Federal Aviation Administration

Memorandum

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To: All Airports Regional Division Managers

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Subject: Engineering Brief No. 105, Vertiport Design

This Engineering Brief provides interim guidance for the design of vertiports for aircraft with vertical takeoff and landing (VTOL) capabilities. Note that this interim guidance will be subject to update as data, analysis, and VTOL aircraft and operations develop in the future.

Attachment

FAA
Airports

ENGINEERING BRIEF #105

Vertiport Design

I Purpose.

This Engineering Brief (EB) specifies design guidance for public and private vertiports and vertistops, including modification of existing helicopter and airplane landing facilities, and establishment of new sites. While the design guidance contained herein refers to vertiport design, the design guidance applies to both vertiports and vertistops where appropriate. This EB is written for vertical takeoff and landing (VTOL) aircraft powered with electric motors and utilizing distributed electric propulsion in contrast to propulsion systems built solely around an internal combustion engine.

At this time, the Federal Aviation Administration (FAA) does not have enough validated VTOL aircraft performance data and necessarily is taking a prescriptive and conservative approach with the recommendations in this EB. Vertiport guidance is expected to evolve into a performance-based design standard, potentially with aircraft grouped by their performance characteristics. This EB is written for aircraft with a maximum takeoff weight (MTOW) of 12,500 lbs (5,670 kg) or less.

This EB is a living document that serves as the FAA's initial interim guidance and will be updated over time to adapt and address new aircraft and technology as performance data is received. Figures in this document are general representations and are not to scale.

II Background.

The FAA has identified a need for guidance for vertiports to be utilized by VTOL aircraft.

The FAA's previous Advisory Circular (AC) on Vertiport Design, published on May 31, 1991, provided guidance for vertiport design and was based on civil tiltrotors modeled after military tiltrotor technology. However, the intended aircraft were never used commercially, and the AC was cancelled on July 28, 2010. Currently the closest type of aviation infrastructure, being used by many for comparison purposes, is heliports and helistops. AC 150/5390-2, *Heliport Design*, is based on helicopters with single, tandem (front and rear) or dual (side by side) rotors. The emerging VTOL aircraft are not proven to perform like conventional helicopters or very large tiltrotor aircraft.

This EB provides the interim guidance needed to support initial infrastructure development for VTOL operations. This EB provides guidance for existing vertiport design and geometry elements. This guidance is correlated to the reference VTOL

aircraft described in paragraph 1.5 below. The Reference Aircraft represents a VTOL aircraft that integrates certain performance and design characteristics of nine emerging aircraft currently in development and is used to specify certain performance and design characteristics that informed the guidance in this EB. The Reference Aircraft was developed based on interactions with original equipment manufacturers (OEMs) and multiple FAA lines of business (LOBs).

There is currently limited demonstrated performance data on how VTOL aircraft operate. Research efforts are underway to better understand the performance capabilities and design characteristics of emerging VTOL aircraft. The FAA will develop a performance-based AC on vertiport design in the future, as additional performance data is gleaned about these emerging VTOL aircraft. The AC will detail categories of vertiport facilities requiring different design criteria depending on the characteristics of the aircraft they plan to support as well as the activity levels at the facility.

The future guidance will address more advanced operations including autonomy, different propulsion methods, density, frequency, and complexity of operations facilities. The AC on vertiport design will also address VTOL aircraft using alternative fuel sources such as hydrogen and hybrid. Future guidance will also include aircraft that do not currently conform to the Reference Aircraft included in this EB (for example, aircraft with an MTOW over 12,500 pounds (5,670 kg)) and address instrument flight rules (IFR) capability and the use of multiple final approach and takeoff areas (FATOs).

To support the development of a comprehensive vertiport design AC, additional research is required to garner VTOL aircraft performance data on downwash/outwash, failure conditions or degradation of performance, landing precision, climb/descend gradients, and all azimuth weather capabilities. The data will be collected and used by the FAA research team to fill in aircraft information gaps. This will require coordination within the FAA across the various LOBs, as well as external collaboration with manufacturers and other stakeholders. A proponent interested in sharing data must work with FAA Office of Airport Safety and Standards to provide validated empirical data that addresses these performance data gaps.

III Application.

This EB is intended as interim guidance for vertiport design until a more comprehensive performance-based vertiport design AC is developed. The guidance herein is not legally binding in its own right and will not be relied upon by the FAA as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with this guidance, as distinct from existing statutes, regulations, and grant assurances, is voluntary only, and nonconformity will not affect existing rights and obligations. The standards and guidance contained in this EB are practices the FAA recommends to establish an acceptable level of safety, performance and operation in the design of new civil vertiports, and for modifications of existing helicopter and airplane landing facilities to accommodate operations of VTOL aircraft.

The vertiport design criteria in this EB is intended for VTOL aircraft that meet the performance criteria and design characteristics of the Reference Aircraft described in

paragraph 1.5 and Table 1-1, flying in visual meteorological conditions (VMC) with the pilot on board. These design recommendations are for a single aircraft using the touchdown and lift off (TLOF) area, FATO area, and Safety Area at one time. Vertiport operators working with the proponent referencing this EB are responsible for confirming the ingress and egress path is clear. See paragraph 2.5.

Table 1-1: Reference Aircraft

Design Characteristics	**Criteria**
Propulsion	Electric battery driven, utilizing distributed electric propulsion
Propulsive units	2 or more
Battery systems	2 or more
Maximum takeoff weight (MTOW)	12,500 pounds (5,670 kg) or less
Aircraft length	50 feet (15.2 m) or less
Aircraft width	50 feet (15.2 m) or less
Operating Conditions	**Criteria**
Operation location	Land-based (ground or elevated) – no amphibian or float operations
Pilot	On board
Flight conditions	VFR
Performance	**Criteria**
Hover	Hover out of ground effect (HOGE) in normal operations
Takeoff	Vertical
Landing	Vertical
Downwash/Outwash	Must be considered in TLOF/FATO sizing and ingress/egress areas to ensure no endangerment to people/property in the vicinity, and no impact to safety critical navigational aids and surfaces, supporting equipment, nearby aircraft, and overall safety

Further research is needed to understand VTOL taxiing and parking needs. In future guidance, parking and taxiway guidance will be included. If necessary in the interim, vertiports designed for ground taxiing can follow AC 150/5300-13, *Airport Design*, taxiway guidelines for Group 1 aircraft. For hover taxi, vertiport design should follow taxiway guidance in AC 150/5390-2, *Heliport Design*, for the Transport Category. For parking, vertiport design should follow guidance in AC 150/5390-2 for the Transport Category.

For vertiport facilities that will also accommodate helicopter operations, the proponent should follow the recommendations in this EB and mark the facility as a vertiport unless the facility is built to the Transport Category heliport design standard, as described in paragraph 3.0.

This EB provides guidance on marking, lighting, and visual aids that identify the facility as a vertiport. This guidance applies to new vertiports or to heliports that are altered to vertiports.

Vertiport facilities that are intended to serve aircraft that do not meet the performance criteria and design characteristics of the Reference Aircraft included in this EB should begin coordination with the applicable FAA Regional or Airports District Office early in the planning and design process for the takeoff and landing area and will be subject to review on a case-by-case basis.

V Questions.
Contact the FAA Airport Engineering Division, AAS-100, for any questions about this EB.

VI Effective Date.
This EB becomes effective as of the date the associated memorandum is signed by the Manager, FAA Airport Engineering Division, AAS-100.

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Tables

1.0 Introduction.

1.1. Engineering Brief (EB) Guideline Justification.

Information collected through a literature review and original equipment manufacturer (OEM) coordination indicates that emerging VTOL aircraft will demonstrate similar performance characteristics to helicopters. However, limited data is available on VTOL aircraft operational characteristics, performance, maneuverability, downwash/outwash impacts, and vertiport obstacle information needs. Consequently, this EB is limited to pilot-on-board, visual flight rule (VFR) operations, and VTOL aircraft that have the characteristics and performance of the Reference Aircraft described in paragraph 1.5.

Heliports provide the most analogous present-day model for vertiports. However, despite the similarities between the two types of aircraft, there are design differences between traditional helicopters and VTOL aircraft. VTOL aircraft have varied configurations and propulsion systems, with and without wings, and with varied landing configurations. As a result, the conversion ratio in AC 150/5390-2 of 0.83 × the overall length being used to calculate the main rotor diameter of the design helicopter is not representative of the diverse characteristics associated with the various VTOL aircraft being developed. In addition, there persists a lack of validated data on the performance capabilities of VTOL aircraft.

The limited tangible data available to validate OEM performance, especially in failure conditions, recommends a wider touchdown and liftoff area (TLOF) and load bearing final approach and takeoff area (FATO) than currently required for a general aviation heliport in AC 150/5390-2. Due to these performance data gaps, including downwash, the larger physical dimensions would accommodate a potentially wider landing scatter and decreased climb performance in different scenarios

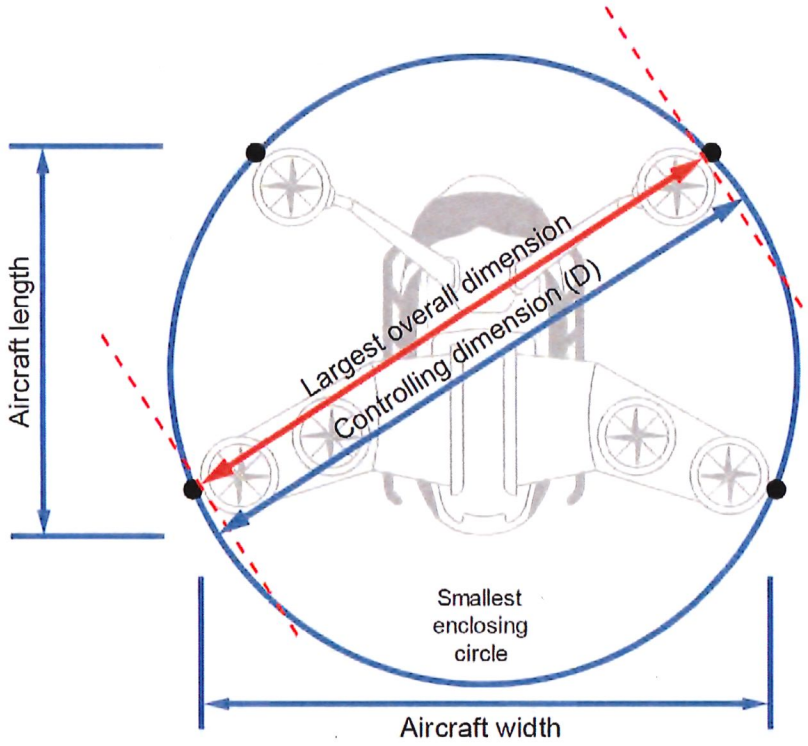
The anticipated Advanced Air Mobility (AAM) density, frequency, and complexity of operations is expected to be high in some cases. These operations are also anticipated to include commercial and air carrier operators, and will require certain safety levels and infrastructure requirements most analogous to the predetermined level of safety set in the Transport Category heliport design guidelines in AC 150/5390-2.

Preliminary data garnered from the VTOL aircraft manufacturers to support the development of this EB claims no need by the aircraft for effective transitional lift (ETL) to fly and an ability to hover out of ground effect (HOGE). Therefore, the minimum sizing standards that accommodate the need for ETL per the Transport Category heliport criteria (e.g., 100 feet (30.5 m) by 200 feet (61 m) FATO) is not specified in this EB. As such, this EB is intended for aircraft that have HOGE capability. If the vertiport design VTOL aircraft is proven not to perform HOGE, this EB is not applicable, and the sponsor must work directly with the FAA to determine alternative vertiport sizing for that design VTOL aircraft.

1.2. Explanation of Terms.
Terms used in this EB:

1. *Approach/Departure Path*: The approach/departure path is the flight track that VTOL aircraft follow when landing at or taking off from a vertiport.
2. *Battery:* One or more electrically connected cells, assembled in a single container having positive and negative terminals. A battery may include inter-cell connectors and other devices.
3. *Battery pack:* Two or more battery systems.
4. *Battery system:* Comprised of the battery, the battery charger and any protective, monitoring, and alerting circuitry or hardware inside or outside of the battery. It also includes vents (where necessary) and packaging.
5. *Controlling dimension (D)*: The diameter of the smallest circle enclosing the VTOL aircraft projection on a horizontal plane, while the aircraft is in the takeoff or landing configuration, with rotors/propellers turning, if applicable. See Figure 1-1.
6. *Design VTOL aircraft:* The design VTOL aircraft is the largest electric, hydrogen, or hybrid VTOL aircraft that is expected to operate at a vertiport. This design VTOL aircraft is used to size the TLOF, FATO and Safety Area. Note that the design VTOL aircraft is different from the Reference Aircraft used to define the performance and design criteria in this EB.
7. *Downwash/Outwash*: The downward and outward movement of air caused by the action of rotating rotor blade, propeller, or ducted fan. When this air strikes the ground or some other surface, it causes a turbulent outflow of air from the aircraft.
8. *Elevated vertiport*: A vertiport is considered elevated if it is located on a rooftop or other elevated structure where the TLOF and FATO are at least 30 inches (0.8 m) above the surrounding surface (a ground level vertiport with the TLOF on a mound is not an elevated vertiport).
9. *Effective transitional lift (ETL):* The pronounced increase in translational lift during transition to forward flight due to the rotor/propeller experiencing a significantly decreased induced airflow.
10. *Failure condition (FC)*: FC is generally defined as an occurrence of any likely event, caused or contributed to by one or more failures, which affects the aircraft's ability to generate lift or thrust and results in a consequential state that has an impact for a given flight phase.

Figure 1-1: Controlling Dimension



11. *Final approach and takeoff area (FATO)*: The FATO is a defined, load-bearing area over which the aircraft completes the final phase of the approach, to a hover or a landing, and from which the aircraft initiates takeoff.

12. *Ground Effect:* A condition of usually improved performance encountered when the aircraft is operating very close to the ground or a surface. It results from a reduction in upwash, downwash, and/or blade tip vortices, which provide a corresponding decrease in induced drag.

13. *Hover:* The word "hover" applies to an aircraft that is airborne and remaining in one place at a given altitude over a fixed geographical point regardless of wind. Pure hover is accomplished only in still air. For the purpose of this EB, the word "hover" will mean pure hover.

14. *Hover out of ground effect (HOGE):* The ability to achieve hover without the benefit of the ground or a surface.

15. *Imaginary surface(s)*: The imaginary planes defined in Title 14 Code of Federal Regulations (CFR) Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, centered about the FATO and the approach/departure paths, which are used to identify the objects where notice to and evaluation by the FAA is required.

16. *Obstruction to air navigation*: Any fixed or mobile object, including a parked aircraft, of greater height than any of the heights or surfaces presented in subpart C of 14 CFR Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace.*
17. *Reference Aircraft:* The Reference Aircraft represents a VTOL aircraft that integrates certain performance and design characteristics of nine emerging aircraft currently in development. This Reference Aircraft is used to specify certain performance and design characteristics that informed the vertiport design guidance in this EB.
18. *Safety Area*: The Safety Area is a defined area surrounding the FATO intended to reduce the risk of damage to aircraft accidentally diverging from the FATO.
19. *Translational Lift:* Translational lift is the improved rotor/propeller efficiency resulting from directional flight.
20. *Touchdown and liftoff area (TLOF)*: The TLOF is a load bearing, generally paved area centered in the FATO, on which the aircraft performs a touchdown or liftoff.
21. *Vertiport*: An area of land, or a structure, used or intended to be used, for electric, hydrogen, and hybrid VTOL aircraft landings and takeoffs and includes associated buildings and facilities.
22. *Vertiport elevation:* The highest elevation of all usable TLOFs within the vertiport expressed in feet above mean sea level (MSL).
23. *Vertistop*: A vertistop is a term generally used to describe a minimally developed vertiport for boarding and discharging passengers and cargo (i.e., no fueling, defueling, maintenance, repairs, or storage of aircraft, etc.). The design standards and recommendations in this EB apply to all vertiports, which includes vertistops.

1.3. Airspace Approval Process and Coordination.

For vertiport development on federally obligated airports, the infrastructure or equipment must be depicted on the Airport Layout Plan (ALP) and a Form 7460-1 submitted for an airspace determination prior to development. The FAA's review of the ALP and airspace determination must be completed prior to the start of operations.

For development on non-federally obligated airports or heliports or for non-federally funded standalone vertiport sites, and in compliance with 14 CFR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports*, the proponent must submit FAA Form 7480-1, *Notice for Construction, Alteration and Deactivation of Airports*, at least 90 days in advance of the day that construction work is to begin on the takeoff and landing area. **Note:** Airspace determination is not tied to this 90-day advance notice. Given the nascence of the AAM industry, the FAA highly encourages that engagement with the appropriate FAA regional or district office begin before the submission of the Form 7480-1, but an FAA evaluation is predicated on the submitted Form 7480-1.

Heliport facilities that are being altered in geometry in accordance with the design criteria in this EB, if non-federally funded, the sponsor will need to submit a new Form 7480-1 to re-designate the facility as a vertiport before VTOL operations should commence at the

site. The Form 7480-1 can be submitted electronically as a Landing Area Proposal (LAP) at OEAAA.faa.gov. The FAA's Flight Standards Service Office will determine when to do an onsite evaluation using risk-based analysis.

1.4. State/Local Role.

Many state departments of transportation, aeronautics commissions, or similar authorities require prior approval and, in some instances, a license or permit to establish and operate landing facilities. Those seeking to establish a vertiport should first contact their respective state or local transportation or aeronautics departments or commissions for specifics on applicable licensing or permitting. Several states and municipalities also administer a financial assistance program like the federal program and are staffed to provide technical advice. Contact information for state aviation agencies is available at https://www.faa.gov/airports/resources/state_aviation/.

In addition to state requirements, many local communities have enacted zoning ordinances, building and fire codes, and conditional use permitting requirements that can affect the establishment and operation of landing facilities. Some communities have developed codes or ordinances regulating environmental issues such as noise and air pollution. Therefore, communities, proponents, or sponsors seeking to establish a public- or private-use vertiport should make early contact with:

- local officials or agencies representing the local zoning board;
- the fire, police, or sheriff's department; and
- stakeholders who represent the area where the vertiport is to be located.

State regulators, departments of transportation, and local communities can also use the guidance and best practices outlined in this EB when reviewing a proposed vertiport facility or developing independent standards.

In addition to state and local coordination, vertiport proponents are encouraged to coordinate potential sites with any nearby airports or aviation stakeholders. Lack of early coordination can cause airspace, operational, safety, capacity, and financial impacts. While the FAA will review all new vertiport proposals for the safe and efficient utilization of navigable airspace by aircraft and the safety of persons and property on the ground, early coordination with these entities may offer early insights into airspace and capacity conflicts before investments are made.

1.5. Reference Aircraft.

The Reference Aircraft represents a VTOL aircraft that integrates certain performance and design features of nine emerging aircraft currently in development. This Reference Aircraft is used to specify the performance and design characteristics for the purposes of vertiport design in this EB.

Emerging VTOL aircraft models are evolving rapidly with OEMs approaching aircraft certification from a wide range of different designs. While aircraft classifications are

useful in takeoff and landing area design and airspace analysis, new VTOL aircraft concepts vary significantly in terms of design, aircraft dimensions, performance, and operational characteristics. Furthermore, these new VTOL aircraft do not have an established safety record and have not yet received FAA airworthiness certification. This makes it impractical to categorize VTOL aircraft as the FAA has traditionally done with FAA certificated fixed wing and rotor aircraft. However, OEM engagement has revealed some common characteristics among VTOL aircraft prototypes including multiple propulsion systems, HOGE capability, and helicopter performance similarities.

The vertiport design guidance in this EB relies on design characteristics, expected performance capabilities, and preliminary assumptions regarding takeoff and landing area design until there is adequate research on these emerging aircraft to develop a performance-based vertiport design AC. Accordingly, the aircraft features and performance capabilities listed in Table 1-1 create a Reference Aircraft type to inform this EB. The design characteristics, performance, and operating conditions that make up this reference VTOL aircraft will be reviewed in the future as the FAA continues to engage with emerging VTOL aircraft manufacturers.

2.0 Vertiport Design and Geometry.

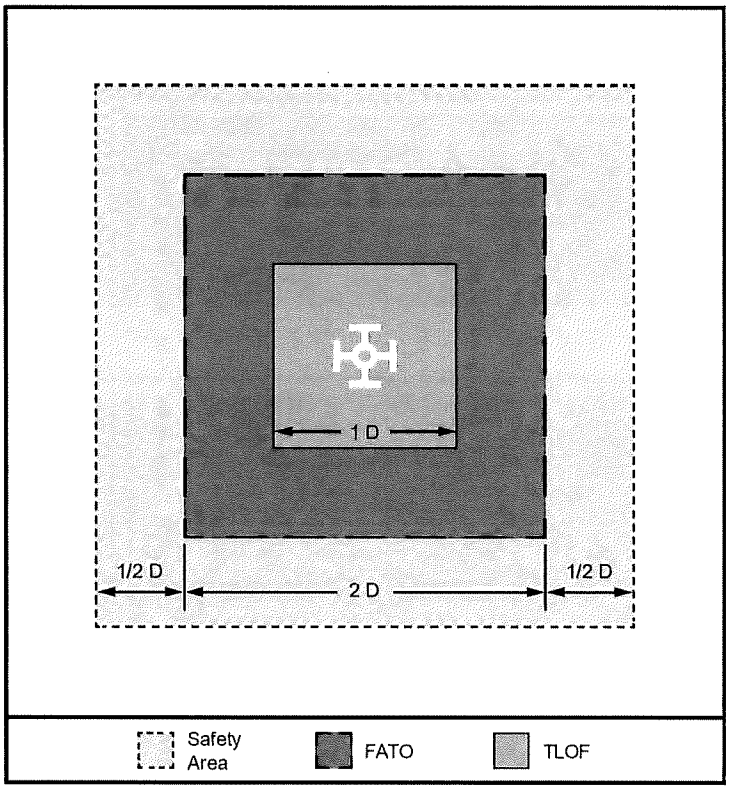
2.1. Overview.

The takeoff and landing area design and geometry contained in this EB includes the TLOF, the FATO, and the Safety Area. The dimensions for these areas are presented in Table 2-1 and are based on the controlling dimension (D) of the design VTOL aircraft as defined for each vertiport facility. The D is the diameter of the smallest circle enclosing the VTOL aircraft projection on a horizontal plane, while the aircraft is in the takeoff or landing configuration, with rotors/propellers turning, if applicable. See Figure 1-1. 1D is equal to the longest distance described above. The following sections provide specific details about these areas. See Figure 2-1 for the relationship among the TLOF, FATO, and Safety Area.

Table 2-1: Takeoff and Landing Area Dimensions

Element	Dimension
TLOF	1D
FATO	2D
Safety Area	3D (½ D added to edge of FATO)

Figure 2-1: Relationship and Dimensions of TLOF, FATO, and Safety Area



Note: As empirical validated performance data for individual VTOL aircraft is analyzed and understood, this criteria may be adjusted appropriately.

2.2. TLOF Guidance.

The TLOF is a load bearing, generally paved area centered in the FATO, on which the VTOL aircraft performs a touchdown or liftoff. The following guidelines apply to the TLOF:

1. Located at ground level, on elevated structures*, or at rooftop level.
2. On level terrain or a level structure.
3. Clear of penetrations and obstructions to the approach/departure and transitional surfaces.
4. Load bearing (static and dynamic for design VTOL aircraft).
    a. Supports the weight of the design VTOL aircraft and/or any ground support vehicles, whichever is more demanding for pavement design. The static loads are equal to the aircraft's maximum takeoff weight applied through the total contact area of the landing gear.
    b. Supports the dynamic loads based on 150 percent of the maximum takeoff weight of the design VTOL aircraft. For design purposes, assume the dynamic load at 150 percent of the maximum takeoff weight applied over the whole landing gear for a landing gear with wheels, and at the single point of contact for a landing gear with skids.
    c. Accounts for rotor/propeller downwash load in load-bearing capacity.
5. Centered within its own FATO.
6. Minimum width is 1D†.
7. For a circular TLOF, minimum diameter is 1D.
8. Minimum length is 1D§.
9. Circular, square, or rectangular in shape‡. The TLOF should have the same shape as the FATO and Safety Area.
10. Design the distance between the TLOF, FATO and Safety Area perimeters to be equidistant regardless of the shape of the TLOF.
11. Meets general surface characteristics and pavement guidelines including the following:

* A vertiport is considered elevated if it is located on a rooftop or other elevated structure where the TLOF and FATO are at least 30 inches (0.8 m) above the surrounding surface.

† The controlling dimension (D) of an aircraft is the longest distance between the two outermost opposite points on the aircraft (e.g., wingtip to wingtip, rotor tip to rotor tip, rotor tip to wingtip, fuselage to rotor tip) measured on a level horizontal plane that includes all adjustable components extended to their maximum outboard deflection. 1D is equal to the longest distance described above. 2D is equal to twice the long distance describe above.

‡ In 2011, the National EMS Pilots Association conducted a survey of 1,314 EMS pilots and found that the square was the preferred visual cue for judging aircraft closure rate, altitude, attitude, and angle of approach. It was rated higher than a circle, triangle, or octagon.

a. Has a paved or aggregate-turf surface (see AC 150/5370-10, *Standard Specifications for Construction of Airports*, items P-217, Aggregate-Turf Runway/Taxiway, and P-501, Cement Concrete Pavement).

b. Uses cement concrete pavement when feasible. An asphalt surface is discouraged as it is susceptible to heat stress and may rut under the weight of a parked VTOL aircraft, creating loose debris and potential catch points for landing gear.

c. Has a roughened pavement finish (e.g., brushed or broomed concrete) to provide a skid-resistant surface for VTOL aircraft and a non-slippery footing for people.

d. Elevations between any paved and unpaved portions of the TLOF and FATO are equal.

e. Surface is stabilized to prevent erosion or damage from rotor/propeller downwash or outwash from VTOL aircraft operations. (Find guidance on pavement design and soil stabilization in AC 150/5320-6, *Airport Pavement Design and Evaluation*, and AC 150/5370-10.)

f. Preferred surface of elevated TLOFs is concrete or metal. If the surface is conductive, it may need to be insulated and/or grounded to the extent feasible to eliminate the threat of conducting electricity in cases of a short circuit or lightning strike. If the surface is metal, it should be grounded. Insulation is permissible if grounding is not feasible. Construct rooftop and other elevated TLOFs of metal, concrete, or other materials subject to local building codes.

g. Elevated TLOFs comply with 29 CFR Section 1926.34, *Means of Egress*, and 29 CFR Section1910.25, *Stairways*, as applicable.

12. Gradient provides positive drainage (between -0.5 and -1.0 percent) off of and away from the pavement as shown in Figure 2-2.

13. For rooftop or other elevated TLOFs, ensure that:

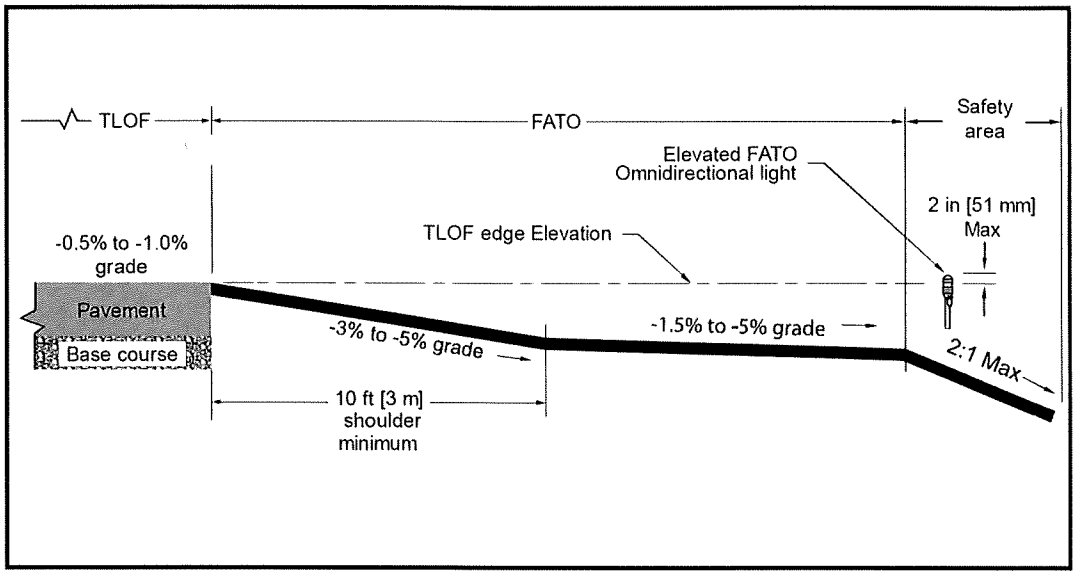
a. The FATO and TLOF are at or above the elevation of the adjacent Safety Area.

b. Elevator penthouses, cooling towers, exhaust vents, fresh-air vents, and other elevated features or structures do not affect VTOL aircraft operations or penetrate the TLOF, FATO, Safety Area, Approach Surface, or Transition Surface.

c. Fresh air vents for any attached building are not impacted by landing facility operations.

d. See paragraph 6.4, Turbulence.

Figure 2-2: Vertiport Gradients and Rapid Runoff Shoulder



Note 1: The slope direction is based on the topography of the site.

Note 2: Grade the TLOF, FATO, and Safety Area to provide positive drainage of the entire area for the TLOF, FATO, and Safety Area.

Note 3: 2:1 maximum Safety Area gradient for vertiports at ground level or where applicable at elevated structures.

2.3. FATO Guidance.

The FATO is a defined area over which the VTOL aircraft completes the final phase of the approach to a hover or a landing and from which the aircraft initiates takeoff. The following guidelines apply to the FATO:

1. Located at ground level, on elevated structures, or at rooftop level.
2. Clear with no penetrations or obstructions except for navigational aids that are fixed-by-function (e.g., flight path alignment marking and lighting, approach lighting, TLOF lights)[§], which must be on frangible mounts.

Note: While there is no accepted standard for frangibility regarding VTOL operations, remove all objects from a FATO and Safety Area except those of the lowest mass practicable and frangibly mounted objects no higher than 2 inches (51 mm) above the adjacent TLOF elevation, to the extent practicable.

3. Load bearing (static and dynamic for design VTOL aircraft), including the following features:

[§] An air navigation aid that must be positioned in a particular location to provide an essential benefit for aviation is fixed-by-function.

a. Supports the weight of the design VTOL aircraft and any ground support vehicles. The static loads are to be equal to the aircraft's maximum takeoff weight applied through the total contact area of the landing gear.

b. Assume dynamic loads at 150 percent of the maximum takeoff weight of the design VTOL aircraft.

c. Rotor/propeller downwash load is accounted for in load-bearing capacity.

4. Centered within its own Safety Area.

5. Minimum width is 2D.

6. Minimum length is 2D.

7. For a circular FATO, minimum diameter is 2D.

8. The same geometric shape as the TLOF** and Safety Area.

9. Design the distance between the TLOF, FATO and Safety Area perimeters to be equidistant regardless of the shape of the TLOF.

10. Meets general surface characteristics and pavement guidelines including the following:

a. Paved or aggregate-turf surface (see AC 150/5370-10, items P-217, Aggregate-Turf Pavement and P-501, Cement Concrete Pavement).

b. Uses cement concrete pavement when feasible. An asphalt surface is less desirable as it may rut under the weight of a parked VTOL aircraft.

c. Has a roughened pavement finish (e.g., brushed or broomed concrete) to provide a skid-resistant surface for VTOL aircraft and a non-slippery footing for people.

d. Elevations between any paved and unpaved portions of the FATO are equal.

e. Surface is stabilized to prevent erosion of damage from rotor/propeller downwash or outwash from VTOL aircraft operations. (Find guidance on pavement design and soil stabilization in AC 150/5320-6 and AC 150/5370-10.)

f. Preferred surface of elevated FATO is concrete. If the surface is metal, it must be insulated/grounded to the extent feasible to eliminate the threat of conducting electricity in the case of a short circuit or lightning strike.

g. Elevated FATOs should be metal or concrete and comply with 29 CFR Section 1926.34 and 29 CFR Section1910.25, as applicable.

11. The FATO surface prevents loose stones and any other flying debris caused by rotor/propeller downwash or outwash.

** In 2011, the National EMS Pilots Association conducted a survey of 1,314 EMS pilots and found that the square was the preferred visual cue for judging aircraft closure rate, altitude, attitude, and angle of approach. It was rated as excellent while the circle was rated as acceptable.

12. Gradient provides positive drainage (between 1.5 and 5.0 percent) off of and away from the pavement, with a minimum 10-foot wide (3 m wide) rapid runoff shoulder sloped between 3.0 and 5.0 percent, as shown in Figure 2-2. Design a negative gradient of not more than 2 percent in any areas where a VTOL is expected to land.
13. The edge of the FATO abutting the TLOF is the same elevation as the TLOF.
14. If the FATO is located on a rooftop or other elevated structures:
    a. The FATO and TLOF elevations are at or above the elevation of the adjacent Safety Areas.
    b. The FATO is above the level of any obstacle in the Safety Area that cannot be removed.
    c. Title 29 CFR Section 1910.28, *Duty to Have Fall Protection and Falling Object Protection*, requires the provision of fall protection if the platform is elevated 4 feet (1.2 m) or more above its surroundings. The FAA recommends such protection for all platforms elevated 30 inches (0.8 m) or more.
    d. Does not use permanent railings or fences that would be safety hazards during aircraft operations.
    e. Optionally, can use safety nets that meet state and local regulations, are at least 5 feet (1.5 m) wide, and meet the following criteria:
        i. The insides and outside edges of the nets are fastened to a solid structure.
        ii. The net is constructed of materials that are resistant to environmental effects and is inspected annually for integrity.
        iii. The net has a load carrying capability of 50 pounds per square foot (244 kg/sq m).
        iv. The net is located at or below the edge elevation of the FATO.
        v. The net is attached to the outer perimeter frame of the FATO.

2.4. Safety Area Guidance.

The Safety Area is a defined area surrounding the FATO intended to reduce the risk of damage to VTOL aircraft unintentionally diverging from the FATO. The following guidelines apply to the Safety Area:

1. Located at ground level, on elevated structures, at rooftop level, and can extend over water or in clear airspace.
2. Clear with no penetrations or obstructions except for navigational aids that are fixed-by-function[††], which must be on frangible mounts. **Note:** See paragraph 2.3.

[††] An air navigation aid that must be positioned in a particular location to provide an essential benefit for aviation is fixed-by-function.

3. For elevated TLOFs, no fixed objects within the Safety Area project above the FATO except those fixed-by-function which must be on frangible mounts. **Note:** See paragraph 2.3.
4. Minimum width is ½ D from the edge of the FATO.
5. Minimum length is ½ D from the edge of the FATO.
6. The same geometric shape as the TLOF and FATO.
7. Design the distance between the TLOF, FATO and Safety Area perimeters to be equidistant regardless of the shape of the TLOF.
8. If at ground level, the surface prevents loose stones and any other flying debris caused by downwash or outwash.
9. If at ground level, gradient provides positive drainage away from the FATO no steeper than 2:1, horizontal units and vertical units, respectively. See Figure 2-2.
10. On rooftop or other elevated FATOs, meets requirements contained in Section 1910.28.

2.5. VFR Approach/Departure Guidance.

2.5.1. VFR Approach/Departure and Transitional Surfaces.
The imaginary surfaces defined in 14 CFR Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, for heliports are applicable to vertiports and include the primary surface, approach, and transitional surfaces. Part 77 establishes standards and notification requirements for objects affecting navigable airspace. This notification provides the basis for:

- evaluating the effect of construction or alteration on aeronautical operating procedures;
- determining the potential hazardous effect of proposed construction on air navigation;
- identifying mitigating measures to enhance safe air navigation; and
- aeronautical charting for new objects.

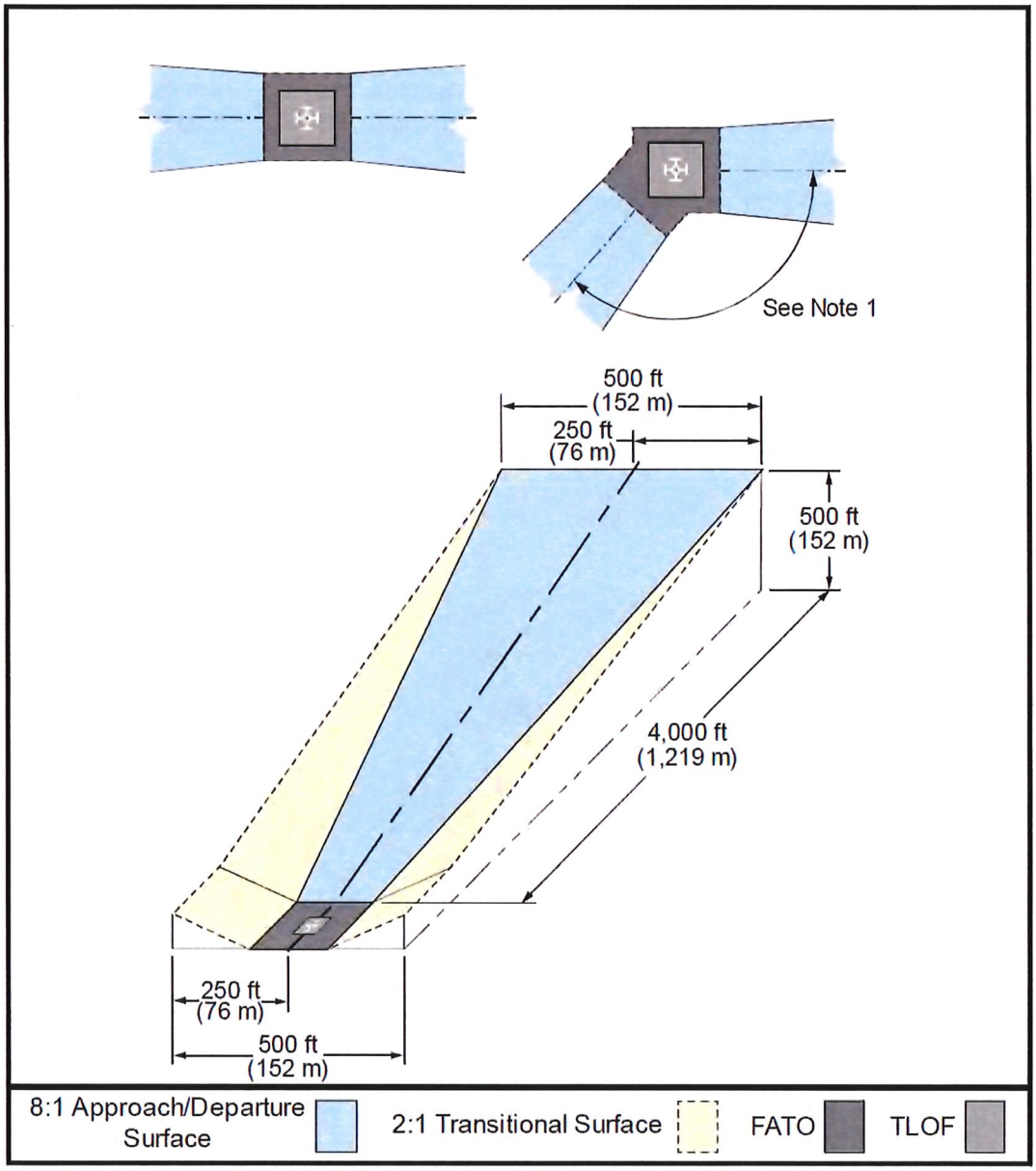
The following applies to these imaginary surfaces:

1. The primary surface coincides in size and shape with the FATO. This surface is a horizontal plane at the elevation of the established vertiport elevation.
2. The approach surface (and, by reciprocal, the departure surface) begins at each end of the vertiport primary surface with the same width as the primary surface and extends outward and upward for a horizontal distance of 4,000 feet (1,219 m) where its width is 500 feet (152 m). The slope of the approach surface is 8:1, horizontal units and vertical units, respectively.

3. The transitional surfaces extend outward and upward from the lateral boundaries of the primary surface and from the approach surfaces at a slope of 2:1, horizontal units and vertical units, respectively, for 250 feet (76 m) measured horizontally from the centerline of the primary and approach surfaces.
4. The approach and transitional surfaces are clear of penetrations unless an FAA aeronautical study determines penetrations to any of these surfaces not to be hazards.

See Figure 2-3 for visual depiction of this guidance.

Figure 2-3: VFR Vertiport Approach/Departure Surfaces



Note 1: The preferred approach/departure surface is based on the predominant wind direction. Where a reciprocal approach/departure surface is not possible in the opposite direction, use a minimum 135-degree angle between the two surfaces.

2.5.2. VFR Approach/Departure Path.

The approach/departure path is the flight track that VTOL aircraft follow when landing at or taking off from a vertiport. The following guidelines apply to the approach/departure path(s):

1. Preferred approach/departure paths are aligned with the predominant wind direction as much as possible, to avoid downwind operations and keep crosswind operations to a minimum.
2. More than one approach/departure path is provided as close to reciprocal in magnetic heading as possible (e.g., 180 degrees and 360 degrees).
3. Additional approach/departure paths are based on an assessment of the prevailing winds or separated from the preferred flight path by at least but not limited to 135 degrees.
4. All approach and departure surfaces are free of obstructions.
5. The approach/departure paths must assure 8:1 horizontal units and vertical units.
6. To the extent practicable, design vertiport approach/departure paths to be independent of approaches to, and departures from, active runways if separate vertiport takeoff and landing areas are needed.
7. The approach and departure path may be curved but only the VFR approach/departure and transitional surfaces outlined in paragraph 2.5.1 are addressed in 14 CFR Part 77, *Safe, Efficient Use and Preservation of the Navigable Airspace*. Therefore, while they may be used, curved approaches are not evaluated by the FAA for the effect of objects (temporary or permanent, existing or new) on aeronautical operating procedures. These curved approaches are also not considered in aeronautical charting for new objects.

See Figure 2-3 for a visual depiction of this guidance.

3.0 Marking, Lighting, and Visual Aids.

This section provides guidance on marking, lighting, and visual aids that identify the facility as a vertiport. This guidance applies to new vertiports or to heliports that are altered to vertiports.

3.1. General.

The following general guidelines apply to markings:

1. Paint or preformed materials define the TLOF and FATO within the limits of those areas. See AC 150/5370-10, Item P-620, for specifications.
2. Reflective paint and retroreflective markers are optional and should be used with caution, as overuse of reflective material can be blinding to a pilot when using landing lights and/or night vision goggles.
3. Outlining markings and lines with a 2-6-inch (55-152 mm)-wide line of a contrasting color is an option to enhance conspicuousness.
4. TLOF perimeter marking is a 12-inch-wide (305 mm wide) solid white line.
5. TLOF size and weight limitation box is included on a TLOF with a hard surface (described in paragraph 3.3) and as an option on a TLOF with a turf surface.
6. FATO perimeter is marked by 12-inch-wide (305 mm wide) dashed white lines that are 5 feet (1.5 m) in length with end-to-end spacing of 5 to 6 feet (1.5 to 1.8 m) apart.

See Figure 3-1 for a visual depiction of the standard vertiport marking.

Figure 3-1: Standard Vertiport Marking

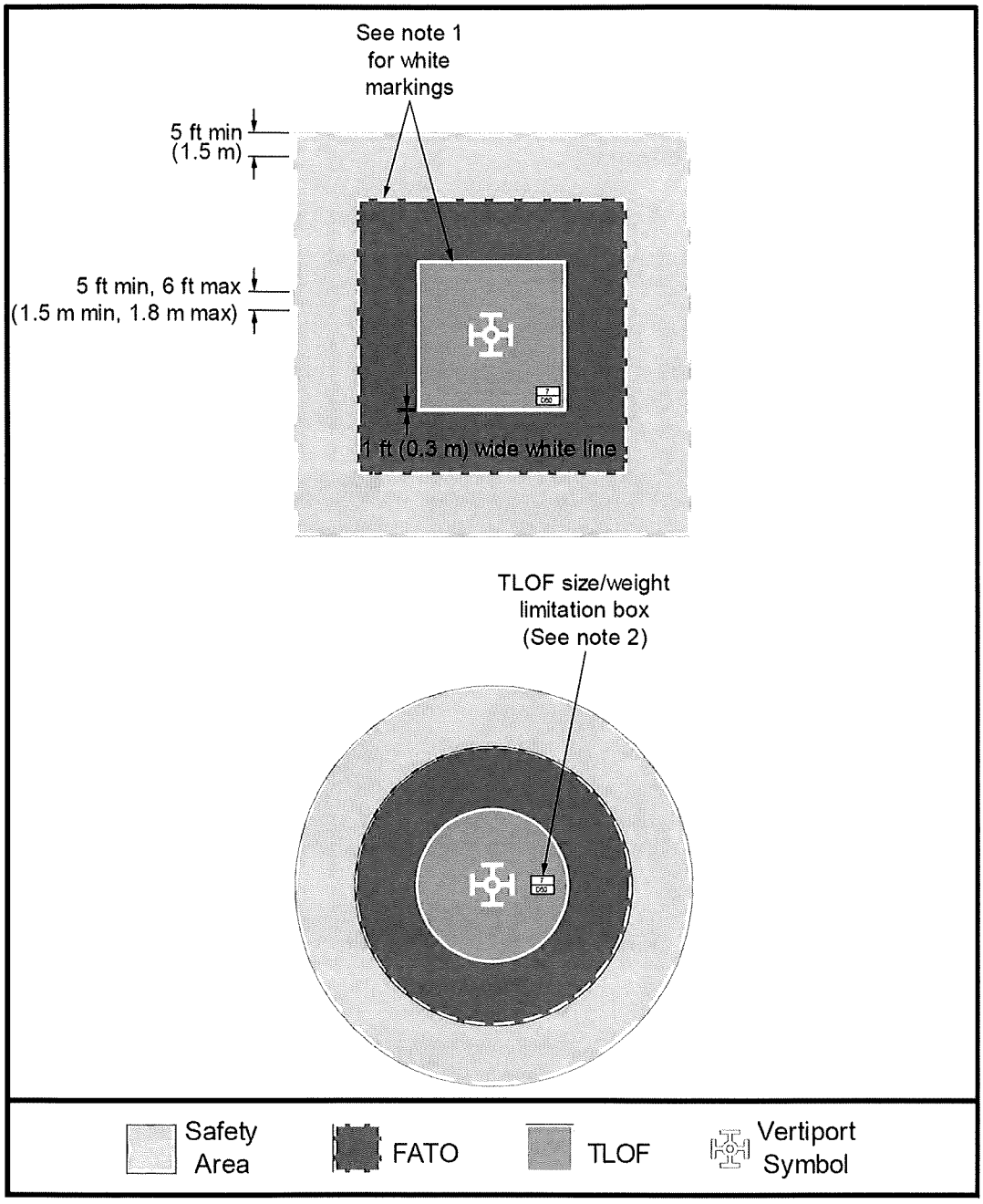


Figure is configured for 50-foot (15.2 m) TLOF.

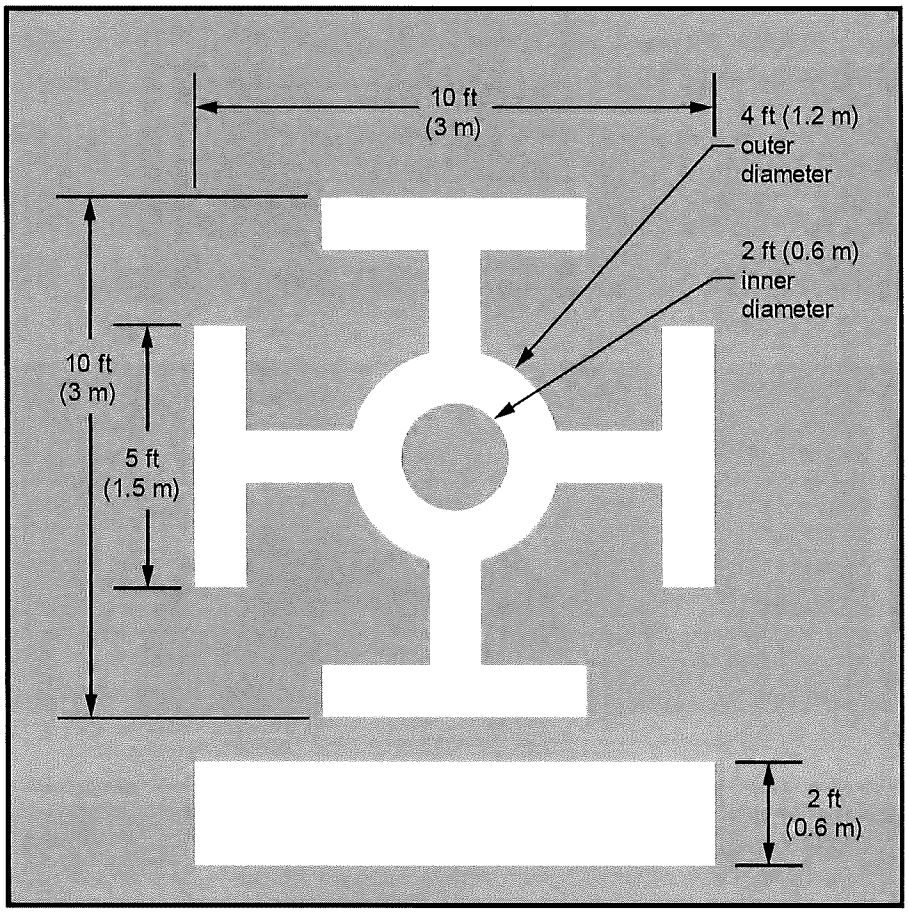
Note 1: Solid and dashed white lines are 12 inches (305 mm) in width. Dashed lines are 5-foot (1.5 m) in length with 5-6-foot (1.5-1.8 m) spaces.

Note 2: See Figure 3-3 for details on the TLOF size/weight limitation box.

3.2. Identification Symbol.

The vertiport identification marking or symbol identifies the location as a vertiport, marks the TLOF, and provides visual cues to the pilot. Vertiport facilities should use the broken wheel symbol shown in Figure 3-2.‡‡ The symbol is in the center of the TLOF. Paint a 2-foot-wide (0.6 m wide) bar, of the same color as the broken wheel, 2 ft (0.6 m) below the broken wheel symbol when necessary to distinguish the preferred approach/departure direction.

Figure 3-2: Vertiport Identification Symbol



Note 1: White lines on the vertiport identification symbol at 12 inches (305 mm) wide.
Note 2: White bar, 10 ft × 2 ft (3 m × 0.6 m), denotes preferred approach/departure direction.

‡‡ The broken wheel symbol placed second in a research test conducted in 1967 for most visible and informative symbol for heliports. The most visible and informative was a Maltese Cross, which the FAA adopted for heliports and then repealed. The broken wheel symbol performs the following functions: identifies the vertiport from a minimum distance and angle; offers a means of directional control on approach; serves as a field of reference in maintaining attitude on approach; assists the pilot in controlling the rate of closure on approach; acts as a point of convergence to a desired location; and assists the pilot when the aircraft is directly over the vertiport. It was adopted by the now cancelled Vertiport Design AC. (Smith, Safe Heliports Through Design and Planning, 1994, p. 41).

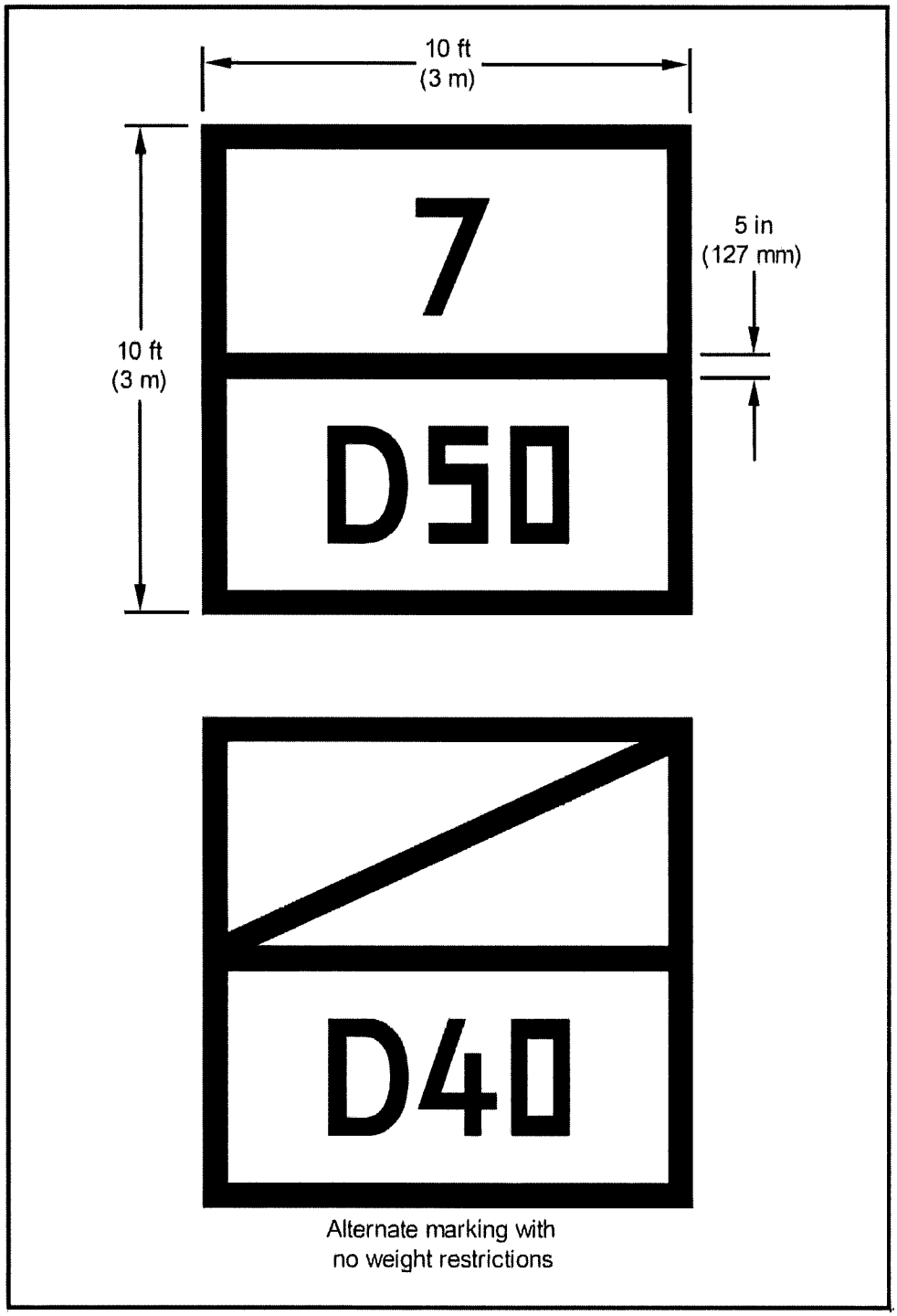
3.3. TLOF Size/Weight Limitation Box.

The TLOF size/weight limitation box indicates the controlling dimension (maximum length or width) and the maximum takeoff weight of the design VTOL aircraft that can use the vertiport. Weight limitation boxes should meet the following guidance:

1. The letter "D" and the weight, in imperial units, of the design VTOL aircraft that the vertiport is designed to accommodate are in a box in the lower right-hand corner of a rectangular TLOF, or on the right-hand side of the symbol of a circular TLOF, when viewed from the preferred approach direction.
2. The numbers are black on a white background.
3. The top number is the maximum takeoff weight of the design VTOL aircraft in thousands of pounds for the design VTOL the TLOF will accommodate. It is centered in the top half of the box.
4. The bottom number is the controlling dimension of the design VTOL aircraft, is centered in the bottom half of the box, and is preceded by the letter "D."
5. An existing TLOF without a weight limit is marked with a diagonal line extending from the lower left-hand corner to the upper right-hand corner in the upper section of the TLOF size/weight limitation box.

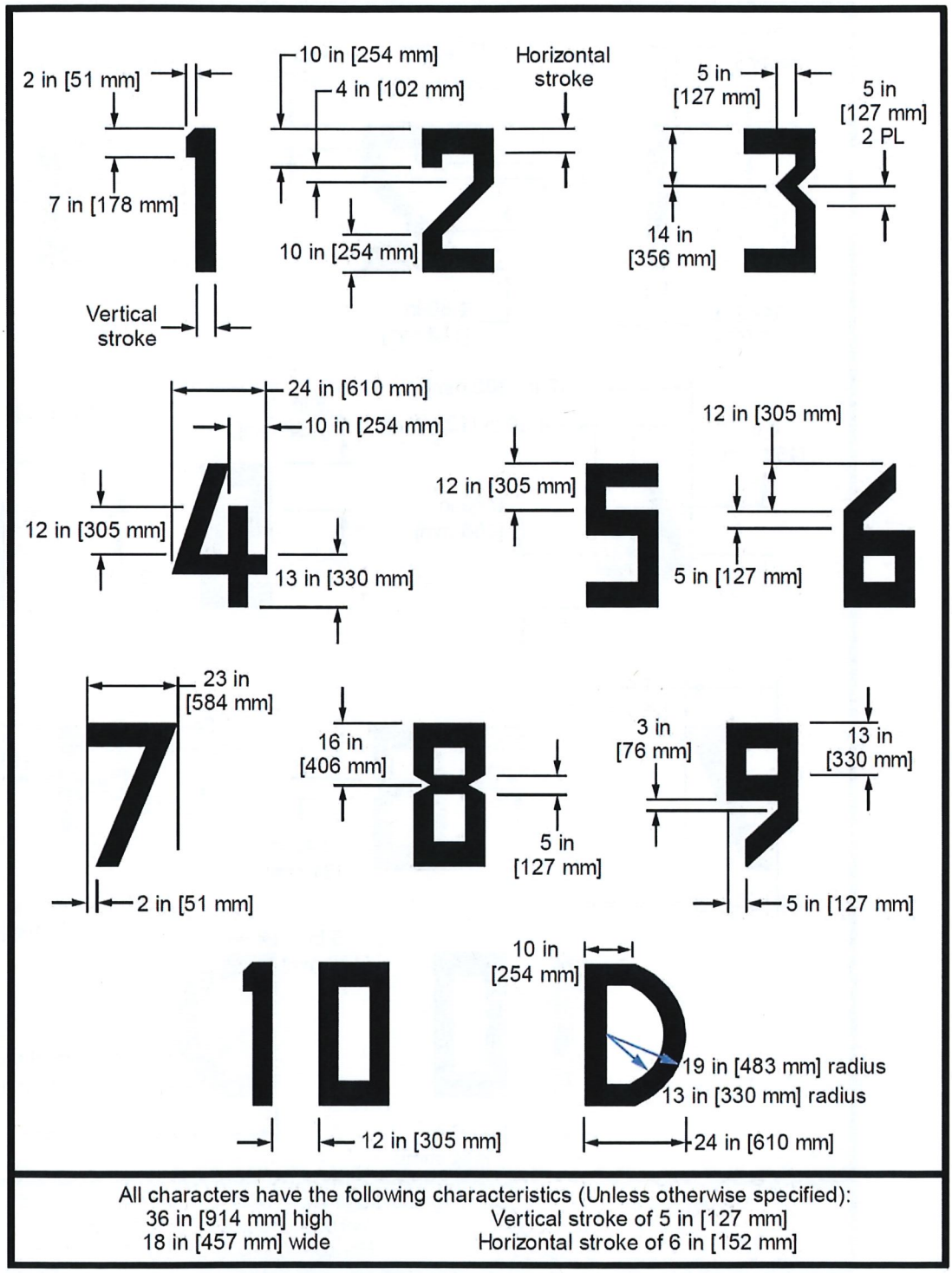
See Figure 3-3 for details on the TLOF size/weight limitation box, and Figure 3-4 and Figure 3-5 for details on the form and proportions of the numbers and letters specified for these markings.

Figure 3-3: TLOF Size/Weight Limitation Box



Note: Make the minimum size of the box 5 ft (1.5 m) square. Where possible, increase this dimension to a 10 ft (3 m) square for improved visibility.

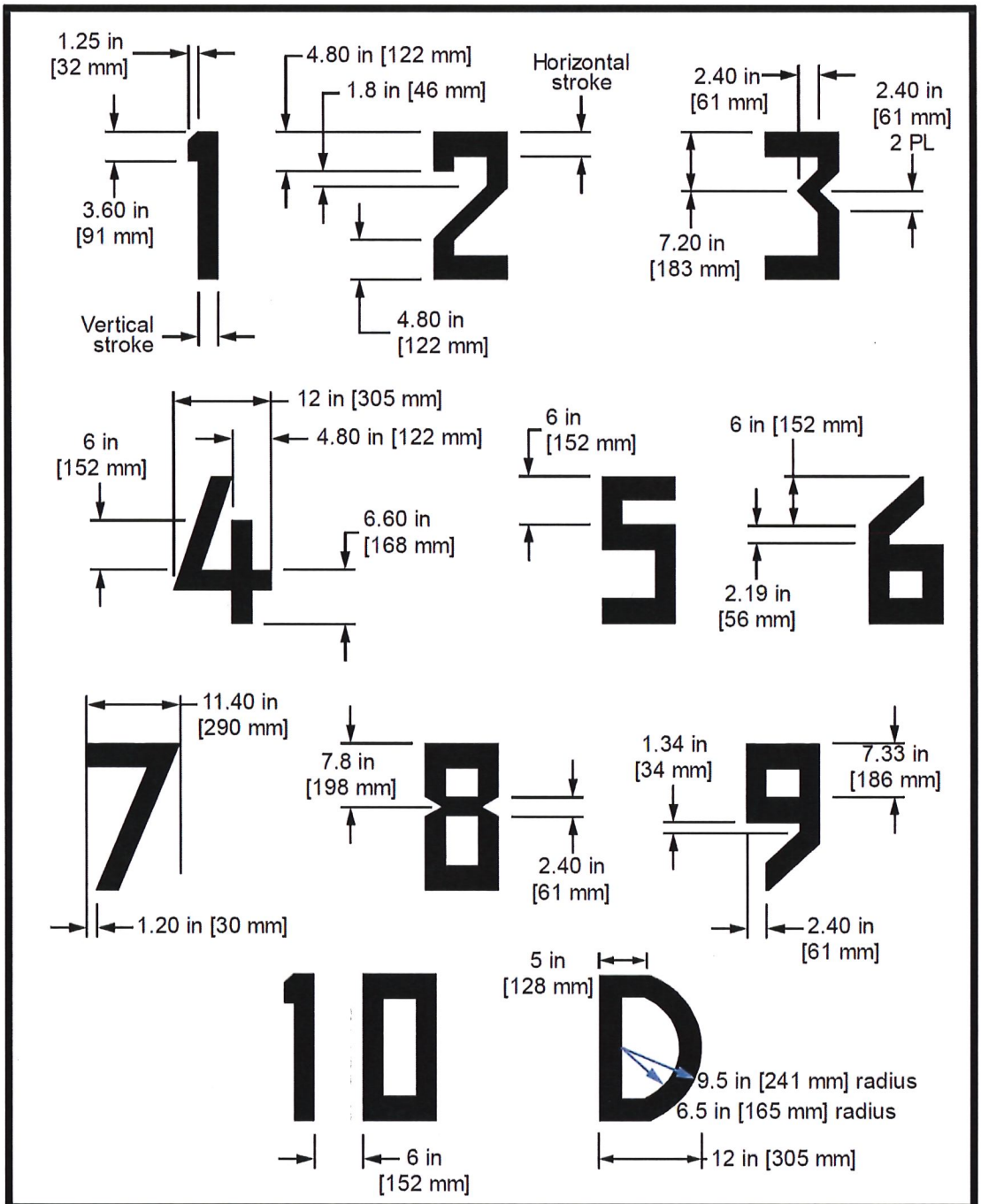
Figure 3-4: Form and Proportions of 36-inch (914 mm) Numbers for Marking Size and Weight Limitations



All characters have the following characteristics (Unless otherwise specified):

36 in [914 mm] high	Vertical stroke of 5 in [127 mm]
18 in [457 mm] wide	Horizontal stroke of 6 in [152 mm]

Figure 3-5: Form and Proportions of 18-inch (457 mm) Numbers for Marking Size and Weight Limitations



All characters have the following characteristics (Unless otherwise specified):

18 in [457 mm] high
9 in [229 mm] wide
Vertical stroke of 2.5 in [64 mm]
Horizontal stroke of 3 in [76 mm]

3.4. Flight Path Alignment Optional Marking and Lighting.
Flight path alignment marking and lighting is optional and includes markings and/or lights when it is desirable and practicable to indicate available approach and/or departure flight path direction(s). Guidance for optional flight path alignment marking and lighting includes:

1. The shaft of each arrow is 1.5 ft (0.5 m) wide and at least 10 feet (3 m) long.
2. The arrow heads are 5 feet (1.5 m) wide and 5 feet (1.5 m) tall.
3. The color of the arrow must provide good contrast against the background color of the surface. Provide a contrasting border around the arrows if needed to increase visibility for the pilot.
4. An arrow pointing toward the center of the TLOF depicts an approach direction.
5. An arrow pointing away from the center of the TLOF depicts a departure direction.
6. In-pavement flight path alignment lighting is recommended. See paragraph 3.5 for additional guidance. For elevated lights, if the TLOF light conflicts with a flight path alignment light, remove the conflicting flight path alignment light fixture.
7. For a vertiport with a flight path limited to a single approach direction or a single departure path, the arrow marking is unidirectional (i.e., one arrowhead only). For a vertiport with only a bidirectional approach/takeoff flight path available, the arrow marking is bidirectional (i.e., two arrowheads).

See Figure 3-6 for additional guidance.

Figure 3-6: Flight Path Alignment Marking and Lighting

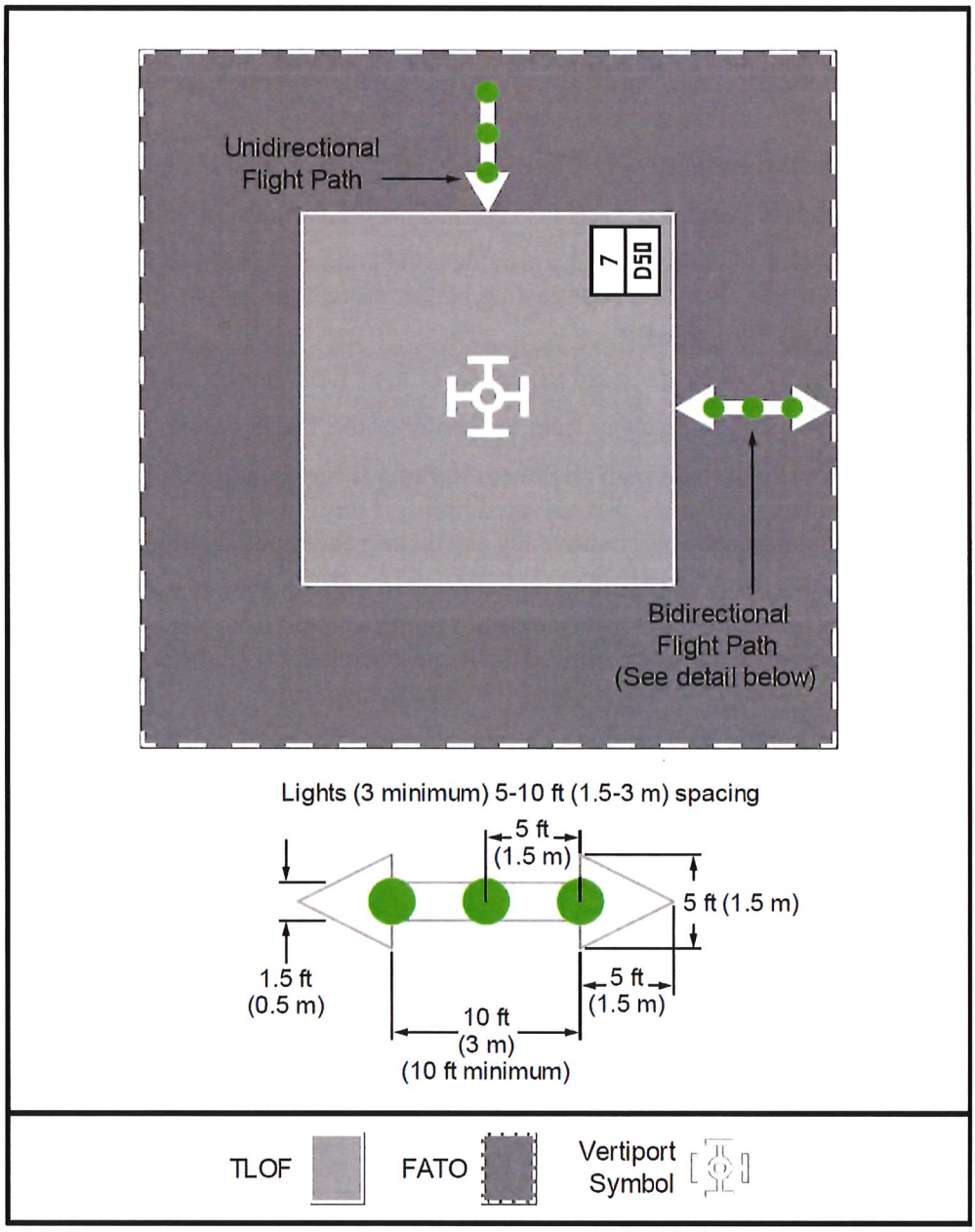


Figure is configured for 50-foot (15.2 m) TLOF

Note 1: Arrowheads have constant dimensions.
Note 2: If necessary, adjust stroke length to match length available. Minimum length = 10 ft (3 m).
Note 3: Light type: omnidirectional green lights, Type L-861H or L-852H.
Note 4: If necessary, locate the lights outside of the arrow.
Note 5: In-pavement flight path alignment lighting is recommended.
Note 6: See paragraph 3.4 for guidance on flight path alignment markings.

3.5. Lighting.

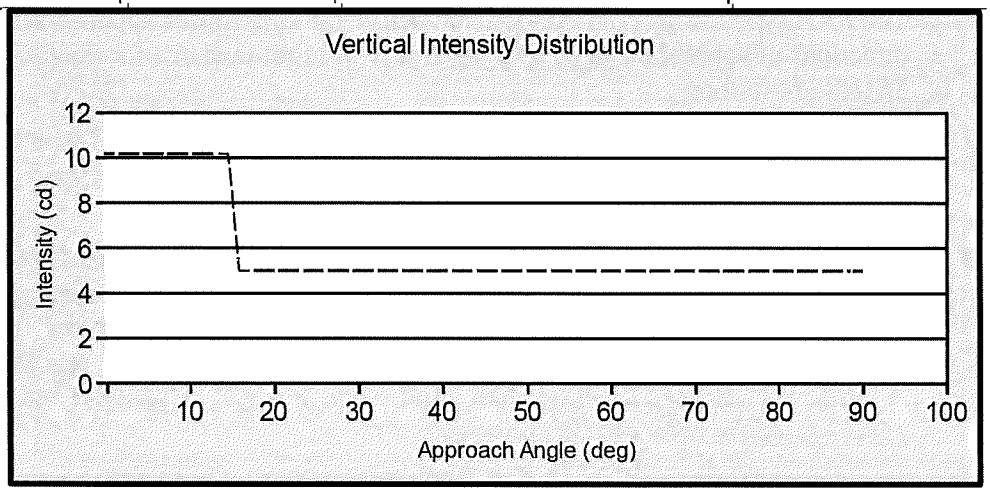
Lighting is required for vertiports that support night operations. The lighting should enable the pilot to both establish the location of the vertiport and identify the perimeter of the operational area. In-pavement lighting is preferred to elevated lighting. The following guidelines apply to lighting:

3.5.1. General.

1. The FAA type L-861H omnidirectional perimeter light fixture supports all possible directions of approach. AC 150/5390-2 provides the standards for the FAA type L-861H light fixture.
2. For reference, the light fixtures are listed in AC 150/5390-2 as FAA type L-861H, elevated heliport perimeter light, and Type L-852H, in-pavement heliport perimeter light.
3. With light fixture FAA type L-861H as the base, elevated (FAA type L-861H) and in-pavement (FAA type L-852H) fixtures will be established in the next update of AC 150/5345-46, *Specification for Runway and Taxiway Light Fixtures*. Use FAA type L-861H for TLOF and FATO perimeter applications and for Flight Path Alignment Lights and Landing Direction Lights. See AC 150/5390-2 and AC 150/5345-46 for additional information.
4. The elevated light emitting diode (LED) vertiport fixture and LED in-pavement fixtures are identified as L-861H (L) and L-852H (L), respectively.
5. Perimeter light fixtures must meet chromaticity requirements for "aviation green" per SAE AS 25050, *Colors, Aeronautical Lights and Lighting Equipment, General Requirements*, when using incandescent lights. For light fixtures that use LEDs, see the standards in EB 67, *Light Sources Other Than Incandescent and Xenon For Airport and Obstruction Lighting Fixtures*.
6. Photometric standards for perimeter light fixtures are included in Table 3-1. See AC 150/5345-46, paragraph 3.3, Photometric Requirements, for detailed measurement methods and standards.

Table 3-1: Perimeter Lighting Intensity and Distribution

	Approach Angle 0 to 15 degrees		Approach Angle 16 to 90 degrees
Color	**Minimum**	**Minimum average intensity**	**Minimum**
Green	10 cd	15 cd	5 cd



7. Elevated perimeter light fixtures will be installed in a load-bearing light base (L-868, Size B) or non-load-bearing light base (L-867, Size B) per AC 150/5345-42, *Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories*. Shallow base type light bases will not be used.
8. Installation of vertiport lighting is to be in accordance with AC 150/5340-30, *Design and Installation Details for Airport Visual Aids*.

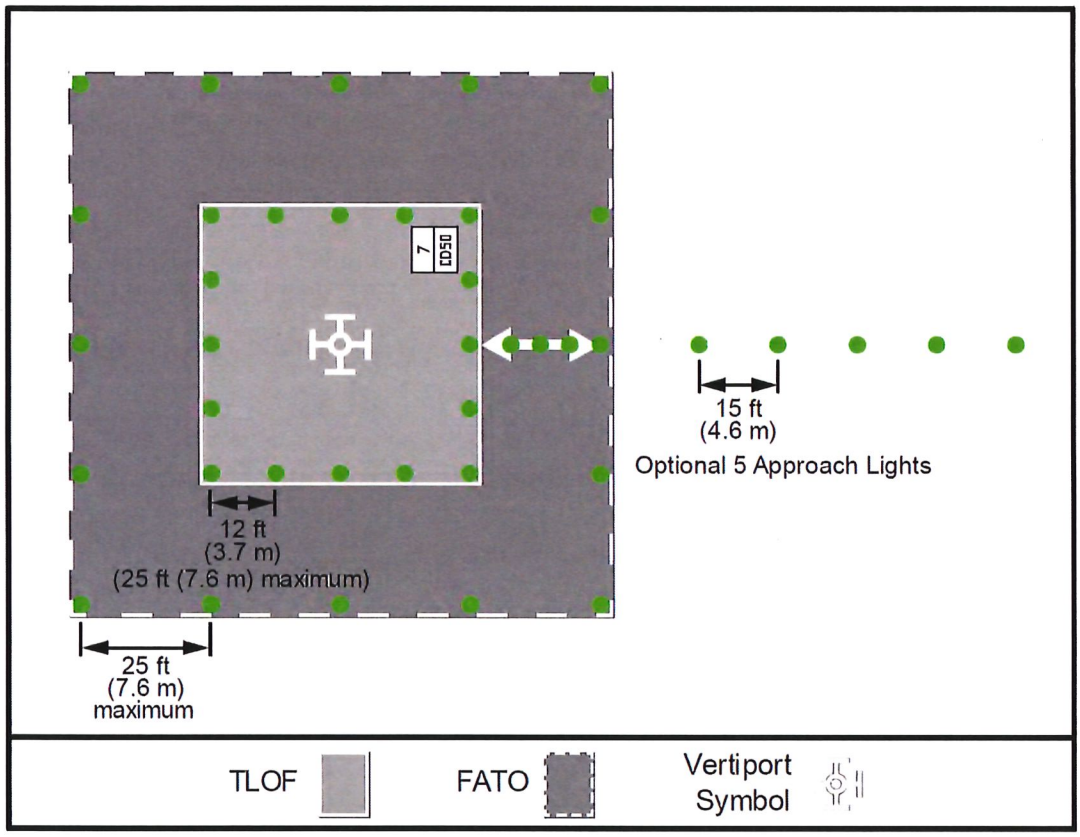
3.5.2. In-Pavement Perimeter Lights on TLOF and FATO.

1. TLOF perimeter lights are green and FAA type L-861H (AC 150/5345-46) or FAA type L-852H. LED versions of FAA type L-861H and L-852H are per AC 150/5345-46 and EB 87.
2. A square TLOF has:
   a. One light in each corner.
   b. Lights uniformly spaced between the corners with no less than five lights on each side.
   c. Lights spaced no more than 25 feet (7.6 m) apart.
   d. A light along the centerline of the approach.
3. A circular TLOF has:
   a. An even number of lights
   b. Minimum of eight lights uniformly spaced.

4. TLOF lights are within 1 foot (0.3 m) inside or outside of the perimeter line.
5. TLOF lights are installed in accordance with AC 150/5340-30.
6. Flight path alignment arrow lighting is recommended for night operations and includes a minimum of three lights spaced 5-10 feet (1.5 to 3 m) apart. These lights may extend across the TLOF, FATO, Safety Area, or any suitable surface in the immediate vicinity of the FATO or Safety Area, if necessary.
7. FATO perimeter lights are optional.
8. If installed, FATO perimeter lights are green and FAA type L-861H (AC 150/5345-46) or FAA type L-852H. LED versions of FAA type L-861H and L-852H are per AC 150/5345-46 and EB 87.
9. A square FATO has:
    a. One light in each corner.
    b. Lights uniformly spaced between the corners with no less than five lights on each side.
    c. Lights spaced no more than 25 feet (7.6 m) apart.
    d. A light along the centerline of the approach.
10. A circular FATO has:
    a. An even number of lights
    b. Minimum of 8 lights uniformly spaced.
11. FATO lights are within 1 foot (0.3 m) of the inside or outside of the perimeter line.
12. Approach lights are optional. When installed they include a line of five green, omnidirectional lights located on the centerline of the preferred approach/departure path. The first light is 30 to 60 feet (9.1 to 18.3 m) from the TLOF. Remaining lights are spaced at 15-foot (4.6 m) intervals aligned on the centerline of the approach path.

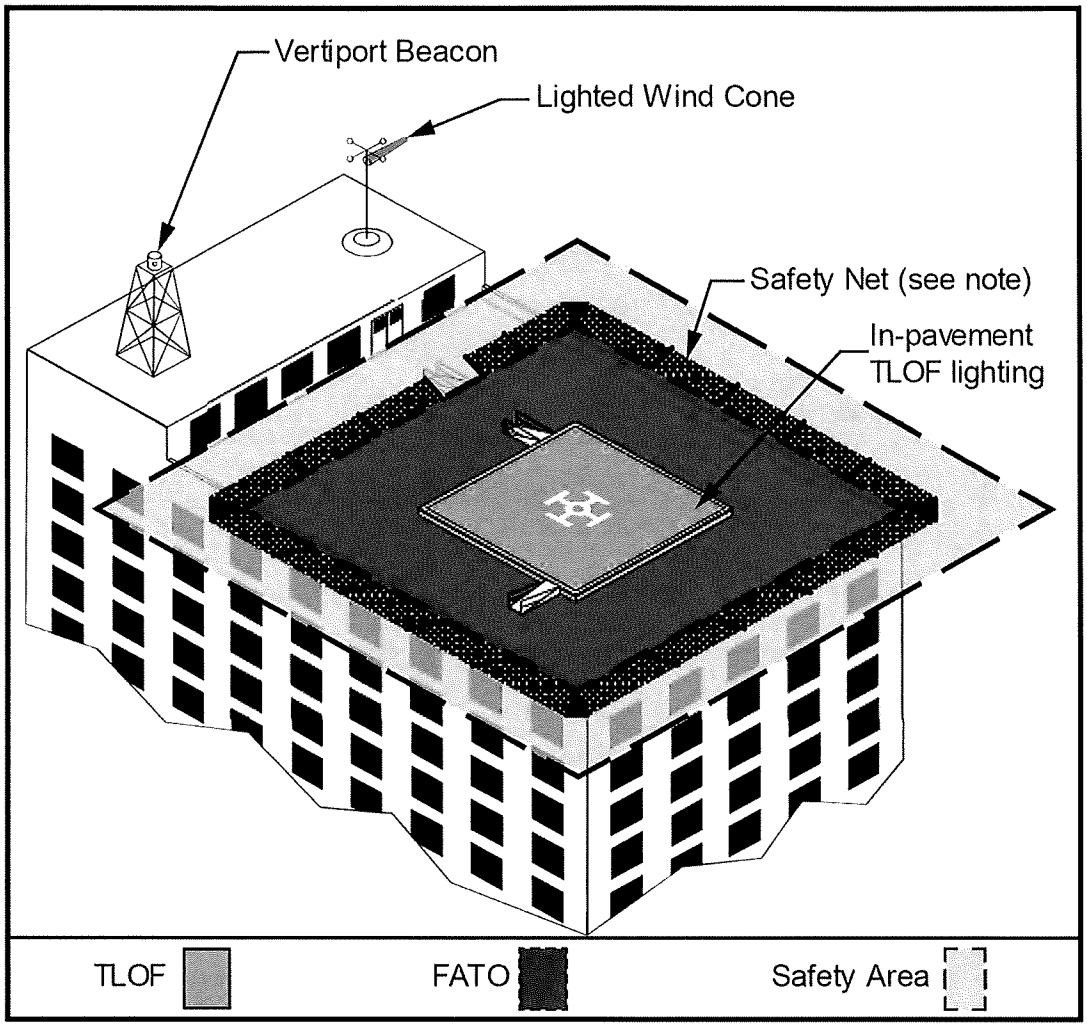
See Figure 3-7 for additional guidance on perimeter lighting for surface level vertiports. See Figure 3-8 and Figure 3-9 for guidance for lighting for elevated vertiports.

Figure 3-7: TLOF/FATO Perimeter Lighting



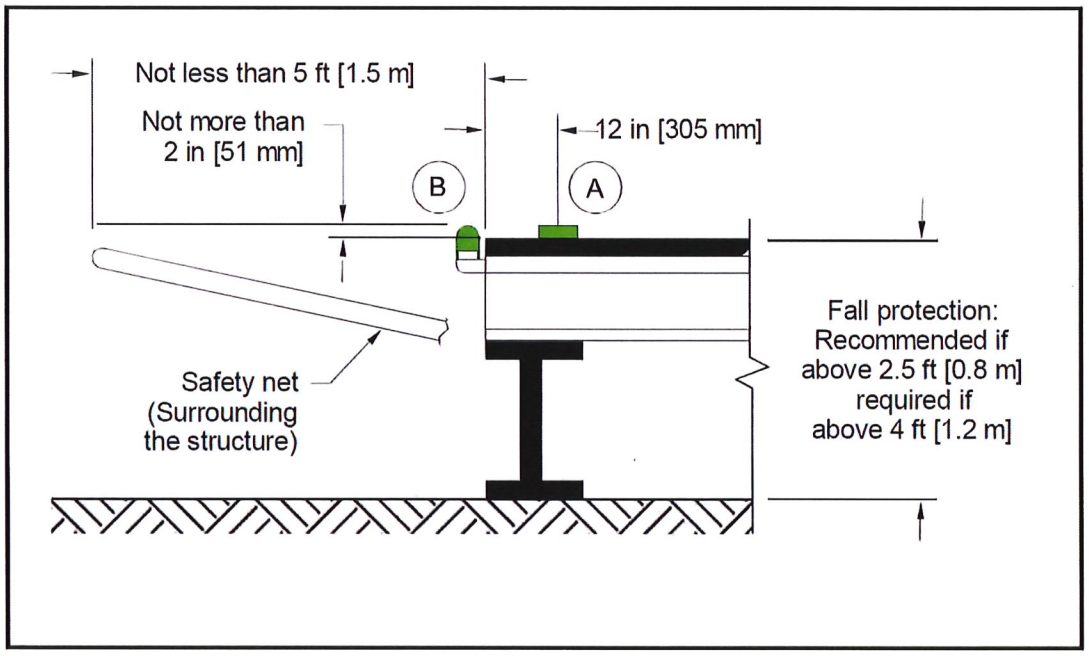
Note 1: In-pavement lights are within 1 foot (0.3 m) of the inside or outside of the TLOF and FATO respective perimeters.
Note 2: Elevated lights are outside and within 10 feet (3 m) of TLOF and FATO respective perimeters.
Note 3: Exhibit is configured for 50-foot (15.2 m) TLOF.

Figure 3-8: Elevated Vertiport Configuration Example



Note: See Figure 3-9 for safety net and lighting details.

Figure 3-9: Elevated FATO Perimeter Lighting



Note 1: Install either "A" Type L-852H, or "B" Type L-861H.

Note 2: In-pavement edge light fixture Ⓐ (Type L-852H).

Note 3: Omnidirectional light Ⓑ, mounted off the structure edge (Type L-861H).

Note 4: Ensure elevated lights do not penetrate a horizontal plane at the TLOF elevation by more than 2 inches (51 mm).

Note 5: For TLOF and FATO lighting standards, see EB 87.

Note 6: A safety net's supporting structure should be located below the safety net.

3.5.3. Elevated Perimeter Lights on TLOF and FATO.

The same standards for in-pavement lights apply to raised lights except for the following:

1. Lights are omnidirectional.
2. Lights are on the outside edge of the TLOF and FATO.
3. Lights are on frangible elevated light fixtures, no more than 8 inches (203 mm) high, and no more than 10 feet (3 m) out from the TLOF and FATO, respective, perimeters.
4. Lights do not penetrate a horizontal plane at the TLOF edge elevation by more than 2 inches (51 mm), as shown in Figure 2-2.

See Figure 3-7 for additional information.

3.5.4. Visual Glideslope Indicators (VGSI).

A VGSI provides pilots with visual vertical course and descent cues. Install the VGSI such that the lowest on-course visual signal provides a minimum of one degree of clearance over any object that lies within ten degrees of the approach course centerline.

3.5.4.1. **Siting.**

1. The optimum location of a VGSI is on the extended centerline of the approach path at a distance that brings the VTOL to a hover with the undercarriage between 3 and 8 feet (0.9 to 2.4 m) above the TLOF.
2. To properly locate the VGSI, estimate the vertical distance from the undercarriage to the pilot's eye.

3.5.4.2. **Control of the VGSI.**

Design the VGSI to be pilot controllable such that it is "on" only when needed as an option.

3.5.4.3. **VGSI Needed.**

A VGSI is an optional feature. However, install a VGSI if one or more of the following conditions exist, especially at night:

1. Obstacle clearance, noise abatement, or traffic control procedures necessitate a slope to be flown.
2. The environment of the VTOL provides few visual surface cues.

3.5.4.4. **Additional Guidance.**

Additional guidance is provided in AC 150/5345-52, *Generic Visual Glideslope Indicators (GVGI)*, and AC 150/5345-28, *Precision Approach Path Indicator (PAPI) Systems*.

3.5.5. Floodlight Option.

The FAA has not evaluated floodlights for effectiveness in visual acquisition of a vertiport. Guidelines for the use and installation of floodlights include:

1. Install floodlights to illuminate the TLOF, the FATO, and/or the parking area if ambient light does not suitably illuminate markings for night operations.
2. Mount these floodlights on adjacent buildings to eliminate the need for tall poles, if possible. Place floodlights clear of the TLOF, the FATO, the Safety Area, the approach/departure surfaces, and transitional surfaces and ensure floodlights and their associated hardware do not constitute an obstruction hazard.
3. Aim floodlights down to provide adequate illumination on the apron and parking surface.
4. Ensure floodlights that might interfere with pilot vision during takeoff and landings are capable of being turned off by pilot control or at pilot request.

Note 1: Floodlights do not replace TLOF or FATO lighting recommendations.

Note 2: White lighting for heliport applications should not be activated until the aircraft has landed and deactivated prior to takeoff.

3.6. Identification Beacon.
An identification beacon is required for night operations. The identification beacon is flashing white/yellow/green with a rate of 30 to 45 flashes per minute. On-airport vertiports are not required to have a vertiport identification beacon. Install beacons per the heliport guidance below:

1. AC 150/5345-12, *Specification for Airport and Heliport Beacons,* provides specifications for a beacon.
2. AC 150/5340-30 provides guidelines for installing a beacon.

3.7. Wind Cone.
Wind cones provide the direction and magnitude of the wind. The following guidelines apply to wind cones:

1. Minimum of one wind cone conforming to AC 150/5345-27, *Specification for Wind Cone Assemblies*.
2. Orange in color to provide the best possible contrast to its location's background.
3. Locate to provide valid wind direction and speed information near the vertiport under all wind conditions.
4. Visible to pilots on the approach path when the aircraft is 500 feet (152 m) from the TLOF.
5. Visible to pilots from the TLOF.
6. Located within 500 feet (152 m) horizontal of the TLOF.
7. If one location does not provide for all the above, multiple locations may be necessary to provide pilots with all the wind information needed for safe operations.
8. See AC 150/5345-27 and AC 150/5340-30 for primary and secondary wind cones for multiple wind cone requirements.
9. Located outside the Safety Area and does not penetrate the approach/departure or transitional surfaces.
10. Follows installation details specified in AC 150/5340-30.
11. Lighted internally or externally for night operations.

4.0 Charging and Electric Infrastructure.

Most early concepts of operation for AAM activity indicate the use of electric propulsion by VTOL aircraft. The electrical needs for these aircraft vary based on design and manufacturer. This EB addresses battery driven technologies. Future guidance will be provided on other emerging energy concepts (e.g., hydrogen).

Electrification of aviation propulsion systems is an evolving area with few industry-specific standards. In addition to relevant national, state, and local building codes, the following sections provide a partial list of relevant standards that may assist when specifying charging systems and facility layout for this emerging industry. Current charging standards for light duty vehicle charging (up to 350kw) align with multiple light electric aircraft currently applying for certification. However, for meeting operational characteristics of higher capacity batteries and novel systems, manufacturers and operators may implement, along with fixed-charger equipment, alternate charging methods including mobile charging systems, fixed battery storage, cable and/or on-board battery cooling, battery swapping, or other concepts.

At the time of this publication, consensus has not been achieved regarding classes of charging or connection standards and could vary based on the aircraft duty cycle, charging speed, battery chemistry, charging system, and battery cooling system, etc. Charging infrastructure design for vertiports should consider adapting to multiple aircraft specific systems. Additional guidance is currently being developed as the AAM industry continues to evolve.

Battery charging must be done in a safe and secure manner. Any aircraft batteries stored on site should be stored safely away from TLOF, FATO, and Safety Areas. As additional research is developed, further recommendations will be released.

4.1. Standards.

4.1.1. Airport/Vertiport Fire Fighting and Safety Considerations.

- 2021 International Fire Code (IFC): To implement alternative energy vectors, there is the need for general precautions, emergency planning and preparedness, and storage of hazardous materials.
- NFPA 110, *Standard for Emergency and Standby Power Systems*: To ensure the continuity of electric aircraft operations, uninterrupted power supply is needed thus creating a need for guidelines on emergency and backup power supply systems.
- NFPA 70, NEC Article 625 - *Electric Vehicle Charging System*: Covers the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the installation of equipment and devices related to electric vehicle charging. It also addresses scenarios that would allow the use of load balancing functions on electrical supply systems.

- NFPA 70, Article 706 - *Energy Storage Systems*: This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be standalone or interactive with other electric power production sources. These systems are primarily intended to store and provide energy during normal operating conditions.

- NFPA 400, *Hazardous Materials Code*: Covers the minimum NFPA standards for the storage and handling of hazardous materials such as lithium batteries.

- NFPA 418, *Standard for Heliports*: This standard establishes fire safety standards for operations of heliports and rooftop hangars for the protection of people, aircraft, and other property. Future editions of this standard will include electric mobility asset considerations.

- NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*: Covers the minimum NFPA standards established for design, installation, and maintenance of a stationary energy storage system including battery storage systems.

4.1.2. Occupational Safety and Health Administration Considerations.

- 29 CFR Section 1910.176, *Handling Materials – General*: This standard provides the minimum requirements for the storage and handling of hazardous materials such as lithium batteries.

4.1.3. Power Quality Considerations.

- IEEE 519-2014, *IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems*: The grid impact of high wattage charging stations needs to be considered when designing and adopting charging stations. This standard provides guidance in the design and compliance of power systems with nonlinear loads.

- IEEE 1826-2020, *IEEE Standard for Power Electronics Open System Interfaces in Zonal Electrical Distribution Systems Rated Above 100 kW*: Airports require power, monitoring, information exchange, control, and protection of interfaces that are based on technological maturity, accepted practices, and allowances for future technology insertions such as the integration of electric aircraft.

4.1.4. Underwriter's Laboratories (UL) Certifications Considerations.
The following standards focuses on certifying the components and safety of the systems.

- UL 2202, *Standard for Safety of Electric Vehicle (EV) Charging System Equipment*: Covers conducting charging system equipment (600 volts or less) for recharging batteries in surface electric vehicles.

- UL 2251, *Standard Testing for Charging Inlets and Plugs*: Covers plugs, receptacles, vehicle inlets, and connectors rated up to 800 amperes and up to 600

volts AC or DC, and intended for conductive connection systems, for use with electric vehicles.

- UL 2580, *Batteries for Use in Electric Vehicles*: Covers electric equipment storage assemblies in electric powered vehicles.

- UL 9540, *Energy Storage System (ESS) Requirements - Evolving to Meet Industry and Regulatory Needs:* This key standard encompasses the design, commissioning, operation, decommissioning, and emergency operations for all energy storage systems.

- UL 9540a, *Test Method.*

4.1.5. Vehicle to Infrastructure Considerations.

- SAE J1772, *SAE Electric Vehicle and Plugin Hybrid Electric Vehicle Conductive Charge Coupler*: This standard was developed to define the fit and function of a conductive coupler for use in charging electric vehicles. It was later expanded to include direct current (DC) charging through combined alternating current/direct current (AC/DC) physical connector referred to as the Combined Charging Standard (CCS).

- SAE AIR7357, *MegaWatt and Extreme Fast Charging for Aircraft* (under development): This standard is a work in progress under SAE leadership and intended to provide a charging interface for battery packs from 150kWh-1MWh within aircraft.

- Megawatt Charging System (MCS): The MCS is intended to extend the capabilities of the CCS to accommodate the charge rate demands of larger vehicles and thus serve the trucking and aviation sectors. Ratings should exceed 1MW (Max 1,250 volt and 3,000 ampere (DC)) while also addressing communication and controls using ISO/IEC 15118 and meeting UL 2251 touch safe standards.

- ISO/IEC 15118-1:2019, *Road Vehicles: Vehicle to Grid Communication Interface*: This standard defines the digital communications protocol to be used for the charging of high voltage electric vehicle batteries from a charging station. Beyond the basic handshakes and charge control between a vehicle and a charging station, this standard also includes convenience and security layers that support the "plug and charge" experience. Additionally, it offers the potential to schedule and coordinate the charging demands with the grid conditions.

5.0 On-Airport Vertiports.

To support AAM operations, certain OEMs and operators are interested in developing vertiports on airports and modifying existing on-airport helicopter landing facilities. All federally obligated airport sponsors are required to ensure the safety, efficiency, and utility of the airport and to provide reasonable and not unjustly discriminatory access to all aeronautical users.

This chapter addresses design considerations for separate vertiport facilities on airports. VTOLs can operate on airports without interfering with airplane traffic and operations. Operations can occur on existing airport infrastructure for its intended purpose or on dedicated vertiport facilities.

Separate vertiport facilities and approach/departure procedures may be needed when the volume of airplane and/or VTOL traffic affects operations. Airports with interconnecting passenger traffic between VTOLs and fixed wing aircraft should generally provide access between the respective terminals for boarding with applicable security measures in place.

Any new vertiport infrastructure or fixed equipment must be depicted on the ALP and submitted for FAA review prior to development and operation. For projects subject to FAA approval, an appropriate level of environmental review under the National Environmental Policy Act (NEPA) is required. These on-airport vertiport facilities must follow all guidance detailed in this EB.

For facilities being built on non-federally obligated airports, in compliance with Part 157, the sponsor or proponent must submit Form 7480-1 at least 90 days in advance of the day that construction work is to begin on the vertiport takeoff and landing area.

5.1. On-Airport Location of TLOF.

Locate the TLOF to provide ready access to the airport terminal with applicable security measures in place or to the VTOL user's origin or destination. If needed, locate the TLOF away from but with access to fixed-wing aircraft movement areas (the runways, taxiways, and other areas of an airport that are used for taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and aircraft parking areas).

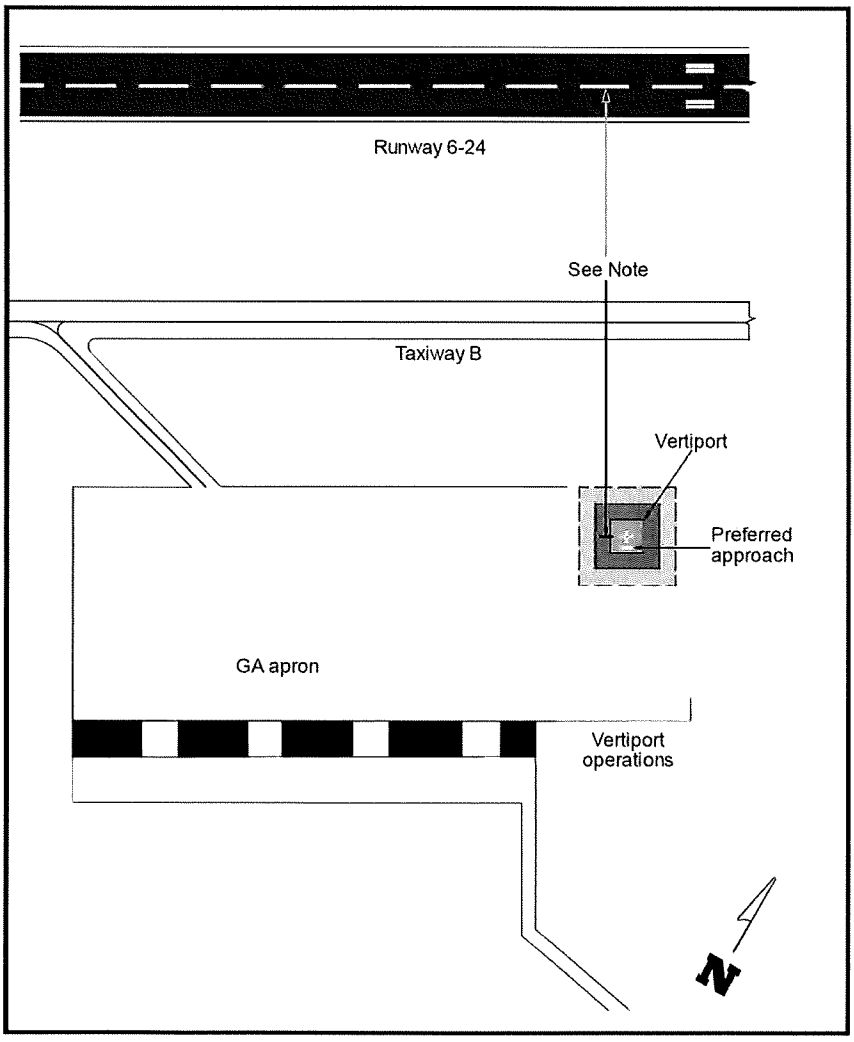
5.2. On-Airport Location of FATO.

See Table 5-1 for standards of the distance between the centerline of an approach to a runway and the centerline of an approach to a vertiport's FATO for simultaneous, same-direction VFR operations. Figure 5-1 depicts an example of an on-airport Vertiport location. The FATO should be located outside of all object free areas (OFAs), Safety Areas, runway protection zones, and safety critical navigational aid areas.

Table 5-1: Recommended Minimum Distance between Vertiport FATO Center to Runway Centerline for VFR Operations

Reference VTOL Aircraft MTOW	Airplane Size	Distance From Vertiport FATO Center to Runway Centerline
12,500 pounds (5,670 kg) or less	Small Airplane (12,500 pounds (5,670 kg) or less)	300 feet (91 m)
12,500 pounds (5,670 kg) or less	Large Airplane (12,500-300,000 pounds (5,670-136,079 kg))	500 feet (152 m)
12,500 pounds (5,670 kg) or less	Heavy Airplane (Over 300,000 pounds (136,079 kg))	700 feet (213 m)

Figure 5-1: Example of an On-airport Vertiport



Note: See Table 5-1.
Note: Figure does not reflect every type of configuration.

6.0 Site Safety Elements.

6.1. Fire Fighting Considerations.

The procedures to put out a battery system fire on an aircraft may differ from one VTOL to another. Previous FAA research with small lithium battery cells found that water and other foam fire extinguishing agents were more effective for suppressing lithium battery fires and preventing thermal runaway than gas or dry powder extinguishing agents during experiments within a 4-foot (1.2 m) by 4-foot (1.2 m) by 4-foot (1.2 m) test chamber[§§]. The cooling effect of the extinguishing agent was the key factor in preventing the fire from spreading. Although this method was found to be effective for small battery packs, it is yet to be determined if similar results would be achieved with large battery packs.

The firefighting techniques for VTOL aircraft are still unknown and may differ from model to model. Providing adequate fire protection for VTOL aircraft on vertiports will require a full understanding of the hazards related to the specific aircraft that will be using the vertiport. This also applies to the utility infrastructure needed to charge the VTOL aircraft.

Vertiport operators may need to comply with applicable local fire, environmental, and zoning regulations. Vertiport operators will need the means to control VTOL aircraft fires. Firefighting personnel, including local first responders, should be trained and equipped to manage the specific needs associated with electric aircraft such as lithium battery fires, electrical fires, toxic gas emissions, and high voltage electrical arcing.

Firefighting equipment should be adjacent to, but outside, the TLOF and FATO area. Fire safety equipment should be clearly marked for conspicuousness from anywhere within or outside the FATO. For elevated sites, fire equipment may be located below the level of the FATO but must be fully accessible under all circumstances and clearly marked to anyone on the TLOF and FATO.

The current NFPA 418, *Standard for Heliports* (2021), is based on conventional liquid fuel and its dangers and risks. This standard is currently under revision to account for electrical hazards and fire safety standards for vertiports, which is expected to be published on or before January 2024. NFPA 855-2020, *Standard for Stationary Energy Storage Systems*, provides safety standards for stationary and mobile energy storage systems. Chapters on emergency response provide relevant guidance for fire protection engineers, system designers, code officials, and emergency responders.

6.2. Security and Safety.

For vertiports located in secured airport environments, unless screening was carried out at the VTOLs passengers' departure location, Transportation Security Administration regulations may require that a screening area and/or screening be provided before passengers enter the airport's secured areas. If necessary, airports should establish multiple VTOL parking positions and/or locations in the terminal area to service VTOL

[§§] Maloney, Thomas. DOT/FAA/TC-13/53, *Extinguishment of Lithium-Ion and Lithium-Metal Battery Fires*. Federal Aviation Administration, 2014.

passenger screening and/or cargo needs. General information about passenger screening is available on the Transportation Security Administration website, www.tsa.gov/public/.

Controlling vertiport access and keeping operational areas clear of people, animals, equipment, debris, and vehicles is important for safety and security. The following guidance apply to safety barriers and access control measures:

1. For ground-level vertiports, erect a safety barrier around the VTOL aircraft operational areas in the form of a fence or a wall outside of the Safety Area and below the 8:1 elevation of the approach/departure surface.
2. If necessary, near the approach/departure paths, install the barrier well outside the outer perimeter of the Safety Area and below the elevation of the approach/departure and transitional surfaces described in paragraph 2.5.
3. Safety barriers must be high enough to present a positive deterrent to persons inadvertently or maliciously entering an operational area, but at a low enough elevation to be non-hazardous to all aircraft operations.
4. Provide control access to airport airside areas with adequate security measures as required or recommended by the Transportation Security Administration.
5. Display a vertiport caution sign like that shown in Figure 6-1 at all vertiport access points.

For on-airport vertiports, proponents should work with their local Transportation Security Administration security representative.

Figure 6-1: Vertiport Caution Sign

6.3. Downwash/Outwash.

The downwash and outwash impacts of VTOL are still being researched. However, the impacts of the ground geometry, surrounding infrastructure, and the re-circulatory flow impact on rotor/propeller aerodynamics performance and vehicle flight dynamics should still be considered in vertiport siting.

If downwash and outwash of the VTOL will create safety issues for people or property, other aircraft operators, or if the VTOL aircraft aerodynamic performance will be impacted by how the downwash and outwash interacts with the surrounding ground or infrastructure, then the TLOF, FATO, and Safety Areas should be adjusted appropriately, or alternative mitigations should be taken.

6.4. Turbulence.

Air (e.g., wind) flowing around and over buildings, stands of trees, terrain irregularities, and elsewhere can create turbulence on ground-level and rooftop vertiports that may affect VTOL operations. The following guidelines apply to turbulence:

1. When possible, locate the TLOF away from buildings, trees, and terrain to minimize air turbulence near the FATO and the approach/departure paths.
2. Assess the turbulence and airflow characteristics near and across the surface of the FATO to determine if a turbulence mitigating design measures are necessary (e.g., air gap between the roof, roof parapet, or supporting structure).
3. A minimum six-foot (1.8 m) unobstructed air gap on all sides above the level of the top of a structure (e.g., roof) and the elevated vertiport will reduce the turbdulent effect of air flowing over it.
4. Where an air gap or other turbulence-mitigating design measures are not taken on elevated structures, operational limitations may be necessary under certain wind conditions.

6.5. Weather Information.
An optional automated weather observing system (AWOS) measures and automatically broadcasts current weather conditions at the vertiport site. When installing an AWOS, locate it at least 100 feet (30.5 m) and not more than 700 feet (213 m) from the TLOF and such that its instruments will not be affected by rotor/propeller wash from VTOL operations. Find guidance on AWOS systems in AC 150/5220-16, *Automated Weather Observing Systems (AWOS) for Non-Federal Applications*, and FAA Order 6560.20, *Siting Criteria for Automated Weather Observing Systems (AWOS)*. Other weather observing systems will have different siting criteria.

6.6. Winter Operations.
Swirling snow dispersed by an VTOL's rotor/propeller wash can cause the pilot to lose sight of the intended landing point and/or obscure objects that need to be avoided. Elevated heliports may use a resistive heating system.

1. Design the vertiport to accommodate the methods and equipment to be used for snow removal.
2. Design the vertiport to allow the snow to be removed sufficiently so it will not present an obstruction hazard.
3. For vertiports in winter weather, an optional dark TLOF surface can be used to absorb more heat from the sun and melt residual ice and snow.
4. Find guidance on winter operations in AC 150/5200-30, *Airport Field Condition Assessments and Winter Operations Safety*.

6.7. Access to Vertiports by Individuals with Disabilities.
Congress has passed various laws concerning access to airports. Since vertiports are a type of airport, these laws are similarly applicable. Find guidance in AC 150/5360-14, *Access to Airports by Individuals with Disabilities*.

Acronym List

AAM	advanced air mobility
AC	Advisory Circular
AC	alternating current
AGL	above ground level
ALP	Airport Layout Plan
AWOS	automated weather observing system
CCS	combined charging standard
CFR	Code of Federal Regulations
D	controlling dimension
DC	direct current
EB	Engineering Brief
ESS	energy storage system
ETL	effective translational lift
EV	electric vehicle
eVTOL	electric vertical takeoff and landing
FAA	Federal Aviation Administration
FATO	final approach and takeoff area
FC	failure condition
GA	general aviation
HOGE	hover out of ground effect
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
IFR	instrument flight rules

ISO	International Organization for Standardization
LAP	Landing Area Proposal
LDR	landing distance required
LED	light emitting diode
LOB	line of business
MCS	megawatt charging system
MSL	mean sea level
MTOW	maximum takeoff weight
NEC	National Electric Code
NEPA	National Environmental Policy Act
NEMSPA	National EMS Pilots Association
NFPA	National Fire Protection Association
OEM	original equipment manufacturer
OFA	object free area
RTODR	rejected takeoff distance required
SAE	SAE International
TDP	takeoff decision point
TLOF	touchdown and liftoff area
TODR	takeoff distance required
TSA	Transportation Security Administration
UL	Underwriters Laboratories
VFR	visual flight rule
VGSI	Visual Glideslope Indicator
VMC	visual meteorological conditions
VTOL	vertical takeoff and landing

Exhibit 59A

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-880-1498

NORTH MARION COUNTY VERTIPORT

SITE PLAN

AIRPORT ROAD - AURORA, OREGON

SITE PLAN

5-14-2024

REVISIONS

PAGE:
L1.1

Aron Faegre Heliport Planning 13200 Fielding Road Lake Oswego Oregon 97034 faegre@earthlink.net

North Marion County Vertiport-Heliport Noise Compatibility Study
22515 Airport Road NE
Aurora, Oregon 97002

May 4, 2024

Noise Evaluation - Introduction

Noise is sometimes defined as unwanted sound. However, sound is measurable, whereas noise is subjective. The relationship between measurable sound and human irritation is the key to understanding aircraft noise impact. A rating scale has been devised to relate sound to the sensitivity of the human ear. The A-weighted decibel scale (dBA) is measured on a logarithmic or "log" scale, by which is meant that for each increase in sound energy level by a factor of 10, there is a designated increase of 1 dBA. This system of measurement is used because the human ear functions over such an enormous range of sound energy impacts. At a psychological level, there is a rule of thumb that the human ear often "hears" an increase of 10 decibels as equivalent to a "doubling" of sound.

The challenge to evaluating noise impact lies in determining what amount and what kind of sound constitutes noise. The vast majority of people exposed to aircraft noise are not in danger of direct physical harm. However, much research on the effects of noise has led to several generally accepted conclusions:

- The effects of sound are cumulative, therefore, the duration of exposure must be included in any evaluation of noise.
- Noise can interfere with sleep and outdoor activities.
- Noise can disturb communication, TV/radio listening, and relaxation.
- When community noise levels have reached sufficient intensity, a certain percentage of the population is likely to become highly annoyed and object to the noise.

Research has also found that individual responses to noise are difficult to predict[49]. Some people are annoyed by perceptible noise events, while others show little concern over the most disruptive events. However, it is possible to predict the responses of large groups of people – i.e. communities. Consequently, community response, not individual response, has emerged as the prime index of aircraft noise measurement.

North Marion County Vertiport-Heliport Usage

The DEQ requirement for establishment of a new airport, which includes heliports and vertiports, requires the creation of the expected 55 Ldn noise contour from the first year's operation. Interest in use of the new

[49] Beranek, Leo, *Noise and Vibration Control*, McGraw-Hill, 1971, pages ix-x.

North Marion County Vertiport-Heliport (NMCVH) has been expressed by Life Flight Network, and by Columbia Helicopters. It is also intended for use by the next generation of aircraft that are powered by electric engines. Thus, for a first year of operation some aircraft from all these potential uses are modeled for noise impact. The usage is expressed in "operations" (i.e. a takeoff and a landing are two operations):

- 100 ops per day by a next generation electric aircraft such as a Joby eVTOL;
- 10 ops per day by a Life Flight Network aircraft like a Bell 407;
- 1 op per 10 days of Boeing Vertol 107 (heavy lift helicopter common with Columbia Helicopters)
- 1 op per 10 days of S64 (Skycrane typical heavy lift helicopter)

The heavy lift helicopters have small numbers of operations because at this site they are based only for repairs and overhaul or storage, only taking off again when being moved to a distant base for use in firefighting or power line work.

eVTOL and Helicopter Flight Paths for the NMCVH

Drawing L0.1 on the following page, shows the approach-departure paths which were created based on the standards of FAA Heliport Design Advisory Circular 150/5390-2 and FAA Vertiport Design Engineering Brief No. 105. Starting from the vertiport-heliport pad, there are three flight paths, each 4,000 feet long as follows: Departure A: 800' straight out @ 112dMN, left turn 50.38d R=1886' 1658.50', followed by 1541.50' straight out. Departure B: 4000' straight out @ 39dMN. Departure C: 900' straight out @ 325dMN, right turn 84.23d R=1886' 2772.5', followed by 427.5' straight out.

The eVTOL and helicopters are given a departure and arrival profile of 1V:2.5H, meaning they fly out along the flight path at a slope of 1 vertical to 2.5 horizontal (21.8 degrees). This is conservative as, for example, Life Flight helicopters typically initially do a near vertical climb for approximately 130 feet as part of the initial profile, which far exceeds the 1V:2.5H.

Day-Night Level (DNL) Noise Methodology

State or local governments are prohibited from establishing laws governing the noise of aircraft, because the federal government requires the airspace available for all aircraft independent of what state or location they come from. This relates to government's role in ensuring interstate commerce exists between the states. Concerning the flight of aircraft, federal law states:

> "The United States Government has exclusive sovereignty of airspace of the United States."
> - 49 U.S.C. 40103(a)

NORTH MARION COUNTY VERTIPORT - APPROACH-DEPARTURE PATHS

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-680-1469

REGISTERED ARCHITECT
ARON FAEGRE
LAKE OSWEGO OREGON
STATE OF OREGON

NORTH MARION COUNTY VERTIPORT
MASTER PLAN
AIRPORT ROAD - AURORA, OREGON

MASTER SITE PLAN

DATE: 5-4-2024

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This result in the federal government itself being the sole regulator of aircraft noise, which it does by: a) ensuring that each manufactured aircraft comply with a required noise certification, and b) providing standards for evaluating the noise impact of aircraft on noise sensitive community uses.

As to the latter noise impact, the U. S. Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), and the Federal Aviation Administration (FAA) have jointly established a methodology to relate measurable sound from a variety of sources to community response. It has been termed "Day-Night Average Sound Level" (DNL or Ldn) and has been adopted by all three agencies for use in evaluating noise impacts. In a general sense, it is the yearly average of aircraft-created noise for a specific location (i.e., from an airport), but includes a calculation penalty for each night flight, due to quieter background levels at night and the higher sensitivity to noise while sleeping. On a map it's units of measurement are designated as Ldn sound level (dBA sound level with day-night accounted for).

The basic unit in the computation of DNL is the sound exposure level (SEL). An SEL is computed by mathematically summing the dBA level for each second during which a noise event occurs. For example, the noise level of an aircraft might be recorded as it approaches, passes overhead, and then departs. The recorded noise level of each second of the noise event is then added logarithmically to compute the SEL. To provide a penalty for nighttime flights (defined as the hours be between 10 PM and 7 AM), 10 dBA is added to each nighttime dBA measurement, second by second. Due to the mathematics of logarithms, this calculation penalty is equivalent to 10-day flights for each night flight[50].

A DNL level is approximately equal to the average dBA level during a 24-hour period with a weighing for nighttime noise events. The main advantage of DNL is that it provides a common measure for a variety of different noise environments. The same DNL level can describe an area with very few high noise events as well as an area with many low level events.

Noise Modeling and Contour Criteria

DNL levels are typically depicted as Ldn contours. Contours are an interpolation of noise levels drawn to connect all points of a constant level that are derived from a calculation of the Ldn sound levels. The noise contours appear similar to topographical contours and are superimposed on a map of the heliport and its

[50] Where Leq ("Equivalent Sound Level") is the same measure as DNL without the night penalty incorporated, this can be shown through the mathematical relationship of:

$$Leq_d = 10 \log \left(\frac{N_d \times 10^{(SEL/10)}}{86{,}400} \right) \qquad Leq_n = 10 \log \left(\frac{N_n \times 10^{((SEL+10)/10)}}{86{,}400} \right)$$

If SEL equals the same measured sound exposure level for each computation, and if $N_d = 10$ daytime flights, and $N_n = 1$ night-time flight, then use of a calculator shows that for any SEL value inserted, $Leq_d = Leq_n$.

surrounding area. It is this map of noise levels drawn about a heliport that is used to predict community response to the noise from aircraft using that heliport. DNL mapping is best used for comparative purposes, rather than for providing absolute values. That is, valid comparisons can be made between scenarios as long as consistent assumptions and basic data are used for all calculations. It should be noted that a line drawn on a map by a computer does not imply that a particular noise condition exists on one side of the line and not on the other. These calculations can only be used for comparing average noise impacts, not precisely defining them relative to a specific location at a specific time. Noise contours are typically plotted in 5 DNL increments, starting at 55 Ldn.

Noise and Land-Use Compatibility Criteria

Federal regulatory agencies of government have adopted standards and suggested guidelines relating DNL to compatible land uses. Most of the noise and land-use compatibility guidelines strongly support the standard that significant annoyance from aircraft noise levels does not occur outside a 65 Ldn noise contour. Federal agencies supporting this standard include the Environmental Protection Agency, Department of Housing and Urban Development, and the Federal Aviation Administration.

Part 150, Airport Noise Compatibility Planning, of the Federal Aviation Regulations, provides guidance for land-use compatibility around heliports. Table 1 presents these guidelines. Compatibility or non-compatibility of land use is determined by comparing the noise contours with existing and potential land uses. All types of land uses are compatible in areas below 65 Ldn. Generally, residential and some public uses are not compatible within the 65-70 Ldn, and above. As noted in Table 1, some degree of noise level reduction (NLR) from outdoor to indoor environments may be required for specific land uses located within higher level noise contours. Land uses such as commercial, manufacturing, and some recreational uses are compatible within 65-70 Ldn contours. Agricultural and forestry uses are compatible even when Ldn is over 85.

Oregon DEQ Standards

When aircraft are in flight, landing, or taking off, they are regulated solely by the FAA since navigable airspace is under federal jurisdiction. However, because aircraft noise occurs at and around heliports, it is also a concern to local governments. The State of Oregon Administrative Rules Section OAR 340-35-045 requires that when establishing a new airport or performing airport master planning with changes to the helistop location, that a projected noise impact analysis for the first year of operation must be prepared and made available to the local land use determination agency.

Table 1: Land-Use Compatibility with DNL

Land Use	Yearly Day-Night Average Sound Level (Ldn) In Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over > 85
Residential						
Residential, other than mobile homes & transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile Home Parks	Y	N	N	N	N	N
Transient Lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and Nursing Homes	Y	25	30	N	N	N
Churches, Auditoriums, and Concert Halls	Y	25	30	N	N	N
Governmental Services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, Business and Professional	Y	Y	25	30	N	N
Wholesale and Retail—Building Materials, Hardware and Farm Equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail Trade--General	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing General	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and Optical	Y	Y	25	30	N	N
Agriculture (except livestock) and Forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock Farming and Breeding	Y	Y(6)	Y(7)	N	N	N
Mining and Fishing, Resource Production and Extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor Sports Arenas, Spectator Sports	Y	Y(5)	Y(5)	N	N	N
Outdoor Music Shells, Amphitheaters	Y	N	N	N	N	N
Nature Exhibits and Zoos	Y	Y	N	N	N	N
Amusements, Parks, Resorts and Camps	Y	Y	Y	N	N	N
Golf Courses, Riding Stables and Water Recreation	Y	Y	25	30	N	N

Y (Yes) Land-use and related structures compatible without restrictions.
N (No) Land-use and related structures are not compatible and should be prohibited.
NLR Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into design and construction of the structure.
25, 30 or 35 Land uses and structures generally compatible; measures to achieve NLR or 25, 30, or 35 dB must be incorporated into design and construction of the structure.

NOTES:

1. Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Levels Reduction (NLR) of at least 25dB and 30dB should be incorporated into building

codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB; thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year-round. However, the use of NLR criteria will not eliminate outdoor noise problems.

2. Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
3. Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
4. Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received office areas, noise sensitive areas, or where the normal noise level is low.
5. Land-use compatible, provided special sound reinforcement systems are installed.
6. Residential buildings require an NLR of 25.
7. Residential buildings require an NLR of 30.
8. Residential buildings not permitted.

SOURCE: Federal Aviation Regulations, Part 150, Airport Noise Compatibility Planning, dated January 18, 1985.

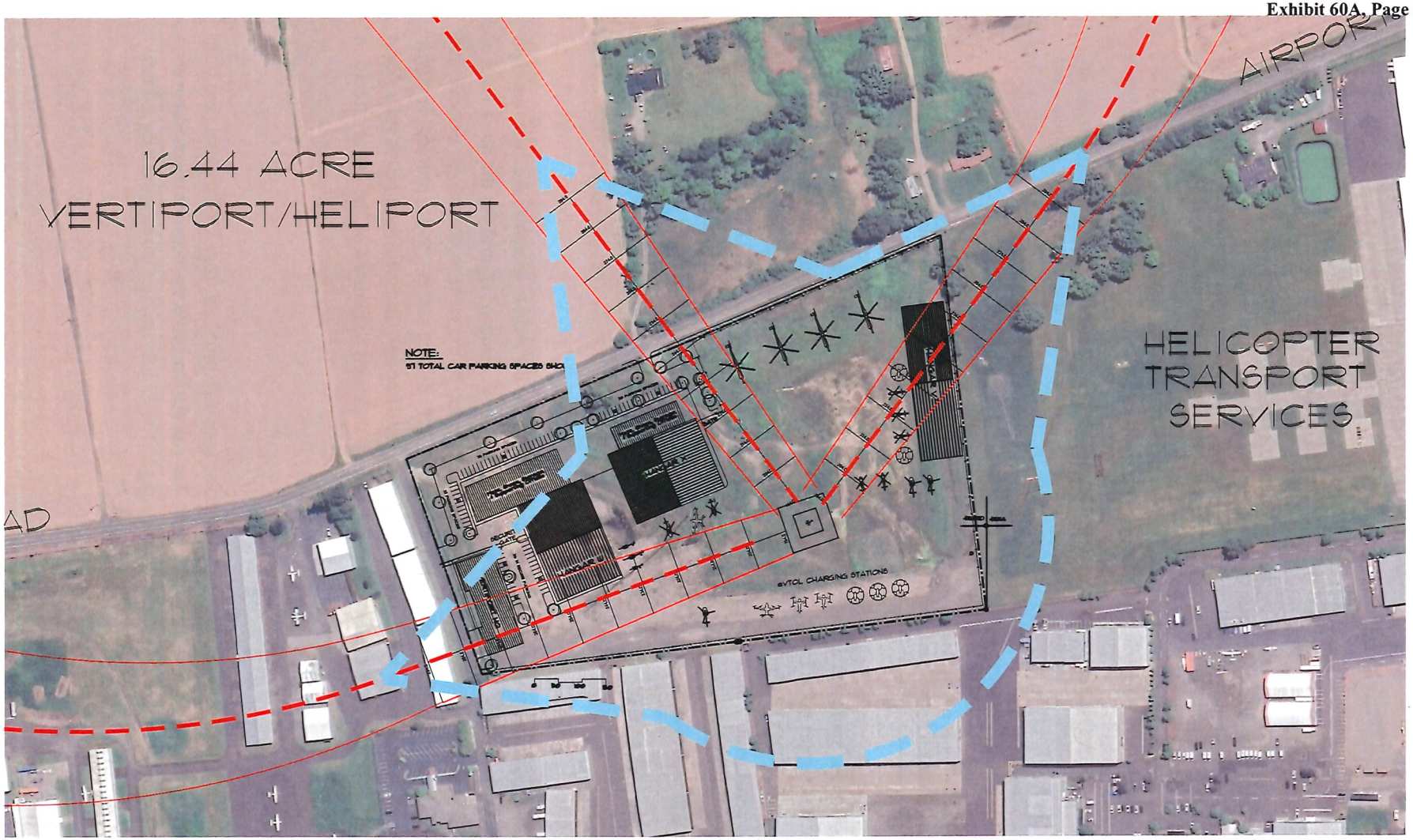
The state heliport noise standards are administered by the Department of Environmental Quality (DEQ), and require that an "airport noise impact boundary" be depicted around an airport. A heliport is a kind of airport, so this applies. DEQ defines this boundary with an annual average day-night noise level of 55 Ldn. This standard is considerably more conservative than the federal standard of 65 LDN and thus promotes a higher level of scrutiny in the land use evaluation of heliport development proposals. DEQ reviews the submittals, but does not evaluate whether the noise levels are acceptable for specific land uses within the boundary.

County Standards

Under the county's conditional use standards, Marion County has the right to grant or take away the right for a helistop. But the county does not have legal authority to set limits of control for the noise level of aircraft when they are in flight. The federal government reserves the right to control all airspace that aircraft use, to maintain a useful way for aircraft to remain functional and useful – and to promote interstate travel. All aircraft using this site will have an FAA noise certification. Under FAA and EPA rules, local governments are not permitted to create additional noise or emissions limitations on the use of aircraft in flight.

DNL Analysis

A calculation of the Ldn levels were made based on noise level data provided from FAA sources, and from FAA reviewed sources (see Appendix information). The calculation based on the prior described criteria is shown in Drawing N1.0 attached on the following page. The 55 Ldn contour is shown to only extend



Scale 1" = 200' @ 11x17 Print

55 Ldn Noise Contour

NORTH MARION COUNTY VERTIPORT

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-680-1469

REGISTERED ARCHITECT
ARON FAEGRE
LAKE OSWEGO OREGON
STATE OF OREGON

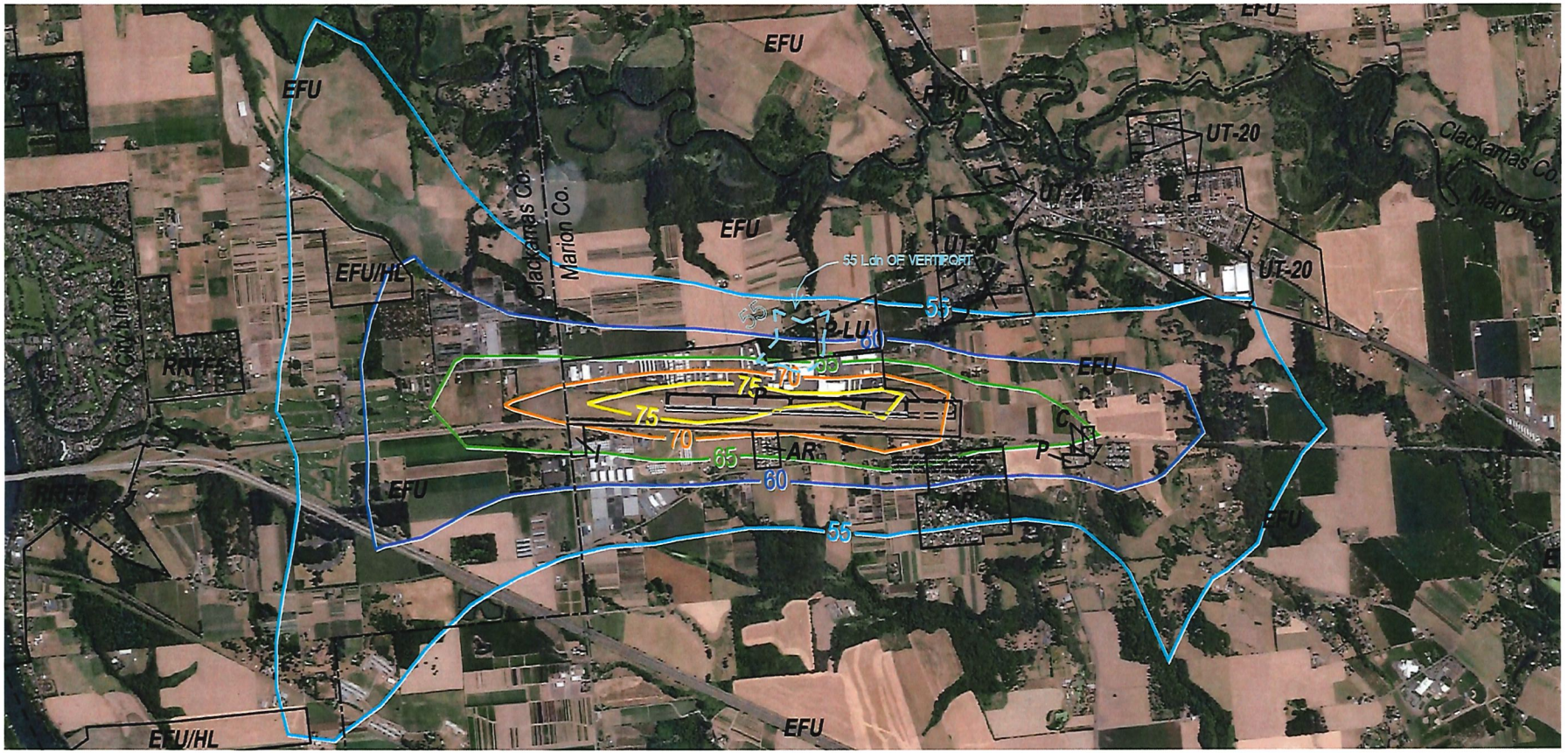
NORTH MARION COUNTY VERTIPORT
MASTER PLAN
AIRPORT ROAD - AURORA, OREGON

55 Ldn NOISE CONTOUR OVERLAID ON 2012 EXISTING NOISE CONTOURS

DATE 5-4-2024
DRAWN BY: AF

REVISIONS

PAGE:
N1.0



2010 Aurora Airport Noise Contours from 2012 Master Plan
Showing Vertiport 55 Noise Contour by Comparison

Scale 1" = 2200' @ 11x17 Print

NORTH MARION COUNTY VERTIPORT

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
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REGISTERED ARCHITECT
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55 Ldn NOISE CONTOUR OVERLAID ON 2012 EXISTING NOISE CONTOURS

DATE: 5-4-2024
DRAWN BY: AF

REVISIONS

PAGE:
N1.1

on to the adjacent Aurora Airport properties, or onto adjacent farm land to the east, and does not include any residences.

Drawing N1.1 on the prior page shows the NMCVH 55 Ldn contour overlaid on the 2012 Aurora Airport Master Plan existing noise contours from aircraft at the Aurora Airport in the year 2010 (the last year contours were created). In this way, it shows that the Aurora Airport 55 Ldn contour is far beyond the NMCVH 55 Ldn contour and thus the airport has much greater impact than what the NMCVH will make. Given the increased activities at Aurora Airport since 2010, the Aurora Airport 55 Ldn is likely today to be much further into the adjacent farm land to the east, making the relative NMCVH impact even less.

Per Table 1, federal noise standards for aircraft and airports noise impact show that there are no restrictions of any kind for impacts of 55 Ldn in any land use. For the adjacent farm land, there is no impact for even impacts of over 85 Ldn. However, for residences in a farm land use, if the Ldn is 65 or higher, then the residence structure should be provided with noise reduction in their wall and roof construction. Again, there are no residences even within the NMCVH 55 Ldn contour, so there are no impacts per federal standards.

Conclusions

The predicted 55 Ldn contour covers only existing Aurora Airport properties, and adjacent farm land to the east. Since there are no 65 Ldn contours on adjacent noises sensitive properties these results are consistent with FAA goals of minimizing noise impact to residential and other noise sensitive areas.

Author: Aron Faegre is an Oregon licensed architect and civil engineer who specializes in planning, design, and environmental impact of aviation facilities. As a heliport planner he has been involved with the planning, analysis, and design of over twenty heliports located throughout the United States.

Appendix

Attached is basic aircraft noise data used for the basis on the noise impact DNL calculation. Also attached is the 2012 Aurora Airport Master Plan "Land Use and Noise Contour" Sheet 6 showing underlying airport noise impact on the subject site and surrounding area.

All Articles

MAY 10, 2022

Joby Confirms Revolutionary Low Noise Footprint Following NASA Testing

Santa Cruz, CA, Ma
company developir

announced that its full-size pre-production aircraft has successfully demonstrated its revolutionary low noise profile, following acoustic testing completed with NASA.

Following analysis of the data obtained over two weeks of testing as part of NASA's Advanced Air Mobility National Campaign, Joby's aircraft was shown to have met the revolutionary low noise targets the Company set for itself.

The aircraft registered the equivalent of 45.2 A-weighted decibels (dBA) from an altitude of 1640 feet (500 meters) at 100 knots airspeed, a sound level which Joby believes will barely be perceptible against the ambient environment of cities.

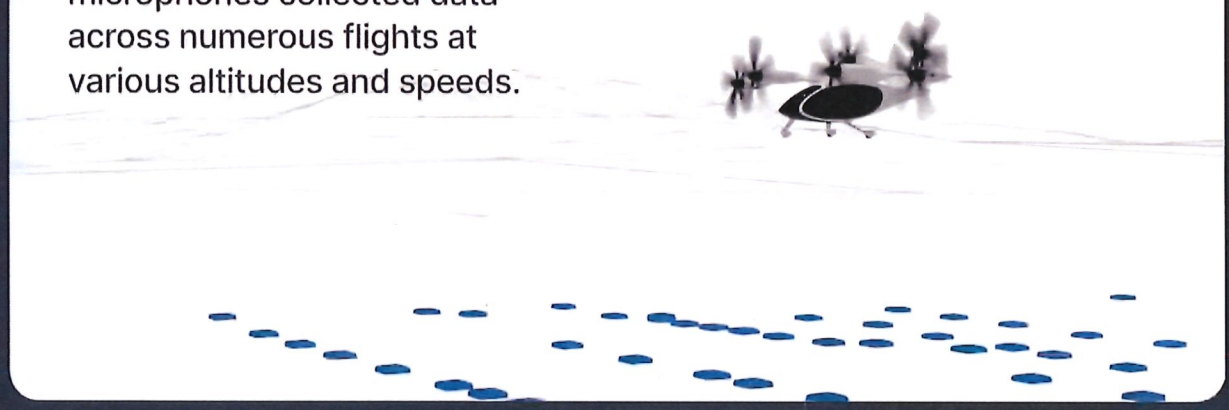
NASA engineers also measured the aircraft's acoustic profile during planned take-off and landing profiles to be below 65 dBA, a noise level comparable to normal conversation, at a distance of 330 feet (100 meters) from the flight path.

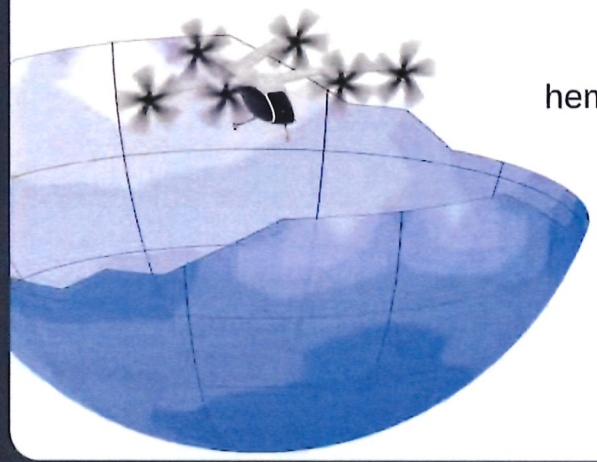
Measuring Acoustics

NASA tests the Joby aircraft

Joby

A field array of 50+ specialized microphones collected data across numerous flights at various altitudes and speeds.

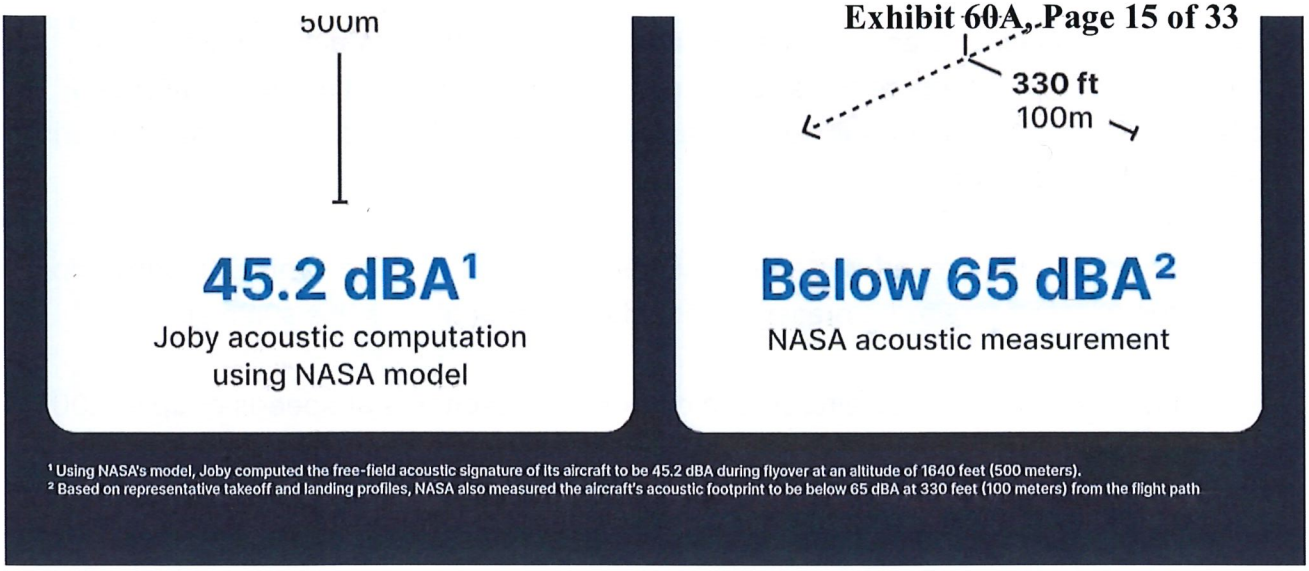




The NASA team used the flight recordings to model acoustic hemispheres, used for computing sound level anywhere on the ground.

OVERHEAD FLIGHT

TAKEOFF & LANDING



"We're thrilled to show the world just how quiet our aircraft is by working with NASA to take these measurements," said JoeBen Bevirt, Founder and CEO of Joby.

"With an aircraft this quiet, we have the opportunity to completely rethink how we live and travel today, helping to make flight an everyday reality in and around cities. It's a game-changer."

All measurements were conducted using NASA's Mobile Acoustics Facility, with more than 50 pressure ground-plate microphones placed in a grid array at Joby's Electric Flight Base near Big Sur, CA.

To measure the Joby aircraft's acoustic footprint during overhead flight, it flew over the grid array six times at an airspeed of 100 knots and a low altitude to measure as much of the aircraft's noise above the background ambience as possible. Data recorded from the field of omni-directional microphones was then processed by NASA into an "acoustic hemisphere," representing the sound emission in all directions below the aircraft at a 100 ft radius. Joby then applied standard processing techniques for spherical spreading and atmospheric attenuation, resulting in an average free-field overhead flight acoustic reading of 45.2 dBA at 1640 feet (500 meters).

Joby also conducted more than 20 take-off and landing tests above the grid array, using a variety of acceleration rates and climb angles to allow NASA to capture acoustics representative of likely operational procedures. This data will be used to adjust flight software and take-off and landing procedures for further low-noise optimization.

From day one, the . propellers and blad

all selected to minimize its acoustics footprint and improve the character of the sound produced. Each of the six propellers can also individually adjust its tilt, rotational speed, and blade pitch to avoid blade-vortex interactions that contribute to the acoustic footprint of traditional helicopters.

More details regarding procedures and measurements will be released by both Joby and NASA in technical papers to be presented at industry conferences this summer.

Joby's piloted five-seat eVTOL aircraft can carry four passengers at speeds of up to 200 mph, with a maximum range of 150 miles on a single charge and zero operating emissions. With more than 10 years of development and over a thousand flight tests completed, Joby is targeting the launch of its aerial ridesharing service in 2024.

ABOUT JOBY AVIATION

Joby Aviation, Inc. (NYSE:JOBY) is a California-based transportation company developing an all-electric vertical take-off and landing aircraft which it intends to operate as part of a fast, quiet, and convenient air taxi service beginning in 2024. The aircraft, which has a maximum range of 150 miles on a single charge, can transport a pilot and four passengers at speeds of up to 200 mph. It is designed to help reduce urban congestion and accelerate the shift to sustainable modes of transit. Founded in 2009, Joby employs more than 1,000 people, with offices in Santa Cruz, San Carlos, and Marina, California, as well as Washington, D.C. and Munich, Germany. To learn more, visit www.jobyaviation.com.

Forward Looking Statements

This press release contains "forward-looking statements" within the meaning of the "safe harbor" provisions of the Private Securities Litigation Reform Act of 1995, including but not limited to, statements regarding the development and performance of our aircraft including our initial plant capacity and regulatory outlook; our business plan, objectives, goals and market opportunity; and our current expectations relating to our business, financial condition, results of operations, prospects and capital needs. You can identify forward-looking statements by the fact that they do not relate strictly to historical or current facts. These statements may include words such as "anticipate", "estimate", "expect", "project", "plan", "intend", "believe", "may", "will", "should", "can have", "likely" and other words and terms of similar meaning in connection with any discussion of the timing or nature of future operating or financial performance or other events. All forward looking statements are subject to risks and uncertainties that may cause actual results to differ materially, including: our limite

ridesharing service

operate a commercial passenger service beginning in 2024; the competitive environment in which we operate; our future capital needs; our ability to adequately protect and enforce our intellectual property rights; our ability to effectively respond to evolving regulations and standards relating to our aircraft; our reliance on a third-party suppliers and service partners; uncertainties related to our estimates of the size of the market for its aircraft and future revenue opportunities; and other important factors discussed in the section titled "Risk Factors" in our Annual Report on Form 10-K, filed with the Securities and Exchange Commission on March 25, 2022, and in other reports we file with or furnish to the Securities and Exchange Commission. Any such forward-looking statements represent management's estimates and beliefs as of the date of this press release. While Joby may elect to update such forward-looking statements at some point in the future, it disclaims any obligation to do so, even if subsequent events cause its views to change.

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investors@jobyaviation.com

+1-831-201-6006

Media:

press@jobyaviation.com

Last Article Next Article

Related Articles

Sound levels of helicopters used for administrative purposes at Grand Canyon National Park

Sarah Falzarano and Laura Levy
Overflights and Natural Soundscape Program
29 October 2007
NPS Report No. GRCA-07-05

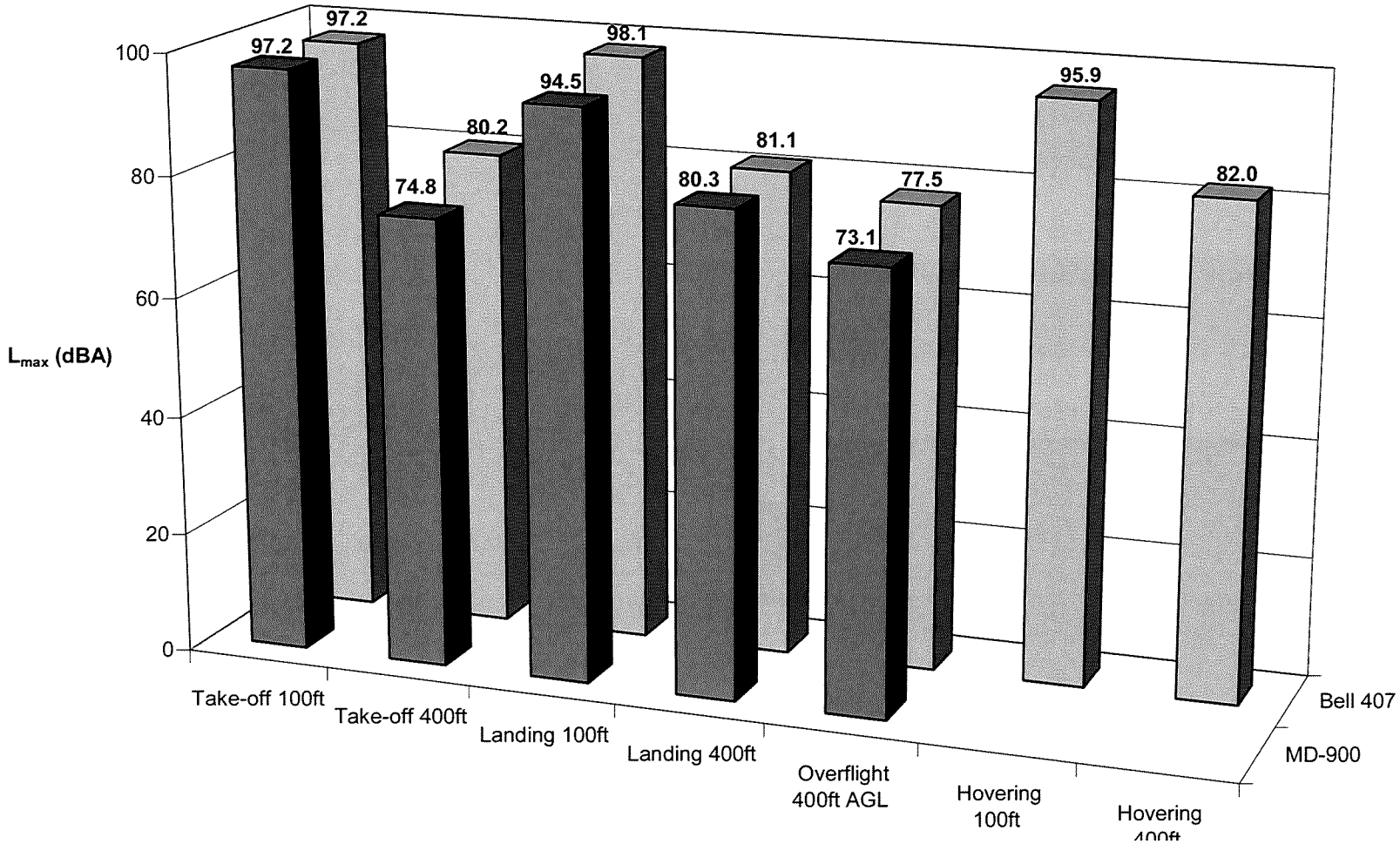

Figure 4. L_{max} levels (in dBA) of the MD-900 and Bell 407 for takeoff, landing, overflight, and hovering.

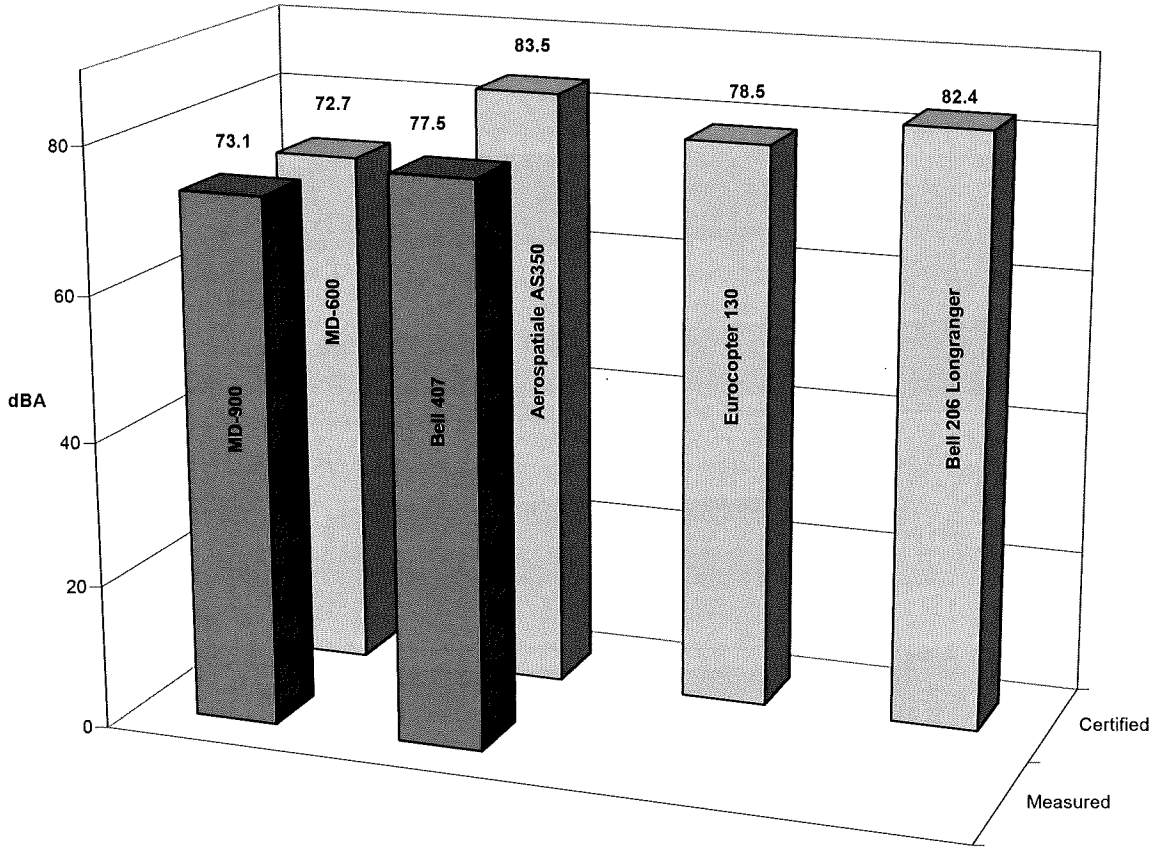

Figure 6. Measured and certified sound levels (L_{max} except for the Aerospatiale AS350 which is SEL) at a distance of 400 ft AGL for overflight. Certified data for the MD-900 and Bell 407 do not exist, but equivalent substitutions are the MD-600 and Aerospatiale AS350.

U.S. Department
of Transportation
Federal Aviation
Administration

Helicopter Noise Definition Report

UH-60A, S-76, A-109, 206-L

Report No. FAA-EE-81-16

by
J. Steven Newman
Edward J. Rickley
David W. Ford

December 1981
Final Reort

Office of Environment
and Energy
Washington, D.C. 20591

TABLE NO. A.6-2.1

BELL 206-L HELICOPTER

DOT/TSC
11/24/80

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1 CENTERLINE - CENTER JUNE 26,1980

EV	EPNL	NEL	DBA(M)	OASPL	PNL(M)	PNLT(M)	DUR(A)	DUR(P)	TC	/**
300 FT. FLYOVER - TARGET INDICATED AIRSPEED 115 KTS										
1	90.9	87.3	81.1	88.6	93.9	95.0	10.5	10.0	1.1	-0.5
2	89.3	85.6	79.9	88.1	92.8	93.9	8.5	8.5	1.1	-0.8
3	90.5	86.9	80.8	88.6	93.9	95.1	9.0	8.5	1.2	-0.6
4	90.3	86.7	81.5	89.4	94.4	95.5	8.0	7.5	1.2	-0.7
Avg.	90.2	86.6	80.8	88.7	93.7	94.8	9.0	8.6	1.1	-0.7
Std Dv	0.7	0.7	0.7	0.5	0.7	0.7	1.1	1.0	0.1	0.1
700 FT. FLYOVER - TARGET INDICATED AIRSPEED 115 KTS										
5	86.5	83.3	73.9	83.6	86.3	87.3	19.5	19.5	0.9	-0.8
6	83.6	80.5	71.4	82.4	83.2	83.9	19.0	19.0	0.7	-0.8
7	85.7	82.4	72.8	81.7	84.8	85.9	23.5	23.0	1.2	-0.7
8	84.4	81.2	72.0	82.5	83.9	84.8	18.5	18.5	1.3	-0.9
Avg.	85.0	81.8	72.5	82.5	84.6	85.4	20.1	20.0	1.0	-0.8
Std Dv	1.3	1.2	1.1	0.8	1.3	1.4	2.3	2.0	0.2	0.1
1000 FT. FLYOVER - TARGET INDICATED AIRSPEED 115 KTS										
9	83.3	80.3	69.5	78.4	81.2	82.3	27.5	29.0	0.9	-0.8
10	82.7	79.8	70.1	80.0	81.0	83.0	22.5	22.5	1.9	-0.9
11	83.3	80.6	69.0	79.7	80.9	82.2	30.5	29.5	1.3	-0.8
12	81.3	78.3	67.9	78.1	79.7	80.8	27.0	26.0	1.1	-0.8
Avg.	82.6	79.8	69.1	79.1	80.7	82.1	26.9	26.7	1.3	-0.8
Std Dv	0.9	1.0	0.9	0.9	0.7	0.9	3.3	3.2	0.5	0.0

* - INDEXES (A,D, ,ETC.) CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,AND AIRCRAFT DEVIATION FROM FLIGHT TRACK

** - /\ ,THE CHANGE IN EPNL ASSUMING TONES 800 Hz AND BELOW TO BE PSEUDOTONES AND EXCLUDING THEM FROM THE PNLT CALCULATIONS

TABLE NO. A.6-3.1

BELL 206L HELICOPTER

DOT/TSC
11/24/80

SUMMARY NOISE LEVEL DATA

AS MEASURED *

SITE: 1 CENTERLINE - CENTER JUNE 26,1980

EV	EPNL	NEL	DBA(M)	OASPL	PNL(M)	PNLT(M)	DUR(A)	DUR(P)	TC	/**
1500 FT. FLYOVER - TARGET INDICATED AIRSPEED 115 KTS										
13	80.4	77.8	65.3	74.7	76.9	78.2	55.5	42.0	1.3	-0.5
14	78.5	75.7	64.5	74.5	76.3	77.5	38.0	37.0	1.2	-0.7
15	79.9	77.1	64.3	74.6	76.0	77.1	48.5	58.0	1.1	-0.8
16	78.6	75.7	63.8	74.7	75.3	76.5	38.0	41.0	1.2	-0.9
Avg.	79.3	76.6	64.5	74.6	76.1	77.3	45.0	44.5	1.2	-0.7
Std Dv	0.9	1.1	0.6	0.1	0.6	0.7	8.6	9.3	0.1	0.2
2000 FT. FLYOVER - TARGET INDICATED AIRSPEED 115 KTS										
17	77.2	74.6	61.8	71.2	73.1	74.6	57.5	52.5	1.5	-0.9
18	75.8	73.3	60.2	70.9	71.5	72.7	49.0	48.0	1.8	-1.0
19	76.7	74.2	60.8	70.3	72.2	73.6	63.0	62.5	1.3	-0.9
Avg.	76.6	74.0	60.9	70.8	72.3	73.6	56.5	54.3	1.6	-0.9
Std Dv	0.7	0.6	0.8	0.4	0.8	1.0	7.1	7.4	0.3	0.0

* - INDEXES (A,D, ,ETC.) CALCULATED USING MEASURED DATA UNCORRECTED FOR TEMPERATURE,HUMIDITY,AND AIRCRAFT DEVIATION FROM FLIGHT TRACK

** - /\ ,THE CHANGE IN EPNL ASSUMING TONES 800 Hz AND BELOW TO BE PSEUDOTONES AND EXCLUDING THEM FROM THE PNLT CALCULATIONS

R

12

Report No. FAA-RD-77-94

NOISE CHARACTERISTICS OF EIGHT HELICOPTERS

H.C. True
E.J. Rickley

July 1977
Final Report

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, D.C. 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-RD-77-94		
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		6. Performing Organization Code: ARD-550
7. Author(s): H. C. TRUE, E. J. RICKLEY *		8. Performing Organization Report No.
9. Performing Organization Name and Address: Department of Transportation, Federal Aviation Administration, Systems Research and Development Service, Washington, D.C. 20591		10. Work Unit No. (TRAIS)
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address: Department of Transportation, Federal Aviation Administration, Systems Research and Development Service, Washington, D.C. 20591		13. Type of Report and Period Covered: FINAL REPORT
		14. Sponsoring Agency Code

15. Supplementary Notes *
Acoustic data acquired and processed into format by "Noise Measurement and Assessment Laboratory" Transportation Systems Center, Cambridge, Massachusetts

16. Abstract: This report describes the noise characteristics of Eight Helicopters during level flyovers, simulated approaches, and hover. The data was obtained during an FAA/DOT Helicopter Noise Program to acquire a data base for possible helicopter noise regulatory action. The helicopter models tested were the Bell 47G, 206L, and 212 (UHIN), the Hughes 300C and 500C, the Sikorsky S-61 (SH-3B) and S-64 (CH-54B) and the Vertol CH-47C. The acoustic data is presented as Effective Perceived Noise Level, A-weighted sound pressure level and 1/3 octave band sound pressure level with a slow meter characteristic per FAR Part 36. Selected waveforms and narrow band spectra are also shown. Proposed methods to quantify impulsive noise ("blade slap") are evaluated for a level flyover for each of the Helicopters.

The tested helicopters can be grouped into classes depending upon where the maximum noise occurs during a level flyover. Helicopters with the higher main rotor tip speeds propagate highly impulsive noise ahead of the helicopter. The maximum noise for most of the helicopters occurs near the overhead position and appears to originate from the tail rotor. Unmuffled reciprocating engine helicopters appear to have significant engine noise behind the helicopter. Noise levels, when compared as a function of gross weight and flown at airspeeds to minimize "compressibility slap" form a band 7 EPNdB wide with a slope directly proportional to gross weight. The quieter helicopters have multibladed rotors and tipspeeds below 700 fps. The duration correction in EPNL is important in evaluating helicopter noise because it penalizes the longer time histories of the helicopters with significant blade slap during a level flyover.

17. Key Words	18. Distribution Statement
Helicopter Noise Levels; Effective Perceived Noise Level, Flyover Noise Time History, Main Rotor, Tail Rotor, Impulsive Noise.	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	171	

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BELL 206-L

FIGURE 34 FLYOVER TIME HISTORIES

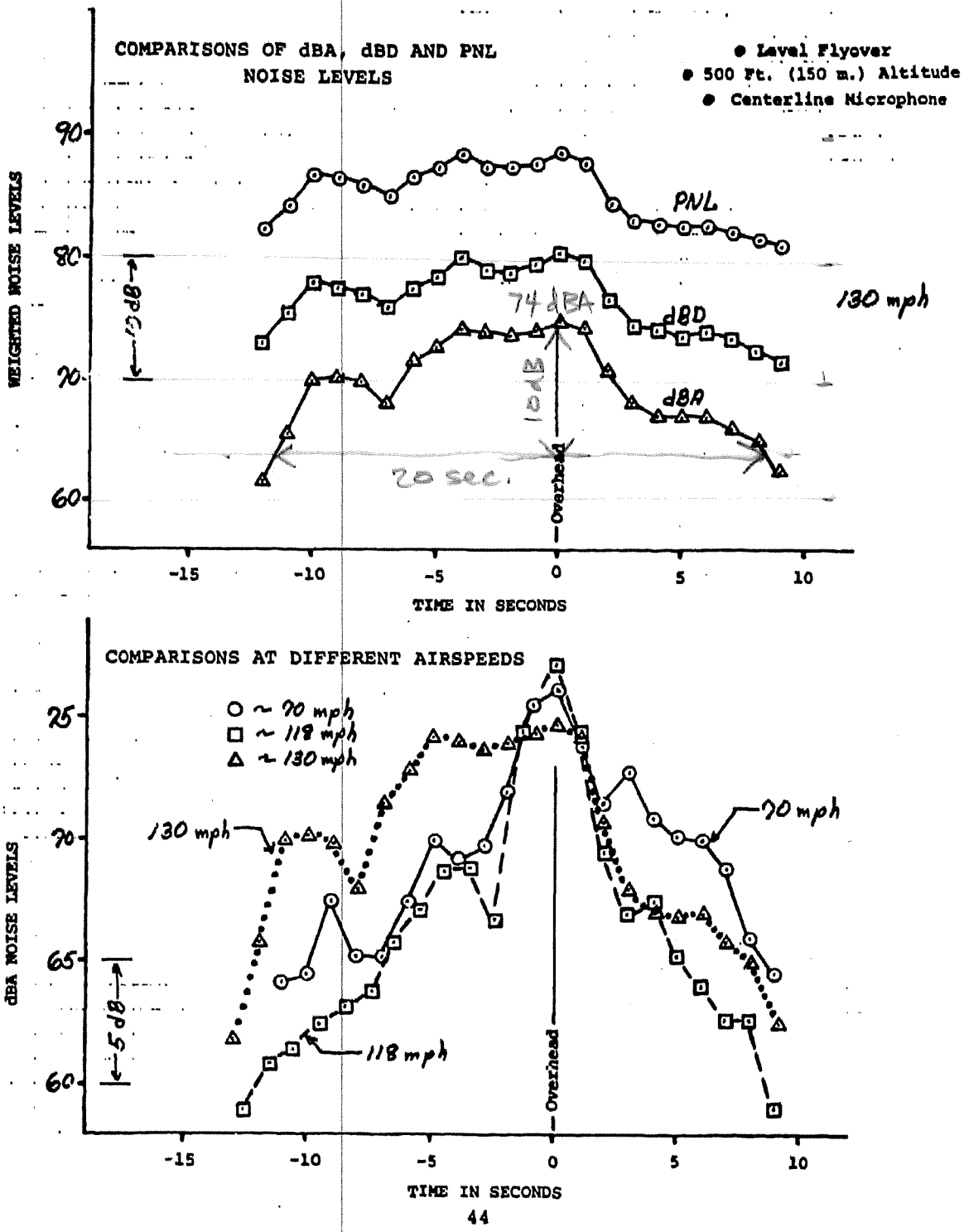
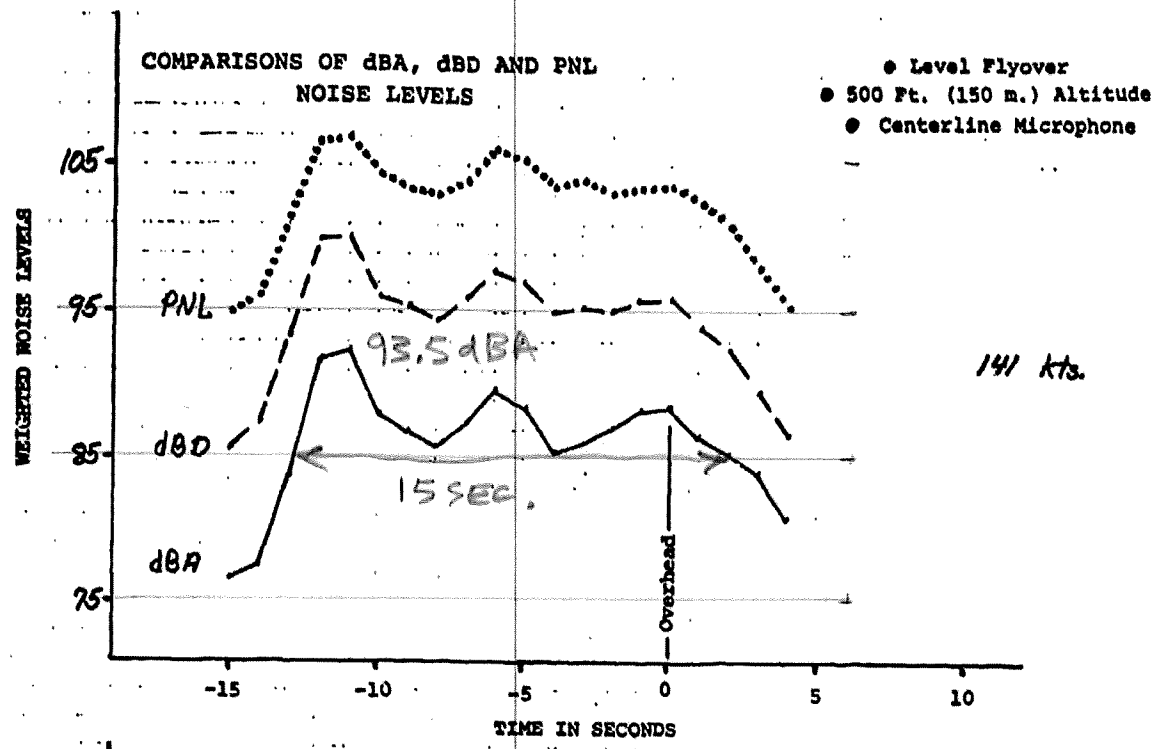
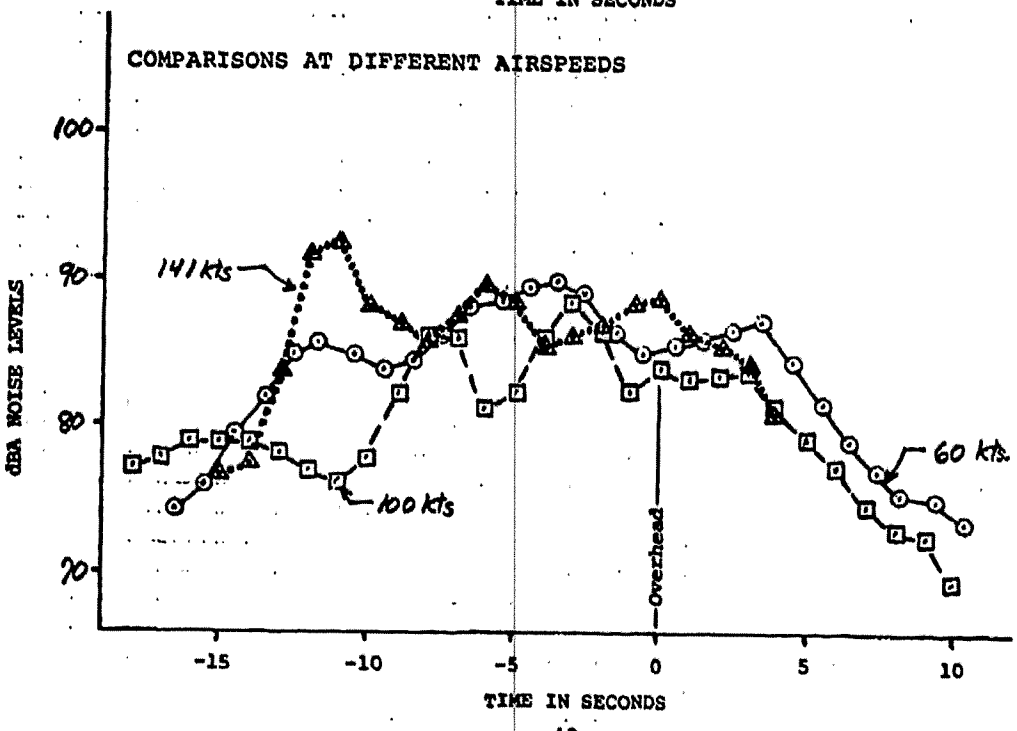


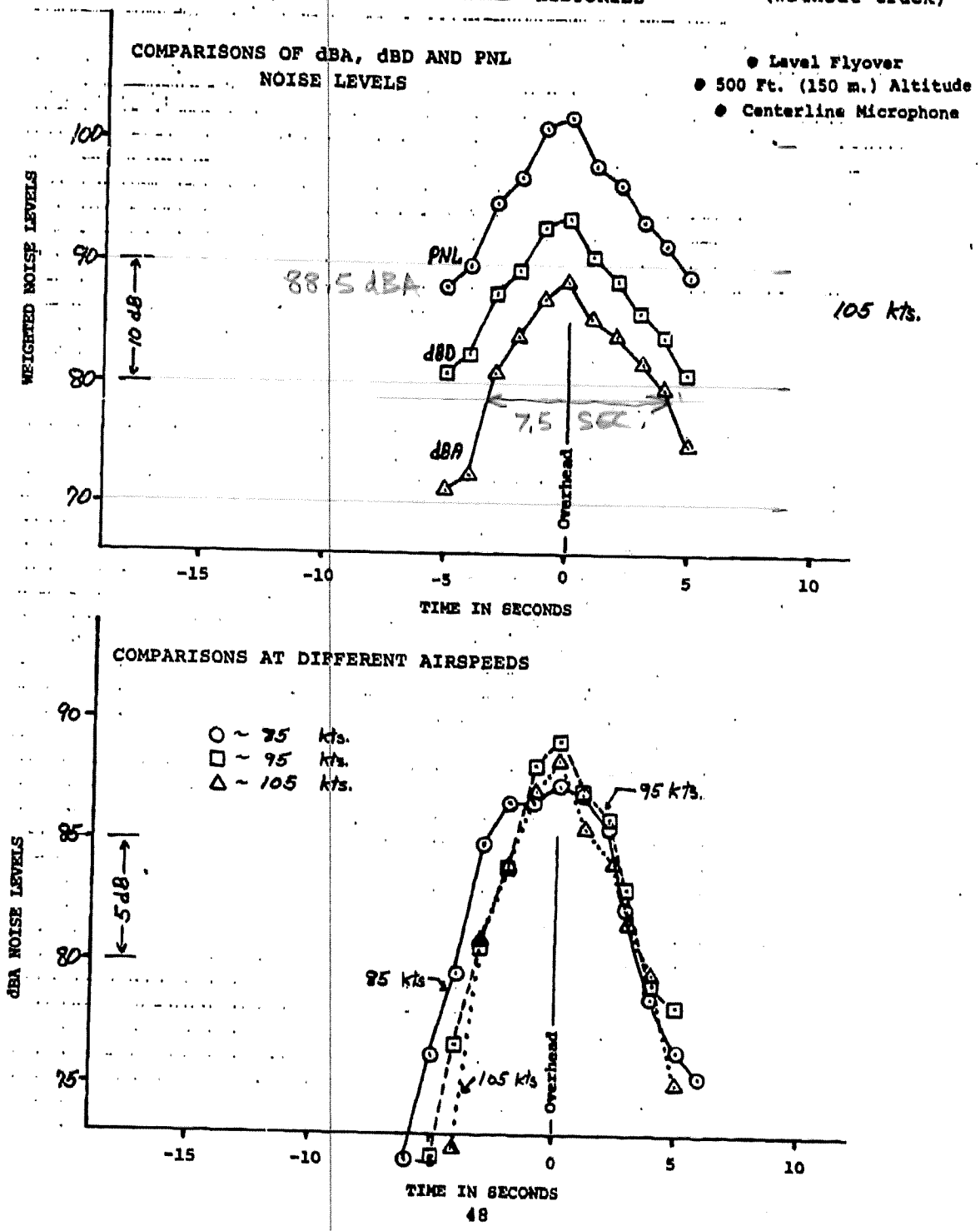
FIGURE 49 BOEING VERTOL CH-47C FLYOVER TIME HISTORIES

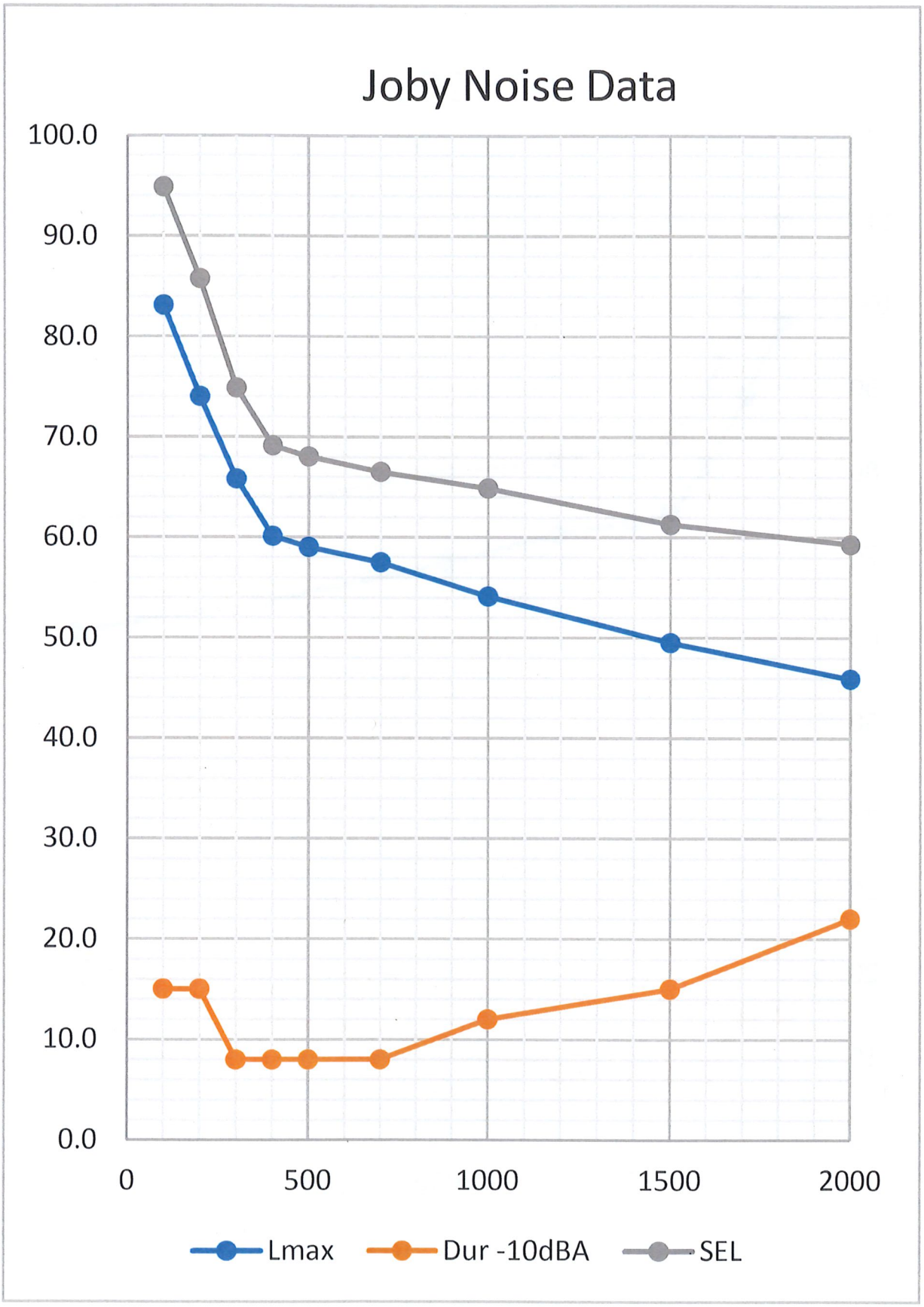




49

FIGURE 36 SIKORSKY S-64 "SKYCRANE" FLYOVER TIME HISTORIES (without truck)

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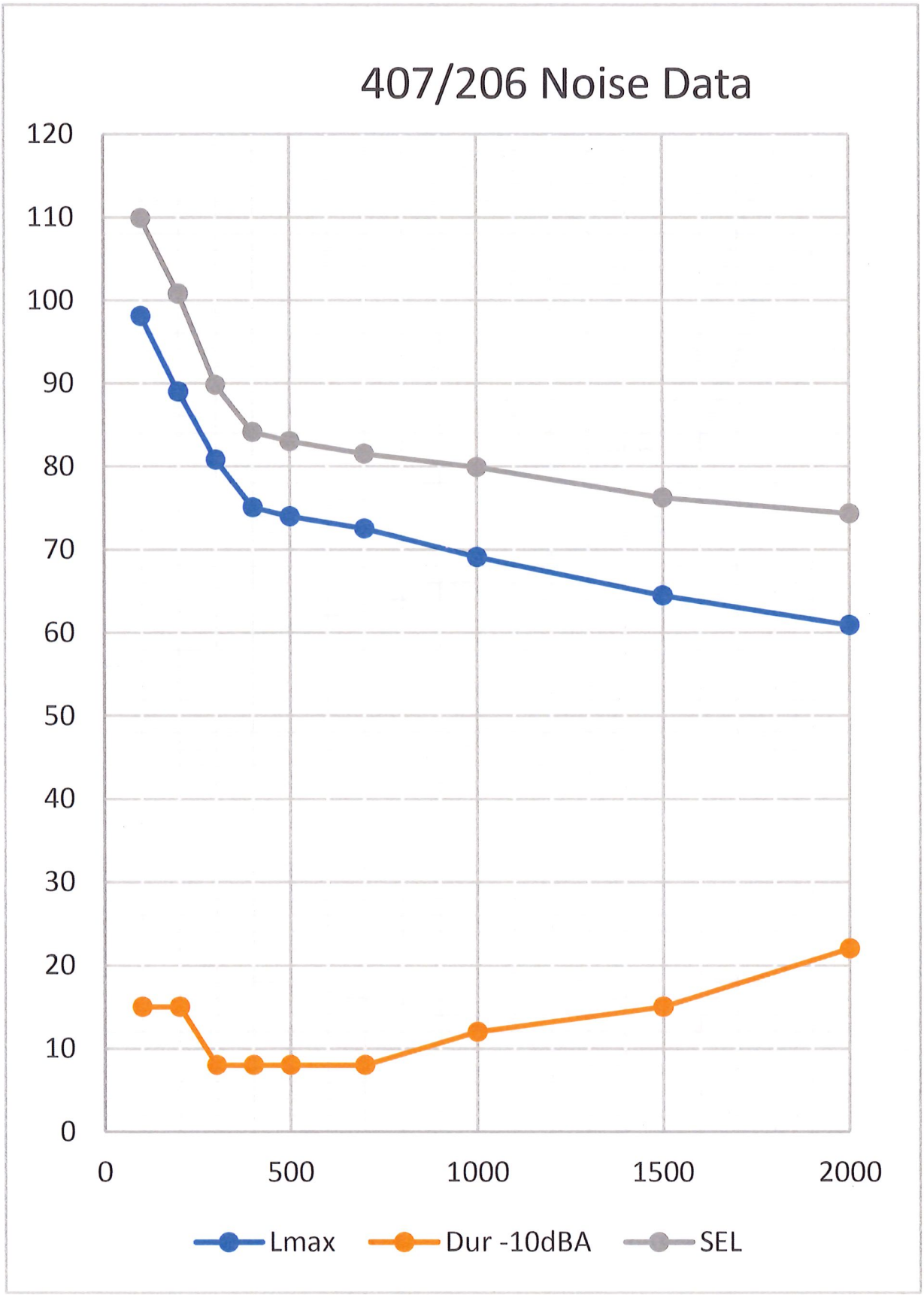
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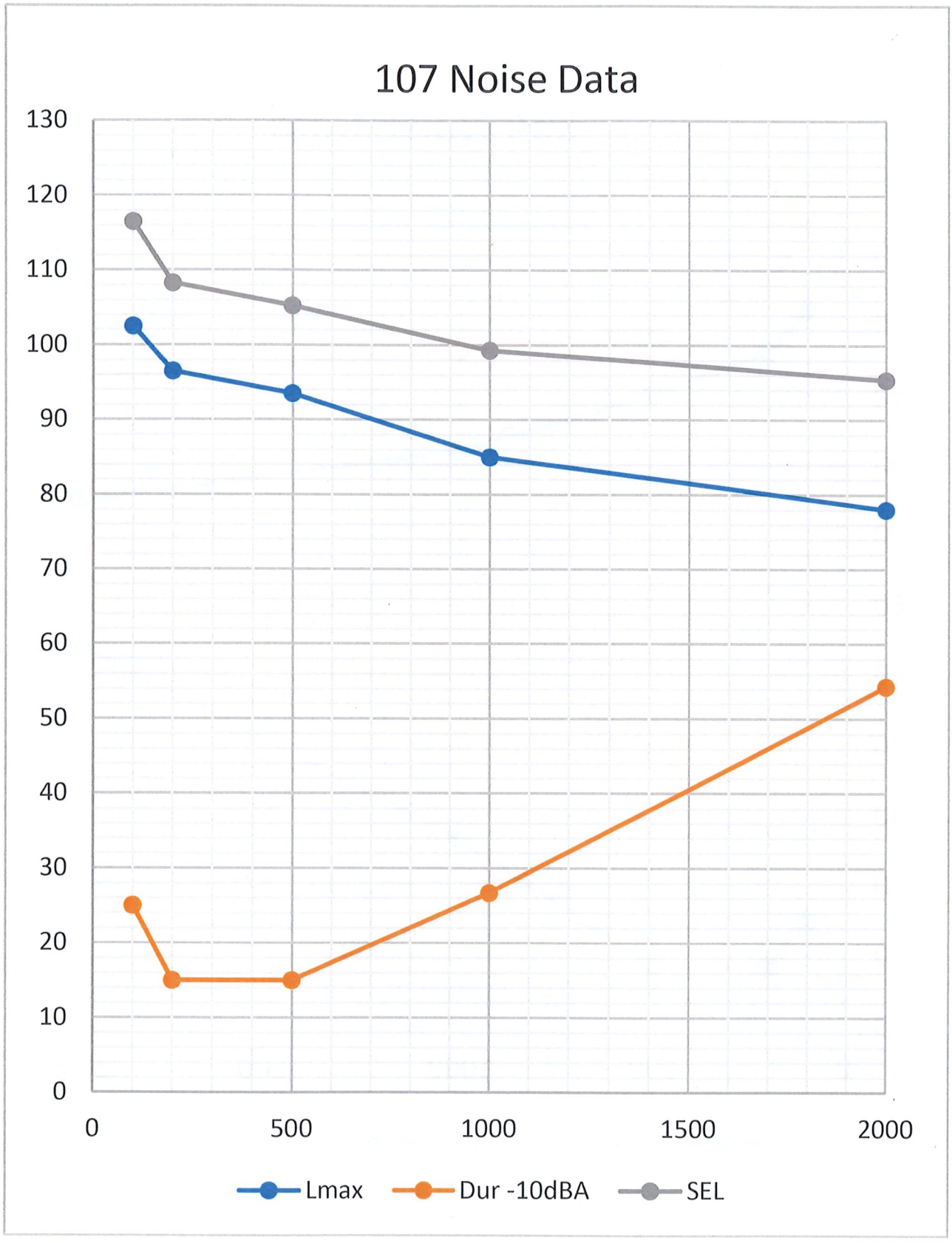
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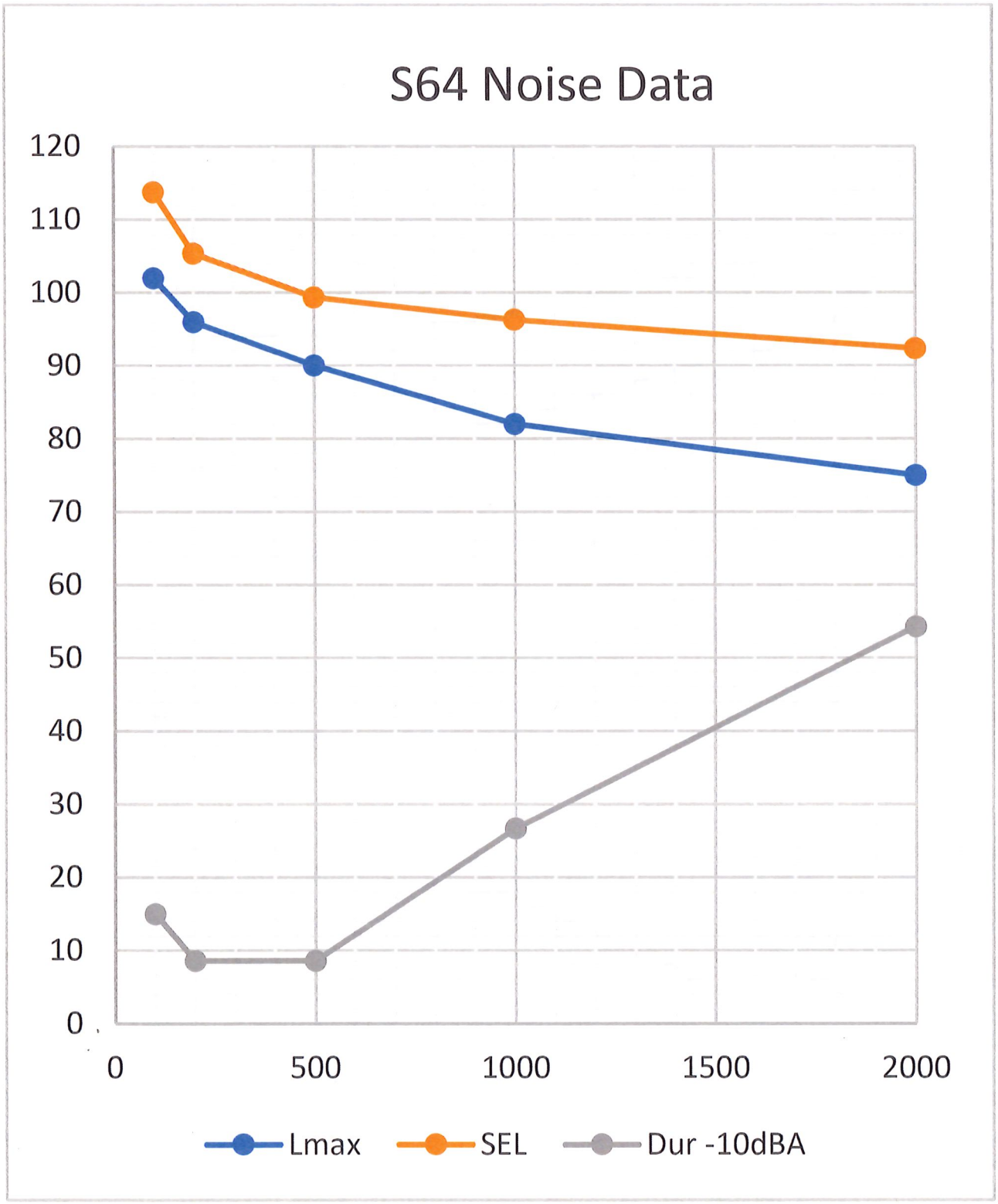
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Dur -10dBA

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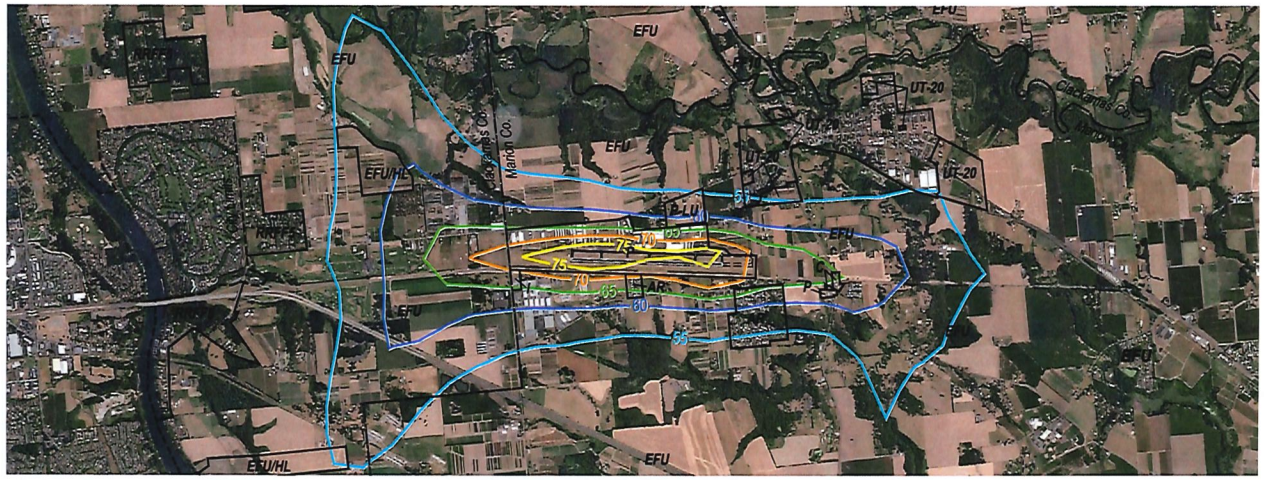
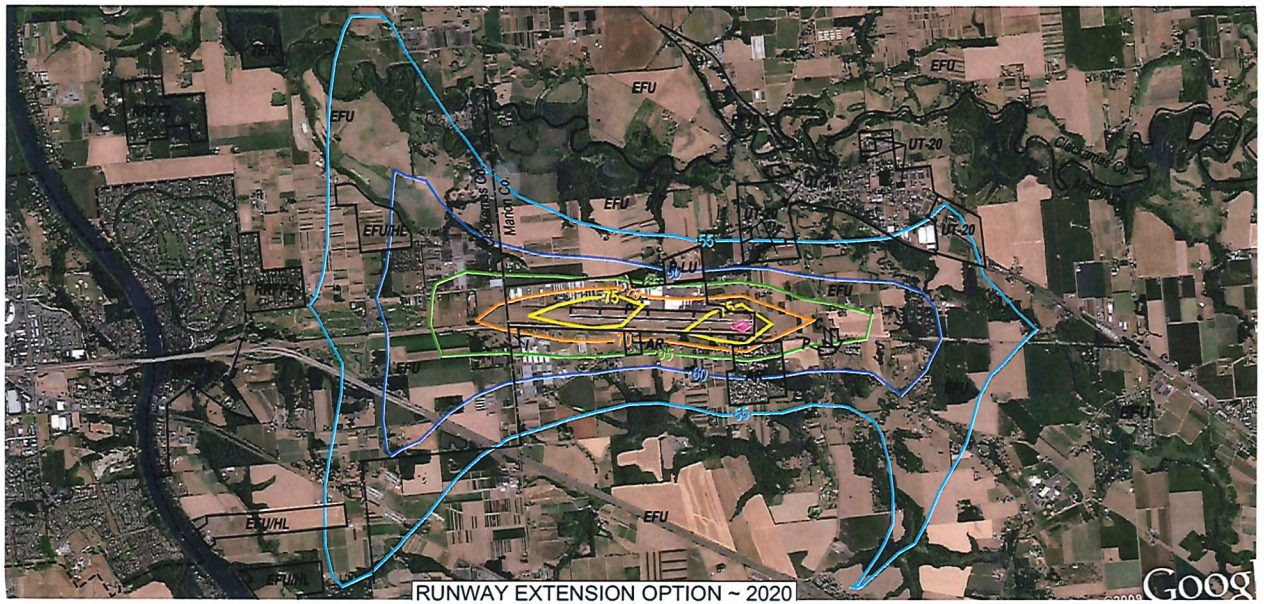


EXISTING CONDITIONS ~ 2010



RUNWAY EXTENSION OPTION ~ 2020

NOTE:
NOISE CONTOURS DEVELOPED IN ACCORDANCE WITH FAA REGULATIONS USING THE INTEGRATED NOISE MODEL (INM) VERSION 7.0. INM IS AN AVERAGE VALUE MODEL AND IS DESIGNED TO ESTIMATE LONG-TERM EFFECTS USING AVERAGE ANNUAL INPUT CONDITIONS. OPERATIONS DATA TAKEN FROM FAA-APPROVED FORECASTS PRESENTED IN CHAPTER 3 OF THE 2011 MASTER PLAN UPDATE. PLEASE REFER TO CHAPTER 5 FOR MORE INFORMATION REGARDING THE NOISE CONTOUR PREPARATION.

MAGNETIC DECLINATION
16.7° EAST CHANGING
0°9' W/YEAR

SCALE
2,000 0 1,000 2,000 4,000
(FEET)
1 INCH = 2,000 FT

MARION COUNTY, OR

ZONING

AR	ACREAGE RESIDENTIAL
C	COMMERCIAL
EFU	EXCLUSIVE FARM USE
I	INDUSTRIAL
P	PUBLIC
UT-20	URBAN TRANSITION

CLACKAMAS COUNTY, OR

ZONING

EFU	EXCLUSIVE FARM USE
EFU/HL	EXCLUSIVE FARM USE/HISTORIC LANDMARK
FF-10	FARM-FOREST 10 ACRE
RRFF5	RURAL RES/FARM/FOREST 5 ACRE
TBR	TIMBER DISTRICT

LEGEND

55 NOISE CONTOUR
ZONE LINE
COUNTY LINE
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OREGON DEPARTMENT OF AVIATION

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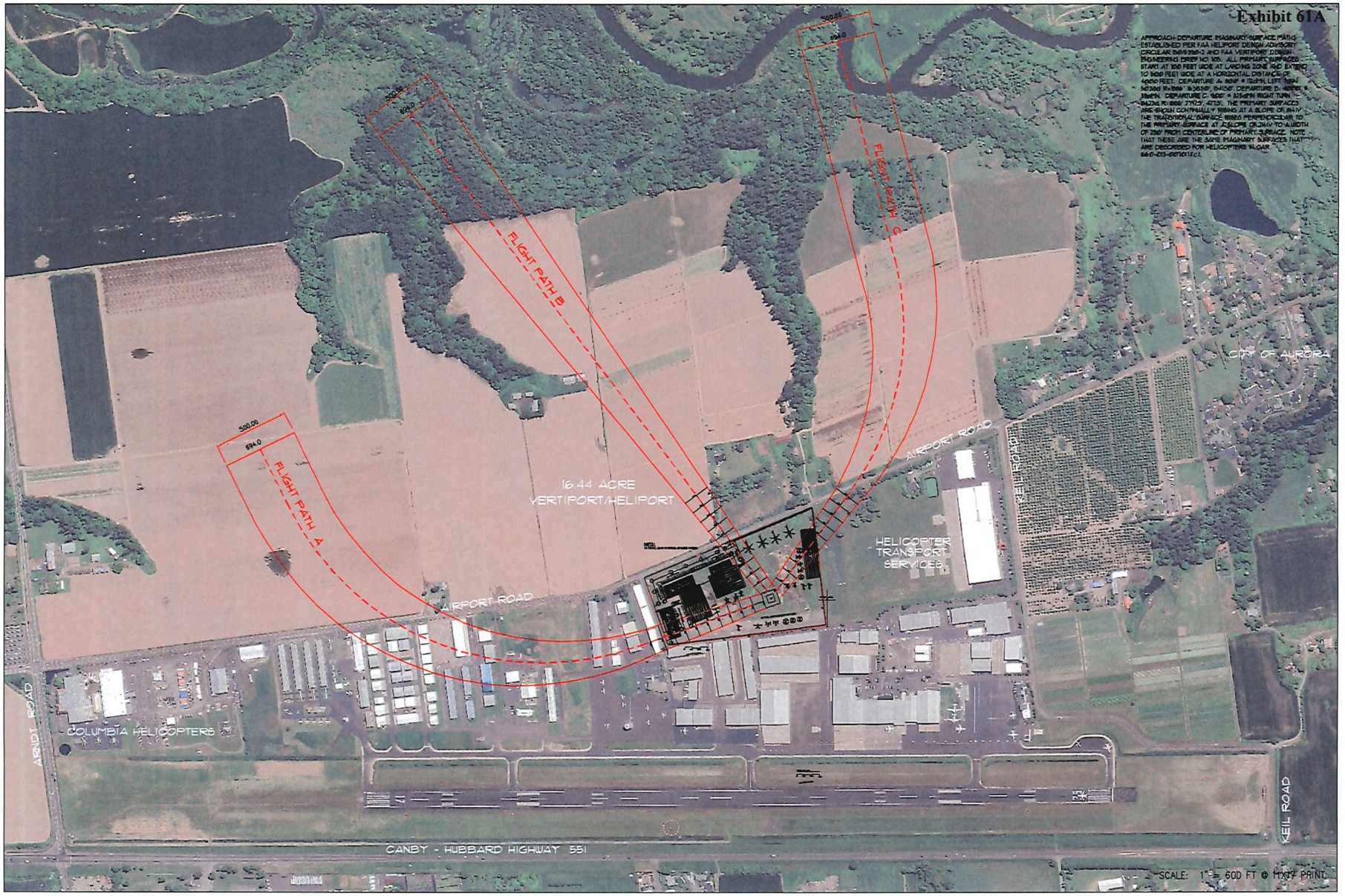

NORTH MARION COUNTY VERTIPORT - APPROACH-DEPARTURE PATHS

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NORTH MARION COUNTY VERTIPORT
MASTER PLAN
AIRPORT ROAD - AURORA, OREGON

MASTER SITE PLAN

DATE 5-14-2024

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Title 14 —Aeronautics and Space
Chapter I —Federal Aviation Administration, Department of Transportation
Subchapter I —Airports

PART 157—NOTICE OF CONSTRUCTION, ALTERATION, ACTIVATION, AND DEACTIVATION OF AIRPORTS

Authority: 49 U.S.C. 106(g), 40103, 40113, 44502.

Source: Docket No. 25708, 56 FR 33996, July 24, 1991, unless otherwise noted.

§ 157.1 Applicability.

This part applies to persons proposing to construct, alter, activate, or deactivate a civil or joint-use (civil/military) airport or to alter the status or use of such an airport. Requirements for persons to notify the Administrator concerning certain airport activities are prescribed in this part. This part does not apply to projects involving:

(a) An airport subject to conditions of a Federal agreement that requires an approved current airport layout plan to be on file with the Federal Aviation Administration; or

(b) An airport at which flight operations will be conducted under visual flight rules (VFR) and which is used or intended to be used for a period of less than 30 consecutive days with no more than 10 operations per day.

(c) The intermittent use of a site that is not an established airport, which is used or intended to be used for less than one year and at which flight operations will be conducted only under VFR. For the purposes of this part, *intermittent use of a site* means:

(1) The site is used or is intended to be used for no more than 3 days in any one week; and

(2) No more than 10 operations will be conducted in any one day at that site.

§ 157.2 Definition of terms.

For the purpose of this part:

Airport means any airport, heliport, helistop, vertiport, gliderport, seaplane base, ultralight flightpark, manned balloon launching facility, or other aircraft landing or takeoff area.

Heliport means any landing or takeoff area intended for use by helicopters or other rotary wing type aircraft capable of vertical takeoff and landing profiles.

Private use means available for use by the owner only or by the owner and other persons authorized by the owner.

Private use of public lands means that the landing and takeoff area of the proposed airport is publicly owned and the proponent is a non-government entity, regardless of whether that landing and takeoff area is on land or on water and whether the controlling entity be local, State, or Federal Government.

Public use means available for use by the general public without a requirement for prior approval of the owner or operator.

Traffic pattern means the traffic flow that is prescribed for aircraft landing or taking off from an airport, including departure and arrival procedures utilized within a 5-mile radius of the airport for ingress, egress, and noise abatement.

§ 157.3 Projects requiring notice.

Each person who intends to do any of the following shall notify the Administrator in the manner prescribed in § 157.5:

(a) Construct or otherwise establish a new airport or activate an airport.

(b) Construct, realign, alter, or activate any runway or other aircraft landing or takeoff area of an airport.

(c) Deactivate, discontinue using, or abandon an airport or any landing or takeoff area of an airport for a period of one year or more.

(d) Construct, realign, alter, activate, deactivate, abandon, or discontinue using a taxiway associated with a landing or takeoff area on a public-use airport.

(e) Change the status of an airport from private use to public use or from public use to another status.

(f) Change any traffic pattern or traffic pattern altitude or direction.

(g) Change status from IFR to VFR or VFR to IFR.

§ 157.5 Notice of intent.

(a) Notice shall be submitted on FAA Form 7480–1, copies of which may be obtained from an FAA Airport District/Field Office or Regional Office, to one of those offices and shall be submitted at least—

(1) In the cases prescribed in paragraphs (a) through (d) of § 157.3, 90 days in advance of the day that work is to begin; or

(2) In the cases prescribed in paragraphs (e) through (g) of § 157.3, 90 days in advance of the planned implementation date.

(b) Notwithstanding paragraph (a) of this section—

(1) In an emergency involving essential public service, public health, or public safety or when the delay arising from the 90-day advance notice requirement would result in an unreasonable hardship, a proponent may provide notice to the appropriate FAA Airport District/Field Office or Regional Office by telephone or other expeditious means as soon as practicable in lieu of submitting FAA Form 7480–1. However, the proponent shall provide full notice, through the submission of FAA Form 7480–1, when otherwise requested or required by the FAA.

(2) notice concerning the deactivation, discontinued use, or abandonment of an airport, an airport landing or takeoff area, or associated taxiway may be submitted by letter. Prior notice is not required; except that a 30-day prior notice is required when an established instrument approach procedure is involved or when the affected property is subject to any agreement with the United States requiring that it be maintained and operated as a public-use airport.

§ 157.7 FAA determinations.

(a) The FAA will conduct an aeronautical study of an airport proposal and, after consultations with interested persons, as appropriate, issue a determination to the proponent and advise those concerned of the FAA determination. The FAA will consider matters such as the effects the proposed action would have on existing or contemplated traffic patterns of neighboring airports; the effects the proposed action would have on the existing airspace structure and projected programs of the FAA; and the effects that existing or proposed manmade objects (on file with the FAA) and natural objects within the affected area would have on the airport proposal. While determinations consider the effects of the proposed action on the safe and efficient use of airspace by aircraft and the safety of persons and property on the ground, the determinations are only advisory. Except for an objectionable determination, each determination will contain a determination-void date to facilitate efficient planning of the use of the navigable airspace. A determination does not relieve the proponent of responsibility for compliance with any local law, ordinance or regulation, or state or other Federal regulation. Aeronautical studies and determinations will not consider environmental or land use compatibility impacts.

(b) An airport determination issued under this part will be one of the following:

(1) ***No objection.***

(2) ***Conditional.*** A conditional determination will identify the objectionable aspects of a project or action and specify the conditions which must be met and sustained to preclude an objectionable determination.

(3) ***Objectionable.*** An objectionable determination will specify the FAA's reasons for issuing such a determination.

(c) ***Determination void date.*** All work or action for which notice is required by this sub-part must be completed by the determination void date. Unless otherwise extended, revised, or terminated, an FAA determination becomes invalid on the day specified as the determination void date. Interested persons may, at least 15 days in advance of the determination void date, petition the FAA official who issued the determination to:

(1) Revise the determination based on new facts that change the basis on which it was made; or

(2) Extend the determination void date. Determinations will be furnished to the proponent, aviation officials of the state concerned, and, when appropriate, local political bodies and other interested persons.

§ 157.9 Notice of completion.

Within 15 days after completion of any airport project covered by this part, the proponent of such project shall notify the FAA Airport District Office or Regional Office by submission of FAA Form 5010–5 or by letter. A copy of FAA Form 5010–5 will be provided with the FAA determination.

Title 14 —Aeronautics and Space
Chapter I —Federal Aviation Administration, Department of Transportation
Subchapter E —Airspace

PART 77—SAFE, EFFICIENT USE, AND PRESERVATION OF THE NAVIGABLE AIRSPACE

Authority: 49 U.S.C. 106 (g), 40103, 40113-40114, 44502, 44701, 44718, 46101-46102, 46104.

Source: Docket No. FAA-2006-25002, 75 FR 42303, July 21, 2010, unless otherwise noted.

Subpart A—General

§ 77.1 Purpose.

This part establishes:

(a) The requirements to provide notice to the FAA of certain proposed construction, or the alteration of existing structures;

(b) The standards used to determine obstructions to air navigation, and navigational and communication facilities;

(c) The process for aeronautical studies of obstructions to air navigation or navigational facilities to determine the effect on the safe and efficient use of navigable airspace, air navigation facilities or equipment; and

(d) The process to petition the FAA for discretionary review of determinations, revisions, and extensions of determinations.

§ 77.3 Definitions.

For the purpose of this part:

Non-precision instrument runway means a runway having an existing instrument approach procedure utilizing air navigation facilities with only horizontal guidance, or area type navigation equipment, for which a straight-in non-precision instrument approach procedure has been approved, or planned, and for which no precision approach facilities are planned, or indicated on an FAA planning document or military service military airport planning document.

Planned or proposed airport is an airport that is the subject of at least one of the following documents received by the FAA:

(1) Airport proposals submitted under 14 CFR part 157.

(2) Airport Improvement Program requests for aid.

(3) Notices of existing airports where prior notice of the airport construction or alteration was not provided as required by 14 CFR part 157.

(4) Airport layout plans.

(5) DOD proposals for airports used only by the U.S. Armed Forces.

(6) DOD proposals on joint-use (civil-military) airports.

(7) Completed airport site selection feasibility study.

Precision instrument runway means a runway having an existing instrument approach procedure utilizing an Instrument Landing System (ILS), or a Precision Approach Radar (PAR). It also means a runway for which a precision approach system is planned and is so indicated by an FAA-approved airport layout plan; a military service approved military airport layout plan; any other FAA planning document, or military service military airport planning document.

Public use airport is an airport available for use by the general public without a requirement for prior approval of the airport owner or operator.

Seaplane base is considered to be an airport only if its sea lanes are outlined by visual markers.

Utility runway means a runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds maximum gross weight and less.

Visual runway means a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA-approved airport layout plan, a military service approved military airport layout plan, or by any planning document submitted to the FAA by competent authority.

Subpart B—Notice Requirements

§ 77.5 Applicability.

(a) If you propose any construction or alteration described in § 77.9, you must provide adequate notice to the FAA of that construction or alteration.

(b) If requested by the FAA, you must also file supplemental notice before the start date and upon completion of certain construction or alterations that are described in § 77.9.

(c) Notice received by the FAA under this subpart is used to:

(1) Evaluate the effect of the proposed construction or alteration on safety in air commerce and the efficient use and preservation of the navigable airspace and of airport traffic capacity at public use airports;

(2) Determine whether the effect of proposed construction or alteration is a hazard to air navigation;

(3) Determine appropriate marking and lighting recommendations, using FAA Advisory Circular 70/7460-1, Obstruction Marking and Lighting;

(4) Determine other appropriate measures to be applied for continued safety of air navigation; and

(5) Notify the aviation community of the construction or alteration of objects that affect the navigable airspace, including the revision of charts, when necessary.

§ 77.7 Form and time of notice.

(a) If you are required to file notice under § 77.9, you must submit to the FAA a completed FAA Form 7460-1, Notice of Proposed Construction or Alteration. FAA Form 7460-1 is available at FAA regional offices and on the Internet.

(b) You must submit this form at least 45 days before the start date of the proposed construction or alteration or the date an application for a construction permit is filed, whichever is earliest.

(c) If you propose construction or alteration that is also subject to the licensing requirements of the Federal Communications Commission (FCC), you must submit notice to the FAA on or before the date that the application is filed with the FCC.

(d) If you propose construction or alteration to an existing structure that exceeds 2,000 ft. in height above ground level (AGL), the FAA presumes it to be a hazard to air navigation that results in an inefficient use of airspace. You must include details explaining both why the proposal would not constitute a hazard to air navigation and why it would not cause an inefficient use of airspace.

(e) The 45-day advance notice requirement is waived if immediate construction or alteration is required because of an emergency involving essential public services, public health, or public safety. You may provide notice to the FAA by any available, expeditious means. You must file a completed FAA Form 7460-1 within 5 days of the initial notice to the FAA. Outside normal business hours, the nearest flight service station will accept emergency notices.

§ 77.9 Construction or alteration requiring notice.

If requested by the FAA, or if you propose any of the following types of construction or alteration, you must file notice with the FAA of:

(a) Any construction or alteration that is more than 200 ft. AGL at its site.

(b) Any construction or alteration that exceeds an imaginary surface extending outward and upward at any of the following slopes:

(1) 100 to 1 for a horizontal distance of 20,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway more than 3,200 ft. in actual length, excluding heliports.

(2) 50 to 1 for a horizontal distance of 10,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway no more than 3,200 ft. in actual length, excluding heliports.

(3) 25 to 1 for a horizontal distance of 5,000 ft. from the nearest point of the nearest landing and takeoff area of each heliport described in paragraph (d) of this section.

(c) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed a standard of paragraph (a) or (b) of this section.

(d) Any construction or alteration on any of the following airports and heliports:

(1) A public use airport listed in the Airport/Facility Directory, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Publications;

(2) A military airport under construction, or an airport under construction that will be available for public use;

(3) An airport operated by a Federal agency or the DOD.

(4) An airport or heliport with at least one FAA-approved instrument approach procedure.

(e) You do not need to file notice for construction or alteration of:

(1) Any object that will be shielded by existing structures of a permanent and substantial nature or by natural terrain or topographic features of equal or greater height, and will be located in the congested area of a city, town, or settlement where the shielded structure will not adversely affect safety in air navigation;

(2) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device meeting FAA-approved siting criteria or an appropriate military service siting criteria on military airports, the location and height of which are fixed by its functional purpose;

(3) Any construction or alteration for which notice is required by any other FAA regulation.

(4) Any antenna structure of 20 feet or less in height, except one that would increase the height of another antenna structure.

§ 77.11 Supplemental notice requirements.

(a) You must file supplemental notice with the FAA when:

(1) The construction or alteration is more than 200 feet in height AGL at its site; or

(2) Requested by the FAA.

(b) You must file supplemental notice on a prescribed FAA form to be received within the time limits specified in the FAA determination. If no time limit has been specified, you must submit supplemental notice of construction to the FAA within 5 days after the structure reaches its greatest height.

(c) If you abandon a construction or alteration proposal that requires supplemental notice, you must submit notice to the FAA within 5 days after the project is abandoned.

(d) If the construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

Subpart C—Standards for Determining Obstructions to Air Navigation or Navigational Aids or Facilities

§ 77.13 Applicability.

This subpart describes the standards used for determining obstructions to air navigation, navigational aids, or navigational facilities. These standards apply to the following:

(a) Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used and any permanent or temporary apparatus.

(b) The alteration of any permanent or temporary existing structure by a change in its height, including appurtenances, or lateral dimensions, including equipment or material used therein.

§ 77.15 Scope.

(a) This subpart describes standards used to determine obstructions to air navigation that may affect the safe and efficient use of navigable airspace and the operation of planned or existing air navigation and communication facilities. Such facilities include air navigation aids, communication equipment, airports, Federal airways, instrument approach or departure procedures, and approved off-airway routes.

(b) Objects that are considered obstructions under the standards described in this subpart are presumed hazards to air navigation unless further aeronautical study concludes that the object is not a hazard. Once further aeronautical study has been initiated, the FAA will use the standards in this subpart, along with FAA policy and guidance material, to determine if the object is a hazard to air navigation.

(c) The FAA will apply these standards with reference to an existing airport facility, and airport proposals received by the FAA, or the appropriate military service, before it issues a final determination.

(d) For airports having defined runways with specially prepared hard surfaces, the primary surface for each runway extends 200 feet beyond each end of the runway. For airports having defined strips or pathways used regularly for aircraft takeoffs and landings, and designated runways, without specially prepared hard surfaces, each end of the primary surface for each such runway shall coincide with the corresponding end of the runway. At airports, excluding seaplane bases, having a defined landing and takeoff area with no defined pathways for aircraft takeoffs and landings, a determination must be made as to which portions of the landing and takeoff area are regularly used as landing and takeoff pathways. Those determined pathways must be considered runways, and an appropriate primary surface as defined in § 77.19 will be considered as longitudinally centered on each such runway. Each end of that primary surface must coincide with the corresponding end of that runway.

(e) The standards in this subpart apply to construction or alteration proposals on an airport (including heliports and seaplane bases with marked lanes) if that airport is one of the following before the issuance of the final determination:

(1) Available for public use and is listed in the Airport/Facility Directory, Supplement Alaska, or Supplement Pacific of the U.S. Government Flight Information Publications; or

(2) A planned or proposed airport or an airport under construction of which the FAA has received actual notice, except DOD airports, where there is a clear indication the airport will be available for public use; or,

(3) An airport operated by a Federal agency or the DOD; or,

(4) An airport that has at least one FAA-approved instrument approach.

§ 77.17 Obstruction standards.

(a) An existing object, including a mobile object, is, and a future object would be an obstruction to air navigation if it is of greater height than any of the following heights or surfaces:

(1) A height of 499 feet AGL at the site of the object.

(2) A height that is 200 feet AGL, or above the established airport elevation, whichever is higher, within 3 nautical miles of the established reference point of an airport, excluding heliports, with its longest runway more than 3,200 feet in actual length, and that height increases in the proportion of 100 feet for each additional nautical mile from the airport up to a maximum of 499 feet.

(3) A height within a terminal obstacle clearance area, including an initial approach segment, a departure area, and a circling approach area, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area or segment to be less than the required obstacle clearance.

(4) A height within an en route obstacle clearance area, including turn and termination areas, of a Federal Airway or approved off-airway route, that would increase the minimum obstacle clearance altitude.

(5) The surface of a takeoff and landing area of an airport or any imaginary surface established under § 77.19, 77.21, or 77.23. However, no part of the takeoff or landing area itself will be considered an obstruction.

(b) Except for traverse ways on or near an airport with an operative ground traffic control service furnished by an airport traffic control tower or by the airport management and coordinated with the air traffic control service, the standards of paragraph (a) of this section apply to traverse ways used or to be used for the passage of mobile objects only after the heights of these traverse ways are increased by:

(1) 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance.

(2) 15 feet for any other public roadway.

(3) 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road.

(4) 23 feet for a railroad.

(5) For a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it.

§ 77.19 Civil airport imaginary surfaces.

The following civil airport imaginary surfaces are established with relation to the airport and to each runway. The size of each such imaginary surface is based on the category of each runway according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway are determined by the most precise approach procedure existing or planned for that runway end.

(a) ***Horizontal surface.*** A horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of a specified radii from the center of each end of the primary surface of each runway of each airport and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc is:

(1) 5,000 feet for all runways designated as utility or visual;

(2) 10,000 feet for all other runways. The radius of the arc specified for each end of a runway will have the same arithmetical value. That value will be the highest determined for either end of the runway. When a 5,000-foot arc is encompassed by tangents connecting two adjacent 10,000-foot arcs, the 5,000-foot arc shall be disregarded on the construction of the perimeter of the horizontal surface.

(b) ***Conical surface.*** A surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

(c) ***Primary surface.*** A surface longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface extends 200 feet beyond each end of that runway; but when the runway has no specially prepared hard surface, the primary surface ends at each end of that runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of the primary surface is:

(1) 250 feet for utility runways having only visual approaches.

(2) 500 feet for utility runways having non-precision instrument approaches.

(3) For other than utility runways, the width is:

(i) 500 feet for visual runways having only visual approaches.

(ii) 500 feet for non-precision instrument runways having visibility minimums greater than three-fourths statute mile.

(iii) 1,000 feet for a non-precision instrument runway having a non-precision instrument approach with visibility minimums as low as three-fourths of a statute mile, and for precision instrument runways.

(iv) The width of the primary surface of a runway will be that width prescribed in this section for the most precise approach existing or planned for either end of that runway.

(d) ***Approach surface.*** A surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface is applied to each end of each runway based upon the type of approach available or planned for that runway end.

(1) The inner edge of the approach surface is the same width as the primary surface and it expands uniformly to a width of:

(i) 1,250 feet for that end of a utility runway with only visual approaches;

(ii) 1,500 feet for that end of a runway other than a utility runway with only visual approaches;

(iii) 2,000 feet for that end of a utility runway with a non-precision instrument approach;

(iv) 3,500 feet for that end of a non-precision instrument runway other than utility, having visibility minimums greater that three-fourths of a statute mile;

(v) 4,000 feet for that end of a non-precision instrument runway, other than utility, having a non-precision instrument approach with visibility minimums as low as three-fourths statute mile; and

(vi) 16,000 feet for precision instrument runways.

(2) The approach surface extends for a horizontal distance of:

(i) 5,000 feet at a slope of 20 to 1 for all utility and visual runways;

(ii) 10,000 feet at a slope of 34 to 1 for all non-precision instrument runways other than utility; and

(iii) 10,000 feet at a slope of 50 to 1 with an additional 40,000 feet at a slope of 40 to 1 for all precision instrument runways.

(3) The outer width of an approach surface to an end of a runway will be that width prescribed in this subsection for the most precise approach existing or planned for that runway end.

(e) ***Transitional surface.*** These surfaces extend outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary surface and from the sides of the approach surfaces. Transitional surfaces for those portions of the precision approach surface which project through and beyond the limits of the conical surface, extend a distance of 5,000 feet measured horizontally from the edge of the approach surface and at right angles to the runway centerline.

§ 77.21 Department of Defense (DOD) airport imaginary surfaces.

(a) ***Related to airport reference points.*** These surfaces apply to all military airports. For the purposes of this section, a military airport is any airport operated by the DOD.

(1) ***Inner horizontal surface.*** A plane that is oval in shape at a height of 150 feet above the established airfield elevation. The plane is constructed by scribing an arc with a radius of 7,500 feet about the centerline at the end of each runway and interconnecting these arcs with tangents.

(2) ***Conical surface.*** A surface extending from the periphery of the inner horizontal surface outward and upward at a slope of 20 to 1 for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation.

(3) ***Outer horizontal surface.*** A plane, located 500 feet above the established airfield elevation, extending outward from the outer periphery of the conical surface for a horizontal distance of 30,000 feet.

(b) ***Related to runways.*** These surfaces apply to all military airports.

(1) ***Primary surface.*** A surface located on the ground or water longitudinally centered on each runway with the same length as the runway. The width of the primary surface for runways is 2,000 feet. However, at established bases where substantial construction has taken place in accordance with a previous lateral clearance criteria, the 2,000-foot width may be reduced to the former criteria.

(2) ***Clear zone surface.*** A surface located on the ground or water at each end of the primary surface, with a length of 1,000 feet and the same width as the primary surface.

(3) ***Approach clearance surface.*** An inclined plane, symmetrical about the runway centerline extended, beginning 200 feet beyond each end of the primary surface at the centerline elevation of the runway end and extending for 50,000 feet. The slope of the approach clearance surface is 50 to 1 along the runway centerline extended until it reaches an elevation of 500 feet above the established airport elevation. It then continues horizontally at this elevation to a point 50,000 feet from the point of beginning. The width of this surface at the runway end is the same as the primary surface, it flares uniformly, and the width at 50,000 is 16,000 feet.

(4) ***Transitional surfaces.*** These surfaces connect the primary surfaces, the first 200 feet of the clear zone surfaces, and the approach clearance surfaces to the inner horizontal surface, conical surface, outer horizontal surface or other transitional surfaces. The slope of the transitional surface is 7 to 1 outward and upward at right angles to the runway centerline.

§ 77.23 Heliport imaginary surfaces.

(a) ***Primary surface.*** The area of the primary surface coincides in size and shape with the designated take-off and landing area. This surface is a horizontal plane at the elevation of the established heliport elevation.

(b) ***Approach surface.*** The approach surface begins at each end of the heliport primary surface with the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet where its width is 500 feet. The slope of the approach surface is 8 to 1 for civil heliports and 10 to 1 for military heliports.

(c) ***Transitional surfaces.*** These surfaces extend outward and upward from the lateral boundaries of the primary surface and from the approach surfaces at a slope of 2 to 1 for a distance of 250 feet measured horizontally from the centerline of the primary and approach surfaces.

Subpart D—Aeronautical Studies and Determinations

§ 77.25 Applicability.

(a) This subpart applies to any aeronautical study of a proposed construction or alteration for which notice to the FAA is required under § 77.9.

(b) The purpose of an aeronautical study is to determine whether the aeronautical effects of the specific proposal and, where appropriate, the cumulative impact resulting from the proposed construction or alteration when combined with the effects of other existing or proposed structures, would constitute a hazard to air navigation.

(c) The obstruction standards in subpart C of this part are supplemented by other manuals and directives used in determining the effect on the navigable airspace of a proposed construction or alteration. When the FAA needs additional information, it may circulate a study to interested parties for comment.

§ 77.27 Initiation of studies.

The FAA will conduct an aeronautical study when:

(a) Requested by the sponsor of any proposed construction or alteration for which a notice is submitted; or

(b) The FAA determines a study is necessary.

§ 77.29 Evaluating aeronautical effect.

(a) The FAA conducts an aeronautical study to determine the impact of a proposed structure, an existing structure that has not yet been studied by the FAA, or an alteration of an existing structure on aeronautical operations, procedures, and the safety of flight. These studies include evaluating:

(1) The impact on arrival, departure, and en route procedures for aircraft operating under visual flight rules;

(2) The impact on arrival, departure, and en route procedures for aircraft operating under instrument flight rules;

(3) The impact on existing and planned public use airports;

(4) Airport traffic capacity of existing public use airports and public use airport development plans received before the issuance of the final determination;

(5) Minimum obstacle clearance altitudes, minimum instrument flight rules altitudes, approved or planned instrument approach procedures, and departure procedures;

(6) The potential effect on ATC radar, direction finders, ATC tower line-of-sight visibility, and physical or electromagnetic effects on air navigation, communication facilities, and other surveillance systems;

(7) The aeronautical effects resulting from the cumulative impact of a proposed construction or alteration of a structure when combined with the effects of other existing or proposed structures.

(b) If you withdraw the proposed construction or alteration or revise it so that it is no longer identified as an obstruction, or if no further aeronautical study is necessary, the FAA may terminate the study.

§ 77.31 Determinations.

(a) The FAA will issue a determination stating whether the proposed construction or alteration would be a hazard to air navigation, and will advise all known interested persons.

(b) The FAA will make determinations based on the aeronautical study findings and will identify the following:

(1) The effects on VFR/IFR aeronautical departure/arrival operations, air traffic procedures, minimum flight altitudes, and existing, planned, or proposed airports listed in § 77.15(e) of which the FAA has received actual notice prior to issuance of a final determination.

(2) The extent of the physical and/or electromagnetic effect on the operation of existing or proposed air navigation facilities, communication aids, or surveillance systems.

(c) The FAA will issue a Determination of Hazard to Air Navigation when the aeronautical study concludes that the proposed construction or alteration will exceed an obstruction standard and would have a substantial aeronautical impact.

(d) A Determination of No Hazard to Air Navigation will be issued when the aeronautical study concludes that the proposed construction or alteration will exceed an obstruction standard but would not have a substantial aeronautical impact to air navigation. A Determination of No Hazard to Air Navigation may include the following:

(1) Conditional provisions of a determination.

(2) Limitations necessary to minimize potential problems, such as the use of temporary construction equipment.

(3) Supplemental notice requirements, when required.

(4) Marking and lighting recommendations, as appropriate.

(e) The FAA will issue a Determination of No Hazard to Air Navigation when a proposed structure does not exceed any of the obstruction standards and would not be a hazard to air navigation.

§ 77.33 Effective period of determinations.

(a) The effective date of a determination not subject to discretionary review under 77.37(b) is the date of issuance. The effective date of all other determinations for a proposed or existing structure is 40 days from the date of issuance, provided a valid petition for review has not been received by the FAA. If a valid petition for review is filed, the determination will not become final, pending disposition of the petition.

(b) Unless extended, revised, or terminated, each Determination of No Hazard to Air Navigation issued under this subpart expires 18 months after the effective date of the determination, or on the date the proposed construction or alteration is abandoned, whichever is earlier.

(c) A Determination of Hazard to Air Navigation has no expiration date.

[Doc. No. FAA-2006-25002, 75 FR 42303, July 21, 2010, as amended by Amdt. 77-13-A, 76 FR 2802, Jan. 18, 2011]

§ 77.35 Extensions, terminations, revisions and corrections.

(a) You may petition the FAA official that issued the Determination of No Hazard to Air Navigation to revise or reconsider the determination based on new facts or to extend the effective period of the determination, provided that:

(1) Actual structural work of the proposed construction or alteration, such as the laying of a foundation, but not including excavation, has not been started; and

(2) The petition is submitted at least 15 days before the expiration date of the Determination of No Hazard to Air Navigation.

(b) A Determination of No Hazard to Air Navigation issued for those construction or alteration proposals not requiring an FCC construction permit may be extended by the FAA one time for a period not to exceed 18 months.

(c) A Determination of No Hazard to Air Navigation issued for a proposal requiring an FCC construction permit may be granted extensions for up to 18 months, provided that:

(1) You submit evidence that an application for a construction permit/license was filed with the FCC for the associated site within 6 months of issuance of the determination; and

(2) You submit evidence that additional time is warranted because of FCC requirements; and

(3) Where the FCC issues a construction permit, a final Determination of No Hazard to Air Navigation is effective until the date prescribed by the FCC for completion of the construction. If an extension of the original FCC completion date is needed, an extension of the FAA determination must be requested from the Obstruction Evaluation Service (OES).

(4) If the Commission refuses to issue a construction permit, the final determination expires on the date of its refusal.

Subpart E—Petitions for Discretionary Review

§ 77.37 General.

(a) If you are the sponsor, provided a substantive aeronautical comment on a proposal in an aeronautical study, or have a substantive aeronautical comment on the proposal but were not given an opportunity to state it, you may petition the FAA for a discretionary review of a determination, revision, or extension of a determination issued by the FAA.

(b) You may not file a petition for discretionary review for a Determination of No Hazard that is issued for a temporary structure, marking and lighting recommendation, or when a proposed structure or alteration does not exceed obstruction standards contained in subpart C of this part.

§ 77.39 Contents of a petition.

(a) You must file a petition for discretionary review in writing and it must be received by the FAA within 30 days after the issuance of a determination under § 77.31, or a revision or extension of the determination under § 77.35.

(b) The petition must contain a full statement of the aeronautical basis on which the petition is made, and must include new information or facts not previously considered or presented during the aeronautical study, including valid aeronautical reasons why the determination, revisions, or extension made by the FAA should be reviewed.

(c) In the event that the last day of the 30-day filing period falls on a weekend or a day the Federal government is closed, the last day of the filing period is the next day that the government is open.

(d) The FAA will inform the petitioner or sponsor (if other than the petitioner) and the FCC (whenever an FCC-related proposal is involved) of the filing of the petition and that the determination is not final pending disposition of the petition.

§ 77.41 Discretionary review results.

(a) If discretionary review is granted, the FAA will inform the petitioner and the sponsor (if other than the petitioner) of the issues to be studied and reviewed. The review may include a request for comments and a review of all records from the initial aeronautical study.

(b) If discretionary review is denied, the FAA will notify the petitioner and the sponsor (if other than the petitioner), and the FCC, whenever a FCC-related proposal is involved, of the basis for the denial along with a statement that the determination is final.

(c) After concluding the discretionary review process, the FAA will revise, affirm, or reverse the determination.

Title 14 —Aeronautics and Space
Chapter I —Federal Aviation Administration, Department of Transportation
Subchapter F —Air Traffic and General Operating Rules

PART 107—SMALL UNMANNED AIRCRAFT SYSTEMS

Authority: 49 U.S.C. 106(f), 40101 note, 40103(b), 44701(a)(5), 46105(c), 46110, 44807.

Source: Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, unless otherwise noted.

Subpart A—General

§ 107.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this part applies to the registration, airman certification, and operation of civil small unmanned aircraft systems within the United States. This part also applies to the eligibility of civil small unmanned aircraft systems to operate over human beings in the United States.

(b) This part does not apply to the following:

(1) Air carrier operations;

(2) Any aircraft subject to the provisions of 49 U.S.C. 44809;

(3) Any operation that the holder of an exemption under section 333 of Public Law 112-95 or 49 U.S.C. 44807 elects to conduct pursuant to the exemption, unless otherwise specified in the exemption; or

(4) Any operation that a person elects to conduct under part 91 of this chapter with a small unmanned aircraft system that has been issued an airworthiness certificate.

[Amdt. No. 107-8, 86 FR 4381, Jan. 15, 2021]

§ 107.2 Applicability of certification procedures for products and articles.

The provisions of part 21 of this chapter do not apply to small unmanned aircraft systems operated under this part unless the small unmanned aircraft system will operate over human beings in accordance with § 107.140.

[Amdt. No. 107-8, 86 FR 4381, Jan. 15, 2021]

§ 107.3 Definitions.

The following definitions apply to this part. If there is a conflict between the definitions of this part and definitions specified in § 1.1 of this chapter, the definitions in this part control for purposes of this part:

Control station means an interface used by the remote pilot to control the flight path of the small unmanned aircraft.

Corrective lenses means spectacles or contact lenses.

Declaration of compliance means a record submitted to the FAA that certifies the small unmanned aircraft conforms to the Category 2 or Category 3 requirements under subpart D of this part.

Small unmanned aircraft means an unmanned aircraft weighing less than 55 pounds on takeoff, including everything that is on board or otherwise attached to the aircraft.

Small unmanned aircraft system (small UAS) means a small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) that are required for the safe and efficient operation of the small unmanned aircraft in the national airspace system.

Unmanned aircraft means an aircraft operated without the possibility of direct human intervention from within or on the aircraft.

Visual observer means a person who is designated by the remote pilot in command to assist the remote pilot in command and the person manipulating the flight controls of the small UAS to see and avoid other air traffic or objects aloft or on the ground.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4381, Jan. 15, 2021]

§ 107.5 Falsification, reproduction, or alteration.

(a) No person may make or cause to be made—

(1) Any fraudulent or intentionally false record or report that is required to be made, kept, or used to show compliance with any requirement under this part.

(2) Any reproduction or alteration, for fraudulent purpose, of any certificate, rating, authorization, record or report under this part.

(b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for any of the following:

(1) Denial of an application for a remote pilot certificate or a certificate of waiver;

(2) Denial of a declaration of compliance;

(3) Suspension or revocation of any certificate, waiver, or declaration of compliance issued or accepted by the Administrator under this part and held by that person; or

(4) A civil penalty.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4381, Jan. 15, 2021]

§ 107.7 Inspection, testing, and demonstration of compliance.

(a) A remote pilot in command, owner, or person manipulating the flight controls of a small unmanned aircraft system must—

(1) Have in that person's physical possession and readily accessible the remote pilot certificate with a small UAS rating and identification when exercising the privileges of that remote pilot certificate.

(2) Present his or her remote pilot certificate with a small UAS rating and identification that contains the information listed at § 107.67(b)(1) through (3) for inspection upon a request from—

(i) The Administrator;

(ii) An authorized representative of the National Transportation Safety Board;

(iii) Any Federal, State, or local law enforcement officer; or

(iv) An authorized representative of the Transportation Security Administration.

(3) Make available, upon request, to the Administrator any document, record, or report required to be kept under the regulations of this chapter.

(b) The remote pilot in command, visual observer, owner, operator, or person manipulating the flight controls of a small unmanned aircraft system must, upon request, allow the Administrator to make any test or inspection of the small unmanned aircraft system, the remote pilot in command, the person manipulating the flight controls of a small unmanned aircraft system, and, if applicable, the visual observer to determine compliance with this part.

(c) Any person holding an FAA-accepted declaration of compliance under subpart D of this part must, upon request, make available to the Administrator:

(1) The declaration of compliance required under subpart D of this part; and

(2) Any other document, record, or report required to be kept under the regulations of this chapter.

(d) Any person holding an FAA-accepted declaration of compliance under subpart D of this part must, upon request, allow the Administrator to inspect its facilities, technical data, and any manufactured small UAS and witness any tests necessary to determine compliance with that subpart.

[Amdt. No. 107-8, 86 FR 4381, Jan. 15, 2021]

§ 107.9 Safety event reporting.

No later than 10 calendar days after an operation that meets the criteria of either paragraph (a) or (b) of this section, a remote pilot in command must report to the FAA, in a manner acceptable to the Administrator, any operation of the small unmanned aircraft involving at least:

(a) Serious injury to any person or any loss of consciousness; or

(b) Damage to any property, other than the small unmanned aircraft, unless one of the following conditions is satisfied:

(1) The cost of repair (including materials and labor) does not exceed $500; or

(2) The fair market value of the property does not exceed $500 in the event of total loss.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Docket No. FAA-2022-1355; Amdt. No. 107-10; 87 FR 75846, Dec. 9 2022]

Subpart B—Operating Rules

§ 107.11 Applicability.

This subpart applies to the operation of all civil small unmanned aircraft systems subject to this part.

§ 107.12 Requirement for a remote pilot certificate with a small UAS rating.

(a) Except as provided in paragraph (c) of this section, no person may manipulate the flight controls of a small unmanned aircraft system unless:

(1) That person has a remote pilot certificate with a small UAS rating issued pursuant to subpart C of this part and satisfies the requirements of § 107.65; or

(2) That person is under the direct supervision of a remote pilot in command and the remote pilot in command has the ability to immediately take direct control of the flight of the small unmanned aircraft.

(b) Except as provided in paragraph (c) of this section, no person may act as a remote pilot in command unless that person has a remote pilot certificate with a small UAS rating issued pursuant to Subpart C of this part and satisfies the requirements of § 107.65.

(c) The Administrator may, consistent with international standards, authorize an airman to operate a civil foreign-registered small unmanned aircraft without an FAA-issued remote pilot certificate with a small UAS rating.

§ 107.13 Registration.

A person operating a civil small unmanned aircraft system for purposes of flight must comply with the provisions of § 91.203(a)(2) of this chapter.

§ 107.15 Condition for safe operation.

(a) No person may operate a civil small unmanned aircraft system unless it is in a condition for safe operation. Prior to each flight, the remote pilot in command must check the small unmanned aircraft system to determine whether it is in a condition for safe operation.

(b) No person may continue flight of the small unmanned aircraft when he or she knows or has reason to know that the small unmanned aircraft system is no longer in a condition for safe operation.

§ 107.17 Medical condition.

No person may manipulate the flight controls of a small unmanned aircraft system or act as a remote pilot in command, visual observer, or direct participant in the operation of the small unmanned aircraft if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of the small unmanned aircraft system.

§ 107.19 Remote pilot in command.

(a) A remote pilot in command must be designated before or during the flight of the small unmanned aircraft.

(b) The remote pilot in command is directly responsible for and is the final authority as to the operation of the small unmanned aircraft system.

(c) The remote pilot in command must ensure that the small unmanned aircraft will pose no undue hazard to other people, other aircraft, or other property in the event of a loss of control of the small unmanned aircraft for any reason.

(d) The remote pilot in command must ensure that the small UAS operation complies with all applicable regulations of this chapter.

(e) The remote pilot in command must have the ability to direct the small unmanned aircraft to ensure compliance with the applicable provisions of this chapter.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]

§ 107.21 In-flight emergency.

(a) In an in-flight emergency requiring immediate action, the remote pilot in command may deviate from any rule of this part to the extent necessary to meet that emergency.

(b) Each remote pilot in command who deviates from a rule under paragraph (a) of this section must, upon request of the Administrator, send a written report of that deviation to the Administrator.

§ 107.23 Hazardous operation.

No person may:

(a) Operate a small unmanned aircraft system in a careless or reckless manner so as to endanger the life or property of another; or

(b) Allow an object to be dropped from a small unmanned aircraft in a manner that creates an undue hazard to persons or property.

§ 107.25 Operation from a moving vehicle or aircraft.

No person may operate a small unmanned aircraft system—

(a) From a moving aircraft; or

(b) From a moving land or water-borne vehicle unless the small unmanned aircraft is flown over a sparsely populated area and is not transporting another person's property for compensation or hire.

§ 107.27 Alcohol or drugs.

A person manipulating the flight controls of a small unmanned aircraft system or acting as a remote pilot in command or visual observer must comply with the provisions of §§ 91.17 and 91.19 of this chapter.

§ 107.29 Operation at night.

(a) Except as provided in paragraph (d) of this section, no person may operate a small unmanned aircraft system at night unless—

(1) The remote pilot in command of the small unmanned aircraft has completed an initial knowledge test or training, as applicable, under § 107.65 after April 6, 2021; and

(2) The small unmanned aircraft has lighted anti-collision lighting visible for at least 3 statute miles that has a flash rate sufficient to avoid a collision. The remote pilot in command may reduce the intensity of, but may not extinguish, the anti-collision lighting if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.

(b) No person may operate a small unmanned aircraft system during periods of civil twilight unless the small unmanned aircraft has lighted anti-collision lighting visible for at least 3 statute miles that has a flash rate sufficient to avoid a collision. The remote pilot in command may reduce the intensity of, but may not extinguish, the anti-collision lighting if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.

(c) For purposes of paragraph (b) of this section, civil twilight refers to the following:

(1) Except for Alaska, a period of time that begins 30 minutes before official sunrise and ends at official sunrise;

(2) Except for Alaska, a period of time that begins at official sunset and ends 30 minutes after official sunset; and

(3) In Alaska, the period of civil twilight as defined in the Air Almanac.

(d) After May 17, 2021, no person may operate a small unmanned aircraft system at night in accordance with a certificate of waiver issued prior to April 21, 2021 under § 107.200. The certificates of waiver issued prior to March 16, 2021 under § 107.200 that authorize deviation from § 107.29 terminate on May 17, 2021.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021; 86 FR 13631, Mar. 10, 2020]

§ 107.31 Visual line of sight aircraft operation.

(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 hazards; and

(4) Determine that the unmanned aircraft does not endanger the life or property of another.

(b) Throughout the entire flight of the small unmanned aircraft, the ability described in paragraph (a) of this section must be exercised by either:

(1) The remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system; or

(2) A visual observer.

§ 107.33 Visual observer.

If a visual observer is used during the aircraft operation, all of the following requirements must be met:

(a) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must maintain effective communication with each other at all times.

(b) The remote pilot in command must ensure that the visual observer is able to see the unmanned aircraft in the manner specified in § 107.31.

(c) The remote pilot in command, the person manipulating the flight controls of the small unmanned aircraft system, and the visual observer must coordinate to do the following:

(1) Scan the airspace where the small unmanned aircraft is operating for any potential collision hazard; and

(2) Maintain awareness of the position of the small unmanned aircraft through direct visual observation.

§ 107.35 Operation of multiple small unmanned aircraft.

A person may not manipulate flight controls or act as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time.

[Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]

§ 107.36 Carriage of hazardous material.

A small unmanned aircraft may not carry hazardous material. For purposes of this section, the term hazardous material is defined in 49 CFR 171.8.

§ 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.

§ 107.39 Operation over human beings.

No person may operate a small unmanned aircraft over a human being unless—

(a) That human being is directly participating in the operation of the small unmanned aircraft;

(b) That human being is located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft; or

(c) The operation meets the requirements of at least one of the operational categories specified in subpart D of this part.

[Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]

§ 107.41 Operation in certain airspace.

No person may operate a small unmanned aircraft 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 has prior authorization from Air Traffic Control (ATC).

§ 107.43 Operation in the vicinity of airports.

No person may operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns at any airport, heliport, or seaplane base.

§ 107.45 Operation in prohibited or restricted areas.

No person may operate a small unmanned aircraft in prohibited or restricted areas unless that person has permission from the using or controlling agency, as appropriate.

§ 107.47 Flight restrictions in the proximity of certain areas designated by notice to airmen.

A person acting as a remote pilot in command must comply with the provisions of §§ 91.137 through 91.145 and 99.7 of this chapter.

§ 107.49 Preflight familiarization, inspection, and actions for aircraft operation.

Prior to flight, the remote pilot in command must:

(a) Assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. This assessment must include:

(1) Local weather conditions;

(2) Local airspace and any flight restrictions;

(3) The location of persons and property on the surface; and

(4) Other ground hazards.

(b) Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards;

(c) Ensure that all control links between ground control station and the small unmanned aircraft are working properly;

(d) If the small unmanned aircraft is powered, ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time;

(e) Ensure that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft; and

(f) If the operation will be conducted over human beings under subpart D of this part, ensure that the aircraft meets the requirements of § 107.110, § 107.120(a), § 107.130(a), or § 107.140, as applicable.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]

§ 107.51 Operating limitations for small unmanned aircraft.

A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with all of the following operating limitations when operating a small unmanned aircraft system:

(a) The groundspeed of the small unmanned aircraft may not exceed 87 knots (100 miles per hour).

(b) The altitude of the small unmanned aircraft cannot be higher than 400 feet above ground level, unless the small unmanned aircraft:

(1) Is flown within a 400-foot radius of a structure; and

(2) Does not fly higher than 400 feet above the structure's immediate uppermost limit.

(c) The minimum flight visibility, as observed from the location of the control station must be no less than 3 statute miles. For purposes of this section, flight visibility means the average slant distance from the control station at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

(d) The minimum distance of the small unmanned aircraft from clouds must be no less than:

(1) 500 feet below the cloud; and

(2) 2,000 feet horizontally from the cloud.

Subpart C—Remote Pilot Certification

§ 107.52 ATC transponder equipment prohibition.

Unless otherwise authorized by the Administrator, no person may operate a small unmanned aircraft system under this part with a transponder on.

[Amdt. No. 107-7, 86 FR 4513, Jan. 15, 2021]

§ 107.53 Automatic Dependent Surveillance-Broadcast (ADS-B) Out prohibition.

Unless otherwise authorized by the Administrator, no person may operate a small unmanned aircraft system under this part with ADS-B Out equipment in transmit mode.

[Amdt. No. 107-7, 86 FR 4513, Jan. 15, 2021]

§ 107.56 Applicability.

This subpart prescribes the requirements for issuing a remote pilot certificate with a small UAS rating.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016. Redesignated by Amdt. No. 107-7, 86 FR 4513, Jan. 15, 2021]

§ 107.57 Offenses involving alcohol or drugs.

(a) A conviction for the violation of any Federal or State statute relating to the growing, processing, manufacture, sale, disposition, possession, transportation, or importation of narcotic drugs, marijuana, or depressant or stimulant drugs or substances is grounds for:

(1) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of final conviction; or

(2) Suspension or revocation of a remote pilot certificate with a small UAS rating.

(b) Committing an act prohibited by § 91.17(a) or § 91.19(a) of this chapter is grounds for:

(1) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of that act; or

(2) Suspension or revocation of a remote pilot certificate with a small UAS rating.

§ 107.59 Refusal to submit to an alcohol test or to furnish test results.

A refusal to submit to a test to indicate the percentage by weight of alcohol in the blood, when requested by a law enforcement officer in accordance with § 91.17(c) of this chapter, or a refusal to furnish or authorize the release of the test results requested by the Administrator in accordance with § 91.17(c) or (d) of this chapter, is grounds for:

(a) Denial of an application for a remote pilot certificate with a small UAS rating for a period of up to 1 year after the date of that refusal; or

(b) Suspension or revocation of a remote pilot certificate with a small UAS rating.

§ 107.61 Eligibility.

Subject to the provisions of §§ 107.57 and 107.59, in order to be eligible for a remote pilot certificate with a small UAS rating under this subpart, a person must:

(a) Be at least 16 years of age;

(b) Be able to read, speak, write, and understand the English language. If the applicant is unable to meet one of these requirements due to medical reasons, the FAA may place such operating limitations on that applicant's certificate as are necessary for the safe operation of the small unmanned aircraft;

(c) Not know or have reason to know that he or she has a physical or mental condition that would interfere with the safe operation of a small unmanned aircraft system; and

(d) Demonstrate aeronautical knowledge by satisfying one of the following conditions, in a manner acceptable to the Administrator:

(1) Pass an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73; or

(2) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, complete training covering the areas of knowledge specified in § 107.74.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]

§ 107.63 Issuance of a remote pilot certificate with a small UAS rating.

An applicant for a remote pilot certificate with a small UAS rating under this subpart must make the application in a form and manner acceptable to the Administrator.

(a) The application must include either:

(1) Evidence showing that the applicant passed an initial aeronautical knowledge test. If applying using a paper application, this evidence must be an airman knowledge test report showing passage of the knowledge test; or

(2) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, a certificate of completion of an initial training course under this part that covers the areas of knowledge specified in § 107.74.

(b) If the application is being made pursuant to paragraph (a)(2) of this section:

(1) The application must be submitted to the responsible Flight Standards office, a designated pilot examiner, an airman certification representative for a pilot school, a certificated flight instructor, or other person authorized by the Administrator;

(2) The person accepting the application submission must verify the identity of the applicant in a manner acceptable to the Administrator; and

(3) The person making the application must, by logbook endorsement or other manner acceptable to the Administrator, show the applicant meets the flight review requirements specified in § 61.56 of this chapter.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Docket FAA-2018-0119, Amdt. 107-2, 83 FR 9172, Mar. 5, 2018; Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021]]

§ 107.64 Temporary certificate.

(a) A temporary remote pilot certificate with a small UAS rating is issued for up to 120 calendar days, at which time a permanent certificate will be issued to a person whom the Administrator finds qualified under this part.

(b) A temporary remote pilot certificate with a small UAS rating expires:

(1) On the expiration date shown on the certificate;

(2) Upon receipt of the permanent certificate; or

(3) Upon receipt of a notice that the certificate sought is denied or revoked.

§ 107.65 Aeronautical knowledge recency.

A person may not exercise the privileges of a remote pilot in command with small UAS rating unless that person has accomplished one of the following in a manner acceptable to the Administrator within the previous 24 calendar months:

(a) Passed an initial aeronautical knowledge test covering the areas of knowledge specified in § 107.73;

(b) Completed recurrent training covering the areas of knowledge specified in § 107.73; or

(c) If a person holds a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meets the flight review requirements specified in § 61.56, completed training covering the areas of knowledge specified in § 107.74.

(d) A person who has passed a recurrent aeronautical knowledge test in a manner acceptable to the Administrator or who has satisfied the training requirement of paragraph (c) of this section prior to April 6, 2021 within the previous 24 calendar months is considered to be in compliance with the requirement of paragraph (b) or (c) of this section, as applicable.

[Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021; 86 FR 13631, Mar. 10, 2021]

§ 107.67 Knowledge tests: General procedures and passing grades.

(a) Knowledge tests prescribed by or under this part are given by persons and in the manner designated by the Administrator.

(b) An applicant for a knowledge test must have proper identification at the time of application that contains the applicant's:

(1) Photograph;

(2) Signature;

(3) Date of birth, which shows the applicant meets or will meet the age requirements of this part for the certificate and rating sought before the expiration date of the airman knowledge test report; and

(4) Permanent mailing address. If the applicant's permanent mailing address is a post office box number, then the applicant must also provide a current residential address.

(c) The minimum passing grade for the knowledge test will be specified by the Administrator.

§ 107.69 Knowledge tests: Cheating or other unauthorized conduct.

(a) An applicant for a knowledge test may not:

(1) Copy or intentionally remove any knowledge test;

(2) Give to another applicant or receive from another applicant any part or copy of a knowledge test;

(3) Give or receive assistance on a knowledge test during the period that test is being given;

(4) Take any part of a knowledge test on behalf of another person;

(5) Be represented by, or represent, another person for a knowledge test;

(6) Use any material or aid during the period that the test is being given, unless specifically authorized to do so by the Administrator; and

(7) Intentionally cause, assist, or participate in any act prohibited by this paragraph.

(b) An applicant who the Administrator finds has committed an act prohibited by paragraph (a) of this section is prohibited, for 1 year after the date of committing that act, from:

(1) Applying for any certificate, rating, or authorization issued under this chapter; and

(2) Applying for and taking any test under this chapter.

(c) Any certificate or rating held by an applicant may be suspended or revoked if the Administrator finds that person has committed an act prohibited by paragraph (a) of this section.

§ 107.71 Retesting after failure.

An applicant for a knowledge test who fails that test may not reapply for the test for 14 calendar days after failing the test.

§ 107.73 Knowledge and training.

An initial aeronautical knowledge test and recurrent training covers the following areas of knowledge:

(a) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(b) Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation;

(c) Aviation weather sources and effects of weather on small unmanned aircraft performance;

(d) Small unmanned aircraft loading;

(e) Emergency procedures;

(f) Crew resource management;

(g) Radio communication procedures;

(h) Determining the performance of the small unmanned aircraft;

(i) Physiological effects of drugs and alcohol;

(j) Aeronautical decision-making and judgment;

(k) Airport operations;

(l) Maintenance and preflight inspection procedures; and

(m) Operation at night.

[Amdt. No. 107-8, 86 FR 4383, Jan. 15, 2021]

§ 107.74 Small unmanned aircraft system training.

Training for pilots who hold a pilot certificate (other than a student pilot certificate) issued under part 61 of this chapter and meet the flight review requirements specified in § 61.56 covers the following areas of knowledge:

(a) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(b) Effects of weather on small unmanned aircraft performance;

(c) Small unmanned aircraft loading;

(d) Emergency procedures;

(e) Crew resource management;

(f) Determining the performance of the small unmanned aircraft;

(g) Maintenance and preflight inspection procedures; and

(h) Operation at night.

[Amdt. No. 107-8, 86 FR 4383, Jan. 15, 2021]

§ 107.77 Change of name or address.

(a) ***Change of name.*** An application to change the name on a certificate issued under this subpart must be accompanied by the applicant's:

(1) Remote pilot certificate with small UAS rating; and

(2) A copy of the marriage license, court order, or other document verifying the name change.

(b) The documents in paragraph (a) of this section will be returned to the applicant after inspection.

(c) *Change of address.* The holder of a remote pilot certificate with small UAS rating issued under this subpart who has made a change in permanent mailing address may not, after 30 days from that date, exercise the privileges of the certificate unless the holder has notified the FAA of the change in address using one of the following methods:

(1) By letter to the FAA Airman Certification Branch, P.O. Box 25082, Oklahoma City, OK 73125 providing the new permanent mailing address, or if the permanent mailing address includes a post office box number, then the holder's current residential address; or

(2) By using the FAA Web site portal at *www.faa.gov* providing the new permanent mailing address, or if the permanent mailing address includes a post office box number, then the holder's current residential address.

§ 107.79 Voluntary surrender of certificate.

(a) The holder of a certificate issued under this subpart may voluntarily surrender it for cancellation.

(b) Any request made under paragraph (a) of this section must include the following signed statement or its equivalent: "I voluntarily surrender my remote pilot certificate with a small UAS rating for cancellation. This request is made for my own reasons, with full knowledge that my certificate will not be reissued to me unless I again complete the requirements specified in §§ 107.61 and 107.63."

Subpart D—Operations Over Human Beings

Source: Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021

§ 107.100 Applicability.

This subpart prescribes the eligibility and operating requirements for civil small unmanned aircraft to operate over human beings or over moving vehicles in the United States, in addition to those operations permitted by § 107.39(a) and (b).

§ 107.105 Limitations on operations over human beings.

Except as provided in §§ 107.39(a) and (b) and 107.145, a remote pilot in command may conduct operations over human beings only in accordance with the following, as applicable: § 107.110 for Category 1 operations; §§ 107.115 and 107.120 for Category 2 operations; §§ 107.125 and 107.130 for Category 3 operations; or § 107.140 for Category 4 operations.

§ 107.110 Category 1 operations.

To conduct Category 1 operations—

(a) A remote pilot in command must use a small unmanned aircraft that—

(1) Weighs 0.55 pounds or less on takeoff and throughout the duration of each operation under Category 1, including everything that is on board or otherwise attached to the aircraft; and

(2) Does not contain any exposed rotating parts that would lacerate human skin upon impact with a human being.

(b) No remote pilot in command may operate a small unmanned aircraft in sustained flight over open-air assemblies of human beings unless the operation meets the requirements of either § 89.110 or § 89.115(a) of this chapter.

[Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021, as amended by 86 FR 62473, Nov. 10, 2021]

§ 107.115 Category 2 operations: Operating requirements.

To conduct Category 2 operations—

(a) A remote pilot in command must use a small unmanned aircraft that—

(1) Is eligible for Category 2 operations pursuant to § 107.120(a);

(2) Is listed on an FAA-accepted declaration of compliance as eligible for Category 2 operations in accordance with § 107.160; and

(3) Is labeled as eligible to conduct Category 2 operations in accordance with § 107.120(b)(1).

(b) No remote pilot in command may operate a small unmanned aircraft in sustained flight over open-air assemblies of human beings unless the operation meets the requirements of either § 89.110 or § 89.115(a) of this chapter.

§ 107.120 Category 2 operations: Eligibility of small unmanned aircraft and other applicant requirements.

(a) To be eligible for use in Category 2 operations, the small unmanned aircraft must be designed, produced, or modified such that it—

(1) Will not cause injury to a human being that is equivalent to or greater than the severity of injury caused by a transfer of 11 foot-pounds of kinetic energy upon impact from a rigid object;

(2) Does not contain any exposed rotating parts that would lacerate human skin upon impact with a human being; and

(3) Does not contain any safety defects.

(b) The applicant for a declaration of compliance for a small unmanned aircraft that is eligible for use in Category 2 operations in accordance with paragraph (a) of this section, must meet all of the following requirements for the applicant's unmanned aircraft to be used in Category 2 operations:

(1) Display a label on the small unmanned aircraft indicating eligibility to conduct Category 2 operations. The label must be in English and be legible, prominent, and permanently affixed to the small unmanned aircraft.

(2) Have remote pilot operating instructions that apply to the operation of the small unmanned aircraft system. The applicant for a declaration of compliance must make available these instructions upon sale or transfer of the aircraft or use of the aircraft by someone other than the applicant who submitted a declaration of compliance pursuant to § 107.160. Such instructions must address, at a minimum—

(i) A system description that includes the required small unmanned aircraft system components, any system limitations, and the declared category or categories of operation;

(ii) Modifications that will not change the ability of the small unmanned aircraft system to meet the requirements for the category or categories of operation the small unmanned aircraft system is eligible to conduct; and

(iii) Instructions for how to verify and change the mode or configuration of the small unmanned aircraft system, if they are variable.

(3) Maintain a product support and notification process. The applicant for a declaration of compliance must maintain product support and notification procedures to notify the public and the FAA of—

(i) Any defect or condition that causes the small unmanned aircraft to no longer meet the requirements of this subpart; and

(ii) Any identified safety defect that causes the small unmanned aircraft to exceed a low probability of casualty.

§ 107.125 Category 3 operations: Operating requirements.

To conduct Category 3 operations, a remote pilot in command—

(a) Must use a small unmanned aircraft that—

(1) Is eligible for Category 3 operations pursuant to § 107.130(a);

(2) Is listed on an FAA-accepted declaration of compliance as eligible for Category 3 operations in accordance with § 107.160; and

(3) Is labeled as eligible for Category 3 operations in accordance with § 107.130(b)(1);

(b) Must not operate the small unmanned aircraft over open-air assemblies of human beings; and

(c) May only operate the small unmanned aircraft above any human being if operation meets one of the following conditions:

(1) The operation is within or over a closed- or restricted-access site and all human beings located within the closed- or restricted-access site must be on notice that a small unmanned aircraft may fly over them; or

(2) The small unmanned aircraft does not maintain sustained flight over any human being unless that human being is—

(i) Directly participating in the operation of the small unmanned aircraft; or

(ii) Located under a covered structure or inside a stationary vehicle that can provide reasonable protection from a falling small unmanned aircraft.

[Amdt. No. 107-8, 86 FR 4382, Jan. 15, 2021, as amended by 86 FR 62473, Nov. 10, 2021]

§ 107.130 Category 3 operations: Eligibility of small unmanned aircraft and other applicant requirements.

(a) To be eligible for use in Category 3 operations, the small unmanned aircraft must be designed, produced, or modified such that it—

(1) Will not cause injury to a human being that is equivalent to or greater than the severity of the injury caused by a transfer of 25 foot-pounds of kinetic energy upon impact from a rigid object;

(2) Does not contain any exposed rotating parts that would lacerate human skin upon impact with a human being; and

(3) Does not contain any safety defects.

(b) The applicant for a declaration of compliance for a small unmanned aircraft that is eligible for use in Category 3 operations in accordance with paragraph (a) of this section, must meet all of the following requirements for the applicant's small unmanned aircraft to be used in Category 3 operations:

(1) Display a label on the small unmanned aircraft indicating eligibility to conduct Category 3 operations. The label must be in English and be legible, prominent, and permanently affixed to the small unmanned aircraft.

(2) Have remote pilot operating instructions that apply to the operation of the small unmanned aircraft system. The applicant for a declaration of compliance must make available these instructions upon sale or transfer of the aircraft or use of the aircraft by someone other than the applicant who submitted a declaration of compliance pursuant to § 107.160. Such instructions must address, at a minimum—

(i) A system description that includes the required small unmanned aircraft system components, any system limitations, and the declared category or categories of operation;

(ii) Modifications that will not change the ability of the small unmanned aircraft system to meet the requirements for the category or categories of operation the small unmanned aircraft system is eligible to conduct; and

(iii) Instructions for how to verify and change the mode or configuration of the small unmanned aircraft system, if they are variable.

(3) Maintain a product support and notification process. The applicant for a declaration of compliance must maintain product support and notification procedures to notify the public and the FAA of—

(i) Any defect or condition that causes the small unmanned aircraft to no longer meet the requirements of this subpart; and

(ii) Any identified safety defect that causes the small unmanned aircraft to exceed a low probability of fatality.

§ 107.135 Labeling by remote pilot in command for Category 2 and 3 operations.

If a Category 2 or Category 3 label affixed to a small unmanned aircraft is damaged, destroyed, or missing, a remote pilot in command must label the aircraft in English such that the label is legible, prominent, and will remain on the small unmanned aircraft for the duration of the operation before conducting operations over human beings. The label must correctly identify the category or categories of operation over human beings that the small unmanned aircraft is qualified to conduct in accordance with this subpart.

§ 107.140 Category 4 operations.

(a) *Remote pilot in command requirements.* To conduct Category 4 operations—

(1) A remote pilot in command—

(i) Must use a small unmanned aircraft that is eligible for Category 4 operations pursuant to paragraph (b) of this section; and

(ii) Must operate the small unmanned aircraft in accordance with all operating limitations that apply to the small unmanned aircraft, as specified by the Administrator.

(2) No remote pilot in command may operate a small unmanned aircraft in sustained flight over open-air assemblies of human beings unless the operation meets the requirements of either § 89.110 or § 89.115(a) of this chapter.

(b) ***Small unmanned aircraft requirements for Category 4.*** To be eligible to operate over human beings under this section, the small unmanned aircraft must—

(1) Have an airworthiness certificate issued under part 21 of this chapter.

(2) Be operated in accordance with the operating limitations specified in the approved Flight Manual or as otherwise specified by the Administrator. The operating limitations must not prohibit operations over human beings.

(3) Have maintenance, preventive maintenance, alterations, or inspections performed in accordance with paragraph (c)(1) of this section.

(c) ***Maintenance requirements for Category 4.*** The owner must (unless the owner enters into an agreement with an operator to meet the requirements of this paragraph (c), then the operator must) meet the requirements of this paragraph (c):

(1) Ensure the person performing any maintenance, preventive maintenance, alterations, or inspections:

(i) Uses the methods, techniques, and practices prescribed in the manufacturer's current maintenance manual or Instructions for Continued Airworthiness that are acceptable to the Administrator, or other methods, techniques, and practices acceptable to the Administrator;

(ii) Has the knowledge, skill, and appropriate equipment to perform the work;

(iii) Performs the maintenance, preventive maintenance, or alterations on the small unmanned aircraft in a manner using the methods, techniques, and practices prescribed in the manufacturer's current maintenance manual or Instructions for Continued Airworthiness prepared by its manufacturer, or other methods, techniques, and practices acceptable to the Administrator;

(iv) Inspects the small unmanned aircraft in accordance with the manufacturer's instructions or other instructions acceptable to the Administrator; and

(v) Performs the maintenance, preventive maintenance, or alterations using parts of such a quality that the condition of the aircraft will be at least equal to its original or properly altered condition.

(2) Maintain all records of maintenance, preventive maintenance, and alterations performed on the aircraft and ensure the records are documented in a manner acceptable to the Administrator. The records must contain the description of the work performed, the date the work was completed, and the name of the person who performed the work.

(3) Maintain all records containing—

(i) The status of life-limited parts that are installed on, or part of, the small unmanned aircraft;

(ii) The inspection status of the aircraft; and

(iii) The status of applicable airworthiness directives including the method of compliance, the airworthiness directive number, and revision date. If the airworthiness directive involves recurring action, the record must contain the time and date of the next required action.

(4) Retain the records required under paragraphs (c)(2) and (3) of this section, as follows:

(i) The records documenting maintenance, preventive maintenance, or alterations performed must be retained for 1 year from when the work is completed or until the maintenance is repeated or superseded by other work.

(ii) The records documenting the status of life-limited parts, compliance with airworthiness directives, and inspection status of the small unmanned aircraft must be retained and transferred with the aircraft upon change in ownership.

(5) Ensure all records under paragraphs (c)(2) and (3) of this section are available for inspection upon request from the Administrator or any authorized representative of the National Transportation Safety Board (NTSB).

(d) ***Compliance with parts 43 and 91 of this chapter.*** Compliance with part 43 and part 91, subpart E, of this chapter fulfills the requirements in paragraphs (b)(3) and (c) of this section.

[Amdt. No. 107-8, 86 FR 4383, Jan. 15, 2021; 86 FR 13633, Mar. 10, 2021]

§ 107.145 Operations over moving vehicles.

No person may operate a small unmanned aircraft over a human being located inside a moving vehicle unless the following conditions are met:

(a) The operation occurs in accordance with § 107.110 for Category 1 operations; § 107.115 for Category 2 operations; § 107.125 for Category 3 operations; or § 107.140 for Category 4 operations.

(b) For an operation under Category 1, Category 2, or Category 3, the small unmanned aircraft, throughout the operation—

(1) Must remain within or over a closed- or restricted-access site, and all human beings located inside a moving vehicle within the closed- or restricted-access site must be on notice that a small unmanned aircraft may fly over them; or

(2) Must not maintain sustained flight over moving vehicles.

(c) For a Category 4 operation, the small unmanned aircraft must—

(1) Have an airworthiness certificate issued under part 21 of this chapter.

(2) Be operated in accordance with the operating limitations specified in the approved Flight Manual or as otherwise specified by the Administrator. The operating limitations must not prohibit operations over human beings located inside moving vehicles.

§ 107.150 Variable mode and variable configuration of small unmanned aircraft systems.

A small unmanned aircraft system may be eligible for one or more categories of operation over human beings under this subpart, as long as a remote pilot in command cannot inadvertently switch between modes or configurations.

§ 107.155 Means of compliance.

(a) ***Establishment of compliance.*** To meet the requirements of § 107.120(a) for operations in Category 2, or the requirements of § 107.130(a) for operations in Category 3, the means of compliance must consist of test, analysis, or inspection.

(b) ***Required information.*** An applicant requesting FAA acceptance of a means of compliance must submit the following information to the FAA in a manner specified by the Administrator:

(1) ***Procedures.*** Detailed description of the means of compliance, including applicable test, analysis, or inspection procedures to demonstrate how the small unmanned aircraft meets the requirements of § 107.120(a) for operations in Category 2 or the requirements of § 107.130(a) for operations in Category 3. The description should include conditions, environments, and methods, as applicable.

(2) ***Compliance explanation.*** Explanation of how application of the means of compliance fulfills the requirements of § 107.120(a) for operations in Category 2 or the requirements of § 107.130(a) for operations in Category 3.

(c) ***FAA acceptance.*** If the FAA determines the applicant has demonstrated compliance with paragraphs (a) and (b) of this section, it will notify the applicant that it has accepted the means of compliance.

(d) ***Rescission.***

(1) A means of compliance is subject to ongoing review by the Administrator. The Administrator may rescind its acceptance of a means of compliance if the Administrator determines that a means of compliance does not meet any or all of the requirements of this subpart.

(2) The Administrator will publish a notice of rescission in the FEDERAL REGISTER.

(e) ***Inapplicability of part 13, subpart D, of this chapter.*** Part 13, subpart D, of this chapter does not apply to the procedures of paragraph (a) of this section.

§ 107.160 Declaration of compliance.

(a) ***Required information.*** In order for an applicant to declare a small unmanned aircraft is compliant with the requirements of this subpart for Category 2 or Category 3 operations, an applicant must submit a declaration of compliance for acceptance by the FAA, in a manner specified by the Administrator, that includes the following information:

(1) Applicant's name;

(2) Applicant's physical address;

(3) Applicant's email address;

(4) The small unmanned aircraft make and model name, and series, if applicable;

(5) The small unmanned aircraft serial number or range of serial numbers that are the subject of the declaration of compliance;

(6) Whether the declaration of compliance is an initial declaration or an amended declaration;

(7) If the declaration of compliance is an amended declaration, the reason for the re-submittal;

(8) The accepted means of compliance the applicant used to fulfill requirements of § 107.120(a) or § 107.130(a) or both;

(9) A declaration that the applicant—

(i) Has demonstrated that the small unmanned aircraft, or specific configurations of that aircraft, satisfies § 107.120(a) or § 107.130(a) or both, through the accepted means of compliance identified in paragraph (a)(8) of this section;

(ii) Has verified that the unmanned aircraft does not contain any safety defects;

(iii) Has satisfied § 107.120(b)(3) or § 107.130(b)(3), or both; and

(iv) Will, upon request, allow the Administrator to inspect its facilities, technical data, and any manufactured small unmanned aircraft and witness any tests necessary to determine compliance with this subpart; and

(10) Other information as required by the Administrator.

(b) ***FAA acceptance.*** If the FAA determines the applicant has demonstrated compliance with the requirements of this subpart, it will notify the applicant that it has accepted the declaration of compliance.

(c) ***Notification of a safety issue.*** Prior to initiating rescission proceedings pursuant to paragraphs (d)(1) through (3) of this section, the FAA will notify the applicant if a safety issue has been identified for the declaration of compliance.

(d) ***Rescission.***

(1) No person may operate a small unmanned aircraft identified on a declaration of compliance that the FAA has rescinded pursuant to this subpart while that declaration of compliance is rescinded.

(2) The FAA may rescind a declaration of compliance if any of the following conditions occur:

(i) A small unmanned aircraft for which a declaration of compliance was accepted no longer complies with § 107.120(a) or § 107.130(a);

(ii) The FAA finds a declaration of compliance is in violation of § 107.5(a); or

(iii) The Administrator determines an emergency exists related to safety in accordance with the authority in 49 U.S.C. 46105.

(3) If a safety issue identified under paragraph (c) of this section has not been resolved, the FAA may rescind the declaration of compliance as follows:

(i) The FAA will issue a notice proposing to rescind the declaration of compliance. The notice will set forth the Agency's basis for the proposed rescission and provide the holder of the declaration of compliance with 30 calendar days from the date of issuance of the proposed notice to submit evidentiary information to refute the proposed notice.

(ii) The holder of the declaration of compliance must submit information demonstrating how the small unmanned aircraft meets the requirements of this subpart within 30 calendar days from the date of issuance of the proposed notice.

(iii) If the FAA does not receive the information required by paragraph (d)(3)(ii) of this section within 30 calendar days from the date of the issuance of the proposed notice, the FAA will issue a notice rescinding the declaration of compliance.

(4) If the Administrator determines that an emergency exists in accordance with paragraph (d)(2)(iii) of this section, the FAA will exercise its authority under 49 U.S.C. 46105(c) to issue an order rescinding a declaration of compliance without initiating the process in paragraph (d)(3) of this section.

(e) ***Petition to reconsider the rescission of a declaration of compliance.*** A person subject to an order of rescission under paragraph (d)(3) of this section may petition the FAA to reconsider the rescission of a declaration of compliance by submitting a request to the FAA in a manner specified by the Administrator within 60 days of the date of issuance of the rescission.

(1) A petition to reconsider the rescission of a declaration of compliance must demonstrate at least one of the following:

(i) A material fact that was not present in the original response to the notification of the safety issue and an explanation for why it was not present in the original response;

(ii) The FAA made a material factual error in the decision to rescind the declaration of compliance; or

(iii) The FAA did not correctly interpret a law, regulation, or precedent.

(2) Upon consideration of the information submitted under paragraph (e)(1) of this section, the FAA will issue a notice either affirming the rescission or withdrawing the rescission.

(f) ***Inapplicability of part 13, subpart D, of this chapter.*** Part 13, subpart D, of this chapter does not apply to the procedures of paragraphs (d) and (e) of this section.

§ 107.165 Record retention.

(a) A person who submits a declaration of compliance under this subpart must retain and make available to the Administrator, upon request, the information described in paragraph (a)(1) of this section for the period of time described in paragraph (a)(2) of this section.

(1) All supporting information used to demonstrate the small unmanned aircraft meets the requirements of §§ 107.120(a), for operations in Category 2, and 107.130(a), for operations in Category 3.

(2) The following time periods apply:

(i) If the person who submits a declaration of compliance produces a small unmanned aircraft, that person must retain the information described in paragraph (a)(1) of this section for two years after the cessation of production of the small unmanned aircraft system for which the person declared compliance.

(ii) If the person who submits a declaration of compliance designs or modifies a small unmanned aircraft, that person must retain the information described in paragraph (a)(1) of this section for two years after the person submitted the declaration of compliance.

(b) A person who submits a means of compliance under this subpart must retain and make available to the Administrator, upon request, and for as long as the means of compliance remains accepted, the detailed description of the means of compliance and justification showing how the means of compliance meets the requirements of §§ 107.120(a), for operations in Category 2, and 107.130(a), for operations in Category 3.

Subpart E—Waivers

§ 107.200 Waiver policy and requirements.

(a) The Administrator may issue a certificate of waiver authorizing a deviation from any regulation specified in § 107.205 if the Administrator finds that a proposed small UAS operation can safely be conducted under the terms of that certificate of waiver.

(b) A request for a certificate of waiver must contain a complete description of the proposed operation and justification that establishes that the operation can safely be conducted under the terms of a certificate of waiver.

(c) The Administrator may prescribe additional limitations that the Administrator considers necessary.

(d) A person who receives a certificate of waiver issued under this section:

(1) May deviate from the regulations of this part to the extent specified in the certificate of waiver; and

(2) Must comply with any conditions or limitations that are specified in the certificate of waiver.

§ 107.205 List of regulations subject to waiver.

A certificate of waiver issued pursuant to § 107.200 may authorize a deviation from the following regulations of this part:

(a) Section 107.25—Operation from a moving vehicle or aircraft. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.

(b) Section 107.29(a)(2) and (b)—Anti-collision light required for operations at night and during periods of civil twilight.

(c) Section 107.31—Visual line of sight aircraft operation. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.

(d) Section 107.33—Visual observer.

(e) Section 107.35—Operation of multiple small unmanned aircraft systems.

(f) Section 107.37(a)—Yielding the right of way.

(g) Section 107.39—Operation over people.

(h) Section 107.41—Operation in certain airspace.

(i) Section 107.51—Operating limitations for small unmanned aircraft.

(j) Section 107.145—Operations over moving vehicles.

[Docket FAA-2015-0150, Amdt. 107-1, 81 FR 42209, June 28, 2016, as amended by Amdt. No. 107-8, 86 FR 4387, Jan. 15, 2021]

Title 40 —Protection of Environment
Chapter I —Environmental Protection Agency
Subchapter U —Air Pollution Controls

PART 1031—CONTROL OF AIR POLLUTION FROM AIRCRAFT ENGINES

Authority: 42 U.S.C. 7401-7671q.

Source: 87 FR 72351, Nov. 23, 2022, unless otherwise noted.

Subpart A—Scope and Applicability

§ 1031.1 Applicability.

This part applies to aircraft gas turbine engines on and after January 1, 2023. Emission standards apply as described in subpart B of this part.

(a) Except as provided in paragraph (b) of this section, the regulations of this part apply to aircraft engines subject to 14 CFR part 33.

(b) The requirements of this part do not apply to the following aircraft engines:

(1) Reciprocating engines (including engines used in ultralight aircraft).

(2) Turboshaft engines such as those used in helicopters.

(3) Engines used only in aircraft that are not airplanes.

(4) Engines not used for propulsion.

§ 1031.5 Engines installed on domestic and foreign aircraft.

The Secretary of Transportation shall apply these regulations to aircraft of foreign registry in a manner consistent with obligations assumed by the United States in any treaty, convention or agreement between the United States and any foreign country or foreign countries.

§ 1031.10 State standards and controls.

No State or political subdivision of a State may adopt or attempt to enforce any aircraft or aircraft engine standard with respect to emissions unless the standard is identical to a standard that applies to aircraft or aircraft engines under this part.

§ 1031.15 Exemptions.

Individual engines may be exempted from current standards as described in this section. Exempted engines must conform to regulatory conditions specified for an exemption in this part and other applicable regulations. Exempted engines are deemed to be "subject to" the standards of this part even though they are not required to comply with the otherwise applicable requirements. Engines exempted with respect to certain standards must comply with other standards as a condition of the exemption.

(a) Engines installed in new aircraft. Each person seeking relief from compliance with this part at the time of certification must submit an application for exemption to the FAA in accordance with the regulations of 14 CFR parts 11 and 34. The FAA will consult with the EPA on each exemption application request before the FAA takes action. Exemption requests under this paragraph (a) are effective only with FAA approval and EPA's written concurrence.

(b) Temporary exemptions based on flights for short durations at infrequent intervals. The emission standards of this part do not apply to engines that power aircraft operated in the United States for short durations at infrequent intervals. Exemption requests under this paragraph (b) are effective with FAA approval. Such operations are limited to:

(1) Flights of an aircraft for the purpose of export to a foreign country, including any flights essential to demonstrate the integrity of an aircraft prior to its flight to a point outside the United States.

(2) Flights to a base where repairs, alterations or maintenance are to be performed, or to a point of storage, and flights for the purpose of returning an aircraft to service.

(3) Official visits by representatives of foreign governments.

(4) Other flights the Secretary of Transportation determines to be for short durations at infrequent intervals. A request for such a determination shall be made before the flight takes place.

§ 1031.20 Exceptions.

Individual engines may be excepted from current standards as described in this section. Excepted engines must conform to regulatory conditions specified for an exception in this part and other applicable regulations. Excepted engines are deemed to be "subject to" the standards of this part even though they are not required to comply with the otherwise applicable requirements. Engines excepted with respect to certain standards must comply with other standards from which they are not excepted.

(a) *Spare engines.* Newly manufactured engines meeting the definition of "spare engine" are automatically excepted as follows:

(1) This exception allows production of a newly manufactured engine for installation on an in-use aircraft. It does not allow for installation of a spare engine on a new aircraft.

(2) Spare engines excepted under this paragraph (a) may be used only if they are certificated to emission standards equal to or lower than those of the engines they are replacing, for all regulated pollutants.

(3) Engine manufacturers do not need to request approval to produce spare engines, but must include information about spare engine production in the annual report specified in § 1031.150(d).

(4) The permanent record for each engine excepted under this paragraph (a) must indicate that the engine was manufactured as an excepted spare engine.

(5) Engines excepted under this paragraph (a) must be labeled with the following statement: "EXCEPTED SPARE".

(b) [Reserved]

Subpart B—Emission Standards and Measurement Procedures

§ 1031.30 Overview of emission standards and general requirements.

(a) *Overview of standards.* Standards apply to different types and sizes of aircraft engines as described in §§ 1031.40 through 1031.90. All new engines and some in-use engines are subject to smoke standards (either based on smoke number or nvPM mass concentration). Some new engines are also subject to standards for gaseous emissions (HC, CO, and NO_X) and nvPM (mass and number).

(1) Where there are multiple tiers of standards for a given pollutant, the named tier generally corresponds to the meeting of the International Civil Aviation Organization's (ICAO's) Committee on Aviation Environmental Protection (CAEP) at which the standards were agreed to internationally. Other standards are named Tier 0, Tier 1, or have names that describe the standards.

(2) Where a standard is specified by a formula, determine the level of the standard as follows:

(i) For smoke number standards, calculate and round the standard to the nearest 0.1 smoke number.

(ii) For maximum nvPM mass concentration standards, calculate and round the standard to the nearest 1 $\mu g/m^3$.

(iii) For LTO nvPM mass standards, calculate and round the standard to three significant figures.

(iv) For LTO nvPM number standards calculate and round the standard to three significant figures.

(v) For gaseous emission standards, calculate and round the standard to three significant figures, or to the nearest 0.1 g/kN for turbojet and turbofan standards at or above 100 g/kN.

(3) Perform tests using the procedures specified in § 1031.140 to measure emissions for comparing to the standard. Engines comply with an applicable standard if test results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard.

(4) Engines that are covered by the same type certificate and are determined to be derivative engines for emissions certification purposes under the requirements of § 1031.130 are subject to the emission standards of the previously certified engine. Otherwise, the engine is subject to the emission standards that apply to a new engine type.

(b) *Fuel venting.*

(1) The fuel venting standard in paragraph (b)(2) of this section applies to new subsonic and supersonic aircraft engines subject to this part. This fuel venting standard also applies to the following in-use engines:

(i) Turbojet and turbofan engines with rated output at or above 36 kN thrust manufactured after February 1, 1974.

(ii) Turbojet and turbofan engines with rated output below 36 kN thrust manufactured after January 1, 1975.

(iii) Turboprop engines manufactured after January 1, 1975.

(2) Engines may not discharge liquid fuel emissions into the atmosphere. This standard is directed at eliminating intentional discharge of liquid fuel drained from fuel nozzle manifolds after engines are shut down and does not apply to normal fuel seepage from shaft seals, joints, and fittings. Certification for the fuel venting standard will be based on an inspection of the method designed to eliminate these emissions.

§ 1031.40 Turboprop engines.

The following standards apply to turboprop engines with rated output at or above 1,000 kW:

(a) *Smoke.* Engines of a type or model for which the date of manufacture of the individual engine is on or after January 1, 1984, may not have a characteristic level for smoke number exceeding the following value:

$SN = 187 \cdot rO^{-0.168}$

(b) [Reserved]

§ 1031.50 Subsonic turbojet and turbofan engines at or below 26.7 kN thrust.

The following standards apply to new turbofan or turbojet aircraft engines with rated output at or below 26.7 kN thrust that are installed in subsonic aircraft:

(a) *Smoke.* Engines of a type or model for which the date of manufacture of the individual engine is on or after August 9, 1985 may not have a characteristic level for smoke number exceeding the lesser of 50 or the following value:

$SN = 83.6 \cdot rO^{-0.274}$

(b) [Reserved]

§ 1031.60 Subsonic turbojet and turbofan engines above 26.7 kN thrust.

The following standards apply to new turbofan or turbojet aircraft engines with rated output above 26.7 kN thrust that are installed in subsonic aircraft:

(a) *Smoke.*

(1) *Tier 0.* Except as specified in (a)(2) of this section, engines of a type or model with rated output at or above 129 kN, and for which the date of manufacture of the individual engine after January 1, 1976 and is before January 1, 1984 may not have a characteristic level for smoke number exceeding the following emission standard:

$SN = 83.6 \cdot rO^{-0.274}$

(2) *JT8D and JT3D engines.*

(i) Engines of the type JT8D for which the date of manufacture of the individual engine is on or after February 1, 1974, and before January 1, 1984 may not have a characteristic level for smoke number exceeding an emission standard of 30.

(ii) Engines of the type JT3D for which the date of manufacture of the individual engine is on or after January 1, 1978 and before January 1, 1984 may not have a characteristic level for smoke number exceeding an emission standard of 25.

(3) *Tier 0 in-use.* Except for engines of the type JT8D and JT3D, in-use engines with rated output at or above 129 kN thrust may not exceed the following smoke number standard:

$SN = 83.6 \cdot rO^{-0.274}$

(4) *JT8D in-use.* In-use aircraft engines of the type JT8D may not exceed a smoke number standard of 30.

(5) *Tier 1.* Engines of a type or model for which the date of manufacture of the individual engine is on or after January 1, 1984 and before January 1, 2023 may not have a characteristic level for smoke number exceeding an emission standard that is the lesser of 50 or the following:

$SN = 83.6 \cdot rO^{-0.274}$

(6) *Tier 10.* Engines of a type or model for which the date of manufacture of the individual engine is on or after January 1, 2023 may not have a characteristic level for the maximum nvPM mass concentration in $\mu g/m^3$ exceeding the following emission standard:

$nvPM_{MC} = 10^{(3 + 2.9 * rO_A - 0.274)}$

(b) *LTO nvPM mass and number.* An engine's characteristic level for nvPM mass and nvPM number may not exceed emission standards as follows:

(1) *Tier 11 new type.* The following emission standards apply to engines of a type or model for which an application for original type certification is submitted on or after January 1, 2023 and for engines covered by an earlier type certificate if they do not qualify as derivative engines for emission purposes as described in § 1031.130:

Table 1 to § 1031.60(b)(1)—Tier 11 New Type nvPM Standards

Rated output (rO) in kN	$nvPM_{mass}$ in milligrams/kN	$nvPM_{num}$ in particles/kN
$26.7 < rO \leq 150$	$1251.1-6.914 \cdot rO$	$1.490 \cdot 10^{16}-8.080 \cdot 10^{13} \cdot rO$
$rO > 150$	214.0	$2.780 \cdot 10^{15}$

(2) *Tier 11 in-production.* The following emission standards apply to engines of a type or model for which the date of manufacture of the individual engine is on or after January 1, 2023:

Table 2 to § 1031.60(b)(2)—Tier 11 In-Production nvPM Standards

Rated output (rO) in kN	$nvPM_{mass}$ in milligrams/kN	$nvPM_{num}$ in particles/kN
$26.7 < rO \leq 200$	$4646.9-21.497 \cdot rO$	$2.669 \cdot 10^{16}-1.126 \cdot 10^{14} \cdot rO$
$rO > 200$	347.5	$4.170 \cdot 10^{15}$

(c) *HC.* Engines of a type or model for which the date of manufacture of the individual engine is on or after January 1, 1984, may not have a characteristic level for HC exceeding an emission standard of 19.6 g/kN.

(d) *CO.* Engines of a type or model for which the date of manufacture of the individual engine is on or after July 7, 1997, may not have a characteristic level for CO exceeding an emission standard of 118 g/kN.

(e) *NO_X.* An engine's characteristic level for NO_X may not exceed emission standards as follows:

(1) *Tier 0.* The following NO_X emission standards apply to engines of a type or model for which the date of manufacture of the first individual production model was on or before December 31, 1995, and for which the date of manufacture of the individual engine was on or after December 31, 1999, and before December 31, 2003:

$NO_X = 40+2 \cdot rPR$ g/kN

(2) *Tier 2.* The following NO_X emission standards apply to engines of a type or model for which the date of manufacture of the first individual production model was after December 31, 1995, or for which the date of manufacture of the individual engine was on or after December 31, 1999, and before December 31, 2003:

$NO_X = 32+1.6 \cdot rPR$ g/kN

(3) *Tier 4 new type.* The following NO_X emission standards apply to engines of a type or model for which the date of manufacture of the first individual production model was after December 31, 2003, and before July 18, 2012:

Table 3 to § 1031.60(e)(3)—Tier 4 New Type NO_X Standards

If the rated pressure ratio (rPR) is—	and the rated output (kN) is—	the NO_X emission standard (g/kN) is—
(i) rPR ≤ 30	(A) 26.7 < rO ≤ 89	37.572 + 1.6·rPR−0.2087·rO
	(B) rO > 89	19 + 1.6·rPR
(ii) 30 < rPR < 62.5	(A) 26.7 < rO ≤ 89	42.71 + 1.4286·rPR−0.4013·rO + 0.00642·rPR·rO
	(B) rO > 89	7 + 2·rPR
(iii) rPR ≥ 82.6	All	32 + 1.6·rPR

(4) *Tier 6 in-production.* The following NO_X emission standards apply to engines of a type or model for which the date of manufacture of the individual engine is on or after July 18, 2012:

Table 4 to § 1031.60(e)(4)—Tier 6 In-Production NO_X Standards

If the rated pressure ratio (rPR) is—	and the rated output (kN) is—	the NO_X emission standard (g/kN) is—
(i) rPR ≤ 30	(A) 26.7 < rO ≤ 89	38.5486 + 1.6823·rPR−0.2453·rO − 0.00308·rPR·rO
	(B) rO > 89	16.72 + 1.4080·rPR
(ii) 30 < rPR < 82.6	(A) 26.7 < rO ≤ 89	46.1600 + 1.4286·rPR−0.5303·rO + 0.00642·rPR·rO
	(B) rO > 89	−1.04 + 2.0·rPR
(iii) rPR ≥ 82.6	All	32 + 1.6·rPR

(5) *Tier 8 new type.* The following NO_X standards apply to engines of a type or model for which the date of manufacture of the first individual production model was on or after January 1, 2014; or for which an application for original type certification is submitted on or after January 1, 2023; or for engines covered by an earlier type certificate if they do not qualify as derivative engines for emission purposes as described in § 1031.130:

Table 5 to § 1031.60(e)(5)—Tier 8 New Type NO_X Standards

If the rated pressure ratio (rPR) is—	and the rated output (kN) is—	the NO_X emission standard (g/kN) is—
(i) rPR ≤ 30	(A) 26.7 < rO ≤ 89	40.052 + 1.5681·rPR−0.3615·rO−0.0018·rPR·rO
	(B) rO > 89	7.88 + 1.4080·rPR
(ii) 30 < rPR < 104.7	(A) 26.7 < rO ≤ 89	41.9435 + 1.505·rPR−0.5823·rO + 0.005562·rPR·rO
	(B) rO > 89	−9.88 + 2.0·rPR
(iii) rPR ≥ 104.7	All	32 + 1.6·rPR

§ 1031.90 Supersonic engines.

The following standards apply to new engines installed in supersonic airplanes:

(a) *Smoke.* Engines of a type or model for which the date of manufacture was on or after January 1, 1984, may not have a characteristic level for smoke number exceeding an emission standard that is the lesser of 50 or the following:

$SN = 83.6 \cdot rO^{-0.274}$

(b) [Reserved]

(c) *HC.* Engines of a type or model for which the date of manufacture was on or after January 1, 1984, may not have a characteristic level for HC exceeding the following emission standard in g/kN rated output:

$HC = 140 \cdot 0.92^{rPR}$

(d) *CO.* Engines of a type or model for which the date of manufacture was on or after July 18, 2012, may not have a characteristic level for CO exceeding the following emission standard in g/kN rated output:

$CO = 4550 \cdot rPR^{-1.03}$

(e) *NO_X* Engines of a type or model for which the date of manufacture was on or after July 18, 2012, may not have a characteristic level for NO_X engines exceeding the following emission standard in g/kN rated output:

$NO_X = 36+2.42 \cdot rPR$

§ 1031.130 Derivative engines for emissions certification purposes.

(a) *Overview.* For purposes of compliance with exhaust emission standards of this part, a type certificate applicant may request from the FAA a determination that an engine configuration be considered a derivative engine for emissions certification purposes. The applicant must demonstrate that the configuration is derived from and similar in type design to an engine that has a type certificate issued in accordance with 14 CFR part 33, and at least one of the following circumstances applies:

(1) The FAA determines that a safety issue requires an engine modification.

(2) All regulated emissions from the proposed derivative engine are lower than the corresponding emissions from the previously certificated engine.

(3) The FAA determines that the proposed derivative engine's emissions are similar to the previously certificated engine's emissions as described in paragraph (c) of this section.

(b) *Determining emission rates.* To determine new emission rates for a derivative engine for demonstrating compliance with emission standards under § 1031.30(a)(4) and for showing emissions similarity in paragraph (c) of this section, testing may not be required in all situations. If the previously certificated engine model or any associated sub-models have a characteristic level before modification that is at or above 95% of any applicable standard for smoke number, HC, CO, or NO_X or at or above 80% of any applicable nvPM standard, you must test the proposed derivative engine. Otherwise, you may use engineering analysis to determine the new emission rates, consistent with good engineering judgment. The engineering analysis must address all modifications from the previously certificated engine, including those approved for previous derivative engines.

(c) *Emissions similarity.*

(1) A proposed derivative engine's emissions are similar to the previously certificated engine's emissions if the type certificate applicant demonstrates that the engine meets the applicable emission standards and differ from the previously certificated engine's emissions only within the following ranges:

(i) ±3.0 g/kN for NO_X.

(ii) ±1.0 g/kN for HC.

(iii) ±5.0 g/kN for CO.

(iv) ±2.0 SN for smoke number.

(v) The following values apply for $nvPM_{MC}$:

(A) ±200 $\mu g/m^3$ if the characteristic level of maximum $nvPM_{MC}$ is below 1,000 $\mu g/m^3$.

(B) ±20% of the characteristic level if the characteristic level for maximum $nvPM_{MC}$ is at or above 1,000 $\mu g/m^3$.

(vi) The following values apply for $nvPM_{mass}$:

(A) 80 mg/kN if the characteristic level for $nvPM_{mass}$ emissions is below 400 mg/kN.

(B) ±20% of the characteristic level if the characteristic level for $nvPM_{mass}$ emissions is greater than or equal to 400 mg/kN.

(vii) The following values apply for $nvPM_{num}$:

(A) 4×10^{14} particles/kN if the characteristic level for $nvPM_{num}$ emissions is below 2×10^{15} particles/kN.

(B) ±20% of the characteristic level if the characteristic level for $nvPM_{num}$ emissions is greater than or equal to 2×10^{15} particles/kN.

(2) In unusual circumstances, the FAA may, for individual certification applications, adjust the ranges beyond those specified in paragraph (c)(1) of this section to evaluate a proposed derivative engine, consistent with good engineering judgment.

§ 1031.140 Test procedures.

(a) ***Overview.*** Measure emissions using the equipment, procedures, and test fuel specified in Appendices 1 through 8 of ICAO Annex 16 (incorporated by reference, see § 1031.210) as described in this section (referenced in this section as "ICAO Appendix #"). For turboprop engines, use the procedures specified in ICAO Annex 16 for turbofan engines, consistent with good engineering judgment.

(b) ***Test fuel specifications.*** Use a test fuel meeting the specifications described in ICAO Appendix 4. The test fuel must not have additives whose purpose is to suppress smoke, such as organometallic compounds.

(c) ***Test conditions.*** Prepare test engines by including accessories that are available with production engines if they can reasonably be expected to influence emissions.

(1) The test engine may not extract shaft power or bleed service air to provide power to auxiliary gearbox-mounted components required to drive aircraft systems.

(2) Test engines must reach a steady operating temperature before the start of emission measurements.

(d) *Alternate procedures.* In consultation with the EPA, the FAA may approve alternate procedures for measuring emissions. This might include testing and sampling methods, analytical techniques, and equipment specifications that differ from those specified in this part. An applicant for type certification may request this approval by sending a written request with supporting justification to the FAA and to the Designated EPA Program Officer. Such a request may be approved only in the following circumstances:

(1) The engine cannot be tested using the specified procedures.

(2) The alternate procedure is shown to be equivalent to or better (*e.g.*, more accurate or precise) than the specified procedure.

(e) *LTO cycles.* The following landing and take-off (LTO) cycles apply for emission testing and calculating weighted LTO values:

Table 1 to § 1031.140(e)—LTO Test Cycles

Mode	Subsonic				Supersonic	
	Turboprop		Turbojet and turbofan			
	Percent of rO	Time in mode (minutes)	Percent of rO	Time in mode (minutes)	Percent of rO	Time in mode (minutes)
Take-off	100	0.5	100	0.7	100	1.2
Climb	90	2.5	85	2.2	65	2.0
Descent	NA	NA	NA	NA	15	1.2
Approach	30	4.5	30	4.0	34	2.3
Taxi/ground idle	7	26.0	7	26.0	5.8	26.0

(f) *Pollutant-specific test provisions.* Use the following provisions to demonstrate whether engines meet the applicable standards:

(1) *Smoke number.* Use the equipment and procedures specified in ICAO Appendix 2 and ICAO Appendix 6. Test the engine at sufficient thrust settings to determine and compute the maximum smoke number across the engine operating thrust range.

(2) *nvPM.* Use the equipment and procedures specified in ICAO Appendix 7 and ICAO Appendix 6, as applicable:

(i) *Maximum nvPM mass concentration.* Test the engine at sufficient thrust settings to determine and compute the maximum nvPM mass concentration produced by the engine across the engine operating thrust range, according to the procedures of ICAO Appendix 7.

(ii) *LTO nvPM mass and number.* Test the engine at sufficient thrust settings to determine the engine's nvPM mass and nvPM number at the percent of rated output identified in table 1 to paragraph (e) of this section.

(3) *HC, CO, and NO_X.* Use the equipment and procedures specified in ICAO Appendix 3, ICAO Appendix 5, and ICAO Appendix 6, as applicable. Test the engine at sufficient thrust settings to determine the engine's HC, CO, and NO_X emissions at the percent of rated output identified in table 1 to paragraph (e) of this section.

(4) *CO_2.* Calculate CO_2 emission values from fuel mass flow rate measurements in ICAO Appendix 3 and ICAO Appendix 5 or, alternatively, according to the CO_2 measurement criteria in ICAO Appendix 3 and ICAO Appendix 5.

(g) *Characteristic level.* The compliance demonstration consists of establishing a mean value from testing some number of engines, then calculating a "characteristic level" by applying a set of statistical factors in ICAO Appendix 6 that take into account the number of engines tested. Round each characteristic level to the same number of decimal places as the corresponding standard. Engines comply with an applicable standard if the testing results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard.

(h) *System loss corrected nvPM emission indices.* Use the equipment and procedures specified in ICAO Appendix 8, as applicable, to determine system loss corrected nvPM emission indices.

Subpart C—Reporting and Recordkeeping

§ 1031.150 Production reports.

Engine manufacturers must submit an annual production report for each calendar year in which they produce any engines subject to emission standards under this part.

(a) The report is due by February 28 of the following calendar year. Include emission data in the report as described in paragraph (c) of this section. If you produce exempted or excepted engines, submit a single report with information on exempted/excepted and normally certificated engines.

(b) Send the report to the Designated EPA Program Officer.

(c) In the report, specify your corporate name and the year for which you are reporting. Include information as described in this section for each engine sub-model subject to emission standards under this part. List each engine sub-model manufactured or certificated during the calendar year, including the following information for each sub-model:

(1) The type of engine (turbofan, turboprop, etc.) and complete sub-model name, including any applicable model name, sub-model identifier, and engine type certificate family identifier.

(2) The certificate under which it was manufactured. Identify all the following:

(i) The type certificate number. Specify if the sub-model also has a type certificate issued by a certificating authority other than FAA.

(ii) Your corporate name as listed in the certificate.

(iii) Emission standards to which the engine is certificated.

(iv) Date of issue of type certificate (month and year).

(v) Whether or not this is a derivative engine for emissions certification purposes. If so, identify the previously certificated engine model.

(vi) The engine sub-model that received the original type certificate for an engine type certificate family.

(3) Identify the combustor of the sub-model, where more than one type of combustor is available.

(4) The calendar-year production volume of engines from the sub-model that are covered by an FAA type certificate. Record zero for sub-models with no engines manufactured during the calendar year, or state that the engine model is no longer in production and list the date of manufacture (month and year) of the last engine manufactured. Specify the number of these engines that are intended for use on new aircraft and the number that are intended for use as non-exempt engines on in-use aircraft. For engines delivered without a final sub-model status and for which the manufacturer has not ascertained the engine's sub-model when installed before submitting its production report, the manufacturer may do any of the following in its initial report, and amend it later:

(i) List the sub-model that was shipped or the most probable sub-model.

(ii) List all potential sub-models.

(iii) State "Unknown Sub-Model."

(5) The number of engines tested and the number of test runs for the applicable type certificate.

(6) Test data and related information required to certify the engine sub-model for all the standards that apply. Round reported values to the same number of decimal places as the standard. Include the following information, as applicable:

(i) The engine's rated pressure ratio and rated output.

(ii) The following values for each mode of the LTO test cycle:

(A) Fuel mass flow rate.

(B) Smoke number.

(C) nvPM mass concentration.

(D) mass of CO_2

(E) Emission Indices for HC, CO, NO_X, and CO_2.

(F) The following values related to nvPM mass and nvPM number:

(*1*) Emission Indices as measured.

(*2*) System loss correction factor.

(*3*) Emissions Indices after correcting for system losses.

(iii) Weighted total values calculated from the tested LTO cycle modes for HC, CO, NO_X, CO_2, and nvPM mass and nvPM number. Include nvPM mass and nvPM number values with and without system loss correction.

(iv) The characteristic level for HC, CO, NO_X, smoke number, nvPM mass concentration, nvPM mass, and nvPM number.

(v) The following maximum values:

(A) Smoke number.

(B) nvPM mass concentration.

(C) nvPM mass Emission Index with and without system loss correction.

(D) nvPM number Emission Index with and without system loss correction.

(d) Identify the number of exempted or excepted engines with a date of manufacture during the calendar year, along with the engine model and sub-model names of each engine, the type of exemption or exception, and the use of each engine (for example, spare or new installation). For purposes of this paragraph (d), treat spare engine exceptions separate from other new engine exemptions.

(e) Include the following signed statement and endorsement by an authorized representative of your company: "We submit this report under 40 CFR 1031.150. All the information in this report is true and accurate to the best of my knowledge."

(f) Where information provided for the previous annual report remains valid and complete, you may report your production volumes and state that there are no changes, without resubmitting the other information specified in this section.

§ 1031.160 Recordkeeping.

(a) You must keep a copy of any reports or other information you submit to us for at least three years.

(b) Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily available. We may review them at any time.

§ 1031.170 Confidential information.

The provisions of 40 CFR 1068.10 and 1068.11 apply for information you submit under this part.

[88 FR 4484, Jan. 24, 2023]

Subpart D—Reference Information

§ 1031.200 Abbreviations.

This part uses the following abbreviations:

Table 1 to § 1031.200—Abbreviations

°	degree
%	percent
CO	carbon monoxide
CO_2	carbon dioxide
EI	emission index
g	gram
HC	hydrocarbon(s)
kg	kilogram
kN	kilonewton
kW	kilowatt
LTO	landing and takeoff
m	meter
mg	milligram
µg	Microgram

NO_X	oxides of nitrogen
Num	number
nvPM	non-volatile particulate matter
$nvPM_{mass}$	non-volatile particulate matter mass
$nvPM_{num}$	non-volatile particulate matter number
$nvPM_{MC}$	non-volatile particulate matter mass concentration
rO	rated output
rPR	rated pressure ratio
SN	smoke number

§ 1031.205 Definitions.

The following definitions apply to this part. Any terms not defined in this section have the meaning given in the Clean Air Act (42 U.S.C. 7401-7671q). The definitions follow:

Aircraft has the meaning given in 14 CFR 1.1, a device that is used or intended to be used for flight in the air.

Aircraft engine means a propulsion engine that is installed on or that is manufactured for installation on an airplane for which certification under 14 CFR chapter I is sought.

Aircraft gas turbine engine means a turboprop, turbojet, or turbofan aircraft engine.

Airplane has the meaning given in 14 CFR 1.1, an engine-driven fixed-wing aircraft heavier than air, that is supported in flight by the dynamic reaction of the air against its wings.

Characteristic level has the meaning given in Appendix 6 of ICAO Annex 16 (incorporated by reference, *see* § 1031.210). The characteristic level is a calculated emission level for each pollutant based on a statistical assessment of measured emissions from multiple tests.

Date of manufacture means the date on which a manufacturer is issued documentation by FAA (or other recognized airworthiness authority for engines certificated outside the United States) attesting that the given engine conforms to all applicable requirements. This date may not be earlier than the date on which engine assembly is complete. Where the manufacturer does not obtain such documentation from FAA (or other recognized airworthiness authority for engines certificated outside the United States), date of manufacture means the date of final engine assembly.

Derivative engine for emissions certification purposes means an engine that is derived from and similar in type design to an engine that has a type certificate issued in accordance with 14 CFR part 33, and complies with the requirements of § 1031.130.

Designated EPA Program Officer means the Director of the Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, Michigan 48105.

Emission index means the quantity of pollutant emitted per unit of fuel mass used.

Engine model means an engine manufacturer's designation for an engine grouping of engines and/or engine sub-models within a single engine type certificate family, where such engines have similar design, including being similar with respect to the core engine and combustor designs.

Engine sub-model means a designation for a grouping of engines with essentially identical design, especially with respect to the core engine and combustor designs and other emission-related features. Engines from an engine sub-model must be contained within a single engine model. For purposes of this part, an original engine model configuration is considered a sub-model. For example, if a manufacturer initially produces an engine model designated ABC and later introduces a new sub-model ABC-1, the engine model consists of two sub-models: ABC and ABC-1.

Engine type certificate family means a group of engines (comprising one or more engine models, including sub-models and derivative engines for emissions certification purposes of those engine models) determined by FAA to have a sufficiently common design to be grouped together under a type certificate.

EPA means the U.S. Environmental Protection Agency.

Except means to routinely allow engines to be manufactured and sold that do not meet (or do not fully meet) otherwise applicable standards. Note that this definition applies only with respect to § 1031.20 and that the term "except" has its plain meaning in other contexts.

Exempt means to allow, through a formal case-by-case process, an engine to be certificated and sold that does not meet the applicable standards of this part.

Exhaust emissions means substances emitted to the atmosphere from exhaust discharge nozzles, as measured by the test procedures specified in § 1031.140.

FAA means the U.S. Department of Transportation, Federal Aviation Administration.

Good engineering judgment involves making decisions consistent with generally accepted scientific and engineering principles and all relevant information, subject to the provisions of 40 CFR 1068.5.

ICAO Annex 16 means Volume II of Annex 16 to the Convention on International Civil Aviation (*see* § 1031.210 for availability).

New means relating to an aircraft or aircraft engine that has never been placed into service.

Non-volatile particulate matter (nvPM) means emitted particles that exist at a gas turbine engine exhaust nozzle exit plane that do not volatilize when heated to a temperature of 350 °C.

Rated output (rO) means the maximum power or thrust available for takeoff at standard day conditions as approved for the engine by FAA, including reheat contribution where applicable, but excluding any contribution due to water injection. Rated output is expressed in kilowatts for turboprop engines and in kilonewtons for turbojet and turbofan engines to at least three significant figures.

Rated pressure ratio (rPR) means the ratio between the combustor inlet pressure and the engine inlet pressure achieved by an engine operating at rated output, expressed to at least three significant figures.

Round has the meaning given in 40 CFR 1065.1001.

Smoke means the matter in exhaust emissions that obscures the transmission of light, as measured by the test procedures specified in § 1031.140.

Smoke number means a dimensionless value quantifying smoke emissions as calculated according to ICAO Annex 16.

Spare engine means an engine installed (or intended to be installed) on an in-use aircraft to replace an existing engine. See § 1031.20.

Standard day conditions means the following ambient conditions: temperature = 15 °C, specific humidity = 0.00634 kg H2O/kg dry air, and pressure = 101.325 kPa.

Subsonic means relating to an aircraft that has not been certificated under 14 CFR chapter I to exceed Mach 1 in normal operation.

Supersonic airplane means an airplane for which the maximum operating limit speed exceeds a Mach number of 1.

System losses means the loss of particles during transport through a sampling or measurement system component or due to instrument performance. Sampling and measurement system loss is due to various deposition mechanisms, some of which are particle-size dependent. Determining an engine's actual emission rate depends on correcting for system losses in the nvPM measurement.

Turbofan engine means a gas turbine engine designed to create its propulsion from exhaust gases and from air that bypasses the combustion process and is accelerated in a ducted space between the inner (core) engine case and the outer engine fan casing.

Turbojet engine means a gas turbine engine that is designed to create its propulsion entirely from exhaust gases.

Turboprop engine means a gas turbine engine that is designed to create most of its propulsion from a propeller driven by a turbine, usually through a gearbox.

Turboshaft engine means a gas turbine engine that is designed to drive a rotor transmission system or a gas turbine engine not used for propulsion.

We (us, our) means the EPA Administrator and any authorized representatives.

§ 1031.210 Incorporation by reference.

Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the EPA must publish a document in the FEDERAL REGISTER and the material must be available to the public. All approved material is available for inspection at EPA and at the National Archives and Records Administration (NARA). Contact EPA at: U.S. EPA, Air and Radiation Docket Center, WJC West Building, Room 3334, 1301 Constitution Ave. NW, Washington, DC 20004; *www.epa.gov/dockets;* (202) 202-1744. For information on the availability of this material at NARA, visit *www.archives.gov/federal-register/cfr/ibr-locations.html* or email *fr.inspection@nara.gov.* The material may be obtained from International Civil Aviation Organization, Document Sales Unit, 999 University Street, Montreal, Quebec, Canada H3C 5H7; (514) 954-8022; *sales@icao.int; www.icao.int.*

(a) Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume II—Aircraft Engine Emissions, Fourth Edition, July 2017 (including Amendment No. 10, applicable January 1, 2021); IBR approved for §§ 1031.140; 1031.205.

(b) [Reserved]

TRANSPORT UP

The Latest News for Aerial Mobility

Vehicles/Manufactures

Oregon will use up to 126 Jump eVTOL aircraft for emergency response

03 December 2023 || 3 min read

Jump Aero, a California-based aircraft manufacturer, has partnered with the Oregon Department of Aviation to explore the integration of their JA1 Pulse Aircraft into the fabric of Oregon's emergency response ecosystem. The recently inked Memorandum of Understanding (MOU) marks a collaborative effort to redefine emergency medical services in rural Oregon, harnessing the speed and sustainability of the JA1 Pulse Aircraft.

The MOU anticipates the potential deployment of up to 126 JA1 Pulse aircraft to ensure swift access to trained professionals at emergency scenes, particularly in areas where the current response times exceed the desired standard of eight minutes due to vast distances and challenging terrains. The JA1 Pulse Aircraft is poised to significantly impact the lives of Oregon's residents and visitors alike.

This collaboration represents significant progress in Jump Aero's mission to provide rapid medical first response coverage to diverse regions. The Oregon Department of Aviation's commitment to exploring innovative solutions echoes their dedication to enhancing emergency services for all residents. Director Kenji Sugahara expressed anticipation about the partnership, stating, "We look forward to cultivating a long-term relationship with Jump Aero as we delve into providing rapid first response to our rural communities with the JA1 Pulse."

Oregon Department of Aviation's progressive stance, emphasizing the JA1 Pulse's potential to not only reduce emergency response times but also to elevate survival rates in rural communities. Dietrich enthused, "We are confident that the JA1 Pulse will emerge as a critical life-saving tool in Oregon, and we eagerly anticipate collaborating with first responders in Oregon and other partner regions."

Headquartered in Petaluma, California, Jump Aero specializes in electric vertical takeoff and landing (eVTOL) aircraft technology and their vision extends beyond innovation to revolutionizing emergency response times in rural areas. For detailed insights into Jump Aero and the JA1 Pulse aircraft, visit www.jumpaero.com.

Why it's important: The Oregon Department of Aviation (ODAV) takes center stage as a state agency dedicated to propelling the development of aviation within Oregon's transportation system while ensuring the safety of its airways. This collaboration with Jump Aero exemplifies the department's unwavering commitment to advancing emergency services in the state, marking a noteworthy stride toward a safer and more resilient state of Oregon.

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