Whitepaper

VOTIX
Drone Orchestration and Automation

Top 10 Tips to Obtain a BVLOS Waiver



Beyond visual line of sight (BVLOS) operations in the United States remain an exception to the general rule that requires the remote pilot in charge (RPIC) to maintain visual line of sight (VLOS) of small Unmanned Aircraft Systems (sUA or UAS). The Federal Aviation Administration (FAA) permits waivers, or approvals, of UAS BVLOS operations and it has granted approximately 90 of them in 2022. And while the FAA's Part 107 Waivers Issued page provides copies of these waivers, the applications filed with them, which "shall be attached to and become a part thereof", still remain publicly unavailable. **So, what's the secret sauce to getting a BVLOS waiver?**

VOTIX, a company that, with its partners, has had great success in obtaining FAA approval for BVLOS operations provides this curated Top 10 list of best practices, using FAA regulations, guidance and its own experiences.

Check out the 10 tips:

#1 - Rules & Resources

#2 - Operational Plan

#3 - UAS Specifications

#4 - Personnel Qualifications

#5 - Telematics

#6 - Detect And Avoid

#7 - Visual Conspicuity

#8 - Fail-Safes

#9 - Positional Data

#10 - Command and Control

By Dawn Zoldi

#1 Rules & Resources

Solving a challenge requires first understanding it. The first step for BVLOS approvals: read the rule and learn about the FAA's interpretation of it.

Part 14 CFR § 107.31 requires a remote pilot in charge (RPIC) to maintain VLOS:

a With vision that is unaided by any device other than corrective lenses, the remote pilot in command, the visual observer (if one is used), and the person manipulating the flight control of the small unmanned aircraft system must be able to see the unmanned aircraft throughout the entire flight in order to:

1. Know the unmanned aircraft's location.
2. Determine the unmanned aircraft's attitude, altitude, and direction of flight.
3. Observe the airspace for other air traffic or hazardst.
4. Determine that the unmanned aircraft does not endanger the life or property of another.

b With vision that is unaided by any device other than corrective lenses, the remote pilot in command, the visual observer (if one is used), and the person manipulating the flight control of the small unmanned aircraft system must be able to see the unmanned aircraft throughout the entire flight in order to:

1. The remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system.
2. A visual observer.



As mentioned, the FAA can waive this provision. It has provided Waiver Safety Guidance intended to be a guide to help users to fill out the Waiver Safety Explanation field in the FAADroneZone operational waiver application.

This field requires users to:

- Describe the proposed operation.
- Describe possible operational risks and methods to lessen/mitigate those risks.
- Address each portion of the "Waiver Safety Explanation Guideline (WSEG)" (Part 107 Waiver Safety Explanation Guidelines and Guiding Questions) in detail.

In next 3 tips (Tips #2 - 4), we elaborate on the information that is not in the WSEG but is on the FAA's waiver page.

#2 Operational Plan

Remember, the FAA's main purview is safety. Explaining the proposed operational plan helps frame the air and ground risk that the proposed waiver application will present.

While the WSEG itself does not discuss the requirement to describe the operational plan, the FAADroneZone operational waiver application field requires it. The FAA's WSEG webpage also lists basic questions, the answers to which applicants should include in their applications.

The FAA wants information about the operational flight area, up front, to appreciate potential risks. As they say, a picture paints 1000 words. Providing a detailed map of this area will go a long way to helping regulators understand the operation.

At a minimum, provide the flight area's latitude and longitude. As that flight area is three-dimensional, users should also include the maximum altitude above ground level (AGL), for the flights.

Flying in or near controlled airspace (Class B, C, D, surface E) makes a mission more complicated. Even for users not planning to fly in controlled airspace, be sure to explain whether there are any other kinds of airspace within 5 miles of the planned flight area. Operating in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person requires prior authorization from Air Traffic Control (ATC). Users should use the DroneZone to request this airspace authorization. (See also the FAA's Flying Near Airports page).

Besides protecting other airspace users, the FAA also wants to protect people and things on the ground. Explain the kind of area(s) the operation will overfly. Rural and sparsely populated areas will usually present less risk than congested, populated neighborhoods, within city limits, over large outdoor gatherings of people or near restricted access sites.

The FAA also expects applicants to describe how the RPIC will operate the UAS within the weather limitations while en route. 14 CFR § 107.51 contains both visibility and cloud clearance requirements for sUA operations.

#3 UAS Specifications

The FAA will also want to know exactly what kind of sUA the applicant will use to fly the planned operation. The FAA wants to know, first, that it will stay in the air and in its designated route and second, that if something goes awry, the applicant has mitigation measures in place to protect others.

With that in mind, applicants should describe the specs of the sUA. Start with whether it is multi-rotor, fixed wing, hybrid (both multi-rotor and fixed wing), single rotor, lighter than air, etc.

Explain the size of the aircraft (length/width/height in inches) and how much it will weigh when flying, with any given payload. Provide details about the UAS's power or energy source in flight, its maximum flight time (in minutes), range (in feet), and speed (in miles per hour).

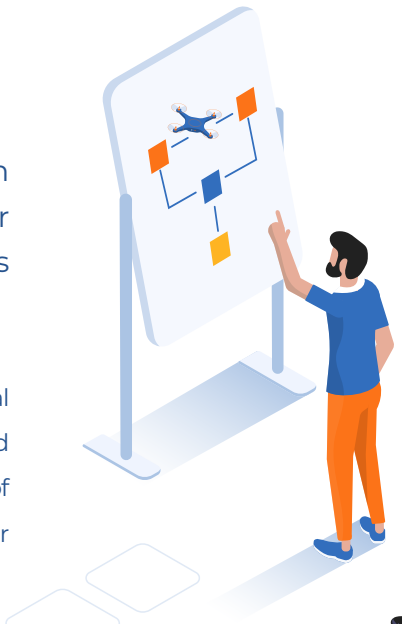
While we discuss detect and avoid in much greater detail below (see Tip # 6), the FAA has said that it "will deny waiver requests submitted without hazard identification and risk mitigation strategies." Pilots can download the FAA's Risk Management Handbook (FAA-H-8083-2) for free.

At a minimum, however, the FAA requires waiver applicants to explain:

- How the applicant will ensure the aircraft only flies where it is directed (e.g., ensure containment, such as geo-fencing, tether, etc.)
- What kind of termination system, if any, does the sUA have? (e.g., immediate flight termination switch)
- If the aircraft carries any external or internal load (or object), how is the load secured?
- What, if any, external or internal load (or object) could be dropped from the aircraft when flying, and how will you assure the safety of people, or other people's property, if it is dropped or detached when flying?



#4 Personnel Qualifications



Besides information about the sUA, the FAA wants to have information about the qualifications of the RPIC(s) flying them, as well as other personnel involved in the operation. The more experienced these folks are, the better the chances for obtaining a BVLOS waiver.

Describe how the minimum number of personnel needed for the operation (e.g. visual observer(s), including the RPIC. Discuss the experience level of these personnel and what kind of training they will have prior to flying BVLOS. Include the training materials and samples of related testing and evaluation documentation, for both initial and recurrent or refresher training.

#5 Telematics



The remainder of these tips dig deeper into describing operational risks and mitigations and directly track the FAA's WSEG. The WSEG, in turn, tracks the small UAS rule.

Part 107.31 (a)(1) requires the RPIC to determine the aircraft's location at all times. Part 107.31 (a)(2) mandates that the RPIC must be able to determine the sUA's attitude, altitude, and direction of flight. This is why the WSEG, up front, requires the applicant to describe how the RPIC will be able to continuously know and determine the sUA's telematics and ensure it remains in the area of intended operation without exceeding the performance capabilities of the command and control (C2) link (see #10 for more C2). When operating BVLOS, this information must be provided to the pilot in an accurate and timely manner.



The FAA has said that it will consider items such as C2 frequency and power, radio frequency (RF) propagation, RF interference and details around one's Radio Line of Sight. C2 that uses RF must comply with relevant Federal Communications Commissions (FCC) guidance. One's C2 should also leverage published industry standards such as those RTCA has published (e.g., RTCA DO-377A, Minimum Aviation System Performance Standards for C2 Link Systems Supporting Operations of Unmanned Aircraft Systems in U.S. Airspace). To be clear, the FAA has stated that ADS-B out is NOT an accepted solution to track a sUA.



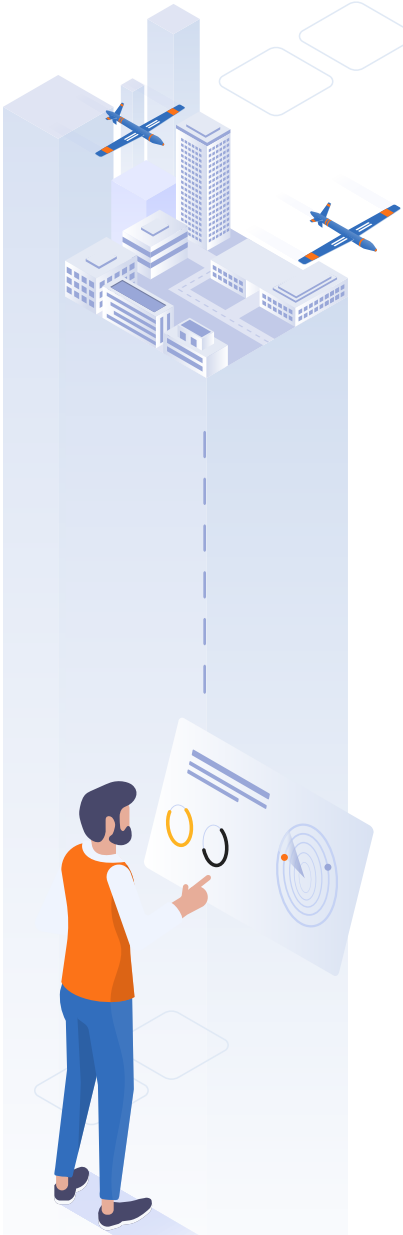
Relatedly, make sure to inform the FAA how, If the primary method of tracking or locating the sUA fails, how the operational plan accounts for getting this information to the RPIC to ensure both the safety of the national airspace system (NAS) and non-participants. Of course, including information about the low likelihood of such failures in the first place would help the application.

#6 Detect And Avoid



Technically, the Code of Federal Regulations requires that pilots "see and avoid" other aircraft and avoid collisions. For sUA, with no pilot on board, RPIC actions, procedures, the use of a VOs or use of equipment and detect and avoid (DAA) technology can fulfill this requirement.

First, the FAA wants the applicant to describe how, in general, the RPIC will identify and know the locations of all air traffic or hazards. This includes not only aircraft but people on the ground and ground-based structures and obstacles. (See § 107.39, which governs operations over people)



In addition to knowing the locations of both aircraft that may be at risk of hitting the sUA, or other hazards, the FAA also wants to know specifically how the RPIC will avoid hitting them. This is because, § 107.37 requires that the sUA must yield the right-of-way to all aircraft, airborne vehicles and launch and reentry vehicles. Yielding the right of way means that the sUA must give way to the aircraft or vehicle and may not pass over, under, or ahead of it unless well clear. No person may operate a sUA so close to another aircraft as to create a collision hazard. The FAA has never issued a waiver to § 107.31 when the proposed operations could not meet the minimum level of safety required in § 107.37.

If an applicant will use humans, in the form of a combination of RPIC and VOs, to fulfill these requirements, the FAA expects that the VO must be able to scan a two mile radius of airspace surrounding the sUA inflight. They say that research supports this minimum distance to detect another aircraft with sufficient time to avoid collisions, when using humans. The humans must also then avoid the aircraft. The FAA has suggested that doing this successfully may require operating the sUA closer to the RPIC/VO.

If using technology for DAA, the FAA will want a description of the equipment or technology, including how it works. Some considerations to include in discussing the tech:

- Does it detect both cooperative and non-cooperative air traffic.
- Is the Avoid response automated, or is there a human in the loop.
- Has the technology been evaluated and validated?

This testing is key in helping the FAA determine the DAA system's reliability and limitations. When possible, provide data from the testing used to make those determinations.

#7 Visual Conspicuity

In addition to the RPIC being able to detect and avoid others, the FAA expects that others should be able to see and avoid the sUA. During BVLOS operations, that expectation translates into a requirement that others will be able to see the sUA at a distance of at least 3 statute miles. Explain how the operation will accomplish this.

#8 Fail-Safes

When something goes wrong, how will the operational team know? The FAA wants waiver applicants to explain how the RPIC will be alerted of any degraded sUAS functionality or malfunctions and how he/she will respond.

In addition to the sUAS details noted in Tip #3 above that determines a level of reliability of the aircraft, the FAA wants applicants to provide the following information with the BVLOS waiver application:

With that in mind, applicants should describe the specs of the sUA. Start with whether it is multi-rotor, fixed wing, hybrid (both multi-rotor and fixed wing), single rotor, lighter than air, etc.

- Mean time between failure testing with results.
- Reliability or maintenance program for the sUAS.
- Life limits on the sUAS and its components.
- System architecture.
- Hardware reliability analysis.
- Software design assurances and control.
- Any operational restrictions or limitations associated with this reliability level, such as, altitude limits or airspeed restrictions imposed by the manufacturer or self-imposed by the operator.

#9 Positional Data

This requirement ties into Tip #5, location data and #10, command and control. Describe the procedures the BVLOS team will follow to ensure that all required persons participating in the operation have relevant knowledge of all aspects of operating a sUA or drone that is outside the VLOS of the RPIC.

The FAA wants assurances of the sUA's Global Positioning System (GPS) functionality, including the ability to determine GPS signal availability for the flight time and location. In the event that GPS fails or provides reduced position accuracy, what's the back up or plan? Explain this in the context of both before and during all intended flights.

#10 Command and Control (C2)

The rubber meets the road in the command and control (C2) of the sUA. The WSEG presumes C2 will be RF-based. It requests a description of the emitters and C2 link used in the sUAS and information related to it including the:

- FCC grant of equipment authorization and FCC ID number for each emitter on the sUA or at the pilot station.
- FCC frequency licenses used by the sUA or at the pilot station.

- If the equipment is licensed by rule, indicate the FCC rule that applies (e.g., 47 CFR § 87.18).
- If the frequency is leased, provide a copy of the leasing agreement.
- Complete description of the emitters.
- Frequency or frequencies used to transmit.
- Antenna type, antenna mainbeam gain, and antenna pattern.
- Maximum range.
- Transmission power in watts and Decibel-milliwatts (dBm).
- Emission modulation.
- Receiver sensitivity.
- System losses.
- Acceptable bit error rate.

Other means to comply with C2 requirements could include use of LTE. Thus far, the FAA has not issued specific guidance on this.

VOTIX Helps Go Beyond: A Vignette

VOTIX, with its pioneering "Drone Orchestration" approach, integrates all processes and systems required for a BVLOS operation, such as enabling and tracking effective C2 and live video stream, including use of cellular connectivity, integrating Detect And Avoid (DAA) technologies and automating conflict resolution, integrating weather tracking, controlling operational limitations and automating fail-safe measures to increase safety. All this in a single panel that the pilot can easily operate from anywhere and perform safe and secure BVLOS flights. A good example is AviSight which, using VOTIX software platform, obtained a ground-breaking waiver this July for recurrent BVLOS inspections over several miles of Shell pipelines in the U.S. using Harris Aerial UAS.

A part of this FAA waiver, VOTIX successfully proved the efficacy of cellular connectivity for C2 and live video stream. Its drone orchestration software harnesses the power of LTE using cellular data through the cloud. This is not a particular emitter/transmitter with a specific FCC grant of authorization, it is LTE which is a commercial wireless broadband communication, widely used and already highly regulated, with great coverage, very affordable and reliable. VOTIX measures the drone's reachability and communication every second and that the applicant's UAS was tele-controlled in real time throughout all testing flights. The FAA approved this waiver in just 9 days of receiving the application with VOTIX reports.

The Bottom Line

The FAA will only grant a BVLOS waiver if the applicant proves that its operation provides an equivalent and acceptable level of safety to the CFR sections above. Answering the applicable questions on the WSEG is the minimum information expected. Providing more than the bare minimum and assessing all possible risks and mitigations, in as much detail as possible, will help ensure the application's success.

VOTIX is disrupting drone operations allowing virtually any drone to be operated remotely through the cloud using cellular connectivity and in compliance with FAA regulations. The Shell example is one of many that illustrates how VOTIX can convert any drone into an automated platform capable of rapidly deploying drone programs at scale at the safety levels required by regulators.

VOTIX has the tech and the experience to help companies succeed in obtaining a BVLOS waiver, the first time, every time.

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