Department of the Interior
Lessons Learned

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Subject: UAS Mishap Lessons Learned

Area of Concern: UAS Operations

Distribution: All Aviation Activities

Discussion: A recent mishap investigation involving a small Unmanned Aerial System (sUAS) illuminated a number of contributing factors that can impact a wide variety of UAS operations.

What happened? A DOI bureau was conducting UAS operations using the Falcon Fixed-wing sUAS to photo map terrain.

The Falcon is classified by the FAA as a "small" UAS as it weighs less than 55 lbs. (actual weight is approximately 12 lbs.). The pilot launched the aircraft and placed it in "auto" mode (autonomous navigation) in order for it to accurately fly its mapping profile. The operating altitude was approximately 200 meters (656 feet) above ground level (AGL).

The Falcon proceeded to the first waypoint and began a turn of approximately 180 degrees in order to track the appropriate mapping transect in the opposite direction. During the turn, aircraft control was lost suddenly and it fell into a nosedive without any input from the pilot. The pilot maintained visual contact with the aircraft as it was about 1.2 km from the launch location.

The pilot depressed the parachute deploy button on the hand controller multiple times but the parachute failed to deploy and the aircraft impacted the ground in a nose low attitude. The aircraft was successfully located, recovered, and subsequently repaired.

The aircraft received substantial damage to the airframe but did not qualify as an accident due to the 300 lb. threshold required by NTSB regulations (49 CFR 830). No personnel were injured, but the mishap was declared as an Incident With Potential (IWP) by the OAS Chief, Aviation Safety, Training, and Program Evaluations.

Lessons Learned: Several contributing factors were identified and can help us avoid similar mishaps in future UAS missions:

1. **Thorough Preflight.** The UAS center wing section was not fully seated during the preflight. A bent electrical pin didn't allow for the wing to seat or fully contact the wing's electrical connector. This caused an intermittent electrical connection to the aileron servos during flight. This same connection also provides power to the position lights, which failed to test correctly when the crew conducted the automated preflight check. The inoperative lights (although not required for this mission), was a leading indicator that something was not connected correctly.

This intermittent connection eventually resulted in to a complete flight control failure and subsequent loss of aircraft control. The crew did not quickly identify the flight control anomalies. In this sequence, they had approximately 15 seconds from the onset of the anomaly to where they could deploy the landing parachute in time to avoid impacting the terrain. Had they identified the loss of control situation sooner, they may have been able to deploy the parachute in time to recover the UAS and avoid damage.

2. **Maintain Visual Contact.** Both the Pilot and the Ground Control Station (GCS) operator must monitor the UAS - the Pilot visually and the GCS operator through the GCS display. The Pilot must operate the UAS by "Visual Line of Sight." This requires that the UAS be visible at all times to the pilot. This distance is not absolute as conditions such as terrain, weather, and viewing angle can all cause changes in how well the pilot can see the sUAS and how far away you should allow it to go. The sUAS was 1.2 km (.75 miles) away, which may have contributed to their inability to identify rapidly its loss of altitude or other anomalies. Operators should adjust distance as needed to monitor attitude and the environment better where the UAS is operating.

3. **Reduce Glare.** The GCS operator may have had difficulty monitoring the status of the UAS due to the sun glare on the computer screens. The GCS consists of commercially available computer monitors that have glossy screens and are highly reflective. During days with bright, direct sunlight, the glare and reflections on the screen significantly inhibit aircraft monitoring and other critical information. Operators should strongly consider using sunshades that shade the monitors, wear darker and lower reflective clothing, and orient the computer monitors to minimize glare from the sun. Modifications to monitors and future systems may include anti-glare filters.

4. **Crew Resource Management (CRM).** This crew used good CRM and they talked to each other about what the UAS was doing, such as leveling off, beginning transects, and making each turn. This is a recommended practice and can readily aid in maintaining the situational awareness.

   UAS crews should be well rehearsed for emergencies such as loss of control, a lack of radio communication fly away, and manned aircraft intrusions at a minimum. They should be ready to execute emergency procedures such as an emergency landing or parachute deployment.

5. **Always Submit a SAFECOM**. UAS operations within the Department of the Interior are still new. Our operators are finding new challenges and operational hazards. Reporting these using the SAFECOM system can be beneficial and serve to allow others to be aware and learn. Many of the contributing factors found in this mishap as well as many other issues reported via SAFECOM have contributed to many improvements to the UAS program and this particular sUAS model.

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