



Aviation Investigation Final Report

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|--------------------------------|---|-------------------------|---------------------------------|
| Location: | Johnson Valley, California | Incident Number: | DCA201A081 |
| Date & Time: | February 6, 2020, 12:00 Local | Registration: | N611TC (A1); FA37NAYXP9 (A2) |
| Aircraft: | Aerospatiale AS350BA (A1); DJI Mavic (A2) | Aircraft Damage: | Minor (A1); Substantial (A2) |
| Defining Event: | Midair collision | Injuries: | 2 None (A1); 1 None (A2) |
| Flight Conducted Under: | Part 91: General aviation - Aerial observation (A1); Part 107: Small UAS (A2) | | |

Analysis

The helicopter was operating under the provisions of 14 CFR Part 91, with an FAA certificate of authorization or waiver to 91.119 (minimum altitudes) to provide videography of an off-road race, under visual flight rules, within Class G airspace in a remote and unpopulated area. The small unmanned aircraft system (sUAS) was operated under the provisions of 14 CFR Part 107, for the same purpose.

The sUAS pilot knew helicopters were operating in close proximity to his position as he was closely following one of the race competitors. Review of video logs indicate the incident helicopter was clearly in view in the sUAS telemetry, however, the remote pilot continued to follow the race vehicle. The remote pilot did not use the service of a visual observer to assist with avoidance of other air traffic.

The helicopter pilot avoided the sUAS, and assumed he was far enough away, when he returned to the racecourse. The sUAS, continuing to follow the racecourse, struck the helicopter on the right side of the windscreen.

Maps of the race layout were provided to the helicopter pilots, but not the sUAS remote pilots, who were also not included in a pre-race organizational meeting for the helicopter pilots. Locations of the remote pilots on the maps were for general orientation, and there was no procedure to provide any sort of separation between the helicopters and sUAS, nor were the sUAS pilots monitoring the helicopter air-to-air frequency.

14 CFR 107.37 *Operation near aircraft; right-of-way rules.* States that
 (a) *Each small unmanned aircraft must yield the right of way to all aircraft,*
 and

(b) No person may operate a small unmanned aircraft so close to another aircraft as to create a collision hazard.

The nature of the race videography brings the aircraft into close proximity with each other. There did not appear to be an appreciation by the race organizers or the sUAS remote pilot of the significance of the sUAS operations as a collision risk to be mitigated. Such tools as defined operating areas, the use of visual observer(s), and/or specified wave-off criteria could have been used to help reduce the risk. Although the race organizers could have provided such an operating framework, it is also incumbent on the certificated remote pilot in command to understand the risks of this operation.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be:

the failure of the small UAS remote pilot to give way to the helicopter, resulting in an inflight collision.

Contributing to the incident was the sUAS remote pilot's failure to assess and mitigate the risks of operations in close proximity to other aircraft. Also contributing to the incident was the lack of inclusion of the sUAS operations as a part of the aviation activity and risk mitigation.

Findings

| | |
|-----------------------------------|---|
| Personnel issues (A1) | Decision making/judgment - Pilot of other aircraft |
| Organizational issues (A1) | Policy/procedure development - Other institution/organization |
| Personnel issues (A2) | Decision making/judgment - Pilot |
| Organizational issues (A2) | Policy/procedure development - Operator |
| Organizational issues (A2) | Policy/procedure development - Other institution/organization |

Factual Information

History of Flight

| | |
|--------------|-----------------------------------|
| Enroute (A1) | Midair collision (Defining event) |
| Enroute (A2) | Midair collision |

HISTORY OF FLIGHT

On February 6, 2020, about 1200 Pacific standard time (PST) an Airbus AS-350BA helicopter, N611TC, and a Dai-Jiang Innovations (DJI) Mavic 2 Zoom small unmanned aircraft (sUAS, or drone), registration FA37NAYXP9, collided in flight while both aircraft were filming an off-road truck race near Johnson Valley, California. The helicopter received minor damage to the right side of the windscreen and the sUAS was substantially damaged. There were no injuries. The helicopter was operated by Icon Helicopters under the provisions of 14 *Code of Federal Regulations (CFR)* Part 91 and an FAA Certificate of Authorization or Waiver to 14 CFR 91.119(b) and (c). The sUAS was operated by an individual under the provisions of 14 *CFR* Part 107. Day visual meteorological conditions prevailed.

Both aircraft were providing video coverage for an off-road racing event called King of the Hammers. Video from the drone, and the accounts of each pilot, indicate the two aircraft were following a vehicle climbing an undulating dirt track in hilly canyon terrain. Video showed the helicopter visible in the drone camera (which was displayed on the drone pilot's screen) above and to the right of the drone. The drone continued to follow the vehicle toward the position of the helicopter. As the track turned to the right, the helicopter passed to the left of the frame and out of view beyond a small rise. The track of the vehicle began to turn to the left around the small rise, when the collision occurred. The drone pilot (RPIC) reported his altitude was about 30 feet above ground, and that he was aware that the incident helicopter as well as others were in the area. The RPIC was operating alone, he did not have a visual observer assisting. According to a map provided by race organizers, the intended position of the RPIC was about 2,300 feet from where the collision occurred. Both the RPIC and the helicopter pilot provided maps indicating the RPIC was about 1,000 feet west, closer to the collision point.

The helicopter pilot reported that he had seen the drone earlier and flown away. On the incident lap, the helicopter pilot reported that it "popped up" in his line of sight and he flew up course. He flew back toward the course assuming that he was far enough away from where he previously saw the drone when the collision occurred.



Figure 1 – Reported area of collision and location of drone RPIC. “AS (AfterShock) Drone” indicated intended position of operator according to race-organizer provided map.



Figure 2 – Snapshot from video 10 seconds prior to collision. Collision occurred on far side of small rise in center frame.



Figure 3 – Snapshot from video just prior to collision.

INJURIES TO PERSONS

None.

DAMAGE TO AIRCRAFT

There were small scratches on the right side of the windscreen of the helicopter.

The right rear motor arm of the drone was separated.

OTHER DAMAGE

None.

PERSONNEL INFORMATION

The helicopter pilot held an FAA commercial pilot certificate, with rotorcraft-helicopter and helicopter instrument rating, and had logged 4,200 hours. He held a valid FAA second class medical certificate. He reported that he had been flying for the race and other similar events for 10 years.

The RPIC held an FAA Remote Pilot Certificate issued February 1, 2019. He had no other aircraft certificates or ratings. He reported 90 hours total time, with 16 hours on the Mavic type drone. He did not have any operating manuals or checklists for the operation.

AIRCRAFT INFORMATION

The N611TC was a 1988 Airbus (Eurocopter) AS-350BA, a 6-seat single engine helicopter, powered by a Turbomeca Arriel 1B turboshaft engine.

The sUAS was a Dai-Jiang Innovations (DJI) Mavic 2 Zoom, a prosumer level quadcopter weighing approximately 2 pounds. It is equipped with a 12mp zoom camera. The aircraft is equipped with an obstacle avoidance system. The manual states the obstacle avoidance system is not available in Sport mode and does not function with moving objects or closing speeds above approximately 25 miles per hour. The sUAS was controlled by a DJI Smart Controller, an integrated remote control and Android-based display and telemetry unit.

METEOROLOGICAL INFORMATION

The Barstow-Daggett County Airport, about 25 miles to the north, reported at 1150 PDT, winds from 290 at 10 knots, visibility 10 miles, clear skies. Temperature was 18°C, dewpoint -7°C, and sea level pressure was 30.10 inches of mercury.

AIDS TO NAVIGATION

N/A

COMMUNICATION

The incident pilots were not in communication with each other, nor was there any provision or requirement to do so.

The helicopter pilots covering the course communicated with each other via a common air-to-air frequency. The drone pilots did not use or monitor radio communications.

AERODROME INFORMATION

N/A

FLIGHT DATA

The helicopter was not equipped with any flight data recording devices, nor was it required to.

The flight logs from the drone remote controller were erased by the owner upon return of the equipment, as the owner was not aware that an incident had occurred. Flight logs from the unmanned aircraft were downloaded by the NTSB for examination along with DJI engineers, however, the files were corrupt and unreadable, likely due to post-incident power cycles.

Video files from the drone were recovered and show the drone flight and the collision. Significant items from the video are included in the History of Flight section.

WRECKAGE INFORMATION

N/A

MEDICAL AND PATHOLOGICAL INFORMATION

N/A

FIRE

None.

SURVIVAL ASPECTS

N/A

TESTS AND RESEARCH

Regulations

14 CFR 107.37 *Operation near aircraft; right-of-way rules.*

(a) Each small unmanned aircraft must yield the right of way to all aircraft, airborne vehicles, and launch and reentry vehicles. Yielding the right of way means that the small unmanned aircraft must give way to the aircraft or vehicle and may not pass over, under, or ahead of it unless well clear.

(b) No person may operate a small unmanned aircraft so close to another aircraft as to create a collision hazard.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Hammerking Productions, Inc. was an event promotion company that owns both King of the Hammers (a single event) and Ultra4 Racing (the race series). They utilized a third party contractor to manage the live video production, who subsequently hired additional third party contracts such as the drone and helicopter pilots and camera operators. Video coverage included live-streaming and remote viewing locations. Spectators were located in specific viewing areas, the collision occurred in an area where spectators were not allowed.

Event organizers provided pre-race information to the helicopter pilots which included a review of the helicopter's paperwork, the flight times and schedule for the race, insurance information, procedures for clearing the course of unauthorized persons, and helicopter landing zones and radio frequencies. They provided a Google Earth kmz map including details of the course and locations to the helicopter pilots. A pilot meeting was held on February 2, including helicopter pilots and event management. It did not include the drone RPICs. Five helicopters and four drones were contracted to cover the event.

According to race management, the locations of the drones indicated on the map were not containment zones but were meant as an indication of the locations where they would have network connection to transmit the video feed. Organizers stated the drones were limited to less than 400 feet (note: this is in accordance with 14 CFR Part 107) and helicopters were required to remain above 500 feet in areas of spectators (note: this is generally in accordance with 14 CFR Part 91). The area of the collision was not accessible by spectators.

Hammerking Productions leased the drones and equipment from a commercial drone and camera company and provided them to the RPICs. According to the incident RPIC, he was hired to operate

under a “verbal contract,” this was his second time doing this. He noted that the RPICs at this race “fly really low and there are a lot of crashes.” He stated that there was no contact between RPICs and helicopter pilots, either pre-race, or during the event. He was not provided any maps or other procedural material from the organizers.

According to Hammerking personnel, they returned all the equipment to the leasing company immediately after the event. They related that they always end up with some broken or lost equipment after the event, and they reimburse the company. At the time, they were not aware of the requirements for preservation of evidence following a midair collision.

OTHER INFORMATION

Pilot Information (A1)

| | | | |
|----------------------------------|---|--|---------|
| Certificate: | Commercial | Age: | 20 |
| Airplane Rating(s): | None | Seat Occupied: | Left |
| Other Aircraft Rating(s): | Helicopter | Restraint Used: | Unknown |
| Instrument Rating(s): | Helicopter | Second Pilot Present: | |
| Instructor Rating(s): | None | Toxicology Performed: | No |
| Medical Certification: | Class 2 Without waivers/limitations | Last FAA Medical Exam: | |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | |
| Flight Time: | (Estimated) 4200 hours (Total, all aircraft), 4200 hours (Total, this make and model) | | |

Pilot Information (A2)

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|----------------------------------|--|--|------|
| Certificate: | Remote | Age: | 44 |
| Airplane Rating(s): | None | Seat Occupied: | None |
| Other Aircraft Rating(s): | Unmanned (sUAS) | Restraint Used: | |
| Instrument Rating(s): | None | Second Pilot Present: | No |
| Instructor Rating(s): | None | Toxicology Performed: | No |
| Medical Certification: | None | Last FAA Medical Exam: | |
| Occupational Pilot: | No | Last Flight Review or Equivalent: | |
| Flight Time: | (Estimated) 90 hours (Total, all aircraft), 16 hours (Total, this make and model), 90 hours (Pilot In Command, all aircraft) | | |

Aircraft and Owner/Operator Information (A1)

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|--------------------------------------|----------------------|---------------------------------------|--|
| Aircraft Make: | Aerospatiale | Registration: | N611TC |
| Model/Series: | AS350BA No Series | Aircraft Category: | Helicopter |
| Year of Manufacture: | 1988 | Amateur Built: | |
| Airworthiness Certificate: | Normal | Serial Number: | 2123 |
| Landing Gear Type: | Skid | Seats: | 6 |
| Date/Type of Last Inspection: | | Certified Max Gross Wt.: | |
| Time Since Last Inspection: | | Engines: | |
| Airframe Total Time: | | Engine Manufacturer: | |
| ELT: | | Engine Model/Series: | |
| Registered Owner: | Icon Helicopters Llc | Rated Power: | |
| Operator: | Icon Helicopters Llc | Operating Certificate(s) Held: | On-demand air taxi (135), Certificate of authorization or waiver (COA) |

Aircraft and Owner/Operator Information (A2)

| | | | |
|--------------------------------------|---------|---------------------------------------|------------|
| Aircraft Make: | DJI | Registration: | FA37NAYXP9 |
| Model/Series: | Mavic 2 | Aircraft Category: | Helicopter |
| Year of Manufacture: | | Amateur Built: | |
| Airworthiness Certificate: | None | Serial Number: | Unknown |
| Landing Gear Type: | Skid | Seats: | 0 |
| Date/Type of Last Inspection: | | Certified Max Gross Wt.: | |
| Time Since Last Inspection: | | Engines: | |
| Airframe Total Time: | | Engine Manufacturer: | |
| ELT: | | Engine Model/Series: | |
| Registered Owner: | On file | Rated Power: | |
| Operator: | On file | Operating Certificate(s) Held: | None |

Meteorological Information and Flight Plan

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|---|---|---|----------------------------|
| Conditions at Accident Site: | Visual (VMC) | Condition of Light: | Day |
| Observation Facility, Elevation: | DAG,1930 ft msl | Distance from Accident Site: | 25 Nautical Miles |
| Observation Time: | 11:50 Local | Direction from Accident Site: | 360° |
| Lowest Cloud Condition: | Clear | Visibility | 10 miles |
| Lowest Ceiling: | None | Visibility (RVR): | |
| Wind Speed/Gusts: | 10 knots / | Turbulence Type Forecast/Actual: | / |
| Wind Direction: | 290° | Turbulence Severity Forecast/Actual: | / |
| Altimeter Setting: | 30.1 inches Hg | Temperature/Dew Point: | 18°C / -7°C |
| Precipitation and Obscuration: | | | |
| Departure Point: | Johnson Valley, CA (A1); Johnson Valley, CA (A2) | Type of Flight Plan Filed: | None (A1); None (A2) |
| Destination: | Johnson Valley, CA (A1); Johnson Valley, CA (A2) | Type of Clearance: | None (A1); None (A2) |
| Departure Time: | | Type of Airspace: | Class G (A1); Class G (A2) |

Wreckage and Impact Information (A1)

| | | | |
|----------------------------|--------|-----------------------------|-----------------------|
| Crew Injuries: | 1 None | Aircraft Damage: | Minor |
| Passenger Injuries: | 1 None | Aircraft Fire: | None |
| Ground Injuries: | N/A | Aircraft Explosion: | None |
| Total Injuries: | 2 None | Latitude, Longitude: | 34.131668,-115.945831 |

Wreckage and Impact Information (A2)

| | | | |
|----------------------------|--------|-----------------------------|-----------------------|
| Crew Injuries: | 1 None | Aircraft Damage: | Substantial |
| Passenger Injuries: | | Aircraft Fire: | None |
| Ground Injuries: | N/A | Aircraft Explosion: | None |
| Total Injuries: | 1 None | Latitude, Longitude: | 34.131668,-115.945831 |

Administrative Information

Investigator In Charge (IIC): English, William

Additional Participating Persons:

Original Publish Date: January 6, 2022

Last Revision Date:

Investigation Class: [Class 3](#)

Note: The NTSB did not travel to the scene of this incident.

Investigation Docket: <https://data.nts.gov/Docket?ProjectID=100950>

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).