

**BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.**

**OPERATION OF SMALL UNMANNED AIRCRAFT OVER PEOPLE –
NOTICE OF PROPOSED RULEMAKING**

Docket No. FAA-2018-1087

COMMENTS OF THE SMALL UAV COALITION

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The Small UAV Coalition¹ provides its comments in response to the FAA’s Notice of Proposed Rulemaking (“NPRM”) for Operation of Small Unmanned Aircraft Over People (“OOP”), 84 Fed. Reg. 3856 (Feb. 13, 2019). As explained more fully below, the Coalition believes that the use of an unmanned aircraft’s kinetic energy as the determinant to allow operations over people fails to consider additional relevant risk factors and thus is unduly restrictive. Specifically, the proposed risk model is based on an assumption that an unmanned aircraft will hit a human being, and the specific limits are derived solely from the probable severity of the injury from the transfer of kinetic energy from a rigid object to a person upon impact. While these proposed kinetic energy limits ostensibly are based on standards developed for commercial space debris, this proposal uses only the impact part of the commercial space risk model, and disregards the probability of occurrence risk.

The Coalition supports the nighttime operations provisions, as well as the proposal to replace recurrent remote pilot testing with recurrent training.

General comments

The proposed rule does not consider the net reduction in risk when a drone is used. At the most basic level, the FAA’s risk model fails to consider the net reduction in risk in operating a small UAS rather than a manned aircraft of any size or a motor vehicle or, in some cases, a human undertaking the task (i.e. climbing a cell tower). UAS operations improve safety by reducing the public’s exposure to the greater dangers associated with operations of significantly larger, heavier, and faster fixed-wing aircraft that are fuel-powered, as well as the even greater danger created by automobiles. UAS operations under 55 pounds are lightweight, nearly all battery-powered, and have no on-board crew. An accident or incident involving a small UAS can even be attenuated by small trees and structures and presents significantly less risk to individuals on the ground than one

¹ Members of the Small UAV Coalition are listed at www.smalluavcoalition.org.

involving a fuel-powered fixed-wing aircraft that can weigh hundreds of thousands of pounds, or collisions between other multi-thousand pound ground vehicles and pedestrians.

The Coalition submits that this approach should be the FAA's touchstone in evaluating the risks not only of UAS operations over people, but also in evaluating risks in petitions for waiver or exemption and future rulemaking actions to enable routine operations beyond the visual line of sight and carrying property.

A 2017 FAA-sponsored and congressionally mandated study recommends this approach. In *Assessing the Risks of Unmanned Aircraft Systems into the National Airspace System*, the National Academies of Sciences, Engineering, and Medicine recommends that FAA should conduct a holistic consideration of safety risks (at 34).

The FAA should expand its perspective on a *quantitative* risk assessment to look more holistically at the total safety risk. Safety benefits, including those outside of aviation (e.g., the benefit of cell tower inspections without a human climbing a cell tower), should be part of the equation. UAS operations should be allowed if they decrease safety risks in society – even if they introduce new aviation safety risks – so long as they result in a net reduction in total safety risk.

The proposal fails to consider the reliability (probability of failure) and risk mitigation features of the unmanned aircraft. The FAA also does not consider the reliability of a drone model being operated by a qualified remote pilot. The preamble does not even offer reliability as a relevant factor in developing a means of compliance, submitting a Declaration of Compliance, or seeking a waiver from the proposed standards. The Coalition urges the FAA revise its risk analysis to take into account both the reliability of the UAS and its probability of failure.

The proposal fails to consider the probability of impact. The Coalition's fundamental concern with the FAA's risk model is that it assumes a small UAS has collided with a human being. In other words, the kinetic energy limits are not based on the *probability* of impact, but only on the *severity* of impact. The preamble concedes that the Category 2 and 3 limits "assume[] a small UAS would experience a failure during an operation over people and that it would impact a person. A one hundred percent chance that each of these events would occur is *impossible*." 84 Fed. Reg. at 3874 (emphasis added). Therefore, the probability of injury such thresholds would present is uncertain.

The preamble relies on the commercial space rules in Part 417, Launch Safety, "and longstanding Range Commander's Council (RCC) standards." 84 Fed. Reg. at 3873.

The FAA does not use this assumption as a basis for manned aviation, whether for transport category or small aircraft. If it did, no aircraft would ever be allowed to fly over people, and the aviation industry would not exist.

In comments submitted by the Alliance for System Safety of UAS through Research Excellence (ASSURE comments) at 3, ASSURE notes:

FAA's safety program relies heavily upon the risk-based approach that includes hazard severity and probability of occurrence. . . The NPRM proposes to achieve their safety objectives by establishing a performance-based standard on severity of the impact without any clear guidelines or application of probability of the collision even occurring.

ASSURE adds that, while the 11 ft-lb. and 25 ft-lb. limits in the NPRM rely heavily on the Range Commander's Council (RCC) thresholds that derive from the impact of commercial space debris, "Commercial Space uses these kinetic energy values for largely rigid objects following destruction of a vehicle *in conjunction with a casualty expectation probability* to assess safety." ASSURE comments at 4 (emphasis added). ASSURE adds that it previously determined that the "RCC probability of fatality data is overly conservative and largely not applicable to elastic UAS." ASSURE comments, at 2-3.

ASSURE concludes, based on the RCC rationale, that "it should be clear that the probability of collision with a human for most operations over people is significantly low." ASSURE comments at 28.

The proposal assumes that all kinetic energy is transferred upon impact. Another assumption the NPRM makes is that if a small drone collides with a human being, all of the kinetic energy is transferred upon impact. The preamble again cites the RCC standards, calling them "instructive." The FAA acknowledges that it is proposing to set the safety level "based on limitation of injuries caused by the total kinetic energy transferred from a rigid object to a person upon impact[.]" rather than using the Aviation Rulemaking Committee's recommendation of impact kinetic energy per unit area (Joules per centimeter squared). 84 Fed. Reg. at 3874. The FAA makes this assumption based on worst case analysis involving a variety of shapes, sizes, and orientation of the drone, as well as the person. Using a rigid object may be simple, but it does not consider the lesser impact small UAS are likely to cause.

FAA admits there is not at the present time a "means of measuring . . . to establish that a specific amount of energy equates with a likelihood of injury." 84 Fed. Reg. at 3874. ASSURE recommends that until such time as the FAA has developed "more accurate probability-based injury risk curves[.]" the FAA should adopt automotive injury risk metrics based on "the extensive flight, Anthropomorphic Text Device (ATD) and Post Mortem Human Surrogate (PHMS) (Cadaver) testing of the ASSURE Task A14 team[.]" ASSURE comments, at 1, 3. The Coalition agrees.

The proposal cites the findings of ASSURE's A4 team, which conducted drop tests and published a report in 2017. ASSURE's A14 team, by contrast, conducted extensive testing based on the ATD and PMHS automotive metrics, and asserts that these metrics are "testable and standardized while still achieving the level of safety goals stated in the NPRM." ASSURE comments at 1. ASSURE explains:

[T]he use of impact kinetic energy values alone does not make sense for sUAS because sUAS don't break apart in-flight (in the majority of cases) and hit people as inelastic, metallic fragments like missiles and spacecraft that generate metallic debris when detonated or are broken up in flight. sUAS fall as complete objects and they absorb tremendous amounts of energy during impact due to their flexibility.

ASSURE comments at 4.

The proposal's narrow focus on kinetic energy is inconsistent with other risk assessment models.

The European Commission has adopted the Specific Operations Risk Assessment (SORA) model, based on its development by the Joint Authorities on Unmanned Systems (JARUS). The preamble refers to the European Union Aviation Safety Agency (EASA) May 2017 Notice of Proposed Amendment (NPA), but does not consider using the SORA model. The Coalition notes that the EASA NPA has since been superseded by Delegated and Implementing Regulations to be published this spring.

The proposal would preclude the vast majority of UAS models from operating over people. The preamble invites comment on the costs of meeting the proposed kinetic energy limits. The regulatory evaluation assumes that only 15 existing UAS models would satisfy the Category 2 or 3 requirements. 84 Fed. Reg. at 3895. The FAA believes there are 2,126 UAS manufacturers in the world. 84 Fed. Reg. at 3897. If these figures are accurate, and assuming conservatively that each manufacturer produces only one UAS model, this would mean that less than 1% of existing UAS models would be able to comply with Categories 2 or 3 as proposed. (ASSURE states, at 14, that the DJI MAVIC Pro, DJI Phantom 3, and SenseFly eBee+ would not be capable of meeting the 11ft.-lb. limit in Category 2.) Further, the FAA estimates that the one-time cost [to a manufacturer] to develop a means of compliance to be \$200,000, 84 Fed. Reg. at 3898, but this estimate is only for a means of compliance; the preamble does not include an estimate of the cost of retrofitting UAS models, including covering exposed rotating parts, using frangible materials, equipping the UAS with a parachute, or other retrofits.

The Coalition urges the FAA reconsider its risk assessment models, and, at a minimum, revise its performance standards to align with ASSURE's recommended use of the ATD and PHMS data. As ASSURE states, at 5:

It seems logical for the FAA to utilize these tests methods and injury risk metrics to establish performance-based metrics for sUAS until such time as sUAS specific injury metrics can be fully defined. This is what ASSURE has been briefing to the public, FAA, EASA, and Transport Canada for more than 4 years.

Comments on specific provisions

107.1 Applicability

The FAA proposes to add a sentence that qualifications for operations over people are included in Part 107. The FAA also proposes to add the citation to the statutory provision in the FAA Reauthorization Act of 2018 that largely replaces section 333 of Public Law 112-95. The Coalition supports these changes.

107.3 Definitions

The FAA proposes to add definitions of “casualty” and “Declaration of Compliance.” “Casualty” is proposed to be defined as Abbreviated Injury Scale (AIS) Level 3 (serious injury) or greater. “Declaration of Compliance” is defined as the document a manufacturer submits to the FAA to certify that a small UAS conforms to the Category 2 or 3 requirements, as applicable. The Coalition supports these definitions.

107.5 Falsification, reproduction or alteration

Under this provision, committing fraud in any record required to be made, kept, or used is grounds for denial of a remote pilot certification or a suspension or revocation of a Part 107 waiver. The FAA proposes to provide that a Declaration of Compliance may also be denied, suspended, or revoked, if it is based on fraud. The Coalition supports this proposal.

107.7 Inspection, testing, and demonstration of compliance

Under this provision, upon request of the FAA Administrator, the remote pilot or owner must provide any record required to be kept under Part 107, such as the remote pilot certificate or the evidence of UAS registration, and must allow the FAA to inspect facilities, data, and small UAS. The FAA proposes to require the provision of such records upon request of an authorized representative of the TSA, NTSB, and any Federal, State, and local law enforcement officer, and to extend the FAA’s inspection authority over any person holding an FAA-accepted Declaration of Compliance. The Coalition supports this proposal, but requests the FAA limit the roles of State and local law enforcement to one of assisting a Federal law enforcement agency.

107.19 Remote pilot in command

The FAA proposes to clarify the remote pilot’s duty to ensure no undue hazard results in the event of loss of control of the small UAS operated by the remote pilot. The Coalition supports this clarification. The FAA decided not to impose a prescriptive standard for a minimum distance, whether vertically or laterally, between a drone operating over a person and that person off distance, and the Coalition agrees that a prescriptive standard is not required where the general duty in 107.19 will suffice.

107.29 Operating at night

The Coalition supports the FAA's decision to allow operations at night by rule, rather than by exemption under section 333 or waiver under Part 107. The Coalition also supports the two general requirements: anti-collision lighting visible for three statute miles, and additional training and testing to account for the risks of, and mitigations for, nighttime operations. The Coalition agrees with the FAA's finding, based in part on the Pathfinder Program, that the increased conspicuity anti-collision lighting provides increases the margin of safety for nighttime operations over operations during the day. The Coalition requests the FAA confirm that these two requirements apply only to drones operating at night and not to drones operating during daylight hours.

The Coalition does not support any requirement for position lighting, a flashing, stroboscopic device, or a specific color or type. Any such requirement would be difficult to differentiate at a distance. Quadcopters in particular can move in any direction so that any position or color requirement would cause confusion for other pilots.

107.35 Operation of multiple small unmanned aircraft

The FAA proposes to extend the prohibition on operating more than one UAS at the same time to a person who manipulates flight controls, in addition to the remote pilot and visual observer. While the Coalition does not object to this provision, it notes that this prohibition is subject to a waiver under 107.205.

107.39 Operation over human beings

This proposal adds a subsection to allow a UAS to operate over a human being if the UAS meets the Category 1, 2, or 3 requirements, as applicable. The Coalition supports this proposal, subject to a revision of the limits in Category 2 and 3 to reflect ASSURE's recommended metrics.

107.49 Preflight familiarization, inspection, and actions for aircraft operations

The FAA proposes to add to the preflight familiarization requirement that the remote pilot in command ensure that the UAS meets the requirements for operations over people set forth in Categories 1, 2, or 3, as applicable. The Coalition supports this proposal, subject to a revision of the limits in Category 2 and 3 to reflect ASSURE's recommended metrics

107.61 Eligibility

Under this section, to be eligible for a remote pilot certificate, the applicant must demonstrate aeronautical knowledge by passing an aeronautical knowledge test or completing training if the applicant holds a Part 61 certificate. The FAA proposes a minor revision to clarify that the Administration has discretion to determine the manner for testing and training. The Coalition supports this proposal.

107.65 Aeronautical knowledge recency

The FAA proposes to replace the requirement to pass a recurrent aeronautical knowledge test with a requirement to complete recurrent training. The Coalition strongly supports this proposal. It will significantly reduce the costs incurred to travel to a test center, and online training will be acceptable. The Coalition also recommends the FAA allow online training and testing for passing the initial aeronautical knowledge test, as directed by section 349 of the FAA Reauthorization Act of 2018.

107.73 Knowledge and training

The Coalition supports including night operations as part of an aeronautical knowledge test and recurrent training.

107.74 Small unmanned aircraft system training

The Coalition supports including night operations as part of training for Part 61 certificate holders.

Subpart D – Operations Over Human Beings

As a general matter, the Coalition supports the FAA's proposal to continue to permit operations over people by waiver or exemption, as set forth initially in Part 107, upon a showing that the operations would meet an equivalent level of safety.

107.100 Applicability

No comment.

107.105 Prohibition on operations over moving vehicles

The FAA proposes a categorical prohibition on a small UAS operating over a human being in a moving vehicle. The preamble states that the kinetic energy impact on a motorcycle driver would be greater than the impact on a person at rest, and that a drone may distract a driver and result in an accident. 84 Fed. Reg. at 3889. This statement makes an assumption of how drivers will react. Moreover, a collision of a drone with a car is probably no more dangerous than a collision between two cars. The Coalition opposes this categorical provision, and notes that the FAA is considering whether to allow operations over moving vehicles in the absence of a waiver.

Moving vehicles will predominantly be protected by a surface that a drone will not likely penetrate upon falling, and thus the risk of injury to a person in a car is minimal. Given that both drone and moving vehicle will be moving, the FAA should consider the reduced probability of impact in this situation. The Coalition recommends that this prohibition not cover small UAS operations that merely transit over moving vehicles and are not operated in a sustained manner.

Also, the Coalition supports the proposal to allow a waiver from this prohibition if an operator can “demonstrate that these operations can be conducted safely pursuant to the certificate of waiver.” 84 Fed. Reg. at 3890.

107.108 Limitations on operations over human beings

The FAA proposes to limit operations over human beings to those operations authorized by Subpart D and section 107.39. The Coalition recommends adding section 107.205 because operations over human beings may be authorized by waiver, and adding 49 U.S.C. 44807 because operations over human beings may also be authorized by exemption.

107.110 Category 1 operations

The FAA proposes to adopt the ARC recommendation that a UAS weighing no more than .55 lbs. may operate over people without any design requirement or operational restriction beyond the limitations in Part 107. Based on data, the FAA concluded that there is a low risk of injury even from an exposed rotating part of a drone in this small weight class. The Coalition supports this proposal. The Coalition also agrees that it will ultimately be the responsibility of the remote pilot in command to confirm the UAS is within the weight limit.

107.115 Category 2 operations

For both Category 2 and 3, the NPRM proposes two performance standards. The UAS must: (1) achieve a safety level in terms of not exceeding a foot-pound limit upon impact with a human being and (2) not have any exposed rotating part. This latter standard essentially focuses on the risk that a rotating propeller will lacerate skin upon impact. Relying on ASSURE for the finding that all propellers can lacerate skin, the FAA proposes to prohibit the operation of any small UAS in Categories 2 or 3 with any exposed rotating part. While the preamble refers to this as a performance standard, it appears to result in installing guards or shrouds to ensure that rotating parts are not exposed on impact. The preamble suggests that a manufacturer may also attempt to demonstrate that the nature of the exposed propeller will not lacerate skin on impact.

Because an impact of 11 ft-lbs. or less “would have a low probability of causing a casualty,” Category 2 operations are allowed to operate over people in any and all settings. The Coalition agrees as a general matter with establishing a performance standard that, if met, would allow operations over people in any and all settings. As noted, however, we take issue with the use of the 11 ft-lbs kinetic energy impact limit.

107.120 Category 3 operations

The transfer of kinetic energy impact of Category 3 operations may be up to 25 ft-lbs. and thus these operations are therefore subject to restrictions. They may not operate over an open-air assembly of persons and any operation over a person who is not directly participating in the operation must not be sustained. There is no definition in the proposal for what is considered a “sustained” operation. The Coalition believes that hovering or circling over persons should be

considered sustained, whereas merely transiting over a person would not be considered “sustained.”

In the proposed rule, for both Category 2 and 3 operations, the drone’s transfer of energy upon impact with a person must be *less than* the ft-lb limit. However, the preamble states, 84 Fed. Reg. at 3874, that the transfer of energy must be *no more than* the ft-lb of kinetic energy. While the Coalition does not agree with these limits, we note the discrepancy between the preamble and proposed text.

107.125 Means of compliance

The Coalition supports in concept the FAA’s proposal that manufacturers may achieve the safety levels through various means of compliance. The FAA proposes three ways to achieve acceptable means of compliance: FAA-provided; industry consensus standards; and custom means offered by a manufacturer or other person.

The FAA-provided means is that a manufacturer may calculate kinetic energy transferred by impact using the formula the FAA details in the preamble. ASSURE examined the proposed equation and concluded: “[t]here will be no aircraft with a commercial viable payload that can meet . . . Category 2 limits] and as such this NPRM will do nothing to expand operations of the sUAS in the U.S.” ASSURE comments at 33. The Coalition urges the FAA instead to use the automotive injury metrics suggested in the ASSURE comments.

As for industry standards, the preamble identifies RTCA, ASTM, SAE, and IEEE. The Coalition believes that other established standards organizations may also provide an industry consensus standard.

For a custom means of compliance, FAA expects that a manufacturer would demonstrate, through testing, analysis, and/or inspection, supported by data, that a hardware, software, or combination fix would achieve the 11-ft lb. and 25 ft-lb. safety levels using a reasonably foreseeable worst-case scenario. This is where parachutes, ballistic recovery systems, and other deployable devices that would create a drag to reduce the speed of descent can be considered. The Coalition believes that the use of deployable devices should be relevant in developing industry consensus standards. Indeed, ASTM is developing a standard for parachutes used with small drones.

107.130 Variable mode and variable configuration of small unmanned aircraft systems

The Coalition supports permitting a small UAS to be eligible for Category 2 or 3, whether through hardware, software, or a combination of both, so long as the remote pilot in command cannot inadvertently switch between modes or configurations.

107.135 Declaration of compliance

The Coalition supports the proposal to allow the “self-certification” of compliance with the safety levels and other requirements in the proposed rule, but notes that the FAA still would “accept” the Declaration upon a determination that the manufacturer has demonstrated compliance with the requirement of the rule. In that sense, it appears similar to the means of compliance set forth in proposed 107.125, because the FAA must accept each Declaration of Compliance, as it must also accept each means of compliance. The Declaration of Compliance will be submitted electronically on a form, suggesting that the submission process will be efficient. Neither the proposed rule nor the preamble describes what FAA acceptance will entail and how long a review might take. The Coalition understands that FAA review and acceptance of a means of compliance under proposed 107.25 may take some time, especially for a custom means of compliance. There does not appear to be any discretionary review of a Declaration of Compliance so that a quick acceptance or denial should be expected.

This provision also would require manufacturers to establish a product support and notification process to notify the small UAS owners and the FAA if there is any defect or condition that causes the UAS no longer to meet the requirements in the rule. The Coalition supports this provision.

107.140 Previously manufactured small unmanned aircraft systems

The Coalition supports the proposal to apply the requirements of this rule to existing UAS models, such that they may not be operated over people under Categories 2 or 3 until a Declaration of Compliance has been submitted to and accepted by the FAA. We suggest that this proposal explicitly recognize that an existing UAS model may be operated pursuant to a waiver or exemption, without a Declaration of Compliance.

107.145 Record retention

The FAA proposes to require persons who submit a Declaration of Compliance to retain supporting information for two years and retain supporting information for a means of compliance for as long as the means is accepted by the FAA. The Coalition supports this proposal.

107.150 Relabeling by remote pilot in command for Category 2 and 3 operations

The Coalition supports the proposal to require a remote pilot in command to relabel a UAS if the label is removed or illegible.

107.205 List of regulations subject to waiver

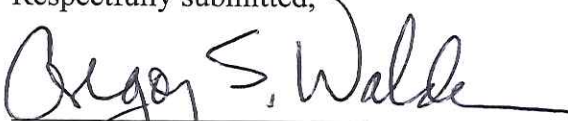
The Coalition agrees that the anti-collision light requirement and the prohibition on operating over moving vehicles should be subject to waiver. In particular, the FAA is prepared to waive the three statute mile visibility requirement where the applicant demonstrates that a distance less than three miles would not reduce the level of safety.

As noted, the Coalition opposes a categorical prohibition on operating UAS over moving vehicles, and at a minimum supports the grant of a waiver where the risk would be low and capable of mitigation.

The FAA states in the preamble that it is proposing a waiver from any OOP requirements in Subpart D, but there is no explicit proposal in the text. Current section 107.205 allows a waiver from prohibition on operations over people. The Coalition suggests revising the current waiver provision to be consistent with the language in the preamble, as follows:

107.205(g). –Section 107.39, *including a waiver of any requirement of an operating category specified in subpart D.*

Respectfully submitted,



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