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The Future of Unmanned Aircraft Systems Pilot Qualification

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THE FUTURE OF UNMANNED AIRCRAFT SYSTEMS PILOT QUALIFICATION

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One of the major issues facing Unmanned Aircraft Systems (UAS) integration into the National Airspace System (NAS) is pilot qualification. To date UAS flights are only conducted in special use airspace or with individual and non-standardized approval. The only printed pilot qualification requirements come from the 2008 Federal Aviation Administration's (FAA) *Interim Operational Approval Guidance 08-01*. Although this interim guidance is an important first step it is time to align UAS pilot qualification with the requirements for manned and model aircraft. UAS Operators and pilots could be incorporated into the NAS under current regulations that govern pilot qualification, by modifying the standards and classification currently used by the U.S. Department of Defense. The FAA needs to make only minor changes to the existing Federal Aviation Regulations (FAR) and certify UAS operators by using type ratings.

Integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS) is a complex issue facing policy makers and regulators. This is an issue that will require a reasonably cautious and conservative approach. Many imposing factors have been identified with UASs integration into the NAS (McCarley & Wickens, 2005), but crew qualification is essential to ensuring the safety of other aircraft and population centers. Knowing that UAS operators have validated aeronautical knowledge, the skills required to fly and a common standard of ability should make other issues regarding safe integration easier for the Federal Aviation Administration (FAA). The current Federal Aviation Regulations (FAR) have evolved over a century incorporating new and sophisticated technologies. The assimilation of technology like satellite based navigation and digital data communication into the existing FAR structure has transformed the NAS from a sparsely regulated and uncontrolled airspace into a system poised to become a technology centered Next Generation (NextGen) airspace system.

NextGen will be a complete overhaul of the NAS, increasing air travel efficiency, dependability, and safety. NextGen adopts a number of new technologies such as the aforementioned digital data communication, Automatic Dependent Surveillance-Broadcast (ADS-B), Systems Wide Information Management (SWIM), and Collaborative Air Traffic Management Technology (CATMT) (Federal Aviation Administration [FAA], 2012c). The combination of these new technologies will help provide an efficient air transportation system that could handle the projected doubling of air traffic over the next 20 years and enable the incorporation of UASs into the NAS (FAA, 2012b). In fact, the Department of Defense is currently testing some of these technologies to enhance situational awareness of UAS crews and increase safe separation of manned and unmanned aircraft (Lacher et al., 2010). When the NextGen system is implemented, technology will solve many of the issues currently surrounding UASs.

However, the recently passed FAA Modernization and Reform Act of 2012 mandates the airspace system of today to accommodate UASs. In this legislation, Congress has mandated the FAA to develop regulations for the testing and licensing of unmanned aircraft by September 2015 (FAA, 2012d). The FAA is now considering the development of UASs and how to proceed in a way that will ensure safety of the population and other air traffic.

American UASs have been remotely piloted since World War II. The first to use a remote pilot was the U.S. Army's OQ-1 target drone (Dalamagkidis, Valavanis, Piegl, 2012) and the U.S. Navy's TDR-1 assault UAS (Fahrney, 1980). Early UAS operators, similar to the UASs of today, were a combination of radio controlled model aircraft enthusiasts and formally trained pilots[1]. The Cold War and the loss of a U-2 over the Soviet Union in 1960 motivated the Department of Defense to invest heavily in UASs technology. The most predominant UAS of the Cold War was the Ryan Model 147 Lightning Bug. Over 3,500 Ryan Model 147s were employed over the skies of China and Vietnam and represent a major evolutionary step into the modern UASs era (Dalamagkidis et al., 2012).

The current era of sophisticated unmanned aircraft technology has roots in Israel's early success remotely piloting aircraft during the 1982 Bekaa Valley conflict (Sanders, 2002). The early 1980s experienced a burst in modern UASs construction. Systems like the Israeli Aerospace Industries' Pioneer and the Leading Systems AMBER (predecessor to the MQ-1 Predator) made their way in to U.S. Department of Defense inventories (Sanders, 2002). These new UASs had sophisticated data links, the ability to fly at altitudes in excess of 15,000 feet Mean Sea Level (MSL), and used remote pilots sitting in Ground Control Stations (GCS) 100 nautical miles from their aircraft (U.S. Navy, 2009).

The 1990s saw the advent of man portable UASs as well as larger systems that were able to fly in Class A airspace and over the horizon (US Air Force, 2012a). Still operated almost exclusively in special access airspace and primarily by the Department of Defense, UASs were poised to expand into a variety of civilian and commercial applications (FAA, 2010). The FAA reported the existence of over 155 different unmanned aircraft designs waiting to penetrate the greater NAS (FAA, 2010).

The FAA took important first steps in dealing with UASs integration. In 2008 the FAA issued *Interim Operational Approval Guidance 08-01*, detailing how military and civilian UASs would access airspace for flight test, training and operations (FAA, 2008b). Currently the FAA allows for the flight of UASs in active Restricted, Prohibited, or Warning Area airspace. For operations in the NAS outside of the aforementioned special airspace, the FAA requires specific authorization (FAA, 2008b). All UAS flights in the NAS must use one of two methods for approval. UAS operators and firms engaged in their production can apply for either a Certificate of Authorization (COA) or the issuance of a special airworthiness certificate (FAA, 2008b). The FAA issues either a COA or a special airworthiness certificate depending on what type of user plans to operate the UAS. For example:

- Certificates of Authorization (COA) are only for aircraft operated by a public user like a governmental agency or state universities (FAA, 2008b).
- Special airworthiness certificate, like an experimental certificate, are for aircraft being flown by civil applicant (non-governmental) (FAA, 2008b).

To date, special airworthiness certificates have been issued on a limited basis. In 2008, manufacturers were issued only 28 certificates (Dalamagkidis, 2012). The FAA guidance makes it very clear that UAS operations will be approved on a case by case basis, when the firm or agency requesting approval can provide enough data to ensure safe operations and collision avoidance. One area of UAS operations that has generated the greatest confusion and potential problems for the FAA is the use of small UAS. Small UAS are defined as less than 55 pounds[2], the same weight limit as remote control aircraft. *Interim Operational Approval Guidance 08-01* (FAA, 2008b) clearly states that *Advisory Circular 91-57* (FAA, 1981), which governs model aircraft, shall not be used as a basis of approval for small UAS operations and is applicable only to recreational and hobbyist use.

The FAA has limited access because of the variety of UAS applicants, the lack of traditional airworthiness certification for UASs and no common level of aeronautical knowledge for UAS operators. To manage UAS issues and promote UASs integration into the NAS, the FAA has taken several first steps. In 2006 the FAA established the Unmanned Aircraft Program Office (UAPO). In 2007 the newly formed UAPO began an effort to open airspace to

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[1] The OQ-1 was built and tested by Reginald Denney, owner of the Reginald Denny Hobby Shops. Denney was an aerial gunner for the Royal Flying Corps in World War I and moved to the United States where he became an actor and opened a radio control aircraft hobby shop prior to starting the Radioplane Company building the first mass produced Unmanned Aircraft in the US (Newcome, 2004)
The US Navy's TDR-1 assault drone and the N2C-2 test platform where flown remotely by Naval Aviators in the late 1930s and 1940s (Fahrney, 1980).

[2] FAA makes reference to the 55 pound weight limit used by the Academy of Model Aeronautics in Order 1110.150 FAA, 2008c).

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small UASs on an individual basis, and in 2008 the UAPO released *Interim Operational Approval Guidance 08-01* (U.S. Government Accountability Office [GAO], 2008). This interim guidance and the COA process outlined has been the backbone of national policy governing the use of UASs in the NAS for the last four years.

Current UAS Pilot qualifications as outlined in Interim Guidance 08-01

Considering the FAA's mandate to regulate air traffic rules, license pilots, certify aircraft and ensure safe air travel (FAA, 2008a), the FAA's interim guidance was a conservative first step that began to define UAS pilot/operator qualification.

The FAA, rightly, would like to ensure a common level of understanding of FARs that are applicable to the airspace where the UA will operate (FAA, 2008b). The FAA divides UAS operators into two categories; operations requiring a pilot certificate, and operations not requiring a pilot certificate.

The FAA's (2008) *Interim Operational Approval Guidance 08-01* states the following:

> **Operations requiring a pilot certificate**:
>
> The (Pilot In Command) PIC shall hold, at a minimum, an FAA pilot certificate under the following circumstances:
>
> - All operations approved for conduct in Class A[3], C[4], D[5], and E[6] airspace.
> - All operations conducted under (Instrument Flight Rules) IFR (FAA instrument rating required).
> - All operations approved for nighttime operations.
> - All operations conducted at joint use or public airfields.
> - All operations conducted beyond line of sight.
> - At any time the FAA has determined the need based on the UAS' characteristics, mission profile, or other operational parameters.
>
> **Operations not requiring a pilot certificate**:
>
> The PIC *may not* be required to hold a pilot certificate for operations approved and conducted solely within visual line of sight in Class G[7] airspace. For the PIC to be exempt from the pilot certificate requirement the following conditions must exist and the alternate compliance method described below must be followed:
>
> - The operation is conducted in a sparsely populated location, and,
> - The operation is conducted from a privately owned airfield, military installation, or off-airport location.
> - Visual line of sight operations conducted no further than 1 NM laterally from the UAS pilot and at an altitude of no more than 400 feet Above Ground Level (AGL) at all times.
> - Operations shall be conducted during daylight hours only.
> - Operations shall be conducted no closer than 5 NM from any airport or heliport. (p. 15)

Independent of these general guidelines the FAA reserves the right to require type ratings or higher level of ratings dependent of the flight characteristics of the applicants UAS (FAA, 2008b).

In addition to basic qualification, the FAA requires UAS operators establish training and currency programs to ensure safety of flight. Any UAS operator flying in a COA or under a special airworthiness certificate must have at a minimum, three takeoffs (launch) and landings (recovery) in the specific UAS in the previous 90 days (FAA, 2008b). In addition to the currency requirements all UAS operators should have basic training specific to the UAS being operated to include normal operations, emergency procedures and loss of command and control link procedures (FAA, 2008b). UAS pilots that hold a FAA issued private pilot license or higher shall also have flight reviews and maintain currency in manned aircraft (per 14

[3] Class A refers to airspace from 18,000 feet MSL to Flight Level 600 (FAA, 2012a).

[4] Class C refers to the airspace around primary airports with specific equipment requirements (FAA, 2012a).

[5] Class D refers to airspace around airports with an operational tower that are not Class B or C (FAA, 2012a).

[6] Class E refers to the airspace from 14,500 feet MSL to 18,000 feet MSL. Class E can also refer to airspace that extends from the surface of a non-towered airfield or a designated altitude (700 or 1,200 AGL) used to transition to adjacent airspace (FAA, 2012a).

[7] Class G refers to uncontrolled airspace (FAA, 2012a).

CFR 61.56).

The seemingly primary directive in *Interim Operational Approval Guidance 08-01* (FAA, 2008b) is the need to dictate how UASs will "see and avoid" other aircraft. This is a requirement for all aircraft under 14 CFR 91.113. The FAA has solved this requirement in the near term with the use of ground based and airborne observers (FAA, 2008b). To ensure flight safety, all UAS operations will require either a ground based or airborne observer unless the UAS is solely operating in an active Restricted, Prohibited or Warning area (FAA, 2008b). Observers are required to have basic aeronautical knowledge and be able to communicate with the UAS operator. Ground observers must maintain unaided visual line of sight with the UAS. Airborne observers must maintain visual line of sight from a chase plane and may not pilot the chase plane while acting as an observer. Over time the UAS industry will create "sense and avoid" systems that will use a variety of technology to meet the "see and avoid" requirement. Until sense and avoid technologies are certified by the FAA, UAS operations will be limited by this rule. All UAS operators, pilots and observers, independent of qualification level are required by the FAA to possess a valid FAA Class 2 medical certificate (14 CFR part 67) and maintain possession during execution of duties as either a UAS operator or observer (FAA, 2008b).

The Way Forward

The FAA has yet to publish any definitive regulation or policy regarding the qualification for UAS operators, but stated that in creating rules for UASs particular attention will be given to how; "UAS(s) handle communication, command, and control", and how UASs will "sense and avoid" other aircraft (FAA, 2010). As stated before sense and avoid will be accomplished by observers until technology can be certified. Observer qualification will be addressed later in this section. How UASs will be "commanded and controlled" is at the heart of establishing UAS qualification rules. The FAA's case by case approach needs to be standardized and simplified by classifying UASs by performance and gross weight, then tying qualification requirements to those classifications. Instead of re-accomplishing work on classification, the FAA should take two important steps: 1. Re-define UAS and 2. Modify existing UAS classifications to meet the FAA's regulatory needs.

The first step in tackling this momentous task is defining UAS. The FAA has defined a Unmanned Aircraft (UA) as "a device used or intended to be used for flight in the air that has no onboard pilot" (FAA, 2008b). The FAA definition seems logical but does not differentiate between UASs and Model Aircraft. In fact the FAA's definition is almost identical to the Academy of Model Aeronautics definition of model aircraft which states, "a model aircraft is a non-human-carrying aircraft capable of sustained flight in the atmosphere" (AMA, 2011b). How will pilots know when policy governing UASs pertain to their operations or when they are simply flying a model aircraft? Does the distinction pertain to size or function? The FAA's UAS questions and Answers page states that their "guidance does not address size of the model aircraft... (and) should be flown a sufficient distance from populated areas and full scale aircraft, and are not for business purpose" (FAA, 2011). Although the FAA is expansive in discussing UASs, the only clues to a workable definition are that UASs are variable in size and function and by excluding "for business" from model aircraft UASs are used for business.

The Department of Defense (DOD) definition is also vague. The DOD defines UAS as, "A powered vehicle that does not carry a human operator, can be operated autonomously or remotely, can be expendable or recoverable" (U.S. Department of Defense, Office of the Secretary of Defense [DOD], 2007). A more precise definition of UAS is needed to eliminate confusion when UAS pilot qualification is required. A suggested definition of UAS that draws on the experiences of the FAA and DOD and clarifies the difference between model aircraft and UASs is: A system of systems consisting of at a minimum an aerial vehicle, a ground control station, and a data link with varying levels of autonomy and artificial intelligence that operates in a capacity other than recreation. Even with re-definition, UAS is an all-encompassing and broad term which required separation into specific categories or types.

The second step in establishing a more defined path for pilot qualification is to categorize UASs and bind qualification requirements to the UAS categories. The DOD has been leading the way in UASs training, qualification and operational employment. The DOD has long recognized the need to classify UASs separately, and with this recognition they have created five groups for classifying UASs. The five groups placed limits on the maximum takeoff weight, operating altitude, and airspeed as shown in Table 1

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(Chairman of Joint Chief of Staff [CJCS], 2009). The DOD in turn uses these UAS groups to determine minimum qualification for UAS crews. This is in contrast to the FAA's current binary classification of (a) UASs requiring a FAA pilot's license and (b) UAS operations that do not require a pilot's license (FAA, 2008b).

Table 1

Department of Defense UAS Categories

UAS Category	Maximum Takeoff Weight (pounds)	Maximum Operating Altitude	Maximum Speed (KIAS)	Example UAS
Group 1	0- 20	<1,200 AGL	100 Kts	RQ-11 Raven
Group 2	21-55	< 3,500 AGL	< 250 Kts	ScanEagle
Group 3	56-1320	< 18,000 MSL	< 250 Kts	RQ-7 Shadow
Group 4	>1320	< 18,000 MSL	No Limit	MQ-1 Predator
Group 5	>1320	> 18,000 MSL	No Limit	MQ-9 Reaper

Source CJCS, 2009

The five groups allow DOD policy makers to exercise a broader array of pilot qualification requirements and ensure that a UAS pilot flying the 39.7 pound Scan Eagle (US Air Force, 2011) will not require the same training and qualification required for a 10,500 pound MQ-9 Reaper (US Air Force, 2012b). The DOD's UAS categories can easily be modified to meet the needs of the FAA and the greater UASs community. In table 2, the five DOD groups have been reduced to four categories of UASs and allocated according to gross weight, operating altitude and maximum speed.

Table 2

Proposed UAS Categories for the purpose of pilot certification

UAS Category	Maximum Takeoff Weight (pounds)	Maximum Operating Altitude	Maximum Speed (KIAS)	Example UAS
Category 1	0- 25[8]	< 400 AGL	< 87 Kts[9]	RQ-11 Raven
Category 2	26-55	< 2,000 AGL[10]	< 87 Kts[11]	ScanEagle
Category 3	56-1320	2000-18,000 MSL	87- 250 Kts	RQ-7 Shadow
Category 4	>1320	> 18,000 MSL	No Limit	MQ-9 Reaper

Additional changes to the DOD's groups have been made to more closely match current UAS guidance and FARs. The proposed category 1 makes the following changes the DOD's group 1; the maximum takeoff weight is increased from 20 pounds to 25 pounds to meet law enforcement needs, the maximum operating altitude is lowered from 1200 feet Above Ground Level (AGL) to 400 feet AGL to align with limits imposed on model aircraft enthusiasts (AMA, 2011b), and the maximum airspeed is limited to less than 87 knots to match the limitations placed on sport pilots (14 CFR part 61subpart J).

Category 2 modifies DOD's group 2 by lowering the maximum altitude from 3,500 feet to 2,000 feet AGL to align with the current Sport Pilot limits and the maximum airspeed is limited to less than 87 knots to match the limitations placed on sport pilots (14 CFR part 61subpart J). Proposed category 3 is the same as the DOD's group 3. The DOD's group 4 has been eliminated in order to make pilot qualification match more closely with the UAS categories and because the only difference between the DOD's group

[8] The DOD originally set the limit to 20 pounds (CJCS, 2009). The FAA in a news release (FAA, 2012) set the limit for law enforcement to fly small UASs at 25 pounds

[9] Under 2,500 AGL, speed is limited to less than 200 Knots (14 CFR 91.117). The limit set by the Academy of Model Aeronautics Safety Regulations (AMA, 2011a), however, it defies logic for category 2 to be more restrictive that category and the same limit is set for both categories

[10] Based on FAA sport pilot limitations of 2000 feet AGL or 10,000 feet MSL, whichever is lower (14 CFR part 61subpart J).

[11] Based on FAA sport pilot limitations of flying 87 KCAS (14 CFR part 61subpart J).

4 and 5 is the altitude limitation. In table 2, if a UAS has a maximum takeoff weight greater than 1320 pounds and or the UAS operates above 18,000 feet MSL, it would be classified as category 4.

The DOD has to date flown the preponderance of UASs in a wide variety of airspace and meteorological conditions. In 2009 the Chairman of the Joint Chief of Staff issued an instruction entitled, *Joint Unmanned Aircraft Systems Minimum Training Standards* (CJCS, 2009). In this instruction the Chairman created four distinct qualification levels for DOD UAS operators and then connected qualification level to specific class of UASs. The following qualification levels have direct correlation to current FAA certifications and ratings. It is not only appropriate but advantageous for the FAA to follow UAS operator qualification categories that are based on the DOD's experience and exceed the requirements established in the FAA's interim guidance. All UAS operators, independent of size or level of autonomy[12], need to have a common level of understanding of federal aviation regulations, airspace and Pilot in Command duties and responsibilities.

Level 1: Pilot requirements to operate a category 1 UAS

A Level 1 operator will have basic aeronautical knowledge obtained by attending an authorized private pilot ground instruction and pass the FAA's written examination. Level 1 qualification is required for operating a UAS under 400 feet AGL and at least five miles from an airport or heliport. UASs flown by Level 1 operators will be less than 25 pounds. Level 1 is also the required training for all airborne or ground based observers.

Level 2: Pilot requirements to operate a category 2 UAS

A Level 2 operator will have all of the qualifications of a Level 1 operator and hold at least an FAA sport pilot license. Level 2 qualification is required for operating a UAS under 2000 feet AGL or 10,000 feet MSL, whichever is lower and is restricted to operating in Class E and G airspace. Level 2 UAS operators will be limited to Visual Meteorological Conditions (VMC) and therefore fly only under Visual Flight Rules (VFR) (14 CFR 91.155). UASs flown by Level 2 operators will be less than 55 pounds and airspeed limited to less than 87 Knots.

Level 3: Pilot requirements to operate a category 3 UAS

A Level 3 operator will have all of the qualifications of a Level 1 operator and hold at least an FAA private pilot license. Level 3 qualification is required for operating a UAS under 18,000 feet AGL and in Class C, D, E, and G airspace. Level 3 UAS operators will be limited to VMC (14 CFR 91.155) and therefore fly only under VFR. UASs flown by Level 3 operators can be more than 55 pounds but less than 1,320 pounds and airspeed will be limited to less than 250 Knots.

Level 4: Pilot requirements to operate a category 4 UAS

A Level 4 operator will have all of the qualifications of a Level 1 operator and hold at least an FAA private pilot license with an instrument rating. Level 4 qualification is required to operate a UAS in Class A airspace, at night or anytime the UAS will be flown in Instrument Flight Rules (IFR) conditions (14 CFR 1.1) . No UAS independent of pilot qualification level will be allowed into Class B airspace (FAA, 2008b). UASs flown by Level 4 operators can be greater than 1,320 pounds.

This paper will use a hypothetical scenario of a pilot flying a Insitu Scan Eagle as an example of the practical application of these qualification levels. If a pilot was to operate a Scan Eagle at 1,500 feet AGL, that pilot would require level 2 qualification based on weight and altitude. If the pilot of same Scan Eagle climbed to 15,000 feet AGL, then he/she would require level 3 qualification based on altitude.

Observers

Observers are used to fulfill the see and avoid requirement (14 CFR 91.113) until technology is improved and the FAA deems the requirement obsolete. Observers are required to have basic aeronautical knowledge equivalent to a level 1 UAS operator and be able to communicate with the UAS's pilot/ operator. Ground observers must maintain unaided visual line of sight with the UAS. Airborne observers must maintain visual line of sight from a chase plane and may not pilot the chase plane while acting as an observer. In either case observers are required to have at least a UAS Operator qualification level of 1.

Adopting a modified version of the DOD's UAS groups and tying qualification levels to those groups is only part of the solution. The extreme diversity in UAS GCS designs and UA performance necessitates that FAA regulate the level of training in UAS type far beyond the normal currency and instructor based upgrade. A viable solution to this piece of the puzzle is the use of type ratings.

Type Ratings

In a study conducted by the Air Force Research Laboratory (Schreiber, Lyon, Martin, 2002), researchers

[12] Autonomy must be limited so that "UAS(s) that have the capability of pilot intervention, or pilot-in-the-loop, shall be allowed in the NAS" which does not include UASs autonomous flights indoors or in Restricted, Prohibited, or Warning areas (FAA,2008b).

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compared seven groups flying various operations in a Predator UAS. The groups included UAS pilots, civilian pilots, military pilots (trained in aircraft other than UASs) and non-pilots. The results of this study, logically, indicate that UAS pilots performed the best and non-pilots performed the worst. This research supported the notion that formally trained pilots are necessary for operating UAS, and UAS training makes a significant difference in aircrew performance when operating UAS. Traditional pilots of manned aircraft train on small aircraft and transfer the basic skills to larger more complex aircraft. These upgrades are typically handled through an instructor-led upgrade process which cover aircraft specifics and differences. Pilots are then required to complete a flight review in accordance with 14 CFR 61.56 and must maintain recent flight experience as prescribed in 14 CFR 61.57. The transfer of cognitive training and aeronautical knowledge gained from small manned aircraft to various UASs may be better than no pilot training at all, however, it does not mean training in a small UAS will necessarily transfer to safely operating a large or even a medium UAS.

Aforementioned, UASs are very diverse in design, function and level of automation, and therefore require in-depth vehicle specific training. The combination of complex systems, lack of normal sensory cues, and no standardized ground control station configuration, has left pilots with low skill transfer between systems (Weeks, 2000). Type ratings have been traditionally used for large aircraft over 12,500 pound maximum takeoff weight (14 CFR 1.1) and turbojets (14 CFR 61.31). However the FAA Administrator may require any aircraft to require a type rating under existing regulations (14 CFR 61.31). UASs are unique because there are significant differences between UAS types. The use of type ratings for UASs would maximize safety and ensure pilots are training in relevant knowledge and skill areas. The use of type ratings in UASs should exclude proposed category 1 UASs that fly under 400 feet AGL.

Commercial Application

Traditionally UASs have been utilized by the Department of Defense and the Department of Homeland Security for military and security operations. However the promise of cost savings over manned aircraft and superior endurance and efficiency has sparked the desire for commercial application of UASs (FAA, 2010). In the last few years over 50 companies, universities and governmental agencies have applied UASs technology to a broader range of operations to include; aerial photography, land surveying, crop monitoring, environmental monitoring and response, and public safety (FAA, 2010). All UAS categories and classes for pilot qualification discussed thus far are for private use. Commercial application will be the major demand for UASs in the future and the "for hire" status of the aircrew will require a higher level of qualification. UAS aircrew or operators employed for the sole purpose of UAS flight test or "for hire" operations should be treated no different than in manned aircraft and should be required to have a FAA commercial pilot license (14 CFR 61) in addition to meeting all other requirements outlined in this paper. The requirement for a Commercial Pilot certificate to operate an UAS should exclude proposed category 1 UASs which fly under 400 feet AGL.

Medical Requirements

Currently all UAS operators and observers, independent of qualification level are required by the FAA to possess a valid FAA Second Class medical certificate (14 CFR part 67) and have it in their possession during execution of their duties as either a UAS operator or observer (FAA, 2008b). Second Class medical certificates require airman to have 20/20 distant visual acuity or better with or without corrective lenses (14 CFR 67 subpart C).

This requirement for UAS operators is onerous. The FAA has established requirements for UAS crews which far exceed the requirements for manned aircraft of equal weight, size and performance. The FAA's current guidance does not account for large UAS's use of monitors and cameras to display images instead of seeing objects with true distance vision, or the fact that according to the FAA Modernization and Reform Act of 2012 model aircraft operators can fly remote controlled aircraft up to 55 pounds, under 400 feet without any medical or pilot qualification requirements. A more logical approach is to apply the medical requirements as proposed in Table 3.

Table 3

Proposed Medical requirements for UAS Operators

UAS Qualification Level	Maximum Takeoff Weight (pounds)	Maximum Operating Altitude	Maximum Speed (KIAS)	Medical Requirements
Level 1	0- 25[13]	< 400 AGL	< 87 Kts[14]	**Valid US Driver's License**
Level 2	26-55	< 2,000 AGL[15]	< 87 Kts[16]	**Valid US Driver's License**
Level 3	56-1320	2000-18,000 MSL	87- 250 Kts	Third Class Medical
Level 4	>1320	> 18,000 MSL	No Limit	Third Class Medical
Level 2,3,4	Commercial Application of a UAS			Second Class Medical[17]

The medical requirements depicted in Table 3 are based on Medical Certificate requirements outlined in the FARs (14 CFR 61.23). Currently the FAA requires Sport pilots, the equivalent to a UAS Level 2 qualification, to hold either any Class Medical or a valid U.S. driver's license. This standard should be applied to both level 1 and level 2 UAS qualified crews. This will ensure the user is safe to operate a 55 pound or less UAS under 2000 feet AGL. FAA certified Sport pilots are able to operate aircraft in the Light Sport category that weigh less than 1,320 pounds and below 2,000 feet AGL with only a valid driver's license (14 CFR 61.23) and could be used as the template for smaller UASs up to 55 pounds.

Pilots wishing to fly larger UASs in the NAS should have medical certificates that align with manned aircraft requirements for equivalent category, class and type of aircraft. All UASs operations requiring a level 3 or 4 pilot qualification should possess a third-class medical. A third class medical certificate requires visual acuity of 20/40 (14 CFR 67 Subpart D) and periodic reissue of the certificate every 60 months if the applicant is under 40 years old or every 24 months if the applicant is over 40 years old (14 CFR 61.23). If a UAS pilot would be operating "for hire" they would require a second class medical, the same as required for commercial pilots (14 CFR 61.23). Commercial pilots require the aforementioned 20/20 distant visual acuity or better with or without corrective lenses (14 CFR 67 subpart C) and reissue every 12 months (14 CFR 61.23).

Summary

UAS Operator qualification is a complex issue that will set the foundation for other integration issues. The FAA's initial guidance is simplistic and will not appropriately manage the diverse requirements of UAS operations. The FAA has understandably made UAS operations very restrictive and placed qualification requirements on UAS crews that far exceed current manned aircraft or model aircraft requirements. These restrictions are further shown to be onerous by the fact that model aircraft enthusiasts are currently able to fly radio controlled aircraft weighing up to 55 pounds (AMA, 2011b) at speeds of 200 miles per hour without medical or license requirements (AMA, 2011a). The Department of Defense has vast experience flying and operating UASs in special access airspace. The Chairman of the Joint Chiefs has issued a policy for UAS operator qualification and aligned the policy with current FAA pilot qualification requirements. Therefore, a logical next step would be to modify this ground breaking work of the DOD and make it work for the greater NAS.✈

13 The DOD originally set the limit to 20 pounds (CJCS, 2009). The FAA increased the weight limit for law enforcement to fly small UASs to up to 25 pounds (FAA, 2012e).

14 Speed limits under 2,500 AGL is limited to less than 200 Knots (14 CFR 91.117). This is also the limit set by the Academy of Model Aeronautics Safety Regulations (AMA, 2011a).

15 Based on FAA sport pilot limitations of 2,000 feet AGL or 10,000 MSL, whichever is lower (14 CFR part 61subpart J).

16 Based on FAA sport pilot limitations of flying 87 KCAS (14 CFR part 61subpart J).

17 Commercial Application of a level 2, 4, or 4 UAS should require a second class medical (14 CFR 67 Subpart C).

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