



AEROSPACE RECOMMENDED PRACTICE

ARP5707™

Issued 2010-11
Reaffirmed 2016-04

Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations

RATIONALE

ARP5707 has been reaffirmed to comply with the SAE five-year review policy.

TABLE OF CONTENTS

1.	SCOPE.....	2
2.	REFERENCES.....	2
2.1	Applicable Documents	2
2.2	Related Publications	3
3.	ABBREVIATIONS AND ACRONYMS.....	4
4.	INTRODUCTION/BACKGROUND	5
5.	EXPECTED USAGE OF THIS DOCUMENT	6
6.	BASIS FOR DEVELOPING PILOT TRAINING RECOMMENDATIONS	7
6.1	Intended Use	8
6.2	Operational Environment	8
6.3	Pilot Requirements	9
6.4	Aircraft System Characteristics	10
7.	DEVELOPMENT OF UAS PILOT TRAINING SYLLABI	14
7.1	Comparing the Private and Commercial Pilot Practical Test Standards	14
7.2	Modifying the Private and Commercial PTS Topics for UAS Pilot training	16
7.3	Modifying the Instrument Rating PTS Topics for UAS Pilot training.....	19
8.	UAS PILOT QUALIFICATION AND TRAINING RECOMMENDATIONS	21
8.1	Certification Restrictions	22
8.2	Type ratings	23
8.3	Specific examples of Training requirements.....	23
8.4	POssession of a Manned Aircraft Certification	24
8.5	Other Topics.....	26

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2016 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
<http://www.sae.org>

SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/ARP5707>

SAE WEB ADDRESS:

Full document details: SAE ARP5707

Documents

Visit Document Sharing Hub

1. SCOPE

This document provides an approach to the development of training topics for pilots of Unmanned Aircraft Systems (UAS) for use by operators, manufacturers, and regulators. The identification of training topics is based initially on Practical Test Standard (PTS) topics for manned aircraft pilots. The topics identified could be used for the construction of a PTS for UAS commercial pilot operations and a PTS for a UAS pilot instrument rating. The UAS commercial pilot rating would contain restrictions on the types of operations that could be flown that would be dependent on the type of UAS used. The UAS type would also influence the specific training topics that would be covered. This document is not intended to outline the requirements for other crewmembers, such as observers, payload operators, or ground personnel, nor does it distinguish between different levels of pilot authority or discuss the roles for pilot-in-command, supplemental pilot, or observer. The recommendations outlined in this document assume that UAS pilot certification will not require a manned certification as a prerequisite. No recommendations are given for recurrent training, specific medical requirements, or whether or not UAS instructors must hold a Certified Flight Instructor (CFI) certificate.

Training and certification of UAS pilots for commercial operations in the National Airspace System (NAS) is a new field. Consequently, the scope of this document is limited to proposing an initial framework to train and certify UAS pilots for fixed wing UAS. As the community grows, certification and training requirements will become more detailed and refined. Additionally, there are other classes of UAS that will need to be addressed in detail in the future. These include rotary wing, ducted fan vertical flight, and lighter-than-air.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 Applicable Documents

Civil Aviation Authority, United Kingdom. *UA and Rocket Operations in UK Airspace – Guidance*. CAP 722, November 12, 2004.

Civil Aviation Safety Authority, Australia. *UA and Rocket Operations*. CASR Part 101, January 2003.

Federal Aviation Administration National Policy (March 2008) Order 8130.34 Airworthiness Certification of Unmanned Aircraft Systems.

Federal Aviation Administration AIR-160 (March 2008) Unmanned Aircraft Systems Operations in the U.S. National Airspace System – Interim Operational Approval Guidance 08-01.

Munsen, K (ed.). *Jane's Unmanned Aerial Vehicles and Targets*. Jane's Information Group, London. (various). Editions

Potter, P., (2005). *Program Review Unmanned Aircraft Systems*. U.S. Department of Transportation, Federal Aviation Administration, Flight Technologies and Procedures Division, Washington, DC

Van Blyenburgh, P. (2006). *UA Systems: Global Review*. UVS International, Avionics'06 Conference, Amsterdam, The Netherlands.

Weibel, R. E. & Hansman, R. J. (2005). *Safety Considerations for Operation of Unmanned Aerial Vehicles in the National Airspace System*. MIT International Center for Air transportation, Cambridge, MA, Report No. ICAT-2005-01.

Williams, K.W. (2004). A summary of UA accident/incident data: Human factors implications. U.S. Department of Transportation, Federal Aviation Administration, Office of Aerospace Medicine, Washington, DC. Technical Report Publication No. DOT/FAA/AM-04/24.

Williams, K.W. (2007). *UA Pilot Medical Certification Requirements*. U.S. Department of Transportation, Federal Aviation Administration, Office of Aerospace Medicine, Washington, DC. Technical Report Publication No. DOT/FAA/AM-07/3.

Williams, K.W. (2008). *Documentation of sensory information in the operation of unmanned aircraft systems*. U.S. Department of Transportation, Federal Aviation Administration, Office of Aerospace Medicine, Washington, DC. Technical Report Publication No. DOT/FAA/AM-08/23.

2.2 Related Publications

Aerospace Daily (1994). Future of UAs depends on commercial, not military markets. *Aerospace Daily*, 170(39), 308.

FAA (1981). Model Aircraft Operating Standards. Federal Aviation Administration, AC 91-57.

Barnes, M. J., Knapp, B. G., Tillman, B. W., Walters, B. A., Velicki, D. (2000). *Crew systems analysis of unmanned aerial vehicle (UA) future job and tasking environments* (Technical Report ARL-TR-2081). Aberdeen Proving Ground, MD: Army Research Laboratory.

Barnes, M.J. & Matz, M.F. (1998). Crew simulations for unmanned aerial vehicle (UA) applications: Sustained effects, shift factors, interface issues, and crew size. *Proceedings of the Human Factors and Ergonomics Society 42nd Annual Meeting*, 143-7.

Bergman, C.A. (1976). An airplane performance control system: A flight experiment. *Human Factors*, 18(2), 173-182

Birmingham, H.P. & Taylor, F.V. (1954). A design philosophy for man-machine systems. *Proceedings of the IRE*, 42, 1748-1758.

Clough, B. T. "Metrics, Schmetrics! How do You Track a UAV's Autonomy?" AIAA-2002-3499. *AIAA 1st Unmanned Aerospace Vehicles, Systems, Technologies, and Operations Conference and Workshop*, Portsmouth, VA. May, 2002.

Clough, B. T. Unmanned Aerial Vehicles: Autonomous Control Challenges, A Researcher's Perspective." AIAA 2003-6404. *2nd AIAA Unmanned Unlimited" Systems, Technologies, and Operations – Aerospace*, September 15-18 2003, San Diego, California.

Cummings, M. L., & Guerlain, S. (2004). Developing operator capacity estimates for supervisory control of autonomous vehicles. Manuscript under review at *Human Factors*.

DeGarmo, M. & Nelson, G.M. (2004). *Prospective unmanned aerial vehicle operations in the future national airspace system*. Paper presented at the American Institute of Aeronautics and Astronautics' 3rd "Unmanned Unlimited" Technical Conference, Workshop and Exhibit, September 20-22, Chicago, IL.

DeGarmo, M. (2004). *Issues concerning integration of unmanned aerial vehicles in civil airspace*. Mitre Corporation Report # MP04W0000323.

Dino, J. (2003). NASA to dedicate new unmanned aerial vehicle technology center. Retrieved on 3/26/2004 from NASA News website, URL http://amesnews.arc.nasa.gov/releases/2003/03_56AR.html.

Dolgin, D., Kay, G., Wasel, B., Langelier, M., & Hoffman, C. (2001). Identification of the cognitive, psychomotor, and psychosocial skill demands of uninhabited combat aerial vehicle (UCAV) operators. Downloaded from URL <http://forum.nomi.med.navy.mil/articles/safeucav/> on 3/10/2005.

Federal Aviation Administration. Order 7610.4K. Special Military Operations, February 19, 2004.

Fogel, L.J., Gill, R.S., Mout, M.L., Hulett, D.G., & Englund, C.E. (1973). *Principles of display and control design for remotely piloted vehicles*. Decision Science, Inc. second semi-annual technical report on Contract #N00014-72-C-0196, Project # NR 196-119/11-29-71 455.

Gawron, V.J. (1998). Human factors issues in the development, evaluation, and operation of uninhabited aerial vehicles. *AUVSI '98: Proceedings of the Association for Unmanned Vehicle Systems International*, Huntsville, AL, 431-8.

Hall, E.P. & Tirre, W.C. (1998). *USAF air vehicle operator training requirements study* (AFRL-HE-TP-SR-1998-0001). Brooks Air Force Base, TX: Air Force Research Laboratory, Human Effectiveness Directorate.

James, T. (1994). Multi-mission/multi-agency reconfigurable UA. *Unmanned Systems, Winter*, 41-42.

Kiggans, R.G. (1975). Air Force RPV operators: Rated vs. non-rated. (MS Thesis Number GSM/SM/75D-15). Wright-Patterson AFB, OH: Air Force Institute of Technology.

Kraus, E.F., & Roscoe, S.N. (1976). Reorganization of airplane manual flight control dynamics. In W.B. Knowles, M.S. Sanders, and F.A. Muckler (Eds.) *Proceedings of the sixteenth annual meeting of the Human Factors Society*. Santa Monica, CA: Human Factors Society, 117-126.

McCarley, J. S. & Wickens, C. D. (2005). *Human Factors Implications of UAS in the National Airspace*. University of Illinois Institute of Aviation Technical Report (AHFD-05-5/FAA-05-1). Savoy, IL

Previc, F.H. & Ercoline, W.R. (1999). The "outside-in" attitude display concept revisited. *International Journal of Aviation Psychology*, 9(4), 337-401.

Reising, J.M. (2003). The role of operators in uninhabited military vehicles: A NATO perspective. *Proceedings of the 12th International Symposium on Aviation Psychology*, Dayton Ohio, April 14-17, 988-92.

Schreiber, B. T., Lyon, D. R., Martin, E. L., & Confer, H. A. (2002). *Impact of prior flight experience on learning Predator UA operator skills* (AFRL-HE-AZ-TR-2002-0026). Mesa, AZ: Air Force Research Laboratory, Warfighter Training Research Division.

Spence, C. F. (ed) (2003). *FAA Aeronautical Information Manual*. McGraw-Hill, New York.

Federal Aviation Administration. *U.S. Airspace Classes at a Glance Card*. http://www.asy.faa.gov/safety_products/airspacecard.html. Accessed July 11, 2005.

Thompson, W.T., Tvaryanas, A.P., & Constable, S. H. (2005). U.S. military unmanned aerial vehicle mishaps: Assessment of the role of human factors using Human Factors Analysis and Classification System (HFACS). U.S. Air Force, 311th Performance Enhancement Directorate, Performance Enhancement Research Division. Document # HSW-PE-BR-TR-2005-0001.

Tirre, W.C. (1998). Crew selection for uninhabited air vehicles: Preliminary investigation of the air vehicle operator (AVO). *Proceedings of the Human Factors and Ergonomics Society 42nd Annual Meeting*, 118-22.

Walters, B.A., Huber, S., French, J., & Barnes, M.J. (2002). *Using simulation models to analyze the effects of crew size and crew fatigue on the control of tactical unmanned aerial vehicles (TUAs)* (ARL-CR-0483). Aberdeen Proving Ground, MD: Army Research Laboratory.

Weeks, J.L. (2000). *Unmanned aerial vehicle operator qualifications* (AFRL-HE-AZ-TR-2000-0002). Mesa, AZ: Air Force Research Laboratory, Warfighter Training Research Division.

3. ABBREVIATIONS AND ACRONYMS

ADM	Aeronautical Decision Making
AFS-400	FAA Aviation Flight Standards, New Technology and Procedures Division
AIM	Aeronautical Information Manual
ATC	Air Traffic Control
CFI	Certified Flight Instructor
CFRs	Code of Federal Regulations
EP	External Pilot

FAA	Federal Aviation Administration
FL	Flight Level, e.g., FL 180 = 18 000 feet
FMS	Flight Management System
GCS	Ground Control Station
GPS	Global Positioning System
IFR	Instrument Flight Rules
IP	Internal Pilot
LAHSO	Land and Hold Short Operations
MTOW	Maximum Take-Off Weight
NAS	National Airspace System
NOTAM	Notice to Airmen
NPRM	Notice of Proposed Rule-Making
PIC	Pilot in Command
PTS	Practical Test Standard
SIDS	Standard Instrument Departures
STARS	Standard Terminal Arrival Routes
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
VFR	Visual Flight Rules

4. INTRODUCTION/BACKGROUND

This Aerospace Recommended Practices (ARP) document contains information and guidance in the form of recommendations for the development and implementation of pilot training for UAS pilots within the context of the operational requirements and an equivalent level of safety for operation in the NAS. The term Unmanned Aircraft System was adopted by the U.S. regulatory and research organizations to reflect that there is more than just an aircraft involved in the risks associated with operating in the NAS. In the most general terms, a UAS includes the aircraft, the Ground (or Remote) Control Station, and the data link used for control of the aircraft. More specifically, the UAS includes all of the subsystems and equipment necessary to control flight of the UA, including taxi, takeoff, departure climb, cruise, arrival, descent, and landing or recovery. A comprehensive list of these UAS elements is provided in Table 1 (van Blyenburg, 2006).

TABLE 1 - UAS ELEMENTS REQUIRED FOR OPERATION IN THE NAS

- The control station(s) and antenna systems
- All associated software and health monitoring systems
- Communications data links (ground/air and air/ground)
- Data terminals for payload management
- The flight termination system
- Launch and recovery systems
- Ground support and maintenance equipment
- Power generation, distribution and supply
- Air Traffic Control communications equipment (voice and data)
- Handling, storage and transport equipment
- All required flight manuals, maintenance manuals and any documentation required for a safe flight

Due to the rapid development of UAS manufacturing for aircraft with a wide range of capabilities, a need has developed for routine access to the NAS in order to meet commercial, civil and military demand for UAS applications. These needs include initiatives that support the public good, promote national security and provide a means for further economic growth. For example, UASs are currently being proposed for a wide variety of public and commercial applications from traffic and border surveillance, law enforcement and drug interdiction to package delivery, agricultural spraying, and forest fire monitoring.

This wide variety of potential uses within the NAS, at a range of altitudes by vehicles with a spectrum of sizes and performance capabilities requires an analysis of the human factor issues that will be involved with integration and operation of UA safely within the NAS. One of the most basic and primary issues critical to this requirement is UAS pilot qualifications and training practices.

Current UA operations can require several team members to operate safely in the NAS. This system uses some combination of pilot, payload operator, chase planes, radar, ground observers, and maintenance personnel to perform the desired mission. As UAS mature and evolve the number of people used to operate a UAS will change and their roles will change. However, there will always be at least one "pilot-in-command". Initially, using a certification and training scheme whose roots are in the training and certification of manned aircraft pilots makes sense. The training of manned aircraft pilots has evolved into a well established system. As UAS commercial operations in the NAS grow, the training and certification requirements will evolve to insure safe and reliable UAS operations. This document provides a model to address the training and certification of pilots of UAS in the NAS.

Though much of the guidance has been developed using existing UAS platforms, great effort was taken to anticipate future advances in UAS capabilities, most notably, increases in range, altitude, and endurance, improvements in autonomous behaviors, and decreases in size. This document has attempted to construct a set of guidelines that is sufficiently broad to capture not only current, but future technology.

5. EXPECTED USAGE OF THIS DOCUMENT

This document provides pilot training recommendations for civil and public UA operators in the NAS for consideration by operators, manufacturers, and regulators. This document divides UAS operation into two distinct categories: Certificated Pilot Operating under Visual Flight Rules (VFR) and Certificated Pilot Operating under Instrument Flight Rules (IFR).

For pilots in the first category, this document provides a comprehensive list of training topic areas that are recommended for flight under VFR rules. These operations will apply to all types of UAS platforms and could involve flight in congested and controlled airspace but may involve restricted flight regimes with smaller platforms. Examples of types of operations might be pipe line or power line inspection, traffic monitoring, or agricultural/environmental spraying.

The second category will include aircraft that operate in instrument meteorological conditions (IMC) or within Class A Airspace. Examples of these types might be Package Delivery or Bank Paper transport

In addition, some pilots will operate with various types of restrictions imposed on the certification. These restrictions normally apply to smaller aircraft or aircraft that do not operate in the manner of manned aircraft within the NAS. These aircraft will typically operate at low altitudes, within visual line of sight of the pilot, off-airport, or with high degrees of automation that do not allow the pilot to exceed specified flight envelope restrictions. These operational restrictions serve to significantly reduce the risk and training requirements for these UAS types. Examples of operations performed with such UAS types might include police urban surveillance or search and rescue operations.

The use of a restricted certification for UAS pilots is specifically addressed as one method for reducing the training time and burden associated with full IFR or VFR operations. These recommendations are intended to be one means for the development of training programs required to operate civil UAS in the NAS.

6. BASIS FOR DEVELOPING PILOT TRAINING RECOMMENDATIONS

The NAS is a complex integration of regulations, procedures, and an infrastructure designed and operated to safely provide aircraft access to the airspace by civil and military *manned* aircraft. The NAS is operated under the auspices of the Code of Federal Regulations (CFRs) which govern the design and operation of airways, aircraft, air navigation aids, airports and air traffic control, as well as the certification of pilots. Figure 1 illustrates the various interactions between systems that determine what training is required for pilots flying in the NAS.

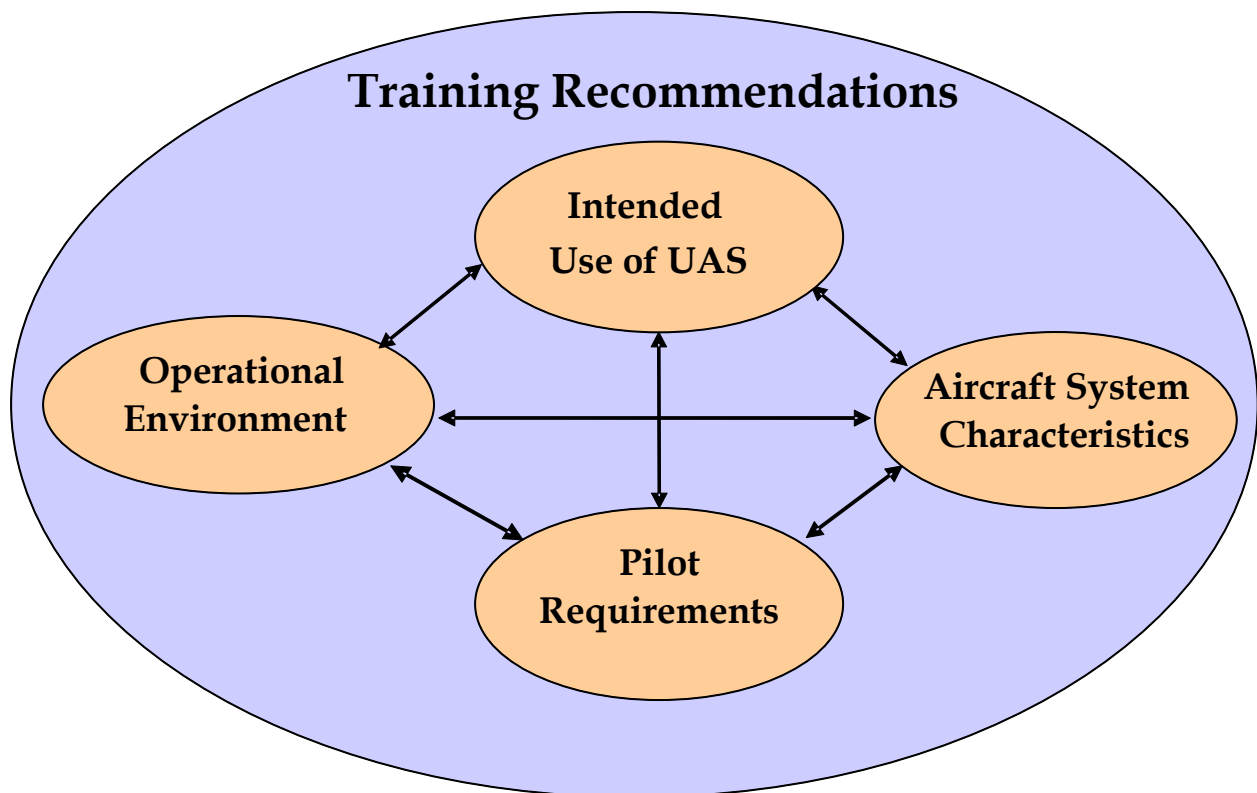


FIGURE 1 - THE BASIS FOR UA PILOT TRAINING RECOMMENDATIONS

6.1 Intended USe

Introducing UA into the NAS is a difficult, inter-related process that includes a comprehensive understanding of each UAS operator's intended use or application of the aircraft. This intended use impacts the size, speed and endurance of the aircraft, the level of control available to the pilot in order to operate safely, and the airspace that will constitute the primary flight regime. All of these parameters collectively influence the amount, duration and content of an approved pilot training program that will allow the pilot to safely and competently fly the aircraft. For example, some flight applications, such as pipeline inspection, can take one or two hours, whereas other applications, such as a telecommunications relay flight, might last for several days or even weeks, depending on the endurance capabilities of the aircraft. Some applications will require daytime flights only, while others might be required to be flown at night. These requirements, in turn, will determine the pilot training requirements necessary for the safe and efficient completion of the flights. The development of training recommendations for UAS requires an understanding of the potential applications in which the aircraft will participate. Table 2 below presents a sampling of these potential applications.

TABLE 2 - POTENTIAL UAS APPLICATIONS

Sensing/Surveillance

1. Homeland Security, Border Patrol, National Guard
2. Crowd Monitoring/Control (Political Rallies, Sports, Demonstrations)
3. Law Enforcement (Traffic Monitoring, Hot Pursuits)
4. USCG (Maritime Patrol, Drug Interdiction)
5. Wildlife Monitoring/Management
6. Aerial Surveys (Real Estate, Agriculture, Ranching, Geology)
7. Atmospheric Research/Sampling
8. Pollution Detection/Monitoring

Entertainment

1. TV, Movies
2. Advertising
3. Sports Events
4. News

Transport

1. Package Delivery
2. Organs/Blood
3. Bank Paper
4. Agricultural/Environmental Spraying
5. Firefighting

Search and Rescue

1. USCG , National Guard
2. Forest Fire Detection/Monitoring
3. Flood Detection/Monitoring
4. Chemical Spills
5. Natural Disasters (Hurricanes, Earthquakes, Tsunamis)

Communications

1. Telecommunications Relay (phone, cell phone, and/or data)
2. Internet Communications Relay

6.2 Operational Environment

Operating any aircraft in the NAS requires a comprehensive understanding of the operational environment. Training programs must address the regulations that cover the typical conditions of flight, such as airspace structure, operations and restrictions within different classes of airspace, airport operations, aircraft separation, right-of-way, minimum safe altitudes, flight restrictions, terrain avoidance, and cruising altitudes, to name a few. Airspace over the United States is divided into restricted, controlled, and uncontrolled airspace. The airspace where operations are under the direct control of the FAA is outside of restricted airspace and is generally referred to as civil airspace. The FAA has divided civil airspace over the United States and within 3 nm of the coast into six different classes. The classifications separate regions of the airspace by the level of service provided by air traffic control, the type and density of operations conducted in the airspace, and the level of safety required (Spence, 2003). Classification has the effect of procedurally separating air traffic, and therefore procedures for different UA classes are likely to depend upon the airspace they operate in.

Classes A, B, C, D, and E are referred to as controlled airspace, and Class G is uncontrolled airspace. Each class has defined boundaries and weather minimums for VFR flight which are described in the FAA's Aeronautical Information Manual (AIM) (Spence, 2003), and on aeronautical navigational charts. A detailed discussion is beyond the scope of this document. The important aspects of airspace classification relevant to UAS operations are the general restrictiveness of each airspace class, communications and entry requirements, and separation services provided by air traffic control. From the requirements, it can be seen that the restrictiveness of airspace decreases in alphabetical order from Class A to Class G. The separation services provided by air traffic control also vary as the restrictiveness of the aircraft decreases, based on the density and type of operations in the class of airspace. UA Systems are capable of operating in all classes of airspace. The specific UAS type of operation and aircraft performance will dictate the specific class where the aircraft spends the majority of operation time (Williams, 2007). The approval of UAS operation within controlled airspace will be determined by the intended operation, the level and reliability of aircraft, and the aircraft performance capabilities, capability to communicate among the aircraft, the ground controller and air traffic controller, and navigation capabilities which includes knowledge of location and transmission of transponder codes.

In addition to airspace classes, some types of operations will present unique operating environments for UAS. For example, some types of operations will be conducted around, or perhaps even inside, of buildings or other structures. For example, police or fire department personnel might have a need to conduct such operations. Some operations will involve off-airport landings and take-offs. These unique operations and operating environments will impose new training requirements on UAS pilots.

6.3 Pilot Requirements

Training recommendations must take into account the activities of the pilot both before and during the flight. Physiology, sensory information, workload, and pilot decision-making, all contribute to the success and safety of a flight. All of these factors, of course, are affected by the intended use of the UAS.

6.3.1 Physiology and Human Factors

As in manned aviation, information pertinent to the human operator and his/her limitations is a necessary part of ground training. Examples include certification requirements, medical qualifications, flight proficiency requirements, and duty cycles and scheduling limitations. Additionally, UAS pilots must be familiar with some of the sensory phenomena unique to unmanned aircraft control, including spatial disorientation and motion sickness.

Unlike manned flight, the sensory cues upon which pilots rely for information about the state of the aircraft are absent in UA Ground Control Stations (GCS) (Williams, 2008). Seagle (1997, as cited in Thompson, Tvaryanas, & Constable) reports that the lack of sensory feedback may contribute to some launch and recovery accidents. In their discussion of sensory feedback as a factor in UA mishaps, Thompson, Tvaryanas, & Constable (2005) suggest that pilots with prior flight experience are more likely to note the absence of sensory feedback. Furthermore, in their investigation of the effects of prior flight experience on UA pilot skills, Schreiber, Lyon, Martin, and Confer (2002) state that their military pilot participants reported that the landing task was quite difficult. The authors suggest that training to "unlearn" some previously acquired piloting skills may be required for experienced pilots transitioning to unmanned aircraft.

Aviation human factors concerns should also be addressed in training, including crew resource management, workload, fatigue, crew scheduling, and physiology. Because the air vehicle and the operator are not co-located, however, a number of unique operational concerns should be addressed in UA operator training programs, including pilot workload and problems associated with over/understimulation.