involved in the accident were baselined to the elapsed time of the critical camera discussed above. Additionally, the flight data plot discussed in section 4.6 of this report utilizes the same reference as discussed above.

The timing format is provided in MM:SS, where MM stands for elapsed minutes and SS stands for elapsed seconds.

4.5. Video Summary

Description of Accident Flight

The entire flight was observed to be completed in day visual meteorological conditions and the sky condition appeared clear. The pilot was observed in a conscious state throughout the entire recording. A windsock was observed near the north end of the runway was half erect. The windsock indicated the wind was blowing approximately from the right of the runway to the left of the runway (crosswind from the right) when referenced in the direction of the aircraft's travel. The windsock's direction was almost perpendicular to runway and was consistent with the reported observation of 040 degrees at 9 knots.

Each recording was reviewed. The six GoPro cameras provided the following views: outboard of the left vertical stabilizer looking forward, above and behind the canopy looking forward, top of the left wing looking toward the fuselage, bottom of the left wing

⁷ In scenarios where a recording device was exposed to a high impact, the possibility exists for the device's file structure to become corrupted. The corruption could cause data to not be viewable in a Windows file system and requires further data recovery techniques be applied.

looking toward the fuselage, inside the cockpit over the pilot's right shoulder looking forward and inside the cockpit mounted abeam the throttle quadrant. The cameras were all started at various times before the pilot initiated the engine start sequence. No conversations pertinent to the accident investigation by the pilot or the ground crew were captured. All preflight activities appeared nominal and in line with procedures that were known to occur during a preflight checkout of the accident aircraft.

The start sequence was observed from multiple views; however, the over-the-shoulder mounted camera provided a view of the pilot's actions within the cockpit as well as a clear view of the instrument panel. The pilot was seated and belted in the aircraft at the time the start sequence was observed. The pilot would remain seated and belted until impact. The pilot pumped the gearbox engagement actuator four times and then gave a hand signal for the ground crew to beware of spinning props. The pilot then flipped the ignition master switch to "On" for the left/forward engine and then depressed the starter. A sound consistent with a starter motor was briefly heard, then the sound consistent with a running engine was detected. The front propeller (associated with the left/forward engine) briefly moved less than a sixteenth of a turn in the counter-clockwise direction. The pilot then turned his attention toward the engine controls for the right/rear engine. The pilot first depressed the starter button for the starter motor associated with the right/rear engine. No sound was observed. The pilot then flipped the ignition master switch to "On" for the right/rear engine and then depressed the starter again. A sound consistent with a starter motor was briefly heard and then the sound of a running engine was detected. The rear most propeller started spinning clockwise immediately upon the depression of the starter motor button for the right engine. The motors idled and the rear most propeller continued to spin clockwise as the front most propeller crept around slowly counter-clockwise. The pilot's movements appeared as though he then began to manipulate an unseen device to the right of his right hip, consistent with the location of the engine clutch engagement lever. Upon this action, the aircraft's airframe shuddered and the forward most propeller began spinning counter-clockwise. The pilot performed a flight control check using the control stick. The left/forward engine RPM read about 2,200 and the right/rear engine RPM read about 1,800. The engine control levers for both the front/left and right/rear appeared about equal in position. RPM indications for both engines initially showed around 1,700 RPMs just prior.

The pilot then began manipulating the throttles. The RPMs come up to about 2,500 RPM on the left engine and 3,000 RPM on the right engine. Initially, the forward engine was indicating about 1,000 more RPMs than the rear engine as the pilot manipulated the throttles.

A new GoPro file was segmented for the in cockpit over-the-shoulder video recording and a new file began. A timestamp was set as time zero at the start of this new recording and is the zero time reference as discussed in section 4.4 of this report. Around 10 seconds into the recording, the pilot checked the "BUS-TIE" and checks the "SP" switches. Both switches were in the "On" position. Switch "PP" was "On". "FUEL X-FER 1," "FUEL X-FER 2," "FAN 1" and "FAN 2" were all "Off." The landing gear switch was in the center switch position. The altimeter and airspeed indicator were reading zero. The G meter displayed 1G.

For both the left/forward and right/rear engines and associated gearbox, all gauge readings appeared nominal and within green indication ranges. Those gauges included the following: engine oil temperatures, engine oil pressures, fuel pressures, water temperatures, volts, gearbox oil temperature and gearbox oil pressure. All engine and gearbox gauges appeared to be in the green arc throughout the flight.

Around 00:16, the pilot slightly increased power on both engines and began taxiing. Around 00:52, the pilot crossed the runway edge marking for runway 35L. Around 00:53, the pilot began to smoothly add power as he slowly turned to track toward the runway centerline. Around 01:04, the aircraft crossed the fixed distance markings for runway 35L. The aircraft was just right of centerline. The pilot continued to add power. Around 01:12, the airspeed indicator became alive. The angle of attack (AoA) indicator read about +7 degrees. At 01:16, the airspeed indicated around 40 knots. Around 01:27, the aircraft was rolling down runway 35L abeam taxiway E, the airspeed was indicated as about 60 knots. Around 01:43, the airspeed indicated around 70 knots. Around 01:53, the aircraft crossed abeam taxiway D. Around 01:58, the airspeed indicated around 80 knots.

Around 02:08, the pilot was seen adding backpressure to the control stick. The airspeed was slightly above 80 knots. Around 02:12, the aircraft crossed abeam taxiway C and the aircraft became airborne. The AoA indicator fluctuated between +11 and +13 degrees. At this time the pilot briefly removed his left hand from the throttle levers; the two throttle control levers were slightly split. The left most lever (left/forward engine) was about 3/4th of a knob-width behind the right most lever (right/rear engine). The pilot made adjustments to the aircraft's pitch attitude using the control stick and he quickly replaced his left hand to the throttle levers as he continued making pitch attitude adjustments. As the aircraft traveled down the runway, its position laterally transitioned from the right of the runway centerline to the left of the runway centerline.

At 02:16, the pilot removed his left hand from the throttle levers and actuated the gear selector switch to the "UP" position. A red light illuminated in the vicinity of the gear switch. Five seconds later the red light extinguished. The pilot quickly replaced his hand to the throttle levers. The throttle levers were still split about 3/4th of a knob-width as seen previously. As the aircraft climbed away from the runway the centerline became visible underneath the aircraft and to the right. The altitude indicator was on zero. At 02:18, the pilot looked briefly over his shoulder to the left.

At 02:25, the aircraft was still airborne and crossed abeam taxiway B. The centerline was still visible below and to the right of the aircraft. The altimeter remained at zero. The pilot looked briefly over his shoulder to the right.

Around 02:39, there was a noticeable pitch change in the ambient engine noise. The pilot did not appear to change the throttle settings. The RPM indicator for the left/forward engine began to climb, the RPM indicator for the right/rear engine appeared to remain at a stabilized setting. At 02:42, the pilot looked downward and to his right correlating to the area of the hydraulic valve lever within the cockpit. The end of runway 35L became visible under the aircraft. The aircraft was significantly left of runway centerline. At 02:44, the pilot appeared to reach with his right arm toward the location of the hydraulic valve lever. The throttles were visible as the pilot removed his left hand from that area and began to fly using his left hand on the control stick. The left/forward engine throttle lever, then appeared to be a knob and half width distance from the right/rear

engine throttle lever. The RPM indicator for the left/forward engine was around 7,750 RPM and trending upward. The AoA indicator began climbing above its previously indicated range of +11 and +13 degrees to about + 15 degrees. About two seconds later at 02:46, the pilot replaced his right hand on the stick and the left hand on the throttle levers. The aircraft entered an uncommanded slight left roll. The left/front engine RPM indicator approached around 8250 RPM, and the engine was heard surging. At 02:48, the left/forward engine RPM reached about 10,000 RPM. Almost immediately thereafter, at 02:49, the pilot used his left hand to pull back the left/forward engine throttle lever. At 02:54, the left/forward RPM lever was almost in the closed position, the ambient engine noise decreased slightly, and the RPM indicator for the left/forward engine rolled back to about 7,000 RPM around 02:55. At the same moment, the airspeed was noted as being around the start of the green arc (70 knots).

At 02:56, the ambient sound of an engine appeared to surge once more. The pilot appeared to have pushed the right/rear engine throttle lever forward. The left/fwd engine RPM then indicated a surge took place to about 9,500 RPM (redline) at 02:58. The position of the left/forward throttle lever was still nearly at the closed position. The aircraft rolled right. The right roll appeared uncommanded. Some flutter was on the aircraft's left aileron. As the aircraft slowed, aileron flutter on the left aileron was seen up until nearly the moment of impact. The airspeed indicator appeared to be slightly below the green arc at around 65 knots.

The pilot regained control of the right roll and the aircraft was once again briefly level. One second later at 02:59 the aircraft began a uncommanded left roll, the airspeed indicated about 65 knots. The AoA indicator showed +18 degrees. The stick appeared to be in a mostly neutral position. The left/forward engine RPM remained around 9,000 RPM and the right/rear RPM was around 4,500 RPM. As the aircraft rolled 90 degrees to the left, the pilot placed both hands on the control stick. The pilot's input to the control stick was commanding a right roll and a positive pitch attitude. The aircraft continued to roll left and the nose dropped significantly, a green bean field came into view out of the front windscreen. The AoA indicator indicated two dashes as the aircraft rolled inverted.

The aircraft impacted the ground around 03:02. At the time of impact, airspeed was indicated just above 65 knots. The left/forward engine showed an indicated RPM of about 9,000. The right/rear engine remained about 4,250 RPM.

During the flight, the maximum altitude of the aircraft was estimated by the group to be between 80 and 100 feet based upon the external footage provided by a documentary film crew in a chase rotorcraft. At no time during the recording did the altimeter appear to be functioning. The chase rotorcraft video is included in this report as attachment 1. The video has been stabilized and converted to .mp4 format.

Description of Test Flight #2

The group reviewed footage from GoPro cameras that captured test flight number 2. This was the second flight of the aircraft after it had been built. There were a number of GoPro recordings, however, a POV chest mounted camera provided the best view of the flight and was used to create the summary below.

The recording showed the aircraft taxiing out to the runway and beginning a takeoff roll. The liftoff speed was around 80 knots. The left/forward engine RPM was around 6500 and the right/rear RPM was around 6000 throughout most of the flight. A throttle split was noticed, the left/forward throttle was slightly more forward than the right/rear throttle throughout the entire flight. AoA ranged between +9 and +13 degrees on climbout. The altimeter functioned normally. Airspeed was around 80 knots as the pilot leveled pitch attitude and turned downwind.

As the aircraft flew the downwind leg of the flight, airspeed increased slowly to about 110 knots, near the blue line indication on the airspeed indicator. AoA was somewhere between +3 and +7 degrees during the downwind leg.

As the pilot turned downwind to base, airspeed was about 110 knots, altitude was indicated as about 500 feet. The pilot began reducing the throttle levers significantly, however, the RPMs only reduced about 500 RPM during the descent phase.

The pilot turned final around 110 knots and 250 feet indicated altitude. The RPMs continued to indicate 6,000 RPM as the throttles were becoming increasingly closed during the descent. On short final, the throttles appeared to be almost in the closed position, left/forward read 4000 RPM and right rear engine read 3000 RPM. At touchdown the AoA was somewhere between +15 and +16 degrees. Indicate airspeed read between 70 and 75 knots.

4.6. Flight Data Plot

A plot was created utilizing information captured from two cockpit mounted cameras. The camera that provided a view over the right shoulder of the pilot captured the instrument panel. The camera mounted abeam the throttle levers provided a view of the throttle lever angles for the left/forward engine and the right/rear engine.

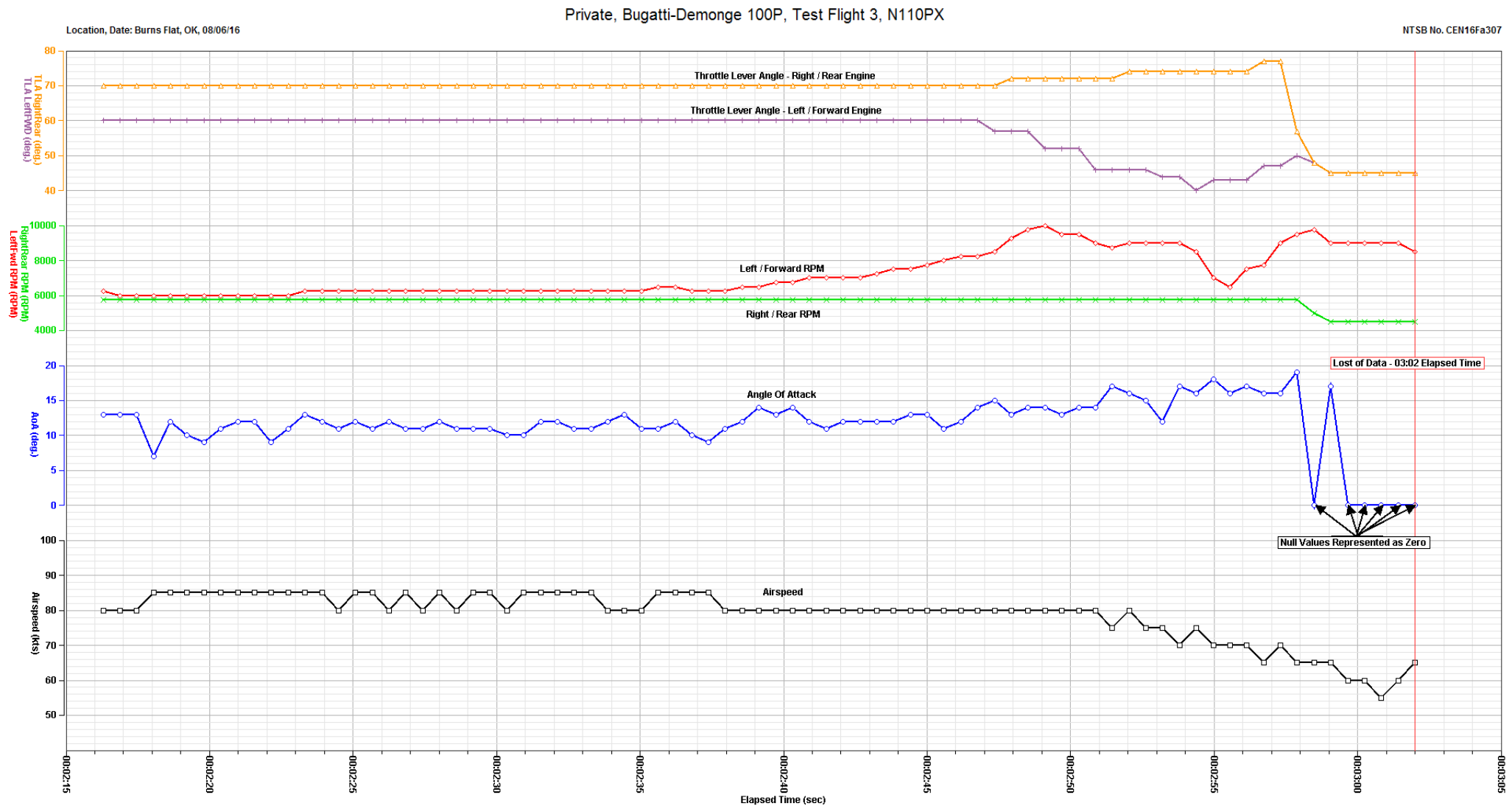
A timecode using the timing correlation information from section 4.4 of this report was applied to both recordings captured from the aforementioned cameras. Readings from the instrument panel and measurements of the throttle lever angle for both throttles were taken once every second. The plot begins roughly around the time the aircraft became airborne. The results were tabulated electronically and plotted.

Figure 2 is a plot of the flight data obtained from the data logging exercise. The time interval displayed is between 02:15 to 03:05 elapsed time.

Attachment 2 to this report is the tabular data used to generate the flight data plot presented in figure 2 below.

Appendix A contains the unit names and abbreviations for the attached plot. Appendix B contains the placarded limitations for the airspeed indicator and engine tachometer according to the aircraft flight manual.

Figure 2. A plot of relevant flight data created from information captured on the GoPro Cameras.



Appendix A – Video Parameters

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters obtained from the recording and table A-2 describes the unit abbreviations used in this report for those parameters.

Table A-1. Verified and provided parameters.

RPM	Visual Description
TLA LeftFWD	Throttle lever angle – left / forward engine
TLA RightREAR	Throttle lever angle – right / rear engine
LeftFWD RPM	RPM - left / forward engine
RightREAR RPM	RPM – right / rear engine
AoA	Angle of Attack
Airspeed	Airspeed

Table A-2. Verified and provided parameters.

RPM	Visual Description
Kts	knots
deg.	degrees
RPM	revolutions per minute

Appendix B – Placarded Limitations

This appendix describes the placarded limitations applicable to this report. The limitations were obtained from the aircraft flight manual. The limitations discussed in the aircraft flight manual appeared to match the evidence provided in the video files. A visual description is given in the right column.

Table B-1. Airspeed Indicator Limitations.

Vspeed	Knots in Airspeed	Visual Description
Vso	70	bottom of green arc
Vyse	105	blue line for best single engine rate of climb
Vno	150	top of green arc, bottom of yellow arc
Vne	200	top of yellow arc, red line

Table B-2. Engine RPM Limitations.

RPM	Visual Description
1000-8500	Normal range, green arc
8500-9800	Caution, yellow arc
9800	Red line