2024 Unmanned Aircraft Systems

Program CIP: 49.0102 — Airline/Commercial/Professional Pilot and Flight Crew

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances the intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Mr. Glen V. East, chair
Mr. Matt Miller, vice chair
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Ms. Kate Riddle, student representative

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Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's career and technical education (CTE) unmanned aircraft systems (UAS) curriculum is aligned to the following standards:

Code of Federal Regulations: Title 14, Chapter 1, Subchapter F, Part 107—Small Unmanned Aircraft Systems
For anyone to fly a drone commercially under the Federal Aviation Administration's (FAA's) small, unmanned aircraft systems (sUAS) rule (Part 107), they must obtain a Remote Pilot Certificate from the FAA. The Part 107 sUAS certificate demonstrates that the applicant understands the regulations, operating requirements, and procedures for safely flying drones. According to the Code of Federal Regulations (CFR), any person may reproduce or republish any material appearing in any regular or special edition of the Federal Register (1 CFR § 2.6). There are no restrictions regarding what is reproduced, who can reproduce it, or where it can be reproduced. The Office of the Federal Register (OFR) of the National Archives and Records Administration (NARA), and the U.S. Government Publishing Office (GPO) jointly administer the federalregister.gov website. (ecfr.gov)

International Society for Technology in Education Standards (ISTE)
Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE (iste.org).

College- and Career-Readiness Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st-Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills.
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description
Unmanned aircraft systems (UAS) is a career and technical education (CTE) pathway in the STEM (science, technology, engineering, and math) cluster that enables high school students to develop drone-related flight skills and data processing capabilities. These skills are necessary to thrive within any of the thrilling and burgeoning professional small unmanned aircraft systems (sUAS) careers. Skills covered in this pathway include an understanding of flight characteristics, drone operation, navigation, autonomous mission planning, remote sensing, data collection, and data processing as it relates to geographic information systems (GIS). Students will maintain and troubleshoot electronics and avionics associated with a variety of UAS types. Local, national, and international airspace regulation and compliance is emphasized within this program. A few of the UAS–related career opportunities that exist currently include real estate photography and videography of listed homes and property; aerial photography and videography of events and natural disasters; inspection of power lines, bridges, and buildings; small package delivery for consumers; and mapping and surveying of land, buildings, and construction projects.

College, Career, and Certifications
The UAS pathway will prepare students for UAS–related employment opportunities during high school and beyond. Students will have the opportunity to become Federal Aviation Administration (FAA)–certified commercial drone pilots upon successful completion of the FAA Part 107 Remote Pilot Certification exam titled *Unmanned Aircraft General—Small*, which will allow them to fly a drone for compensation. Upon receiving their license, students may then pursue employment while in high school depending on their skill level and self-determination. There are numerous two-year and four-year UAS–related postsecondary degree programs, both in-state and out-of-state, that would allow students to pursue further education and training to enhance their skills and knowledge base. The certified commercial drone pilots this course produces can be a valuable resource for any company that has recognized UAS capabilities and applications within their industry.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as sophomores. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class with the teacher at a time.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school–level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and Test of Adult Basic Education (TABE) reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any training sessions provided, please contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu

Course Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses that should be completed in the following sequence:

1. **Introduction to Unmanned Aircraft Systems—Course Code: 235130**
2. **Foundations of Unmanned Aircraft Systems—Course Code: 235125**
3. **Applications of Unmanned Aircraft Systems—Course Code: 235120**
4. **Advanced Unmanned Aircraft Systems—Course Code: 235115**

Course Description: Introduction to Unmanned Aircraft Systems
This credit covers introductory topics related to unmanned aircraft systems (UAS). Students will develop effective skills in communication, writing, technology, leadership, and team building within class- and work-related situations. They will demonstrate safe and consistent multirotor flight and equipment use while utilizing UAS flight simulation software. They will research the history and future implementation of UAS, will maintain an official flight log, and will receive a Federal Aviation Administration (FAA)–issued TRUST (The Recreational UAS Safety Test) certification to become eligible to fly small, unmanned aircraft systems (sUAS) recreationally. They will investigate the functionality and interaction of aircraft control surfaces while comparing simulated flight experiences among a variety of fixed-wing, multirotor, and vertical takeoff and landing (VTOL) aircraft types. Initially, the software simulator will be used to test their proficiency regarding takeoff, hovering, landing, target landing, flying in designated patterns, and emergency recovery procedures. Then, they will practice real world, manual indoor entry-level multirotor flight including takeoff, hovering, landing, flying in straight lines, box patterns, and figure-eight patterns. Lastly, students will conduct these basic flight patterns while using an outdoor-capable multirotor drone.

Course Description: Foundations of Unmanned Aircraft Systems
This credit introduces students to FAA Part 107 regulations where they will discuss the purpose, and the responsibilities of a Remote Pilot in Command (RPIC). This credit also focuses on UAS components, construction, and flight. Students will explore UAS technology and its application within a variety of industries. They will discuss the rules for operating in the vicinity of airports, explore the importance of preflight inspections, and understand the need for remote pilot certification. They will also focus on flight theory while developing an understanding of aerodynamic principles, flight control, and aircraft propulsion. They will analyze the effects of the center of gravity on flight stability and will describe gravitational influences on the four forces of flight. They will demonstrate the use of flight controls to maintain aircraft stability and discover the limitations of airframe performance. They will also develop a research plan to design and build a multirotor sUAS, select appropriate components, assemble the sUAS, program the flight controller and transmitter, integrate the camera system, and perform necessary checks on the power system, battery, and charger. Concentration on UAS technology in both public and private sectors, as well as its relevance to other career clusters, will become vital as students develop their comprehensive student portfolios they will maintain throughout their academic and professional journey.

Course Description: Applications of Unmanned Aircraft Systems
This credit focuses on FAA regulations and procedures for sUAS operations, flight techniques and camera settings for capturing data, data processing software, and concepts relevant to UAS missions. Students will demonstrate their knowledge of safety measures, preflight procedures, emergency procedures, and how to avoid hazardous operations. They will explore the impact that filters and a variety of camera settings have on video footage and then they will apply basic image analysis techniques using image processing software. They will discover the applications of photogrammetry software, investigate the Global Positioning System (GPS), and understand how geographic information systems (GIS) are implemented within various industries. A range of sensors will be explored when collecting data, including some of the following passive or active remote sensing systems: acoustic, electro-optical/infrared (EO/IR), hyperspectral, light detection and ranging (LiDAR), multispectral, radar, and thermal sensors.

Course Description: Advanced Unmanned Aircraft Systems
This credit focuses on the planning, execution, and documentation of sUAS autonomous missions using multirotor systems; fixed-wing aircraft flight; and the planning, execution, and documentation of a flight mission culminating within a capstone project. Students will discuss safety considerations for autonomous mission planning and demonstrate the use of ground station systems, including computer-based and tablet-based systems. They will incorporate mission control software, manage sensor functionality, design mission plans, conduct preflight checks, and perform various autonomous multirotor missions such as survey grids, tower inspections, photography, and videography, based on local industry and community needs. Students will learn and perform preflight and systems checks, including verifying correct movements of flight surfaces, radio system range checks, and airframe and propeller damage inspection. They will demonstrate fixed-wing flight skills using a software simulator and will develop emergency procedures flow charts for recovery from unusual attitudes. Students will research, select, and integrate appropriate sensors and aircraft for their instructor-approved mission, perform the mission, collect data, and process it into a deliverable package. Finally, they will complete a professional digital portfolio which encapsulates the accomplishments that have been completed throughout the UAS program.

Introduction to Unmanned Aircraft Systems—Course Code: 235130

Unit	Unit Title	Hours
1	Introduction to UAS and Student Organizations	30
2	UAS Safety Regulations and Operational Policies	10
3	UAS Flight Simulation	55
4	Multirotor Flight	45
Total		**140**

Foundations of Unmanned Aircraft Systems—Course Code: 235125

Unit	Unit Title	Hours
4	Multirotor Flight (Continued)	12
5	Introduction to FAA Part 107	25
6	Flight Theory	35
7	UAS Components, Construction, and Flight	60
8	Career Exploration and Preparation	8

Total		**140**

Applications of Unmanned Aircraft Systems—Course Code: 235120

Unit	Unit Title	Hours
9	FAA Part 107 Integration	62
10	Advanced Image Capture and Analysis	45
11	Introduction to Sensors and Data Processing Systems	25
12	Autonomous Multirotor Missions	8
Total		**140**

Advanced Unmanned Aircraft Systems—Course Code: 235115

Unit	Unit Title	Hours
12	Autonomous Multirotor Missions (Continued)	35
13	Fixed-Wing Flight	40
14	UAS Capstone Project	65
Total		**140**

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses that should be completed in the following sequence:

1. **Unmanned Aircraft Systems I—Course Code: 235100**
2. **Unmanned Aircraft Systems II—Course Code: 235110**

Course Description: Unmanned Aircraft Systems I
This course covers introductory topics related to UAS. Students will develop effective skills in communication, writing, technology, leadership, and team building within class- and work-related situations. They will demonstrate safe and consistent multirotor flight and equipment use while utilizing UAS flight simulation software. They will research the history and future implementation of UAS, will maintain an official flight log, and will receive an FAA–issued TRUST certification to become eligible to fly an sUAS recreationally. They will investigate the functionality and interaction of aircraft control surfaces while comparing simulated flight experiences among a variety of fixed-wing, multirotor, and VTOL aircraft types. Initially, the software simulator will be used to test their proficiency regarding takeoff, hovering, landing, target landing, flying in designated patterns, and emergency recovery procedures. Then, they will practice real world, manual indoor entry-level multirotor flight including takeoff, hovering, landing, flying in straight lines, box patterns, and figure-eight patterns. Lastly, students will conduct these basic flight patterns while using an outdoor-capable multirotor drone. This course also introduces students to FAA Part 107 regulations where they will discuss the purpose, and the responsibilities of a RPIC. This course also focuses on UAS components, construction, and flight. Students will explore UAS technology and its application within a variety of industries. They will discuss the rules for operating in the vicinity of airports, explore the importance of preflight inspections, and understand the need for remote pilot certification. They will also focus on flight theory while developing an understanding of aerodynamic principles, flight control, and aircraft propulsion. They will analyze the effects of the center of gravity on flight stability and will describe gravitational influences on the four forces of flight. They will demonstrate the use of flight controls to maintain aircraft stability and discover the limitations of airframe performance. They will also develop a research plan to design and build a multirotor sUAS, select appropriate components, assemble the sUAS, program the flight controller and transmitter, integrate the camera system, and perform necessary checks on the power system, battery, and charger. Concentration on UAS technology in both public and private sectors, as well as its relevance to other career clusters will become vital as the students develop their comprehensive student portfolios that they will maintain throughout their academic and professional journey.

Course Description: Unmanned Aircraft Systems II
This course focuses on FAA regulations and procedures for sUAS operations, flight techniques and camera settings for capturing data, data processing software, and concepts relevant to UAS missions. Students will demonstrate their knowledge of safety measures, preflight procedures, emergency procedures, and how to avoid hazardous operations. They will explore the impact that filters and a variety of camera settings have on video footage and then they will apply basic image analysis techniques using image processing software. They will discover the applications of photogrammetry software, investigate the GPS, and understand how GIS are implemented

within various industries. A range of sensors will be explored when collecting data, including some of the following passive or active remote sensing systems: acoustic, EO/IR, hyperspectral, LiDAR, multispectral, radar, and thermal sensors. This course also focuses on the planning, execution, and documentation of sUAS autonomous missions using multirotor systems; fixed-wing aircraft flight; and the planning, execution, and documentation of a flight mission culminating within a capstone project. Students will discuss safety considerations for autonomous mission planning and demonstrate the use of ground station systems, including computer-based and tablet-based systems. They will incorporate mission control software, manage sensor functionality, design mission plans, conduct preflight checks, and perform various autonomous multirotor missions such as survey grids, tower inspections, photography, and videography, based on local industry and community needs. Students will learn and perform preflight and systems checks, including verifying correct movements of flight surfaces, radio system range checks, and airframe and propeller damage inspection. They will demonstrate fixed-wing flight skills using a software simulator and will develop emergency procedures flow charts for recovery from unusual attitudes. Students will research, select, and integrate appropriate sensors and aircraft for their instructor-approved mission, perform the mission, collect data, and process it into a deliverable package. Finally, they will complete a professional digital portfolio which encapsulates the accomplishments that have been completed throughout the UAS program.

Unmanned Aircraft Systems I—Course Code: 235100

Unit	Unit Title	Hours
1	Introduction to UAS and Student Organizations	30
2	UAS Safety Regulations and Operational Policies	10
3	UAS Flight Simulation	55
4	Multirotor Flight	57
5	Introduction to FAA Part 107	25
6	Flight Theory	35
7	UAS Components, Construction, and Flight	60
8	Career Exploration and Preparation	8
Total		**280**

Unmanned Aircraft Systems II—Course Code: 235110

Unit	Unit Title	Hours
9	FAA Part 107 Integration	62
10	Advanced Image Capture and Analysis	45
11	Introduction to Sensors and Data Processing Systems	25
12	Autonomous Multirotor Missions	43
13	Fixed-Wing Flight	40
14	UAS Capstone Project	65
Total		**280**

Career Pathway Outlook

Overview

The unmanned aircraft systems (UAS) pathway covers the broad field of occupations related to data collected by a Federal Aviation Administration (FAA) Part 107 commercially licensed Remote Pilot in Command (RPIC) while conducting both manual and autonomous sUAS flight operations. Students enrolled in this course will utilize software to simulate and practice corrective measures taken during drone flight. They will construct, maintain, and fly drones in a variety of challenging patterns. They will conduct manual and autonomous drone fights in an outdoor setting under the supervision of either their teacher or another licensed drone pilot all while learning about aerospace science, FAA safety regulations, environmental factors, and weather conditions that impact their flight experience. A commercial drone pilot's work environment can involve urban areas, rural agricultural areas, construction sites, industrial facilities, remote wildlife areas, disaster and emergency response sites, film industry settings, corporate or sports events, music festivals, and formal events such as weddings. A UAS pilot's work environment can also vary when inspecting bridges, roads, railways, pipelines, and ecological conservation research sites.

UAS is a science that focuses on the implementation, workflow integration, and safe management of autonomous or manually remote piloted aircraft for a range of flight operations within numerous industrial trades. Commercial drone pilots may start their own businesses in an extensive selection of trades and services that profit from data collection such as aerial photography and videography, mapping and surveying, agriculture and precision farming, emergency services and disaster response, filmmaking and media production, roof inspections, and cleaning services involving drone operation. Careers that require expertise in manipulating data taken from UAS missions include data scientist, data analyst, GIS specialist, operations analyst, photogrammetrist, remote sensing specialist, software engineer, and UAS mapping and surveying technician. According to the U.S. Code of Federal Regulations (CFR)—14 CFR §107.61, specifically—a person must be at least 16 years of age in order to be eligible for a remote pilot certificate with a small, unmanned aircraft systems (sUAS) rating. In order to conduct commercial flight missions, a certificate is issued to remote pilots who have successfully passed the FAA–required Part 107 remote pilot exam titled "Unmanned Aircraft General—Small."

Most careers related to UAS require at least a high school diploma and a commercial drone pilot license, although careers with the highest earning potential—data scientists, engineers, lawyers, photogrammetry specialists, and postsecondary teachers, for example—require advanced degrees. Students can utilize their acquired UAS–related skills and knowledge within educational pathways related to engineering, agriculture, geosciences, video production, law enforcement, and military applications. They can accomplish this by attending some of the two-year and four-year UAS–related postsecondary degree programs available within Mississippi and across the nation.

Needs of the Future Workforce

Data science is the sixth-fastest growing occupation nationally and it experienced a 36% growth rate in 2022, according to the U.S. Bureau of Labor and Statistics. Data science and analysis is

closely associated with UAS regarding the information obtained while implementing drone payloads such as remote sensors and cameras. Other notable occupations within the top twenty fastest growing careers that relate to UAS are as follows: statisticians engaged in remote sensing and data collection, logisticians overseeing inventory management and warehouse inspections, wind turbine service technicians conducting thermal imaging inspections, and solar photovoltaic installers completing site planning and design. Highly skilled UAS operators who employ the use of sensors to collect a variety of numerical and graphical data are prevalent within diverse industries. The needs and patterns of growth shown below in Table 1.1 are connected to a range of occupations that could incorporate UAS operational functions and some occupations listed could be associated with FAA–related UAS regulatory policies as well.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earnings, 2023
Aerospace Engineers	90	100	10	11.1%	$39.80
Agricultural Technicians	210	240	30	14.3%	$20.69
Animal Control Workers	130	140	10	7.7%	$14.60
Anthropologists and Archeologists	30	30	0	0%	$33.69
Architecture and Engineering Occupations	15,820	16,610	790	5%	$38.63
Atmospheric and Space Scientists	70	70	0	0%	$31.80
Audio and Video Equipment Technicians	230	280	50	21.7%	$21.70
Building and Grounds Cleaning and Maintenance Occupations	39,670	47,460	7790	19.6%	$13.06
Career/Technical Education Teachers, Postsecondary	860	870	10	1.2%	$25.06
Cartographers and Photogrammetrists	60	60	0	0%	$30.24
Civil Engineers	2,080	2,140	60	2.9%	$44.87
Construction and Building Inspectors	670	700	30	4.5%	$27.22
Cost Estimators	1,300	1,340	40	3.1%	$31.38
Data Scientists and Mathematical Science	70	70	0	0%	$31.70
Database Administrators and Architects	450	470	20	4.4%	$36.53
Detectives and Criminal Investigators	870	890	20	2.3%	$28.13

Electrical and Electronics Engineering Technicians	850	870	20	2.4%	$28.79
Electrical Engineers	1,260	1,300	40	3.2%	$46.42
Electrical Power-Line Installers and Repairers	2,020	2,130	110	5.4%	$33.14
Electronics Engineers, Except Computer	490	490	0	0%	$44.80
Emergency Management Directors	140	150	10	7.1%	$24.48
Environmental Engineering Technicians	110	140	30	27.3%	$25.13
Environmental Engineers	530	530	0	0%	$35.53
Excavating and Loading Machine and Dragline Operators, Surface Mining	420	430	10	2.4%	$21.83
Farm and Home Management Advisors	90	100	10	11.1%	$35.72
Farmers, Ranchers, and Other Agricultural Managers	6,580	7,160	580	8.8%	$18.66
Farming, Fishing, and Forestry Occupations	10,510	11,040	530	5%	$18.52
Fire Inspectors and Investigators	50	60	10	20%	$23.54
Fish and Game Wardens	50	50	0	0%	$21.96
Forest Fire Inspectors and Prevention Specialists	210	240	30	14.3%	$15.04
Geological and Hydrologic Technicians	140	150	10	7.1%	$29.23
Geoscientists, Except Hydrologists and Geographers	390	390	0	0%	$44.20
Historians	130	130	0	0%	$20.31
Insurance Claims and Policy Processing	1,040	1,160	120	11.5%	$19.17
Lawyers	3,830	4,030	200	5.2%	$48.67
Line Supervisors of Landscaping, Lawn	1,460	1,770	310	21.2%	$22.46
Media and Communication Workers	70	70	0	0%	$30.25

Private Detectives and Investigators	140	150	10	7.1%	$18.99
Producers and Directors	280	290	10	3.6%	$29.21
Property Appraisers and Assessors	590	600	10	1.7%	$22.20
Property, Real Estate, and Community	3,470	3,700	230	6.6%	$22.17
Roofers	620	660	40	6.5%	$17.17
Sales and Related Occupations	118,910	125,090	6180	5.2%	$16.74
Service Unit Operators, Oil, Gas, and Mining	140	190	50	35.7%	$26.99
Soil and Plant Scientists	130	130	0	0%	$42.59
Surveying and Mapping Technicians	640	690	50	7.8%	$22.06
Surveyors	430	440	10	2.3%	$26.16
Urban and Regional Planners	170	200	30	17.6%	$31.97

Source: Mississippi Department of Employment Security; mdes.ms.gov (2023).

Perkins V Requirements and Academic Infusion

The unmanned aircraft systems curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in UAS-related fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for UAS careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The UAS educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several in Mississippi that will foster the types of learning expected from the UAS curriculum. SkillsUSA and the Technology Student Association (TSA) are examples of such organizations with many outlets for UAS students. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of UAS–related careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the UAS curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The UAS curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the UAS curriculum that will allow and encourage collaboration with professionals currently in the UAS field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the UAS classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and UAS professionals. Thus, supervised collaboration and immersion into UAS around the students are keys to student success in knowledge and skills development.

Professional Organizations

Association for Career and Technical Education (ACTE)
acteonline.org

Airborne International Response Team (AIRT) DRONERESPONDERS
droneresponders.org

Academy of Model Aeronautics (AMA)
modelaircraft.org

Airborne Public Safety Association (APSA)
publicsafetyaviation.org

The National Association for Amateur Radio (ARRL)
arrl.org

American Society for Testing and Materials (ASTM)
astm.org

Association for Uncrewed Vehicle Systems International (AUVSI)
auvsi.org

Civil Air Patrol (CAP)
gocivilairpatrol.com

Commercial Drone Alliance (CDA)
commercialdronealliance.org

Energy Drone and Robotics Coalition (EDR Coalition)
edrcoalition.com

Federal Aviation Administration (FAA)
faa.gov/uas

First-Person View Freedom Coalition (FPVFC)
fpvfc.org

Flite Test Community Association (FTCA)
ftca.flitetest.com

Mississippi Association for Spatial Technologies (MAST)
mastgis.org

Radio Technical Commission for Aeronautics (RTCA)
rtca.org

SkillsUSA
skillsusa.org

STEM+C Creative Aeronautics (STEM+C)
stemplusc.org

Technology Student Association (TSA)
tsaweb.org

Unmanned Safety Institute (USI)
flyusi.org

Women and Drones
womenanddrones.com

Women in Aviation International (WAI)
wai.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences of students. If the unmanned aircraft systems program is using a national certification, work-based learning, or another measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Introduction to UAS and Student Organizations

Competencies and Suggested Objectives
1. Discuss the benefits of participating in a program area student organization related to unmanned aircraft systems (UAS) technology, such as a community-based organization (CBO) (i.e., Academy of Model Aeronautics [AMA]). DOK1 a. Explore various student organization competitions. b. Describe competition skills or tasks needed to successfully prepare for a competition. c. Participate in a student organization competition. d. Perform the tasks required to complete an assignment for a student competition.
2. Establish and charter a CBO and participate in club programming and educational programs. DOK4
3. Explore opportunities provided by student organizations (i.e., Technology Student Association [TSA], SkillsUSA). DOK2 a. Identify leadership and personal development skills. b. Work as a team to design a community service project for which the knowledge and skills learned in the course can be used to improve the lives of others.
4. Demonstrate effective communication skills in career development. DOK3 a. Demonstrate and describe the importance of effective communication skills, including verbal, nonverbal, writing, and technological communication skills. b. Apply appropriate speaking and listening skills to class- and work-related situations.
5. Demonstrate leadership- and team-building skills in class- and work-related situations. DOK3 a. Define leadership and team building. b. Discuss the attributes of a high-quality leader and teamwork. c. Identify the roles of a leader.
6. Explore the history, development, and future of UAS. DOK1 a. Define terms associated with UAS and operation. • Advisory circulars (AC) • Aeronautical • Aircraft • Airspace • Airspace restrictions • Applicable AC and regulations related to commercial use (i.e., 14 CFR § 107 and 135, or current law) • Applicable AC and regulations related to recreational use (i.e., 14 CFR § 48, or current law) • Aviation • Civil twilight • Drone • Federal Aviation Administration (FAA) • FAA Part 107 (14 CFR § 107) • FAR (Federal Aviation Regulations)

- Fixed wing aircraft
- Hover
- Manned aircraft
- Multirotor aircraft
- National airspace system (NAS)
- Restricted airspace
- Rotary-wing aircraft
- Small unmanned aircraft systems (sUAS)
- UAS
- Unmanned aerial vehicle (UAV)
- Unmanned aircraft
- Vertical takeoff and landing aircraft (VTOL)
- Waiver

b. Research and discuss the history and evolution of UAS.
c. Discuss the current state of the UAS industry.
d. Research possibilities for future developments in the UAS industry.

7. Compare and contrast the common configurations of rotary- and fixed-wing UAS. DOK2
   a. Identify common rotary aircraft configurations, including single-rotor, tri-rotor, quad-rotor, hex-rotor, and octo-rotor aircraft.
   b. Explain the purpose of each of the types of rotary aircraft configurations.
   c. Identify fixed-wing aircraft configurations.
   d. Explain the purpose of fixed-wing aircraft.
   e. Discuss applications and describe possible missions for both rotary- and fixed-wing aircraft, discussing the advantages and disadvantages of each.
8. Develop and maintain an official flight log to record hours of flight and simulation experience. DOK3
9. Complete any necessary steps required by the FAA or other organizations to become eligible to fly a UAS recreationally (i.e., The Recreational UAS Safety Test [TRUST] or other current requirements). DOK4

Note: An routinely updated list of FAA–recognized CBOs can be found online at this website: faa.gov/uas/recreationalfliers/faa-recognized-community-based-organizations

Unit 2: UAS Safety Regulations and Operational Policies

Competencies and Suggested Objectives
1. Demonstrate an understanding of safety guidelines and operational rules related to unmanned aircraft system (UAS) operation and use. DOK3 a. Using Federal Aviation Administration (FAA) guidelines, define the types of UAS aircraft (i.e., governmental, civil operations, model aircraft, etc.). b. Explain safety guidelines regarding the operation and use for each type of drone. c. Describe basic safety regarding the use of batteries in a UAS. d. Describe the effects of weather conditions on safe UAS operation. e. Discuss the risks of flying a UAS. f. Relate ethical flight operation to safely operating a UAS.
2. Investigate and formulate your understanding of community standards for recreational and hobby aircraft used in education as set by the community-based organization (CBO) (i.e., Academy of Model Aeronautics [AMA], etc.). DOK3 a. Explain why there are community standards. b. Compare the differences between a community standard and regulation or law. c. Review the applicable CBO guidelines for operating model aircraft or small unmanned aircraft systems (sUAS) and complete the CBO sUAS information and safety course or equivalent course, if available.
3. Explain the concept of airspace and how it defines where a UAS can be flown. DOK3 a. Identify altitude, speed, and weather restrictions as described in the FAA Part 107 guidelines. b. Identify and describe the types of airspace where UAS operation is prohibited without proper waivers or approvals in place. • Class A, B, C, D, or E airspace • Within restricted airspace • Temporary flight restrictions (TFRs) (i.e., sporting events, etc.) • Restricted and prohibited areas • Other areas by Notice to Air Missions (NOTAM) c. Investigate a UAS flight plan using the appropriate airspace application or other current applications that include Low Altitude Authorization and Notification Capability (LAANC) authorization available online or via mobile electronic device.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.
Note: Material from this unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 3: UAS Flight Simulation

Competencies and Suggested Objectives
1. Demonstrate proficiency in operating equipment used in unmanned aircraft systems (UAS) flight. DOK3 a. Define and discuss terms associated with flight simulation. • Radio transmitter/controller • Toggle switches • Trim buttons • Variable sliders • Display/camera views • Environmental conditions • Aircraft selection
2. Describe functions of aircraft control surfaces and how they are used to fly. DOK4 a. Identify the throttle, rudder, elevator, aileron, flaps, and any combination of those surfaces and their respective functions in flight.
3. Compare UAS aircraft types by initial simulated flight experience. DOK2 a. Complete a fixed-wing flight simulation and describe the experience. b. Complete a multirotor flight simulation and describe the experience. c. Complete a vertical takeoff and landing (VTOL) flight simulation and describe the experience. d. Relate aircraft flight characteristics to where each can be used.
4. Recall safety guidelines for operation of the various types of UAS. DOK1 a. Differentiate between the consequences of unsafe actions in simulation flight versus actions in real flight.
5. Demonstrate safe, consistent multirotor flight through a simulation practical test. DOK3 a. Takeoff and hover for a set period time in a fixed area and land. b. Land on a designated target. c. Fly a straight line to and from a destination in a tail-in orientation. d. Fly a straight line to a destination in a tail-in orientation and return in a nose-in orientation. e. Fly left and right box patterns. f. Fly a figure-eight pattern in both a nose-in and nose-out orientation. g. Emergency recovery procedures and maneuvers.

Unit 4: Multirotor Flight

Competencies and Suggested Objectives
1. Identify and describe parts of a multirotor drone and discuss how each part interacts. DOK4 a. Explain and describe the following parts for identification and preflight check purposes: • Aircraft orientation markers • Battery system • Charging system • Chassis/frame • Electronic Speed Controller (ESC) • Flight controller • Global Positioning System (GPS) • Landing gear • Motors • Propeller • Receiver • Telemetry b. Discuss the function of each part and how it affects the multirotor drone in various ways.
2. Demonstrate manual indoor entry-level multirotor flight practice. DOK3 a. Take off and hover for a set period time in a fixed area and land. b. Land on a designated target. c. Fly a straight line to and from a destination in a tail-in orientation. d. Fly a straight line to a destination in a tail-in orientation and return in a nose-in orientation. e. Fly left and right box patterns. f. Fly a figure-eight pattern in both a nose-in and nose-out orientation.
3. Conduct basic flight patterns with an outdoor capable multirotor. DOK3

Note: Reinforced throughout any unit requiring students to fly is test material directly relating to the *Unmanned Aircraft General (UAG)—Small* test which requires a passing score to be compliant with the Federal Aviation Administration (FAA) Part 107 Remote Pilot Certification regulations.

Unit 5: Introduction to FAA Part 107

Competencies and Suggested Objectives

1. Discuss the purpose of Federal Aviation Administration (FAA) Part 107. DOK1
   a. Describe the responsibilities of a Remote Pilot in Command (RPIC).
   b. Explain why FAA is the airspace authority for Part 107.
2. Explain the operating rules for small unmanned aircraft systems (sUAS). DOK3
   a. Define terms associated with the operation of sUAS.
      - Air traffic
      - Air traffic control
      - Airport authority
      - Airport control tower
      - Airspace
      - Carriage
      - Categories 1 - 4
      - Chartered club (i.e., Academy of Model Aeronautics [AMA], etc.)
      - Civil aircraft
      - Civil twilight
      - Class A airspace
      - Class B airspace
      - Class C airspace
      - Class D airspace
      - Class E airspace
      - Class G airspace
      - Commercial aircraft
      - FAA–Recognized Identification Areas (FRIAs)
      - Hazardous material
      - Knots
      - Nautical mile
      - Nighttime flight
      - Preflight inspection
      - Prohibitions
      - Radio frequency line of sight
      - Remote identification
      - Visual line of sight (VLOS)
   b. Describe the operating limits for sUAS (e.g., less than 400 ft, 87 knots/100 mph).
   c. List prohibitions for operating sUAS.
      - Operation from a moving vehicle or aircraft
      - Alcohol or drugs
      - Beyond visual line-of-sight (BVLOS)
      - Multiple sUAS
      - Carriage of hazardous material
      - Operation near aircraft and over human beings

- Less than 55 lbs

d. Discuss the rules for operating unmanned aircraft in the vicinity of an airport.
   - Prohibited in flying in Class B, C, D, or E airspace without flight authorization (i.e., Low Altitude Authorization and Notification Capability [LAANC], etc.).
   - Advisement of airport authority or air traffic control tower of intent to operate.
   - Not operating in any manner that is hazardous to air traffic at any airport.
e. Explain the importance of a preflight inspection prior to operating an unmanned aircraft.
f. Describe weather and cloud clearance requirements for flight.
g. Describe any other hazardous operations as they apply to UAS flight.
h. Explain the need for sUAS remote pilot certification.
   - Who should obtain FAA Part 107 Remote Pilot Certificate?
   - Responsibilities of a certified FAA Part 107 remote pilot.

Note: It is the responsibility of the teacher and student to ensure that all competencies of the most current topics in the FAA Part 107 Remote Pilot Certification test, titled *Unmanned Aircraft General (UAG)—Small*, are covered and mastered before taking the assessment. FAA Part 107 material listed throughout this curriculum is not completely exhaustive.

Unit 6: Flight Theory

Competencies and Suggested Objectives

1. Develop and apply an understanding of the concepts involved in aerodynamics, flight control, and aircraft propulsion. DOK4
   a. Define terms associated with flight theory.
      - Aerodynamics
      - Airspeed
      - Altitude
      - Angle of attack
      - Bernoulli's principle
      - Center of gravity
      - Drag
      - Flight stability
      - Lift
      - Pitch
      - Propulsion
      - Roll
      - Stall
      - Throttle
      - Thrust
      - Weight
      - Yaw
   b. Explain phenomena in terms of principles of aerodynamics and flight control.
      - Aerodynamic forces and their effect on flight (i.e., lift, weight, thrust, drag, etc.)
      - Bernoulli's principle
   c. Cite examples and provide diagrams to explain how the location of the center of gravity affects flight stability.
2. Explain the influences on the four forces of flight. DOK3
   a. Describe how wing type and design influence lift (i.e., airfoil, etc.).
   b. Demonstrate how the weight of an unmanned aerial vehicle (UAV) affects the time that it can remain airborne.
   c. Describe how the stability and safety of a UAV is affected by thrust.
   d. Demonstrate how the drag of a UAV affects operation during flight.
3. Demonstrate the use of flight controls to maintain aircraft stability and flight operation. DOK3
   a. Describe and demonstrate the use of the four main control channels (i.e., throttle, roll, pitch, and yaw).
   b. Identify directional movements relative to flight surfaces in Mode 2 (i.e., parts of the aircraft, etc.).
   c. Describe the limitations of airframe on performance (i.e., weight, power, airspeed, etc.).
   d. Discuss the compatibility of power systems used in unmanned aircraft system (UAS) flight (i.e., electrical vs. fuel).

4. Analyze multiple real-world examples that demonstrate the concepts of the four forces of flight (i.e., vintage aircraft [drag], aerobatic aircraft [thrust], electrical vs. fuel, etc.). DOK3

Unit 7: UAS Components, Construction, and Flight

Competencies and Suggested Objectives
1. Demonstrate the safe use of tools needed to construct a small, unmanned aircraft system (sUAS). DOK3 a. Identify the proper tools needed for multirotor construction. b. Demonstrate the safe use of tools used in multirotor construction.
2. Discuss basic flight theory and physical science as it applies to sUAS operation. DOK2 a. Describe an aircraft's payload effects on flight performance. b. Determine motor and electrical system requirements, including battery, propeller selection, and propeller pitch angle.
3. Assemble an sUAS under 60 grams (i.e., Tiny Whoop, etc.). DOK4 a. Develop a research plan to design and build a multirotor. b. Select the appropriate frame and components, including propellers, motor, flight controllers, and live view camera systems. c. Use the principles of the scientific method to build and test the operation of the multirotor and flight controller. • Install the selected flight controller. • Program the flight controller and transmitter. • Flight tune the multirotor. • Integrate, connect, and test the live view camera system, including the monitor. • Check the power system, battery, and charger systems.

Note: Reinforced throughout any unit requiring students to fly is test material directly relating to the *Unmanned Aircraft General (UAG)—Small* test which requires a passing score to be compliant with the Federal Aviation Administration (FAA) Part 107 Remote Pilot Certification regulations.

Unit 8: Career Exploration and Preparation

Competencies and Suggested Objectives
1. Investigate the use and application of unmanned aircraft system (UAS) technology in various industries. DOK4 a. Research and describe how UAS technology is used in the public and private sector. b. Explore how UAS technology is applicable to other career clusters.
2. Develop a student portfolio consisting of various elements that will enhance students' future careers and educational opportunities. DOK4 a. Create and maintain a portfolio, preferably electronic, consisting of at least the following elements: • Certifications • Documented work, flight experience, and flight hours • Important assignments or tasks • Portfolio of work • Professional references • Résumé b. Discuss why documentation of hours, experience, and professional work is important for the students' success. c. Discuss how to maintain and use this portfolio as this UAS program continues and as future career or educational opportunities arise.

Unit 9: FAA Part 107 Integration

Competencies and Suggested Objectives

1. Investigate and apply the concepts found within each Federal Aviation Administration (FAA) Part 107 category. DOK4
   a. Identify and analyze FAA regulations and procedures for small, unmanned aircraft system (sUAS) operations (i.e., limitations, registration, remote pilot certificate sUAS–rating privileges, waiver requirements, etc.)
   b. Classify and differentiate among categories, classes, and types of airspace in the National Airspace System (NAS).
   c. Demonstrate knowledge and best practices of navigation.
      - Calculate and connect the concepts of distance, speed, and headings.
      - Differentiate among and analyze critical elements of charts and maps.
   d. Investigate and explain the need for airport and off-airport operations and communication protocols.
   e. Discuss the importance of concepts related to aeronautical decision making and judgement (i.e., problem solving, risk management, and situational awareness, etc.).
   f. Recognize and apply best practices regarding crew resource management and radio communication procedures.
   g. Discuss and analyze various weather conditions that affect sUAS operations.
      - General weather theory (i.e., temperature, precipitation, visibility, cloud types, and wind conditions, etc.)
      - Identify aviation weather information sources (i.e., automated weather observing systems (AWOS), automated surface observing systems (ASOS), etc.).
      - Discuss the effects that weather can have on small, unmanned aircraft performance.
   h. Make observations regarding aircraft performance.
   i. Describe and demonstrate best practices regarding emergency procedures.
   j. Identify and evaluate an understanding of human factors as they relate to sUAS. (i.e., fatigue, stress, and workload).
   k. Demonstrate and apply maintenance and preflight inspection procedures.
2. Demonstrate proficiency in evaluating the airspace of the practice area. DOK3
   a. Identify a local airspace's features and its proximity to airports or heliports using the appropriate application or tool (i.e., FAA's B4UFly application, etc.).
   b. Contact required outside agencies prior to flight (i.e., airport operator, control tower, etc.).
3. Demonstrate compliance and understanding of FAA flight regulations. DOK3
   a. During flight, demonstrate appropriate safety measures.
   b. In preparing for flight, demonstrate proper preflight procedures.
   c. Demonstrate an understanding of emergency procedures during flight.
   d. Explain drug and alcohol restrictions for a pilot and flight crew.
   e. Review restrictions on hazardous operation and operation of unmanned aircraft systems (UAS) from a moving vehicle.
   f. Review line-of-site requirements.

Note: It is the responsibility of the teacher and student to ensure that all competencies of the most current topics in the FAA Part 107 Remote Pilot Certification test, titled *Unmanned Aircraft General (UAG)—Small*, are covered and mastered before taking the assessment. FAA Part 107 material listed throughout this curriculum is not completely exhaustive.

Unit 10: Advanced Image Capture and Analysis

Competencies and Suggested Objectives
1. Explore and make observations regarding the various uses for capturing data with unmanned aircraft systems (UAS) technology in the industry. DOK2
2. Demonstrate and critique flight techniques for capturing data. DOK4 a. Identify and make observations about image overlap. b. Compare and contrast distance vs. timed exposure when capturing images over a timed interval.
3. Identify and analyze camera settings. DOK4 a. Define saturation in terms of capturing imagery. b. Discuss and investigate the following camera settings: • Aperture • Exposure • Field of view • Frames per second (fps) • ISO sensitivity • Resolution • Shutter speed • White balance c. Discuss and compare how various filters affect video footage.
4. Discuss and apply concepts related to basic image analysis techniques using image processing software. DOK4

Note: Reinforced throughout any unit requiring students to fly is test material directly relating to the *Unmanned Aircraft General (UAG)—Small* test which requires a passing score to be compliant with the Federal Aviation Administration (FAA) Part 107 Remote Pilot Certification regulations.

Unit 11: Introduction to Sensors and Data Processing Systems

Competencies and Suggested Objectives
1. Explain basic data processing software and concepts as it applies to unmanned aircraft system (UAS) missions. DOK2 a. Define terms and explain concepts related to data processing software. • 3D model • Cloud-based utilization • Commercial post-processing software • Continually operating reference station (CORS) • Data Management • Data processing • Digital surface model (DSM) • Geographic information system (GIS) • Global Positioning System (GPS) • Ground control point (GCP) • Normalized Difference Vegetation Index (NDVI) • Oblique vs. nadir sensor angle • Open-source software • Orthomosaic model • Photogrammetry • Post-processing kinematic (PPK) • Real-time kinematic (RTK) • Telemetry b. Show how photogrammetry software can be used in UAS data collection.
2. Explain the purpose and benefits of the GPS. DOK2 a. Define terms associated with GPS (layer, elevation, latitude, longitude). b. Describe the purpose of GPS. c. Discuss how satellites are used in GPS networks. d. Demonstrate how to identify a geographic location. e. Discuss the accuracy and security aspects of GPS. f. Identify the GPS coordinates at your local flight field and other nearby locations using various applications, including Google Earth, ArcGIS Online, QGIS, or other software and related systems.
3. Analyze and discuss GIS tools and technologies. DOK4 a. Identify practical uses for GIS implementation. b. Explore map projections and coordinate systems. c. Apply online mapping techniques. d. Research, identify, and describe various sensors that would be used to collect data for GIS implementation. e. Investigate and explain how GIS are used in various industries.

f. Access geographic information specific to the local area and be able to explain the benefit of that information (i.e., Mississippi Automated Resource Information System [MARIS], etc.)

4. Explain the basic concepts of remote sensing and identify common sensors used with UAS. DOK2

   a. Compare and contrast passive versus active remote sensing systems.

      Passive remote sensing systems:

      - Electro-optical/infrared (EO/IR) - Red, green, blue (RGB) and infrared (IR) sensors for multiple band analysis
      - Hyperspectral
      - Multispectral
      - RGB cameras
      - Thermal
      - Visible and near infrared light (VNIR)

      Active remote sensing systems:

      - Acoustic
      - Laser spectroscopy
      - Light detection and ranging (LiDAR)
      - Radar

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Unit 12: Autonomous Multirotor Missions

Competencies and Suggested Objectives
1. Discuss and justify autonomous mission planning safety considerations. DOK3
2. Demonstrate the use of ground station systems. DOK3 a. Operate computer-based systems. b. Operate tablet-based systems.
3. Incorporate mission control computer software and related systems into a small, unmanned aircraft system (sUAS) flight mission. DOK3 a. Manage the functionality of the sensors. b. Design a mission plan involving mission control software. c. Conduct a preflight aircraft and systems check.
4. Perform multiple autonomous multirotor missions. DOK4 a. Fly a variety of autonomous multirotor missions that tailor to the needs and desires of both the local industry and the surrounding community (i.e., survey grids, tower inspections, photography, videography, etc.).

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Unit 13: Fixed-Wing Flight

Competencies and Suggested Objectives
1. Complete the steps for a preflight and systems check of an aircraft to be flown. DOK2 a. Check voltage of power system. b. Check flight surfaces for correct movements. c. Perform a range check of the radio system. d. Inspect the airframe and propellers for damage.
2. Demonstrate fixed-wing flight skills via simulation with the pilot at a fixed position. DOK2 a. Taxi to takeoff position. b. Take off. c. Climb to a predetermined flight altitude. d. Perform left- and right-banked turns while maintaining the current altitude. e. Perform landing approaches without landing (i.e., touch-and-go landing [TGL]). f. Perform a successful landing on a runway surface.
3. Formulate and construct an emergency procedures flow chart and plan for recovery from unusual attitudes (e.g., angle of attack, leaning, inverted, etc.). DOK3 a. Determine the orientation of the aircraft. b. Apply appropriate control inputs to return the aircraft to level and controlled flight.
4. Assess flight dynamics based on vehicle loading. DOK3 a. Calculate maximum takeoff weight (MTOW) including any added payloads. b. Weigh aircraft to ensure MTOW is not exceeded. c. Determine if the aircraft is set up with the proper center of gravity location.

Enrichment
1. Design and execute a preprogrammed autonomous fixed-winged flight mission. a. Ensure that the mission does not exceed flight time limitations of the aircraft. b. Set the mission speed and altitude of the aircraft. c. Understand sensor trigger for geotagging. d. Ensure the mission heading aligns appropriately with the prevailing wind direction. e. Launch the mission. f. Program the home location or alternate landing zone location.

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Unit 14: UAS Capstone Project

Competencies and Suggested Objectives
1. Plan an instructor approved flight mission. DOK2
2. Research, select, and integrate the appropriate sensor(s) and aircraft for the mission. DOK4
3. Perform and fully execute an instructor-approved mission type of your choice and then collect associated data (e.g., site survey, structure scan, crop or vegetation scan, etc.). DOK4
4. Process data into a deliverable package. DOK4
5. Conduct a third-party review of the final report (i.e., unassociated school faculty member, local industry partner, etc.). DOK4
6. Completion of digital portfolio. DOK4

Suggested Capstone Ideas
1. Augment the capstone project by correlating one or more small, unmanned aircraft system (sUAS)–related concepts across curricular boundaries, including either academic courses or other career and technical education (CTE) pathways within the school district. DOK4 a. Build a functional vertical takeoff and landing (VTOL) sUAS and perform a mission. b. Build a functional multirotor and perform an autonomous mission. c. Explore sensor applications to various data products. d. Create a professional deliverable derived from an available dataset (i.e., private sector, public sector partners, etc.).

Enrichment
1. If applicable, incorporate community or industry representatives into the project.

Note: Reinforced throughout any unit requiring students to fly is test material directly relating to the *Unmanned Aircraft General (UAG)—Small* test which requires a passing score to be compliant with the Federal Aviation Administration (FAA) Part 107 Remote Pilot Certification regulations.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to UAS and Student Organizations		
	1.	Discuss the benefits of participating in a program area student organization related to unmanned aircraft systems (UAS) technology, such as a community-based organization (CBO) (i.e., Academy of Model Aeronautics [AMA], etc.).
	2.	Establish and charter a CBO and participate in club programming and educational programs.
	3.	Explore opportunities provided by student organizations (i.e., Technology Student Association [TSA], SkillsUSA).
	4.	Demonstrate effective communications skills in career development.
	5.	Demonstrate leadership- and team-building skills in class- and work-related situations.
	6.	Explore the history, development, and future of UAS.
	7.	Compare and contrast the common configurations of rotary- and fixed-wing UAS.
	8.	Develop and maintain an official flight log to record hours of flight and simulation experience.
	9.	Complete any necessary steps required by the Federal Aviation Administration (FAA) or other organizations to become eligible to fly a UAS recreationally (i.e., The Recreational UAS Safety Test [TRUST] or current requirements).
Unit 2: UAS Safety Regulations and Operational Policies		
	1.	Demonstrate an understanding of safety guidelines and operational rules related to UAS operation and use.
	2.	Investigate and formulate your understanding of community standards for recreational and hobby aircraft used in education as set by the CBO (i.e., AMA, etc.).
	3.	Explain the concept of airspace and how it defines where a UAS can be flown.
Unit 3: UAS Flight Simulation		
	1.	Demonstrate proficiency in operating equipment used in UAS flight.
	2.	Describe functions of aircraft control surfaces and how they are used to fly.
	3.	Compare UAS aircraft types by initial simulated flight experience.
	4.	Recall safety guidelines for the operation of the various types of UAS.

	5.	Demonstrate safe, consistent multirotor flight through a simulation practical test.
Unit 4: Multirotor Flight		
	1.	Identify and describe parts of a multirotor drone and discuss how each part interacts.
	2.	Demonstrate manual indoor entry-level multirotor flight practice.
	3.	Conduct basic flight patterns with an outdoor capable multirotor.
Unit 5: Introduction to FAA Part 107		
	1.	Discuss the purpose of FAA Part 107.
	2.	Explain the operating rules for small unmanned aircraft systems (sUAS).
Unit 6: Flight Theory		
	1.	Develop and apply an understanding of the concepts involved in aerodynamics, flight control, and aircraft propulsion.
	2.	Explain the influences on the four forces of flight.
	3.	Demonstrate the use of flight controls to maintain aircraft stability and flight operation.
	4.	Analyze multiple real-world examples that demonstrate the concepts of the four forces of flight (i.e., vintage aircraft [drag], aerobatic aircraft [thrust], electrical vs. fuel, etc.).
Unit 7: UAS Components, Construction, and Flight		
	1.	Demonstrate the safe use of tools needed to construct an sUAS.
	2.	Discuss basic flight theory and physical science as it applies to sUAS operation.
	3.	Assemble an sUAS under 60 grams (i.e., Tiny Whoop, etc.).
Unit 8: Career Exploration and Preparation		
	1.	Investigate the use and application of UAS technology in various industries.
	2.	Develop a student portfolio consisting of various elements that will enhance students' future careers and educational opportunities.
Unit 9: FAA Part 107 Integration		
	1.	Investigate and apply the concepts found within each FAA Part 107 category.
	2.	Demonstrate proficiency in evaluating the airspace of the practice area.
	3.	Demonstrate compliance and understanding of FAA flight regulations.
Unit 10: Advanced Image Capture and Analysis		
	1.	Explore and make observations regarding the various uses for capturing data with UAS technology in the industry.
	2.	Demonstrate and critique flight techniques for capturing data.
	3.	Identify and analyze camera settings.
	4.	Discuss and apply concepts related to basic image analysis techniques using image processing software.
Unit 11: Introduction to Sensors and Data Processing Systems		

	1.	Explain basic data processing software and concepts as it applies to UAS missions.
	2.	Explain the purpose and benefits of the Global Positioning System (GPS).
	3.	Analyze and discuss geographic information systems (GIS) tools and technologies.
	4.	Explain the basic concepts of remote sensing and identify common sensors used with UAS.
Unit 12: Autonomous Multirotor Missions		
	1.	Discuss and justify autonomous mission planning safety considerations.
	2.	Demonstrate the use of ground station systems.
	3.	Incorporate mission control computer software and related systems into an sUAS flight mission.
	4.	Perform multiple autonomous multirotor missions.
Unit 13: Fixed-Wing Flight		
	1.	Complete the steps for a preflight and systems check of an aircraft to be flown.
	2.	Demonstrate fixed-wing flight skills via simulation with the pilot at a fixed position.
	3.	Formulate and construct an emergency procedures flow chart and plan for recovery from unusual attitudes (e.g., angle of attack, leaning, inverted, etc.).
	4.	Assess flight dynamics based on vehicle loading.
Unit 14: UAS Capstone Project		
	1.	Plan an instructor approved flight mission.
	2.	Research, select, and integrate the appropriate sensor(s) and aircraft for the mission.
	3.	Perform and fully execute an instructor-approved mission type of your choice and then collect associated data (e.g., site survey, structure scan, crop or vegetation scan, etc.).
	4.	Process data into a deliverable package.
	5.	Conduct a third-party review of the final report (i.e., unassociated school faculty member, local industry partner, etc.).
	6.	Completion of digital portfolio.

Appendix A: Industry Standards

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Standards															
Subpart A															
§107.1			X			X				X					
§107.2						X				X					
§107.3		X	X	X	X	X	X	X	X	X			X	X	X
§107.5		X	X			X				X					
§107.7		X	X	X	X	X	X	X	X	X	X	X	X	X	X
§107.9			X	X		X	X			X					
Subpart B															
§107.11			X			X				X					
§107.12		X	X	X	X	X	X	X	X	X			X	X	X
§107.13			X			X		X		X			X	X	X
§107.15			X		X	X		X		X			X	X	X
§107.17						X				X			X		X
§107.19		X	X	X	X	X	X	X	X	X			X	X	X
§107.21						X		X		X			X	X	X
§107.23						X				X				X	
§107.25						X				X				X	
§107.27						X		X		X			X	X	X
§107.29		X	X	X		X	X			X					
§107.31		X	X	X		X	X	X		X			X	X	X
§107.33		X	X			X		X		X		X	X	X	X
§107.35				X		X		X		X			X	X	X
§107.36						X				X					
§107.37						X				X				X	
§107.39			X			X				X				X	
§107.41		X	X			X				X				X	
§107.43						X				X					
§107.45			X			X				X				X	
§107.47			X			X		X		X			X	X	X
§107.49		X	X	X	X	X	X	X		X			X	X	X
§107.51			X	X		X	X	X		X			X	X	X
Subpart C															
§107.52						X				X					
§107.53				X		X				X			X		
§107.56		X	X	X	X	X	X	X	X	X			X		
§107.57		X	X	X	X	X	X	X	X	X			X	X	
§107.59		X	X	X	X	X	X	X	X	X			X		
§107.61		X	X	X	X	X	X	X	X	X			X	X	X
§107.63		X	X	X	X	X	X	X	X	X			X	X	X
§107.64		X	X	X	X	X	X	X	X	X			X		X
§107.65		X	X	X	X	X	X	X	X	X				X	X
§107.67						X				X					
§107.69			X			X				X					
§107.71						X				X					
§107.73		X	X	X	X	X		X		X			X	X	X
§107.74			X	X		X		X		X			X	X	X
§107.77		X	X	X	X	X	X	X	X	X			X	X	
§107.79		X	X	X	X	X	X	X	X	X			X		
Subpart D															
§107.100			X			X				X				X	
§107.105						X				X					
§107.110						X		X		X			X	X	X
§107.115						X		X		X			X	X	X
§107.120		X	X	X	X	X	X	X		X					
§107.125			X			X		X		X			X	X	X
§107.130		X	X	X	X	X	X	X		X					
§107.135						X				X					

§107.140		X	X	X	X	X	X	X	X	X	X		X	X	X
§107.145		X	X			X		X		X			X	X	X
§107.150		X		X		X				X					
§107.155		X	X	X		X				X	X		X	X	
§107.160		X	X	X		X	X			X	X	X	X	X	X
§107.165		X				X				X				X	X
Subpart E															
§107.200		X	X	X	X	X	X	X	X	X			X		
§107.205		X	X			X				X				X	

Part 107 - Small Unmanned Aircraft Systems
Code of Federal Regulations (CFR) - Title 14 (Aeronautics and Space), Chapter I (Federal Aviation Administration, Department of Transportation), Subchapter F (Air Traffic and General Operating Rules)

Authority: 49 U.S.C. 106f., 40101 note, 40103b., 44701a.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.

1. 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.
2. [Amdt. No. 107–8, 86 FR 4381, Jan. 15, 2021]

§ 107.3 Definitions.

1. 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:
2. *Control station* means an interface used by the remote pilot to control the flight path of the small unmanned aircraft.
3. *Corrective lenses* means spectacles or contact lenses.
4. *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.

5. *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.
6. *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.
7. *Unmanned aircraft* means an aircraft operated without the possibility of direct human intervention from within or on the aircraft.
8. *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 § 107.67b.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.

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 § 91.203a.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, § 107.120a., § 107.130a., 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 § 91.17a. or § 91.19a. 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 § 91.17c. of this chapter, or

a refusal to furnish or authorize the release of the test results requested by the Administrator in accordance with § 91.17c. 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. 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 § 107.39a. and b..

§ 107.105 Limitations on operations over human beings.

Except as provided in §§ 107.39a. 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 § 89.115a. 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 § 107.120a.;
   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 § 107.120b.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 § 89.115a. 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 § 107.130a.;
    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 § 107.130b.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 § 89.115a. 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 § 107.120a. for operations in Category 2, or the requirements of § 107.130a. 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 § 107.120a. for operations in Category 2 or the requirements of § 107.130a. 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 § 107.120a. for operations in Category 2 or the requirements of § 107.130a. 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 § 107.120a. or § 107.130a. or both;
9. A declaration that the applicant—
    i. Has demonstrated that the small unmanned aircraft, or specific configurations of that aircraft, satisfies § 107.120a. or § 107.130a. 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 § 107.120b.3. or § 107.130b.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 § 107.120a. or § 107.130a.;
        ii. The FAA finds a declaration of compliance is in violation of § 107.5a.; 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. 46105c. 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 §§ 107.120a., for operations in Category 2, and 107.130a., 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

§§ 107.120a., for operations in Category 2, and 107.130a., 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 107.29a.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 107.37a.—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]