

Publication of Draft Safety Standards for Small Unmanned Aircraft

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1. Background

Regarding delivery services using small unmanned aircraft (aka drones), the first company in the United States to receive approval based on Part 135 of the Federal Aviation Regulations (FAR) was Wing Aviation (an affiliate company of Google) in April 2019. Later, the same kind of permission was granted to UPS Flight Forward in September 2019 and Amazon Prime Air in August 2020.

Applications for these approvals, however, excluded some FAR Part 135 stipulations, which obligate the provision of aircraft certification under FAR 135.25. However, this exclusion is temporary, and prompt acquisition of aircraft certification is recommended.

In respect to aircraft certification, the Federal Aviation Administration (FAA) published a draft of safety standards in November 2020. This report will disclose the contents of this publication.

2. The Draft Safety Standards for Small Unmanned Aircrafts

2.1 Categorized as Special Class

For the delivery services conducted by UPS Flight Forward and Amazon Prime Air mentioned earlier, Matternet's M2 and Amazon Logistics' M27 small unmanned aircraft have been used. Type certifications applications for both aircraft were submitted to the FAA in October 2017 and in May 2018, respectively.

Since they are a different type of aircraft from other existing airplanes or rotorcraft, which already have safety standards, type certification applications for Special

Aircraft under FAR 21.17(b) were submitted for these small unmanned aircraft. For Special Class aircraft, current safety standards are applied as deemed appropriate by the FAA depending on the design of the aircraft, such as FAR Part 23, 25, 27, 29, 35, which are presently in place for existing airplanes and rotorcraft, or others are administered as the FAA considers necessary in order to secure equivalent safety.

Regarding Special Class type certification for small unmanned aircraft, the FAA announced a policy proposal in February 2020 and established it officially in September 2020¹⁾. For the time being, the FAA will draft individual safety standards and collect public comments for every Special Class type certificate application, and after identifying common applicable safety standards, will begin rulemaking.

The draft safety standards for small unmanned aircraft announced in November 2020 are based on the policy of the Special Class type certification mentioned above. Furthermore, the draft safety standards have also been published for each of the 10 small unmanned aircraft which have applied for type certification, including those for Matternet's M2 and Amazon Logistics' MK27. As comparison of the draft safety standards for Matternet's M2 and Amazon Logistics' MK27 will reveal that they are essentially the same, the following sections will use the draft safety standards for Amazon Logistics' MK27 as an example to describe what contents are included.²⁾

2.2 Components of the Draft Safety Standards

The published draft safety standards consist of 4 parts: "General," "Design and Construction," "Operating

Limitations and Information,” and “Testing.”

First, in “General,” small unmanned aircraft applicants requesting type certification are required to define and submit their Concept of Operations (CONOPS) to the FAA in order to support them in characterizing and analyzing risks and impacts. The following information must at least be included in a Concept of Operations:

- The intended type of operations
- Unmanned aircraft (UA) specifications
- Meteorological conditions
- Operators, pilots, and personnel responsibilities
- Control station and supporting equipment
- Command, control, and communication functions
- Operational parameters, such as population density, geographic operating boundaries, airspace classes, launch and recovery areas, congestion of the proposed operating area, communications with air traffic control, line of sight, and aircraft separation.

The following sections will explain specific details of “Design and Construction,” “Operating Limitations and Information,” and “Testing.”

2.3 Standards for “Design and Construction”

“Design and Construction” specifies safety standards that the FAA does not believe are sufficient with verification by testing alone.

The standards for operation stations are unique to unmanned aircraft and are not currently present in safety standards for existing manned aircraft. Based on information available in cockpits to operators of manned aircraft, operation stations are required to be designed to provide operators all the information necessary to continue flying safely. This information includes items such as warning when communication links with an aircraft are lost, status of important power sources and propulsion device parameters, speed, elevation, location, and the strength of the signal of communication links.

Furthermore, regarding aircraft software, in order to minimize error, all software related to safe operations are required to undergo testing and verification, and software problems and changes are to be managed through a system. Regarding cyber security, in order to keep aircraft safety from being adversely affected, aircraft equipment, systems, and connections must be protected by identifying,

analyzing and minimizing security risks.

In cases when a communication link becomes lost, aircraft designs are required to be able to automatically and immediately perform a predetermined landing. In regard to lightning strikes, aircraft designs must prevent loss of control of the aircraft when hit by lightning or the UAS flight manual must ban flying in weather conditions with expected lightning. In stormy weather conditions, such as those with rain or snow, aircraft must be designed to prevent loss of control, or the UAS flight manual must ban flight during these situations or provide ways to detect and avoid them.

Furthermore, regarding important parts whose system failures directly lead to the loss of control of aircraft, applicants are required to create a list of relevant parts, and are to set the necessary inspections and maintenance, as well as define the service life. This information must also be included in the Instruction for Continued Airworthiness (ICA).

2.4 Standards for “Operating Limitations and Information”

The standards for “Operating Limitations and Information” are like those for existing manned aircraft.

First, it is required for created UAS flight manuals to include information on operation restrictions, non-emergency and emergency operation situations, and performance and loading, and then to receive approval from the FAA.

Furthermore, information necessary to maintain airworthiness must be prepared and approved using the standards in FAR Part 23, which are the safety standards for small aircraft.

2.5 Standards for “Testing”

While existing safety standards for manned aircraft rest on verifying design requirements through component-level analysis and testing, small unmanned aircraft are smaller in size and have less complexity. Therefore, it has been proposed to demonstrate reliability by testing at the aircraft level.

To begin with, testing is required to verify that small unmanned aircraft are durable and reliable in relation to the maximum population density specified in operation

restrictions.

Testing must include the most adverse combinations of flight distance, flight time, route complexity, weight, center of gravity, altitude, temperature, speed, wind velocity, and weather. It is also required that there be no exceptional skill or alertness needed by the operator. Furthermore, for transportation of cargo, the aircraft must be able to carry cargo and operate safely at its most critical combination of aircraft weight and center of gravity.

In addition to these, testing must prove that an aircraft will not lose control if a failure were to occur with the propulsion systems, communication link, global positioning system, in a single point of failure in the flight control systems, or at control stations.

Additionally, testing must demonstrate the following abilities: electric power can be provided to all systems of an aircraft, an operator can dynamically reroute the aircraft, the aircraft can safely be stopped at takeoff and landing, cargo can be released to avoid the loss of control of an aircraft, and other aircraft and obstacles can be detected and avoided.

Regarding airframe structures, they must be able to withstand the repeated loads predicted over their service life without failure. Upon verification of service life through testing, this information must be included in the ICA.

Verification by these tests must be conducted with an added margin of 5% or more weight to that of the aircraft's maximum gross weight, which is finally described in the UAS flight manual.

3. Conclusion

Regarding the above-mentioned draft safety standards published in November 2020, public hearings were conducted about a month later. Currently the FAA is reviewing the final safety standards, taking submitted opinions into consideration. Although the timing for the final safety standards to be determined is not yet certain, as only a few dozen of comments were submitted, it is expected that they will be formulated promptly and evaluation of a type certification for small unmanned aircraft will be advanced.

For small unmanned aircraft, 2 important standards were published at the end of December 2020, including for flight

over people and remote ID. These standards underwent some major changes from the drafts discussed in conducted public hearings, the details of which will be explained in a separate report.

References

1) FAA, Type Certification of Certain Unmanned Aircraft Systems

<https://www.federalregister.gov/documents/2020/09/18/2020-17882/type-certification-of-certain-unmanned-aircraft-systems>

2) FAA, Airworthiness Criteria: Special Class Airworthiness Criteria for the Amazon Logistics, Inc. MK27

<https://www.federalregister.gov/documents/2020/11/20/2020-25663/airworthiness-criteria-special-class-airworthiness-criteria-for-the-amazon-logistics-inc-mk27>