

16.687

Private Pilot Ground School

Massachusetts Institute of Technology

IAP 2019



Small UAS Operations



Michael Holzwarth

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- Bought DJI Phantom 2/GoPro Hero3 in 2014
- Hawaii vacation video: 50,000 views
- Summer 2016: Cape Cod video picked up by local TV (\$1,400 fine from National Park Service)
- First sUAS license in Massachusetts: August 31, 2016
- Fall 2016: Good Morning America features foliage video (4.7 million views)
- 2017: Hired by Above Summit as Lead Drone Operator and Production Coordinator



Part 107

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- New regulatory chapter first released in 2016
- Full text of regulations: [FAR 107](#)
- Plain-language interpretation and guidance: [Advisory Circular 107-2](#)
- Good introduction material, FAQ, and links to relevant documents: <https://jrupprechtlaw.com/faas-new-far-part-107-drone-operators-need-know>



	Hobby Use	Part 107
Pilot Requirements	No pilot requirements	Must have Remote Pilot Airman Certificate Must be 16 years old Must pass TSA vetting
Aircraft Requirements	May require registration if over 0.55 lbs.	Must be less than 55 lbs. Must be registered if over 0.55 lbs. (online) Must undergo pre-flight check to ensure UAS is in condition for safe operation
Location Requirements	5 miles from airports without prior notification to airport and air traffic control	Class G airspace* Can't interfere with airport operations/traffic patterns
Operating Rules	Must ALWAYS yield right of way to manned aircraft Must keep the aircraft in sight (visual line-of-sight) UAS must be under 55 lbs. Must follow community-based safety guidelines Must notify airport and air traffic control tower before flying within 5 miles of an airport	Must keep the aircraft in sight (visual line-of-sight)* Must fly under 400 feet* Must fly during the day* Must fly at or below 100 mph* Must yield right of way to manned aircraft* Must NOT fly over unprotected, non-participating people* Must NOT fly from a moving vehicle*
Example Applications	Educational or recreational flying only	Flying for commercial use (e.g. providing aerial surveying or photography services) Flying incidental to a business (e.g. doing roof inspections or real estate photography)
Legal or Regulatory Basis	Public Law 112-95, Section 336 – Special Rule for Model Aircraft FAA Interpretation of the Special Rule for Model Aircraft	Title 14 of the Code of Federal Regulation (14 CFR) Part 107



Multi-person Crew

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- Required: Remote PIC with Small UAS Rating on Remote Pilot certificate
- Two roles:
 - Visual Observer
 - Manipulator of Controls
- Roles can be split among multiple communicating people
- Manipulator of Controls need not be certificated, but PIC must be able to take over at any time

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Human Factors and Decision-Making

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- Alcohol and Drugs: same rules
- Crew Resource Management: same concepts
- Fatigue and Stress: still bad for safety
- Hazardous Attitudes: still hazardous
- PIC Emergency Authority still exists

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Performance

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Same performance issues as with full-size aircraft, but typically more sensitive

- High Density Altitude: bad
- Humidity: bad
- High Weight: bad
- High Winds: potentially bad

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Loading

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- Don't count on book performance (and there is no book!) if you've loaded up your drone.
- Understand how load changes effect stability and performance

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Drones at Night

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- Need a waiver at “night”
- During civil twilight, anti-collision lighting required (visible for 3 sm; 107.29)
- Unlike with manned aircraft, “Civil twilight” is not civil twilight, except in Alaska. (Instead just add or subtract 30 minutes from sunset/sunrise)

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Regulatory Fine Print

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- Don't be careless or reckless (107.23)
- Don't drop stuff if it creates a hazard
- 107.9: If you crash... report to FAA within 10 calendar days if
 - Serious injury or any loss of consciousness to anyone
 - Damage to property (other than sUAS) exceeding \$500

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Preflight

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- Ensure drone is in condition for safe operation prior to each flight
 - Should follow manufacturer recommendations for maintenance / inspection (including software updates)*
- Assess operating environment (weather, airspace, people/property on the surface, other hazards)
- Brief participants about emergencies, roles, hazards
- Ensure control links working properly
- Ensure sufficient battery for flight

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Boston Area

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- Logan Class B airspace goes down to the surface for roughly 8 nm around BOS
- Hanscom, Lawrence, Beverly, and Norwood all own Class D airspace to the surface
- Can request an authorization (temporary) or waiver (longer-term)
- Suburbanites have had good luck calling the Hanscom Tower (though FAA says not to)

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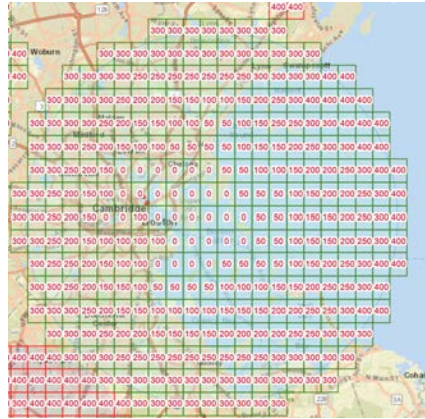
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The Grid

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- https://www.faa.gov/uas/commercial_operators/uas_facility_maps
- With wide-area auth, anywhere under the grid
- Same-day authorization in one box: Low Altitude Authorization and Notification Capability (LANNC)



Source: Public Domain



Part 107 Waiver Process

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- All waivers requested through online FAA form, NOT air traffic control: https://www.faa.gov/uas/request_waiver/
- must justify safety case and compliance with Performance-Based Waiver Standards
- Dynamic policy area (new and changing processes)

Request a Waiver/Airspace Authorization Small Unmanned Aircraft System (sUAS)

UAS operators who want to fly outside the requirements of the Small UAS Rule (Part 107) may request a waiver and/or airspace authorization using the form below.

Applicants are encouraged to review the form instructions (PDF) and the list of regulations subject to waiver prior to submitting this form. Please provide all required information in order to facilitate evaluation of your request.

Paperwork Reduction Act and Privacy Act Statements (PDF)

You are not required to respond to this collection of information unless it displays a valid OMB control number.

Waivers under 14 CFR Part 107, Subpart D OMB Control Number: 2120-0027 Expiration Date: 08/31/2019	Airspace Authorizations under 14 CFR Part 107 OMB Control Number: 2120-0768 Expiration Date: 05/31/2017
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Source: Public Domain



Certification: Original Issuance

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- Required knowledge test: FAA Unmanned Aircraft General (UAG)
 - Self-study permitted
 - Mix of UAS-specific questions and general aviation system knowledge
 - No endorsement required
 - Repeat every 24 months
- Airman Certification Standards
 - https://www.faa.gov/training/testing/testing/acs/media/uas_acs.pdf



Source: Public Domain



Certification: Traditional Pilots

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- Must familiarize with sUAS-specific material with FAA-approved course:
 - <https://www.faasafety.gov/gslac/ALC/CourseLanding.aspx?CID=451>
- Recurrent knowledge test or *training course* every 24 calendar months

This module focuses on certification and other requirements related to the aircraft and Remote Pilot in Command (Remote PIC). As a Remote PIC, you must satisfy these requirements before operating a small UAS.

This lesson focuses on the aircraft itself and describes:

- Small UAS characteristics
- Part 107 exclusions
- Requirements for registration, markings, and condition

Source: Public Domain



For this class:

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Option 1:

1. Obtain Private Pilot license
2. Take online course for sUAS certificate eligibility
3. Request verification from any CFI or other authorized person on IACRA

Option 2:

1. Pass final exam in this course to demonstrate knowledge of airspace, airport operations, weather, etc.
2. Take online course for sUAS certificate eligibility (<https://www.faasafety.gov/gslac/ALC/CourseLandin.aspx?CID=451>)
3. Self-study any areas of weakness, sign up for Unmanned Aircraft Generation (UAG) written exam at a testing center

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Source: Public Domain



Movies

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- *Equalizer 2* (Denzel Washington, Bill Pullman)
- *Eve* (John Malkovich, Colin Farrell)
- *Knives Out* (Daniel Craig, Chris Evans)
- *The Society* (Netflix series)
- *Minds Wide Open* (Discovery)
- *Nosferatu* (AMC)

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Life on Set

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- Hired by the day (\$2,000)
- Team of three:
 - Remote PIC (fly drone)
 - Camera Operator (point)
 - Visual Observer/Drone Tech
- Dronefly Titan X8 Heavy Lift (DJI A3 software) with RED or Arri
- DJI Inspire 2 with X7 camera
- 12 days on set -> 12 seconds in final cut
- Bring a book!

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Questions

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Personal Results:

- <https://youtu.be/izM8iQZBNCU> (2014-2017)

MIT OpenCourseWare
<https://ocw.mit.edu/>

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