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Unmanned Aircraft System Regulation Review

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Final Report

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15. Supplementary Notes <p>This study was completed in March 2007. On February 6, 2007, the Federal Aviation Administration (FAA) issued a notice in the Federal Register clarifying that an unmanned aircraft system falls in the definition of aircraft. Also, on March 13, 2008, the FAA issued Interim Operational Approval Guidance 08-01 to replace Policy Memorandum 05-01, which is referenced in this report.</p>					
16. Abstract <p>A top-level review on the applicability of Title 14 Code of Federal Regulation (CFR) to unmanned aircraft systems (UAS) operating in the National Airspace System (NAS) was conducted under this research effort. The goal of this review was to systematically examine the relevant federal regulations, statutes, orders, and policies to identify the known issues resulting from the rapid growth of UAS technology.</p> <p>The review went through sections of 14 CFR to assess their applicability to UAS operating in the NAS based on their face values, i.e. not the intent of the rule, rather a direct understanding of the text. The review results were categorized into four levels: Clearly Apply, May Apply by Interpretation, Does not Apply, and Could Apply With Revision.</p> <p>Reviews of other relevant documents, including the Federal Aviation Administration Advisory Circulars, Technical Standard Orders, and Airman Information Manual, were also evaluated. Some of the documents were examined more closely.</p>					
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LIST OF ACRONYMS

AC	Advisory Circular
AFS	Flight Standards Service
AIM	Aeronautical Information Manual
CAB	Civil Aeronautics Board
CFR	Code of Federal Regulations
CGAR	Center of Excellence for General Aviation Research
COA	Certificate of Waiver of Authorization
FAA	Federal Aviation Administration
FR	Federal Register
MASPS	Minimum Aviation System Performance Standard
NAS	National Airspace System
RTCA	Radio Technical Commission for Aeronautics
SAA	See and avoid
SC	Special Committee
TSO	Technical Standard Order
UA	Unmanned aircraft
UAS	Unmanned aircraft system
UAV	Unmanned aerial vehicle
USC	United States Code

EXECUTIVE SUMMARY

A top-level review on the applicability of Title 14 Code of Federal Regulation (CFR) to unmanned aircraft systems (UAS) operating in the National Airspace System (NAS) was conducted under this research effort. The goal of this review was to systematically examine the relevant federal regulations, statutes, orders, and policies to identify the known issues resulting from the rapid growth of UAS technology. These issues include, but are not limited to, communication, control and relay stations; pilot-operator training and certification; “detect, sense and avoid” requirements; “see and avoid” regulations; manufacturing standards and certification; integration into the NAS; and international standards and operating environments.

The review examined sections of 14 CFR to assess their applicability to UAS operating in the NAS based on their face values, i.e., not the intent of the rule, rather a direct understanding of the text. The review results were categorized into four levels: Clearly Applies, May Apply by Interpretation, Does not Apply, and Could Apply With Revision.

The review found that 30% of 14 CFR sections were categorized as Clearly Applies to UAS operations, 16% of them were categorized as Does not Apply. The remaining 54% might be considered in the other two May or Could categories, particularly since a UAS is not explicitly defined in the 14 CFR.

Due to the limitation of available resources, reviews of other relevant documents, including the Federal Aviation Administration (FAA) Advisory Circulars, Technical Standard Orders, and Airman Information Manual, were also evaluated. Some of the documents were examined more closely. In the total review, 33% clearly applied and 12% did not apply. The remaining 55% may have potential to apply, dependent upon the regulatory definition of a UAS.

The FAA Flight Standards Service (AFS)-400 UAS Policy 05-01, while not a regulatory document, provides a definition for an unmanned aircraft (UA). It does not, however, clearly distinguish between a UA and a model aircraft. The latter, having a long history of self-regulation, fell outside the FAA’s area of interest.

A Policy Statement issued February 13, 2007, cited at 72 Federal Register 6689, “Unmanned Aircraft Operations in the National Airspace System,” is intended to be a clarification of the FAA’s current policy regarding operations of UA in the NAS. The policy states, in part:

“The current FAA policy for UAS operations is that no person may operate a UAS in the National Airspace System without specific authority. For UAS operating as public aircraft the authority is the COA, for UAS operating as civil aircraft the authority is special airworthiness certificates, and for model aircraft the authority is AC 91-57.

The FAA recognizes that people and companies other than modelers might be flying UAS with the mistaken understanding that they are legally operating under the authority of AC 91-57. AC 91-57 only applies to modelers, and thus specifically excludes its use by persons or companies for business purposes.

The FAA has undertaken a safety review that will examine the feasibility of creating a different category of unmanned “vehicles” that may be defined by the operator’s visual line of sight and are also small and slow enough to adequately mitigate hazards to other aircraft and persons on the ground. The end product of this analysis may be a new flight authorization instrument similar to AC 91-57, but focused on operations which do not qualify as sport and recreation, but also may not require a certificate of airworthiness. They will, however, require compliance with applicable FAA regulations and guidance developed for this category.”

The comment period for this Policy Statement commenced February 13, 2007, and was not limited by the text of the document.

The author’s recommendation is to consider the development of UA and their related systems against which current regulations may be applied or revised, and against which new regulations may be developed to provide for a safe integration of UAS operations into the NAS.

1. INTRODUCTION.

An unmanned aircraft system (UAS) regulatory review was undertaken by the Center of Excellence for General Aviation Research (CGAR) for the Federal Aviation Administration (FAA).

1.1 OBJECTIVES.

FAA Order 8040.4 specifies that “the FAA shall use a formal, disciplined, and documented decision-making process to address safety risks in relation to high-consequence decisions...” (See appendix A.) The introduction of UAS into the National Airspace System (NAS) represents the incorporation of new vehicles and, potentially, new classes of aircraft, which present a certain level of risk to the current NAS stakeholders. The objective of this study was to provide a systematic regulatory review to identify top-level gaps in existing regulations to facilitate the requirements of the FAA’s decision- and rulemaking processes.

1.2 BACKGROUND.

The history of unmanned aerial vehicles is well documented in *Unmanned Aviation: A Brief History of Unmanned Aviation* by L. R. Newcomb. The recent expansion of the use of unmanned aircraft (UA) and UAS by the United States military and the application of UAS in the civil sector generated discussion about issues associated with the incorporation of UAS into the NAS. The question remains, however, as to whether the current regulatory structure can be applied directly to UA and their operating systems. For instance, the micro UAS may be powered by electric motors. In this instance, questions arise as to whether the current regulations that apply to aircraft powerplants apply equally to such UAS. Additionally, do regulations applying to aircrew relate to the pilots of UAS?

When examining the current regulations, it seemed obvious that specific parts or subparts would not apply to UAS, such as those requiring a certain number of flight attendants onboard a particular aircraft. However, there remains the vast majority that might apply, depending upon any number of variables or interpretations.

Most importantly, do the applicable regulations provide for an equivalent level of safety to that of manned aircraft, or will new or revised regulations be required to fill gaps identified through a comprehensive regulation study?

The goal of this UAS regulation review was to systematically examine the relevant federal regulations, statutes, orders, and policies to identify the known issues resulting from the rapid growth of UAS technology, including, but not limited to, communication; control and relay stations; pilot-operator training and certification; “detect, sense and avoid” requirements; “see and avoid” (SAA) regulations; manufacturing standards and certification; integration into the NAS; and international standards and operating environments.

1.3 INVESTIGATIVE TEAM.

The CGAR team consisted of representatives from the University of Alaska Anchorage and the University of North Dakota.

2. REGULATORY REVIEW AND EVALUATION APPROACH.

The CGAR team conducted a comprehensive literature search to examine the known issues resulting from the rapid growth of UAS technology and the attempts by the FAA to respond with the mandated level of oversight required by federal law. These issues include:

- Communications
- Control and relay stations
- Detect, sense and avoid requirements
- SAA regulations
- Pilot-operator training, qualification, and certification
- Manufacturing standards and certification
- Operating standards and integration into the NAS
- Regulatory compliance and enforcement
- Access to the NAS for uncertified or unregulated military systems
- Needs and demands of the Defense and National Security agencies
- International standards and operating environments

The top-level review began with examination of a significant volume of academic papers, scientific journals, technical publications, government reports, government agency technical documents, industry technical publications, presentations and conferences, and industry sources. (See appendix A.)

The primary source for this study was the Code of Federal Regulations (CFR), from which any potential user of the NAS must derive its authority or permission to operate a UA or unmanned rotorcraft. To assist in identifying and analyzing applicable regulations, a spreadsheet matrix was created, wherein all current CFRs, Advisory Circulars (AC), Orders, Policy Statements, Technical Standard Orders (TSO) and other relevant and legally binding documents are preliminarily categorized as Clearly Applies, May Apply by Interpretation, Does not Apply, and Could Apply With Revision. The categorization of a particular regulation is subject to further interpretation, depending upon the opinion of the reader.

- Clearly Applies:
 - A regulation, order, or TSO that was specifically directed toward UAS
 - Has such a broad application that all aircraft, regardless of size or character, would be included
 - Pertains to general procedures for obtaining certification or other FAA requirements

- May Apply by Interpretation:
 - A little vague from a legal perspective
 - Anticipates arguments on both sides of an issue, but acknowledges ambiguities
- Does not Apply:
 - Regulations in which there could be no conceivable interpretation that would include a UAS (For example, regulations prescribing the minimum number of flight attendants on a passenger aircraft)
- Could Apply With Revision:
 - A regulation that would readily lend itself to application with a minor revision or addition of supplemental language (For example, 14 CFR Part 9.1001-1443, which created a new category for fractional ownership operations)

The CGAR team members also gathered information as a result of their memberships in other organizations and their participation in other studies concerning UAS issues. (See appendix A.)

3. RESULTS AND DISCUSSION.

3.1 HISTORICAL PERSPECTIVE.

The team's research began at the earliest recorded federal aviation regulations, spanning the period from the enactment of the Air Commerce Act of 1926 to the present. Beginning with the definitions and the underlying intent of the regulations, the first question was, Were the earliest regulations intended to protect people and property on the ground or to ensure the safety of the occupants of aircraft? This is a simple question without a clear answer. The best reference for the intent of a regulation is its history, as reflected in legislative debate or committee hearings, notes kept by the proponents and opponents, recorded testimony, public comment, and so on. The Administrative Procedures Act became the law in 1944. This Act established formal procedures that must be followed by all federal agencies in promulgating and enforcing regulations, including a rulemaking process, adjudication procedures, and opportunities for public comment and debate. These procedures were designed to promote the charter of the agency and ensure that those affected by the agency's business are afforded due process and a nonarbitrary application of rule and procedure. The Attorney General's Report on the Administrative Procedures Act, prepared in 1941 by Robert H. Jackson (later appointed to the United States Supreme Court), discusses the Civil Aeronautics Board (CAB) and its safety and regulatory function; however, it offers little enlightenment about the overall intent of the Air Commerce Act and the regulations established by the CAB.

One valuable source was the Federal Register (FR), which offered some guidance on the intent behind some regulations, such as 91.111 and 91.113, regarding the right-of-way rules. Unfortunately, not all new rules or rule changes are thoroughly treated in the FR, specifically with reference to intent and history. Notices of Proposed Rulemaking contain proposed rules, the reasons for them, and comments representing the opinions or suggestions of interested

parties, some of which may appear in the final rule. A more thorough regulation study, which has not been done with regard to UAS, would include review of all such historical documents. However, a regulation study was done on a limited basis with respect to certain terms or regulations pertaining to right-of-way rules, see-and-avoid requirements, visibility rules, and careless and reckless operation prohibitions.

The FAA archives could also serve as a potential source of useful information for determining the fundamental intent of aviation regulations. The archives contain materials and documents that might explain the intent of many of the regulations that the team determined to be clearly applicable to UAS or amenable to application through interpretation or amendment. For example, opinion papers or letters of interpretation from FAA branch or division managers in the Chief Counsel's office, directed to individuals and entities asking for interpretations of particular regulations, might prove to be of considerable value when making applicability determinations. Such letters, however, are rarely published and were not available for this review. To ensure the accuracy and thoroughness of future work, the team would need to examine these documents, and others, so they could inform the reader what the agency intended when a particular regulation was written or vetted through the rulemaking process.

3.2 TITLE 14 CODE OF FEDERAL REGULATIONS.

A regulatory review of 14 CFR statutes relative to aviation focuses on the federal aviation regulations. This review is documented in a Microsoft[®] Excel[®] spreadsheet interactively linked to the referenced publications. The user can click on a link in the spreadsheet to view the appropriate document. This discussion provides a general overview of the specific information referred to in appendix A.

A total of 436 items are shown as evaluated in 14 CFR. Some of the document evaluations were consolidated, as entire documents were categorized into one of the four classifications used in the review: Clearly Applies, May Apply by Interpretation, Does not Apply, or Could Apply With Revision. As a result, the 436 items refer only to those entries listed on the spreadsheet.

Within the rated 14 CFR documents, as shown in figure 1, 30% Clearly Applies to UA operations, while 16% Does not Apply. The remaining items either May Apply by Interpretation (42%) or Could Apply With Revision (12%). These percentages are for the itemized entries on the spreadsheet. A precise, line-by-line discussion of applicability for all 14 CFR documents may alter these percentages, but in general, 14 CFR is applicable to UAS.

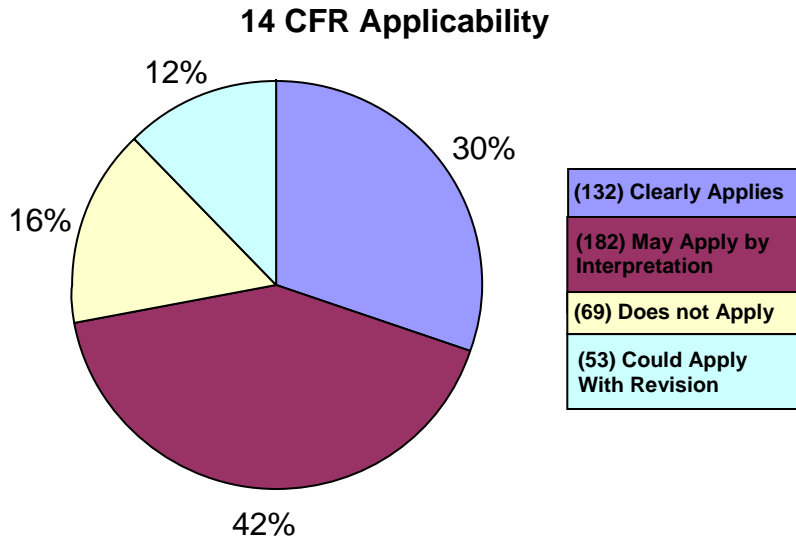


Figure 1. The 14 CFR Review Summary

In many instances, the rating of May Apply by Interpretation is based upon the assumption that a UA may be considered certified (e.g., aircraft, rotorcraft, etc), in which case, the regulation may be interpreted to apply to a UA.

14 CFR 1.1 is a list of definitions but does not provide a definition of a UA or a UAS. As the remainder of 14 CFR is examined, it is clear either that there is no guidance for the current or future UAS developer or operator or that such individuals or entities are governed by all current and applicable regulations. The latter option fails to consider whether the aircraft or rotorcraft is piloted by an onboard human being or is operated remotely by a human being using a form of data link and communications technology. The implications of not altering the regulatory environment to include guidance for UAS are two-fold. First, those wishing to operate UAs in the NAS do so at their own risk, subject to after-the-fact interpretations and applications of the regulations by the FAA through enforcement proceedings. Second, potential users must proceed as if they are designing, building, and operating unmanned vehicles that comply with the same regulations as manned aircraft, thus requiring full certification and operational capability.

Table 1 is a sample from 14 CFR 1.1 and shows the complexities of interpretation of the current regulations.

Table 1. The UAS-Related Definitions Contained in 14 CFR 1.1

Term	Definition	Questions
Aircraft	Device that is used or intended to be used for flight in the air	Does size, weight, speed, intended use, or navigation/communication capability have any bearing on the definition? What about model aircraft? Do all <u>aircraft</u> require registration and a pilot's license to fly/operate?
Aircraft engine	Engine that is used or intended to be used for propelling aircraft	Would this also include miniature turbojets or reciprocating engines that power model aircraft? (yes if literal)
Airframe	Fuselage, booms, nacelles, cowlings, fairings, airfoil surfaces (including rotors but excluding propellers and rotating airfoils of engines), and landing gear of an aircraft and their accessories and controls	Does this include even the ground-based control station from which a UAS operator/pilot would control the aircraft?
Airplane	Engine-driven fixed-wing aircraft heavier than air, that is supported in flight by the dynamic reaction of the air against its wings	Does this include UAS powered by electric motors, which is technically not the same thing as an "engine," but the practical effect is the same?
Crewmember	Person assigned to perform duty in an aircraft during flight time	Taken literally, anyone operating a UAS is by definition not a crewmember. What are they, then? Are they subject to any of the other regulations, such as operating limitations in Part 91, or qualifications under Part 61? Can an unmanned aircraft be legally (in compliance with the CFRs) flown by someone who is not by definition a crewmember?

The current regulations recognize two broad categories of aircraft: (1) regulated aircraft (any general aviation or commercial aircraft), and (2) lightly regulated, nontraditional aircraft (ultralights).

A third category of unregulated flying devices that is defined as aircraft according to the 14 CFR 1.1 definition, but probably was not contemplated by the authors of those regulations, includes radio-controlled model aircraft. Some of these recreational models, while purportedly not flown for any commercial purpose (in compliance with AC 91.57), are larger and, in some cases, much faster than many commercial UAs, yet they remain an unregulated UA.

Where UAs fit into the current or any future regulatory scheme depends upon how they will be defined and categorized. This, in turn, may be driven by the need to classify types of UAs on the basis of a variety of characteristics:

- Operating altitudes
- Endurance
- Operational characteristics (such as vertical takeoff and landing capabilities)
- Operating environment
- Mission type (intent), either in a military or civilian setting
- Kinetic speed and/or mass
- Takeoff weight
- Range and maximum altitude
- Gross categories, such as size (wingspan, weight, etc.) or complexity (wind-up rubber band versus miniature jet turbines)

14 CFR Part 21 provides the procedures for certification. It is also the first Part of 14 CFR with a full range of ratings. As noted earlier, the questions that require resolution are the definition of a UA or UAS and whether it should be a certified product. Results of this study show 9% Clearly Applies, 77% May Apply by Interpretation, 3% Does not Apply, and 11% Could Apply With Revision, as shown in figure 2. The assumption, again, is that a UAS is a certified product and, therefore, is governed by this regulation.

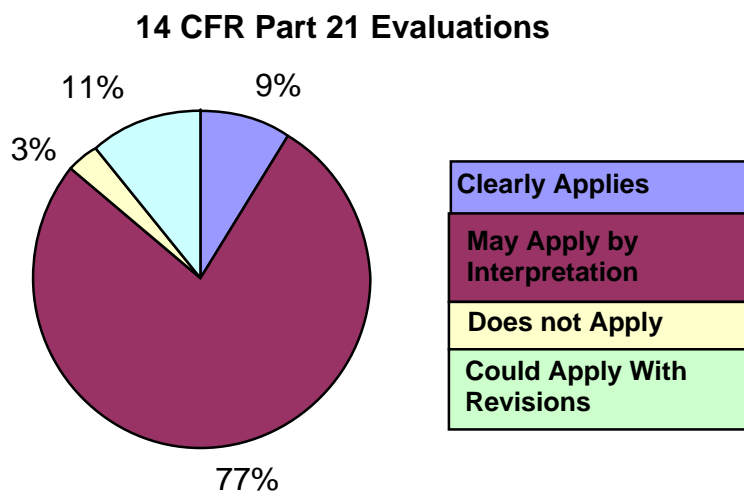


Figure 2. The 14 CFR Part 21 Review Summary

14 CFR Part 23 covers airworthiness standards for normal, utility, acrobatic, and commuter category airplanes. If a UA or UAS is certified, a significant portion of this regulation applies. As shown in figure 3, 3% Clearly Applies, 66% May Apply by Interpretation, 18% Does not Apply, and 13% Could Apply With Revision.

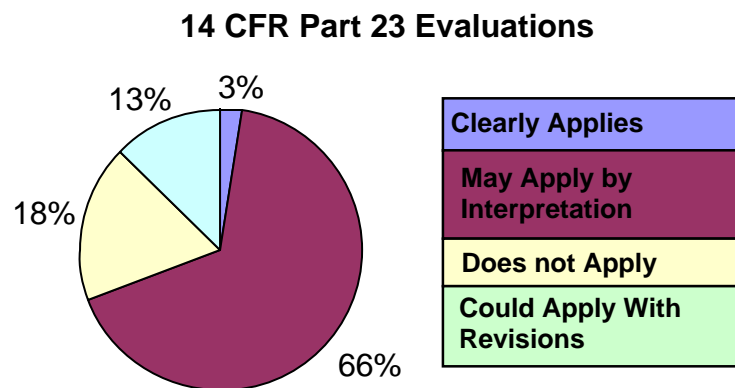


Figure 3. The 14 CFR Part 23 Review Summary

14 CFR Part 25 defines the airworthiness standards for transport category airplanes. The individual paragraph evaluations can be divided into two categories: (1) those that require a crew member or are in place because of crew members Does not Apply (44%) and (2) items not associated with crew members May Apply by Interpretation (66%), depending upon how a UA or UAS is defined for regulation.

14 CFR Part 27 describes airworthiness standards for normal category rotorcraft. As with 14 CFR Part 25, the dividing line between the two evaluations noted is the human factor. Those items referring to crew members Does not Apply (20%). Items not associated with crew members May Apply by Interpretation (80%), depending upon how a UA or UAS is defined for regulation.

14 CFR Part 29 defines airworthiness standards for transport category rotorcraft. As with normal category rotorcraft, the dividing line between the two evaluations noted is the human factor. Those items referring to crew members Does not Apply (38%). Items not associated with crew members May Apply by Interpretation (62%), depending upon how a UA or UAS is defined for regulation.

14 CFR Part 61 covers certification of pilots, flight instructors, and ground instructors. Much of the applicability of this regulation hinges upon whether a UA or UAS is a registered aircraft or rotorcraft and whether its operator is defined as a pilot. As shown in figure 4, the evaluations for this regulation included 17% May Apply by Interpretation, 17% Does not Apply, and 66% Could Apply With Revision.

14 CFR Part 61 Evaluations

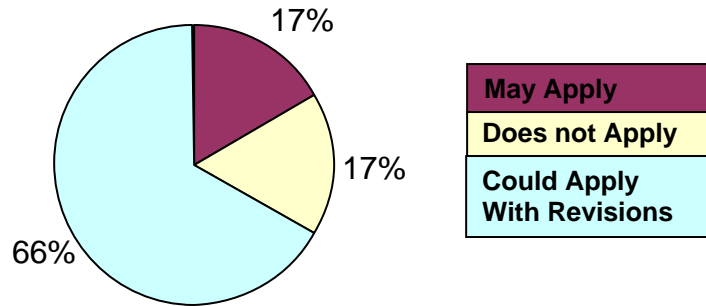


Figure 4. The 14 CFR Part 61 Review Summary

14 CFR Part 65 covers certification of airmen other than flight crew members. As with previous reviews, this section is influenced by whether a UA or UAS is considered a registered aircraft or rotorcraft. In this case, the evaluations for this regulation included 67% May Apply by Interpretation and 37% Does not Apply.

14 CFR Part 91 prescribes rules governing the operation of aircraft. Again, applicability is tied to a definition for UA or UAS. In this review, the evaluation showed 36% Clearly Applies, 37% May Apply by Interpretation, 23% Does not Apply, and 4% Could Apply With Revision, as shown in figure 5.

14 CFR Part 91 Evaluation

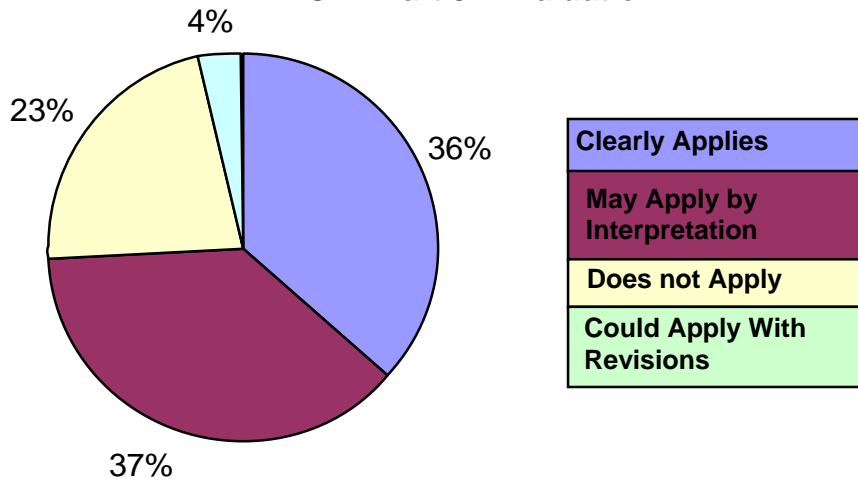


Figure 5. The 14 CFR Part 91 Review Summary

14 CFR Part 137 prescribes rules governing agricultural aircraft operations. Depending upon the definitions of UA or UAS, almost all of this regulation applies: 35% Clearly Applies, 56% Could Apply With Revision, and the remaining 9% Does not Apply, as shown in figure 6.

14 CFR Part 137 Evaluation

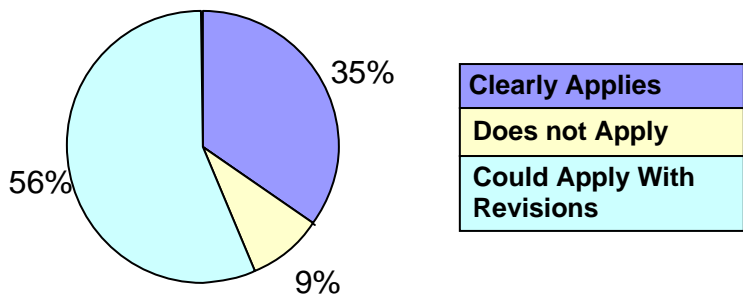


Figure 6. The 14 CFR Part 137 Review Summary

The remaining sections of the 14 CFR mostly fall into one or two of the evaluation rating sections. All are prefaced by the assumption that the UAS community will fall under the definition of a certified and/or registered item. The review resulted in 14 CFR Parts evaluated as follows:

- Clearly Applies

Part Number	Subject Matter
3	Record Making
11	Rulemaking Procedures
14	Equal Access to Justice
39	Airworthiness Directives
47	Aircraft Registration
49	Recording of Aircraft Titles and Security Documents
60	Certification: Pilots, Flight Instructors, and Ground Instructors
71	Designation of Airspace
73	Special Use Airspace
77	Objects Affecting Navigable Airspace
95	Instrument Flight Rules Altitudes
97	Standard Instrument Approach Procedures
99	Security Control of Air Traffic
183	Representatives of the Administrator
185	Testimony and Legal Proceedings
187	Fees
189	Use of FAA Communications Systems
193	Protection of Information
198	Aviation Insurance

- Does not Apply

Part Number Subject Matter

17	Protests and Contract Disputes
31	Airworthiness Standards: Manned Free Balloons
105	Parachute Operations
121	Operating Requirements: Domestic, Flag, and Supplemental Operations
125	Certification and Operations: Airplanes Having a Seating Capacity of 20 or More...
129	Operations: Foreign Air Carriers
135	Operating Requirements: Commuter and On Demand
139	Certification of Airports
150-161	Airport Related Regulation
200 Series	Office of the Secretary Department of Transportation Proceedings
400 Series	Commercial Space Transportation
1200 Series	National Aeronautics and Space Administration
1300 Series	Air Transportation System Stabilization

- May Apply by Interpretation

Part Number Subject Matter

16	Airport Enforcement
34	Fuel Venting and Exhaust Emission Requirements for Turbine Engine Powered Airplanes
35	Airworthiness Standards: Propellers
43	Maintenance, Preventive Maintenance, Rebuilding, and Alteration
45	Identification and Registration Marking
93	Special Air Traffic Rules
119	Air Carriers and Operators for Compensation or Hire: Certification and Operations
133	Rotorcraft External-Load Operations
136	National Parks Air Tour Management
145	Repair Stations
147	Aviation Maintenance Technician Schools
170	Criteria for Air Traffic Control Services and Navigation Facilities
171	Non-Federal Navigation Facilities

- Could Apply With Revision

Part Number Subject Matter

33	Airworthiness Standards: Aircraft Engines
67	Medical Standards and Certification
101	Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons
103	Ultralight Vehicles
141	Schools and Other Certificated Agencies
142	Training Centers

- The remaining regulations, evaluated but not broken down into sections in the spreadsheet, showed mixed results:

Part Number Subject matter

13	Investigation and Enforcement (5% Does not Apply, 95% fell in one of the other three evaluations)
15	Federal Tort Claims Act Administrative Claims and Indemnification (sections either Clearly Applies or Does not Apply)
36	Noise Standards: Aircraft Type and Airworthiness Certification (Appendices Clearly Applies, Basic Could Apply With Revision)

3.3 OTHER U.S. REGULATIONS AND DOCUMENTS.

3.3.1 United States Code.

The application of regulations within the transportation codes is contingent upon the definition of UAS and UA. In 49 CFR 107 and 49 CFR 175 regarding the transportation of hazardous materials, the regulations fell into the May Apply by Interpretation category. In other areas of 49 CFR, such as sections 106 (g)(1)(A), 40101 (a)(1), 40101 (d)(1), 40102 (a)(3), 40102 (a)(6), 40102 (a)(22), 40102 (a)(24), and 44701 (d)(2), regulations fell into the Clearly Applies category.

In both Title 5 United States Code (USC) 552 (Freedom of Information Act) and Title 18 USC 5101-5123 (Hazardous Materials Transportation Act) regulations fell into the Clearly Applies category for UAS operations.

The focus of this study was the regulation of UAS operations in the NAS. In the early stages of the research, it became obvious that the complexity of the UAS as a system (vehicle, control and communications links, etc.) subject it to regulations in many areas, such as, transportation, communications, and security. The research team, therefore, consciously limited its review of USC and CFR to those noted.

3.3.2 Advisory Circulars.

A review of ACs highlighted the need for a definition of a UAS. Of the ACs reviewed, all potentially apply to UAS Operations: 44% Clearly Applies, 43% May Apply by Interpretation, and 13% Could Apply With Revision, as shown in figure 7.

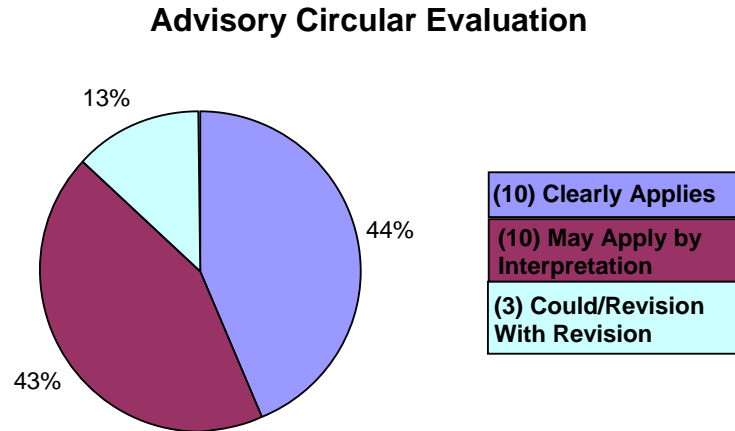


Figure 7. The AC Review Summary

The extensive volumes of ACs should be reviewed at greater depth after a definition of UAS is established.

Included in the ACs is a publication that refers to Model Aircraft Operating Standards (91-57). This publication and the lack of a regulatory definition for either a model aircraft or UA and UAS, blurs the line between what has been acceptable self-regulation of the model aircraft community and the growing pressure for, as yet undefined, UA operations.

3.3.3 Aeronautical Information Manual.

The research team recognized that the Aeronautical Information Manual (AIM) provides the basic flight information and air traffic control procedures for manned operations in the NAS. A majority of the AIM should be applicable to UAS operations, once their definition and status is codified. At that time, the AIM should be thoroughly reviewed and modified, as necessary, to incorporate needed changes. The team deferred an in-depth AIM review at this time.

3.3.4 The FAA Orders and Policy Statements.

All FAA Orders were evaluated for applicability to UAS. The results showed that 43% Clearly Applies, 19% as May Apply by Interpretation, and 38% remain in an Undetermined status, as shown in figure 8. The Undetermined group pertains primarily to military operations. Those regulations could potentially fit into the Could Apply With Revision category.

FAA Orders Evaluation

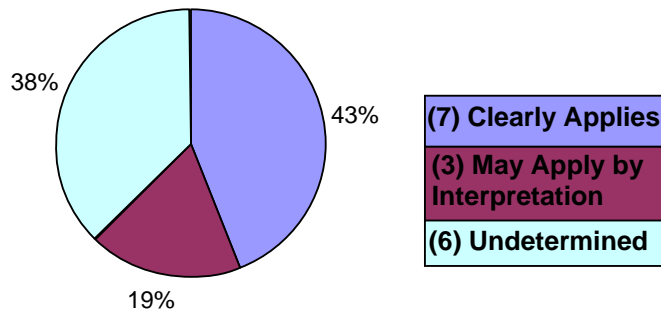


Figure 8. The FAA Orders Review Summary

Four policy statements were reviewed. Of the four, two statements were categorized as Clearly Applies pertaining to UAS operations.

The FAA Memorandum, Flight Standards Service (AFS)-400 UAS Policy 05-01 "...provides guidance to be used to determine if unmanned aircraft systems (UAS) may be allowed to conduct flight operations in the U.S. National Airspace System (NAS)." The following information is also provided.

- UA operations have increased dramatically during the past several years. In response to this increasing activity, it has become necessary to develop guidance for the Flight Technologies and Procedures Division (AFS-400) staff to use when evaluating applications for Certificates or Waiver of Authorization (COAs). This policy is not meant as a substitute for any regulatory process. This policy was jointly developed by, and reflects the consensus opinion of, AFS-400; the Avionics Systems Branch (AIR-130), FAA Aircraft Certification Service; and the Office of System Safety and Procedures, FAA Air Traffic Organization (ATO).

Although not a regulation, this policy memorandum sets forth framework of a regulatory scheme to operate military UAS in the NAS. It specifically states in section 6.2 that civil COAs will not be considered, and that anyone intending to operate a civil UAS in the NAS will have to follow current airworthiness certification processes. At first glance, it would appear that merely removing the language pertaining to civil COA applications would create a policy for civil UAS operations without a formal regulation, but perhaps it would serve as a precursor to a Notice of Proposed Rulemaking or a mechanism leading to a formal set of rules for UAS operations in the NAS.

Also included in this memorandum is the start of a definition for a UAS.

"Unmanned Aircraft – a device that is used or intended to be used for flight in the air that has no onboard pilot. This includes all classes of airplanes, helicopters, airships, and translational lift aircraft that have no onboard pilot. A UA is an aircraft as defined in 14 CFR 1."

A Policy Statement issued February 13, 2007, cited at 72 FR 6689, “Unmanned Aircraft Operations in the National Airspace System,” is intended to be a further clarification of the current FAA policy regarding operations of UA in the NAS. The policy states, in part:

“The current FAA policy for UAS operations is that no person may operate a UAS in the National Airspace System without specific authority. For UAS operating as public aircraft the authority is the COA, for UAS operating as civil aircraft the authority is special airworthiness certificates, and for model aircraft the authority is AC 91-57.

The FAA recognizes that people and companies other than modelers might be flying UAS with the mistaken understanding that they are legally operating under the authority of AC 91-57. AC 91-57 only applies to modelers, and thus specifically excludes its use by persons or companies for business purposes.

The FAA has undertaken a safety review that will examine the feasibility of creating a different category of unmanned “vehicles” that may be defined by the operator’s visual line of sight and are also small and slow enough to adequately mitigate hazards to other aircraft and persons on the ground. The end product of this analysis may be a new flight authorization instrument similar to AC 91-57, but focused on operations which do not qualify as sport and recreation, but also may not require a certificate of airworthiness. They will, however, require compliance with applicable FAA regulations and guidance developed for this category.”

The comment period for this Policy Statement commenced February 13, 2007, and is not limited by the text of the document.

3.3.5 Technical Standard Orders.

TSOs provide regulatory standards for aviation-related systems and equipment associated with certified aircraft. The team’s review found all the selected TSOs relevant to UAS and UA, assuming the UA is to be a registered aircraft, as shown in figure 9.

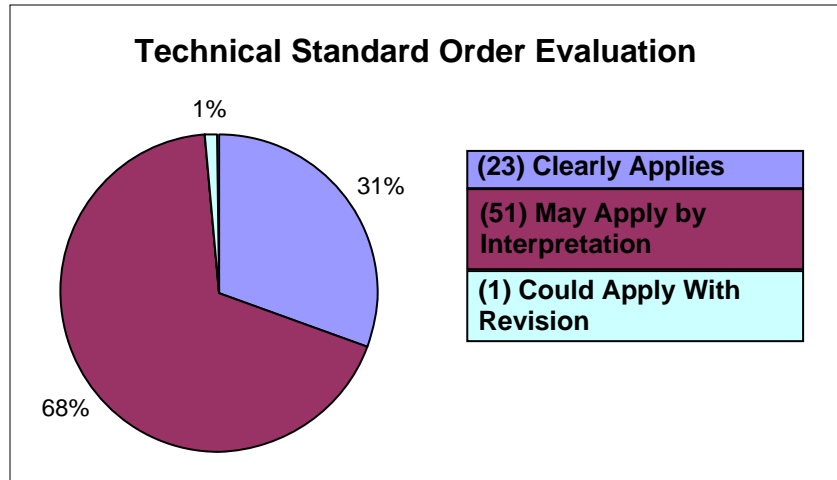


Figure 9. The TSO Review Summary

3.3.6 Industry Documents.

The Radio Technical Commission for Aeronautics (RTCA) Special Committee (SC) 203 was formed in 2004. The primary responsibility of SC-203 is to develop Minimum Aviation System Performance Standards (MASPS) for UAS. A MASPS specifies characteristics that should be useful to designers, installers, manufacturers, service providers, and users of systems intended for operational use within a defined airspace. A MASPS describes the system (subsystems/functions) and provides information needed to understand the rationale for system characteristics, operational goals, requirements, and typical application. SC-203 also reviews the issues of ground pilot training and qualifications, and making appropriate recommendations.

SC-203's mandate includes the establishment of MASPS for Unmanned Aircraft Systems by December 2005; MASPS for Command, Control, and Communication Systems for Unmanned Aircraft Systems by June 2006; and MASPS for Sense and Avoid Systems for Unmanned Aircraft Systems by December 2007. The Committee's stated philosophy is to use a systems approach to determine the acceptable "Expected Behavior" of an Unmanned Aircraft within a defined airspace, to establish safety and performance requirements based upon required functionality, and to honor the cornerstone directive to "do no harm."

RTCA documents reviewed by the team, with the exception of DO-304, were in draft status and, therefore, were not categorized.

4. SUMMARY.

Of all the regulation documents reviewed, only 12% did not apply to unmanned aircraft systems (UAS) operations. The remaining documents clearly apply to UAS operations (33%) or could be made to apply by interpretation (44%) or revision (11%).

As noted earlier, a total of 436 items were evaluated in Title 14 Code of Federal Regulations (CFR). Other document evaluations were consolidated, as entire documents were found to fall

within one of the four classifications used in the review: Clearly Applies, May Apply by Interpretation, Does not Apply, or Could Apply With Revision.

A general working definition of an unmanned aircraft (UA) was found in FAA AFS-400 UAS Policy 05-01, but no regulatory definition of a UA or UAS was found in any existing regulation. The operative element of UAS is “aircraft,” which is defined by 14 CFR 1.1.

Additional questions that may need clarification are:

- What is the effect, if any, of the modifying word “unmanned” on the regulation of aircraft?
- Is there a class of UA that, for whatever reason, need not be regulated under the current safety mandate of “do no harm”?

To determine if and how the current regulatory scheme applies to UA, a more in-depth analysis of regulations should be conducted.

The challenges to the FAA in regulating UAS operations in the National Airspace System (NAS) are to

1. define the terms associated with UAS operations (such as UAS, UA, crew, and operator).
2. define those UAs conventionally known as model aircraft and to determine if they are to be allowed continued self-regulation.
3. review, set, and implement required operational capabilities for UAS operations.
4. revise regulations, as required, to encompass and facilitate introduction of UAS activity in the NAS.

Although aviation technology has made significant progress since 1941, the basic precepts under which the regulatory agency (first, the Civil Aviation Administration (CAA), then the Civil Aeronautics Board, and then the FAA) operates have changed little in the ensuing 66 years. The FAA has broad powers to secure safe operation of aircraft. It does so through issuance of airmen’s certificates, airworthiness certificates, and control and oversight of the national airspace. The current regulatory scheme has evolved over a substantial period, but the framers of the regulatory scheme and their successors clearly never envisioned the inclusion of UA or unmanned rotorcraft in the NAS. The unique technological challenges presented by UAS and the growing demands and needs of the UAS community, whether military, civil, or public, call for an appropriate response to implement regulatory change. The recommendations for consideration are

- to develop a legal definition of a UAS and its associated elements (hardware, software, crews, interlinks, etc), either internally or in cooperation with industry and other interested parties. This should include systems not subject to regulation and should allow application of the appropriate current regulations to UAS operations.

- to perform more detailed reviews of the 14 CFR Parts, the AIM, Technical Standard Orders (TSO), Advisory Circulars, and other operationally oriented regulations to review applicability and suggest modifications for UAS operations.
- to conduct a regulation review with an emphasis on foreign and International Civil Aeronautics Organization regulation activity of UAS operations to allow interoperability of U.S.-certified systems in the international environment.
- to conduct an industry survey concerning future UAS technology applications.
- to review historical documents in the FAA archives and the law library that could provide guidance on the meaning and intent of pertinent regulations. This may facilitate a more comprehensive understanding of how the current regulations apply to UA operations.

Due to the sheer number of existing regulations that clearly apply or could apply by interpretation or amendment, the burden that falls on the rulemakers is either (1) to go through every regulation and statute and appropriately amend each one to resolve any ambiguity as to whether and how it applies to UAS design, manufacture, and operation, or (2) to create an entirely new subpart of 14 CFR that specifically addresses the particular issues that arise from UAS operation. The latter strategy was employed in the creation of 14 CFR Part 91.1001-1443, which pertains to fractional ownership of business aircraft. By specific reference to other relevant parts and subparts and by filling in the gaps with new language, the FAA brought the fractional ownership community fully within the regulatory scheme through the rulemaking process, and did so without economically disrupting the growing business aircraft industry. Perhaps the same goal can be achieved with UAS.

APPENDIX A—RESEARCH DATA

The research data is included in a Microsoft® Excel® file accompanying this report. The data may be accessed as follows:

From the CD:

1. Double click on “Appendix A.”
2. Double click on “Regulation Study_11-29_Rev5”
3. The tabs at the bottom indicate specific areas of the Regulations Review. Select one, and click on the tab.
4. When an evaluation area has a blue “x,” it has linked regulatory material.
 - a. To view, click on the “x”
 - b. To close, click on the “x” in the upper right of the dropdown

This file can also be downloaded separately from www.actlibrary.tc.faa.gov.