U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Effective Date: SEP 21 2011

SUBJ: Airman Testing Standards and Training Aviation Rulemaking Committee (ARC)

1. PURPOSE. This document establishes the Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) according to the Administrator's authority under Title 49 of the United States Code (49 U.S.C.), section 106(p)(5).

2. BACKGROUND.

a. The FAA Flight Standards Service (AFS) promotes safety by educating and advising users through the development, implementation, analysis and distribution of technical information. Among other responsibilities, AFS plans, develops, and maintains materials related to airman certification training and testing. These materials include airman knowledge and skill tests, computer testing supplements, knowledge test guides, practical test standards, training handbooks, and computer testing sites listings. Stakeholders include the public, private industry, and other components of AFS.

b. To carry out the FAA's safety mandate, AFS must ensure that the technical information related to airman knowledge and skill tests, computer testing supplements, knowledge test guides, practical test standards, and training handbooks is regularly updated. These updates must enhance safety and meet the needs of stakeholders by incorporating the most current and relevant standards, policies, procedures, and techniques for airman certification, training, and testing. To that end, the FAA is chartering the Airman Testing Standards and Training ARC to make recommendations on the content, planning, development, production, and review of the aforementioned technical information.

3. OBJECTIVES AND SCOPE OF THE ARC. The Airman Testing Standards and Training ARC will provide a forum for the U.S. aviation community to offer its experience and expertise in the elements of aeronautical knowledge and aeronautical experience required for safer operation in today's National Airspace System (NAS). Specifically, the ARC will develop and recommend:

a. A prioritized list of up to five pilot and/or instructor certificates and/or ratings its work will address.

b. An aeronautical knowledge standard for the selected certificates and ratings. The aeronautical knowledge standard for each certificate and/or rating should set forth the overall precepts that will conceptually frame, guide, and justify its specific technical subject areas.

c. Methods for regular industry participation in the planning, development, production, and review of technical information (e.g., training handbooks, knowledge test guides, and supplements) intended to convey the elements of the knowledge standard.

d. Precepts for development and appropriate review of updated knowledge tests that will accurately and reliably measure the airman's mastery of the aeronautical knowledge standard. This task should include recommendations on types of questions to be included.

The ARC's initial session should address how its recommendations will be accomplished. For example, the ARC may propose standing committees, working groups, forums, or processes to vet various proposals for revised standards, handbooks, and/or tests. The ARC should also consider how to select appropriate representation for any standing committees or working groups.

Within sixty (60) days of its initial meeting, the ARC will complete the prioritized list described in 3(a) and submit it to the Associate Administrator for Aviation Safety for approval. The ARC will submit a report of its final recommendations on Tasks 3(b)-3(d) within 12 months of its initial meeting.

4. ARC PROCEDURES.

The ARC provides advice and recommendations to the Associate Administrator for Aviation Safety. The committee acts solely in an advisory capacity.

The ARC will discuss and present information, guidance, and recommendations that its members consider relevant in addressing the objectives.

5. ORGANIZATION, MEMBERSHIP, AND ADMINISTRATION.

a. The FAA will establish an ARC representing the aviation community, including industry associations, universities, training providers, and professional associations.

- **i.** The ARC will consist of no more than 20 representatives.
- **ii.** The FAA will invite selected organizations and individuals to participate as a member in the ARC.
- **iii.** The FAA will identify the number of ARC members that each organization may select to participate. The FAA will then request that each organization name its representative(s). Only the representative for the organization will have authority to speak for the organization or group that he or she represents.
- **iv.** The ARC may establish specialized work groups that will include at least one committee member and invited subject matter experts from industry and Government, as necessary.
- **v.** Active participation and commitment by members will be essential for achieving the committee objectives and for continued membership on the ARC.
- **vi.** Although not required, committee meeting quorum is desirable.

b. The Associate Administrator for Aviation Safety will receive the committee recommendations and reports.

c. The Associate Administrator for Aviation Safety is the sponsor of the ARC and will select an industry chair from its membership. Also, the Associate Administrator will select the FAA-designated representative(s) for the committee. Once appointed, the chair will:

- **i.** Determine, in coordination with the other members of the ARC, when a meeting is required.

ii. Arrange notification to ARC members of time and place for each meeting.

iii. Draft an agenda for each meeting and conduct the meeting.

iv. Ensure that a Record of Discussions of ARC meetings is kept.

6. PUBLIC PARTICIPATION. The Airman Testing Standards and Training ARC meetings are not open to the public. Persons or organizations that are not members of this ARC and are interested in attending a meeting must request and receive approval before the meeting from the chair or the designated Federal representative.

7. AVAILABILITY OF RECORDS. Consistent with the Freedom of Information Act, 5 U.S.C. § 522, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the ARC will be available for public inspection and copying at the FAA Flight Standards Service, 800 Independence Avenue SW. Washington, DC 20591. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations part 7.

8. PUBLIC INTEREST. Forming the Airman Testing Standards and Training ARC is determined to he in the public interest to fulfill the performance of duties imposed on FAA by law.

9. EFFECTIVE DATE AND DURATION. This ARC is effective upon issuance. The ARC will remain in existence for a period not to exceed eighteen months unless sooner terminated or extended by the Administrator.

J. Randolph Babbitt
Administrator

Proposed Representation for
Airman Testing Standards and Training Aviation Rulemaking Committee

Industry Chair	General Aviation Manufacturers Association
FAA	Flight Standards Service – AFS-3

Aircraft Owners and Pilots Association
AOPA Air Safety Institute
Aviation Supplies and Academics
National Air Transportation Association
National Association of Flight Instructors
Society of Aviation and Flight Educators
Cessna Pilot Training Centers
Gleim Publications
King Schools
Redbird Simulators
Sportys Academy
Jeppesen

Aviation Accreditation Board International (AABI)
University Aviation Association (UAA)

Technical Experts:

AFS-600
AFS-800

A Report from the

Airman Testing Standards and Training Aviation Rulemaking Committee to the Federal Aviation Administration

Recommendations to Enhance the Airman Knowledge Test Content and Its Processes and Methodologies for Training and Testing.

April 13, 2012

April 13, 2012

Ms. Margaret Gilligan
Associate Administrator for Aviation Safety, Federal Aviation Administration (FAA)
800 Independence Avenue, SW.
Washington, DC 20571

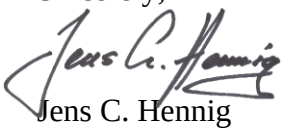
Dear Ms. Gilligan,

The FAA established the Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) on September 21, 2011, with the objective for industry to provide the FAA with its experience and expertise in the elements of aeronautical knowledge and aeronautical experience required for safe operation in the National Airspace System.

On behalf of the ARC members, per section 5b of the ARC charter, I am providing you the recommendations and associated report in response to the four tasks identified by the FAA. The ARC's nine recommendations to the FAA are outlined in the Executive Summary of the report. A detailed review of the recommendations and detailed background and supporting material for each are provided in the main body of the report.

The ARC looks forward to the FAA's response to these recommendations and offers to assist with their implementation, as well as any needed public communication about changes to the airman testing process.

Sincerely,



Jens C. Hennig
Industry Chair, Airman Testing Standards and Training ARC

Cc: Susan Parson, AFS–3, Designated Federal Official
Van Kerns, AFS–600

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

EXECUTIVE SUMMARY

Background

The aviation training community has raised concerns to the Federal Aviation Administration (FAA) over the past few years about how the airman standards, handbooks, and testing materials are not keeping pace with aviation training methods and technology. The aviation community has also faulted the FAA for its piecemeal and often unilateral efforts to revise standards, training material, and testing methodologies. The FAA responded by chartering the Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) in 2011. The ARC was established to comprehensively address the feedback from the aviation industry and provide recommendations to improve the process. See Appendix C, ARC Charter.

This report contains the ARC's recommendations to enhance the airman testing process by setting standards that result in improved relevance of the material being tested and a better correlation between airman testing and the education and training of applicants for FAA certification. Additionally, this report seeks to leverage the aviation community's resources to interact with the FAA for the mutual goal of increasing aviation safety through better training and assessment.

Description of Tasks Assigned to the ARC

The FAA asked the ARC to review and provide recommendations in four areas:

1. *A prioritized list of up to five pilot and/or instructor certificates and/or ratings its work will address.*
2. *An aeronautical knowledge standard for the selected certificates and ratings. The aeronautical knowledge standard for each certificate and/or rating should set forth the overall precepts that will conceptually frame, guide, and justify its specific technical subject areas.*
3. *Methods for regular industry participation in the planning, development, production, and review of technical information (e.g., training handbooks, knowledge test guides, and supplements) intended to convey the elements of the knowledge standard.*
4. *Precepts for development and appropriate review of updated knowledge tests that will accurately and reliably measure the airman's mastery of the aeronautical knowledge standard. This task should include recommendations on types of questions to be included.*

This report does not map directly to the four task assignments, but instead provides a prioritized set of recommendations that propose changes to the content, process, and methodology by which airman testing is conducted.

Summary of the ARC's Process to Complete the Assigned Tasks

The ARC began its work in early October 2011 and established an aggressive schedule to provide its recommendations to the FAA by March 31, 2012, leaving an additional 6 months for follow up questions and to address any additional tasks from the FAA before the term of the ARC expires.

The ARC met in October, December, January, and March in four face-to-face meetings, conducted numerous conference calls, and convened in subgroups to work offline. Through these meetings, the ARC developed its position on a practical way forward to improve airman testing, with the goal of enhancing safety by ensuring that applicants for pilot certification and other aviation personnel are properly qualified to execute their responsibilities.

The ARC identified several other efforts focused on qualifying and evaluating pilots, including multiple ARCs created in response to the Airline Safety and Federal Aviation Administration Extension Act of 2010 (Public Law 111–216). Although these activities were restricted by the FAA's ex parte limits of rulemaking, the ARC took steps to fully understand the work of these other committees.

The ARC, however, benefitted from its charter's focus on the specific subject of testing and evaluation of applicants for initial application for a certificate or rating, as well as from the FAA selecting committee membership from organizations and companies specifically dedicated to the airman certification process. As shown by the recommendations and supporting material in this report, the ARC's discussions focused on the mechanics, theories, and current methodologies for effectively communicating required knowledge and the processes by which applicants' understanding and retention of that knowledge can be assessed.

Benefits of Effective Airman Certification

The testing and evaluation of applicants for airman certification is an essential element in assuring aviation safety. The FAA asked the ARC to examine the aeronautical knowledge standards, the current test process and content, and the training handbooks.

The ARC believes dedicating resources to make airman certification testing more effective is key to enhancing aviation safety. Beyond improving safety, the ARC's recommended changes to the airman certification standards and process will benefit the aviation system by standardizing the training and evaluation of airmen, raising the aviation community's perception of testing credibility and providing a clear link between the regulations, guidance, handbooks, test standards, and knowledge test.

The airman certification regulations contained in parts 61 and 141 of Title 14 of the Code of Federal Regulations identify the broad aeronautical knowledge areas for airman training and testing. The handbooks and testing guides provide essential, detailed descriptions of the knowledge and practical skills that must be taught by instructors for applicants to achieve the standards and pass specific tests. These standards, tests, and handbooks are the primary mechanisms by which the FAA communicates the knowledge and skills necessary to operate safely in the aviation system. The knowledge test, in combination with the practical test administered by a designated pilot examiner, is the method by which the FAA evaluates and verifies that the knowledge and skills developed by the applicant during training adequately meet safety standards.

It is the ARC's opinion that many applicants view the knowledge test only as a trivial hurdle to overcome before moving on to the final certification test (the practical test) instead of a key point at which the FAA determines the applicant's ability to operate safely in the system. Fully linking the different components used to train and assess applicants will provide a systems view

for how to best leverage each step in the process, including better communicating to trainers the important areas of emphasis during the training process and providing a feedback loop for the FAA.

Finally, recognizing the FAA's limited resources, the ARC—responding directly to the task regarding methods for industry participation—recommends several ways the FAA can leverage the aviation industry's expertise and resources to enhance training and testing processes.

ARC Recommendations

The ARC makes nine consensus recommendations in this report with proposed timelines, where applicable. Each recommendation is followed by a summary of the committee's discussions and supporting background information.

The ARC recommends the FAA leverage aviation industry expertise for airman testing standards, handbooks, and test questions while also ensuring key FAA policy offices directly engage in the process (see recommendations 1 and 2). Additionally, the ARC recommends a more effective structure for identifying the standards for airman qualification through the creation of airman certification standards documents, an evolution from today's practical test standards (PTS), test guides, and learning statement codes, while expanding the foundational philosophy for knowledge test questions and directly communicating to the aviation training community changes to tests and the aggregate test results (see recommendations 3, 4, 7, and 8). The airman certification standards for each certificate will become the main guide for applicants to determine the required knowledge, skills, and risk management, as well as the degree of mastery applicants must achieve during their training to pass the test for certification. Questions will fully leverage rote learning where appropriate, while challenging the applicant to understand the needed knowledge without being concerned with trick questions or inconsequential direct excerpts from specific documents.

The ARC expended significant time to determine the best approach for reviewing test questions for relevance. It recommends, at least for the near term, the FAA return the knowledge test item question bank to the public domain (see recommendation 5). The ARC recognizes this recommendation is controversial, but returning the question bank to the public domain—where it previously resided—is the most effective way by which the aviation industry and FAA can work cooperatively to review, revise, and better focus what knowledge applicants must demonstrate during knowledge tests.

Several of these recommendations also require a substantial modernization of the technological infrastructure used by the FAA to administer the airman testing, for which the ARC recommends the FAA urgently provide the necessary resources to acquire testing technology that is commercially available and proven in many similar applications (see recommendation 6).

Finally, the ARC evaluated whether safety would be improved by establishing a pass rate for individual sections of a test, which other industry forums have advocated. The ARC recommends the FAA retain a single knowledge test for each certificate or rating and not move to a system of scoring individual subject areas (see recommendation 9). The ARC believes focusing FAA resources on improving the quality of questions and aligning what is tested with safety priorities far outweighs any perceived benefit from the administration of multiple subtests.

LIST OF ARC RECOMMENDATIONS

Recommendation 1

The ARC recommends the FAA establish by September 30, 2012, a stakeholder body or coordinated bodies of subject matter experts and relevant FAA policy offices to—

- Assist with the development and boarding of knowledge questions.
- Provide continuous review of standards.
- Undertake the review and development of handbook content.
- Assist with the review of the current bank of FAA knowledge test questions for validity and quality.

Recommendation 2

The ARC recommends the FAA revise the quality management system (QMS) process through which key policy offices, including AFS–200, AFS–300, AFS–800, AVP, and ATO[1], make recommendations to the FAA Airman Testing Standards Branch (AFS–630) about needed changes to training and testing documents.

Recommendation 3

The ARC recommends the FAA transition to a single testing standards document, the airman certification standards (an update to the PTS), to include—

- Knowledge,
- Skills, and
- Risk management.

The ARC proposes a schedule for transitioning to the airman certification standards for each certificate in the following order:

- Certificated flight instructor (CFI) (develop and publish by March 31, 2013; with an effective date within 6 months),
- Private pilot (develop and publish by September 30, 2013; with an effective date within 6 months),
- Instrument rating (develop and publish by March 31, 2014; with an effective date within 6 months), and
- Commercial pilot (develop and publish by September 30, 2014; with an effective date within 6 months).

[1] Air Transportation Division (AFS–200), Aircraft Maintenance Division (AFS–300), General Aviation and Commercial Division (AFS–800), Office of Accident Investigation (AVP), and Air Traffic Organization (ATO).

Recommendation 4

The ARC recommends the following concerning the philosophy of question development:

- The FAA should maintain discretion to write questions that reference multiple documents such that applicants must correlate data.
- Although questions must refer to specific FAA guidance documents, the FAA should not use exact quotes from specific passages unless testing specific required rote knowledge.
- Test questions should be written to be pertinent to safe operations and necessary for sound airmanship.
- Tests should incorporate scenario-based questions that assess the applicant's ability to manage the many risks of flying.
- Test questions should not only be relevant to the way pilots operate in the real world, utilizing current technologies both in and outside the cockpit, but also test how those technologies can be used to facilitate proper risk management skills.
- The FAA should adopt a continuous review process to ensure test questions are relevant to the current technology used in aviation, with priority given to removing obsolete information from the tests.

Recommendation 5

The FAA should return the knowledge test item question bank to the public domain by December 31, 2012, in a way that maintains the integrity of questions requiring calculations or interpolations in accordance with the guidance below:

- Remove numbers from questions that require calculations or interpolations.
- For scenario-based questions testing risk management skills, remove any facts and numbers that determine the appropriate course of action, such as wind direction.
- For questions that appropriately test rote knowledge, provide a sufficient number and variety of questions to ensure broad knowledge (such as airspace requirements, regulations, and airport signage and markings).

After 3 to 5 years, the FAA should determine whether it is appropriate to make the question bank, completely or in part, nonpublic, provided the following conditions have been met:

- The advisory group identified in recommendation 1 has been operating for a minimum of 3 years and will continue to operate for knowledge tests for every certificate or rating.
- The advisory group has reviewed all test questions in use.
- Correlation between knowledge tests and practical tests indicates that the new testing system has not been effective in creating airmen who demonstrate improved knowledge and risk management skills.

Recommendation 6

The ARC recommends the FAA urgently allocate additional resources to AFS–630 for an improved computer system (including both hardware and software) for development, maintenance, and delivery of knowledge tests that can—

- Randomly generate tests that include all required knowledge areas (instead of manually created form tests).
- Display onscreen images with regularly updated figures in place of FAA computer testing supplements.
- Improve data management.
- Be updated and maintained as technology improves.

Recommendation 7

The ARC recommends the FAA improve the feedback mechanism subsequent to knowledge testing by June 30, 2013, by—

- Providing the applicant and instructor the specific missed question(s) to identify the deficient knowledge by review of the Airman Knowledge Test Report.
- Publishing the aggregate results of knowledge testing failure areas to provide a mechanism through which training organizations, providers, and publishers can improve and better target their instruction.
- Reviewing the benefit of integrating the results of aggregate knowledge testing into the Aviation Safety Information Analysis and Sharing (ASIAS) system.

Recommendation 8

The ARC recommends the FAA establish and continuously communicate a schedule for publishing standards, handbooks, and knowledge test questions by June 30, 2013.

To communicate new important safety information while adhering to the publication schedule, the ARC recommends the FAA establish a process through which high priority topics are identified and communicated to stakeholders by use of "hot sheets" that provide time-sensitive information critical to flight safety between scheduled publication dates.

Recommendation 9

The ARC recommends the FAA continue to administer a single knowledge test for each certificate or rating and not transition to testing and scoring individual required subject areas.

SAFETY CONCERNS

The general aviation (GA) fatal accident rate has stalled and remains at an unacceptable level of approximately 1.3 fatal accidents per 100,000 hours, or approximately one fatal accident per 75,000 flight hours. If a typical pilot flies 1,000 hours, 1 in 75 will perish. Stated differently, the GA fatality rate is eight times that of cars on a per-mile basis.[2] These statistics are far from the near-zero probability of being involved in a fatal scheduled air carrier accident.

Recent safety initiatives in the commercial air carrier industry have reduced its accident rate by an impressive 80 percent over the past 15 years, and additional efforts are underway to meet the FAA's goal for the air carrier industry of reducing the safety risk by 50 percent by 2020. Similarly, the FAA's goal for GA safety is a reduction to no more than one fatal accident per 100,000 hours by 2018.

Although both the GA and commercial accident rates provide the clinical statistics for safety, the human story of each event cannot be overlooked. Most people engaged in GA know of someone who has been killed in an airplane accident.[3] Many of these pilots did not court risk, but inadvertently exposed themselves and their passengers to risks they did not fully understand.

Pilots may not fully understand the risks involved with flying because the system through which they are trained and tested currently has limitations. Looking specifically within the scope of the ARC and assuming the knowledge tests are fully relevant to identifying the risks, one problem lies in the way test results are reported. It is possible for a person to—

- Take and pass the required knowledge test,
- Receive incomplete training on subjects they did not answer correctly on the knowledge test, and
- Receive incomplete training from an instructor (who also may have had incomplete training) for the practical test in a way that fails to address the subjects not answered correctly on the knowledge test.

If the designated examiner also fails to identify these discrepancies during the practical test, the applicant becomes a pilot without fully understanding the risks involved.

Though this scenario is an extreme example of the problem, it does occur. The aviation industry has adopted new risk management tools for pilots and incorporated a systems approach to training and safety. The next logical step is integrating those tools into the airman testing process.

[2] In 2009, the National Highway Transportation Safety Administration reported a rate of 1.13 fatal car accidents per 100 million vehicle miles, compared with the 2009 National Transportation Safety Board statistic showing an aircraft fatal accident rate of 1.32 per 100,000 hours flown in GA aircraft (assuming typical aircraft speed of 150 miles per hour).

[3] An aviation speaker on the ARC has made it a habit for the last decade to ask for a show of hands of the attendees at seminars in the FAA pavilions in Oshkosh, Wisconsin, and Lakeland, Florida, and other venues, of those who have known someone personally who was killed in a GA accident. In every case, a strong majority of attendees have raised their hands.

The ARC recognizes the GA accident rate will always be higher than the commercial air carrier accident rate. Air carriers incorporate multiple professionals—dispatchers, managers, schedulers, flight crew, and others—involved with ensuring the safety of every flight and have access to more advanced training and resources than GA. Still, the ARC believes revising the training and testing methods used in GA likely will improve safety among all affected categories of flight.

PURPOSE OF THE KNOWLEDGE TEST

The knowledge test plays an important role in assessing the aeronautical knowledge of the applicant; the test is the first in the airman certification process and the only test in the process the Federal Aviation Administration (FAA) issues directly. The oral and flight tests that comprise the practical test are normally administered by designated pilot examiners (DPE) who are designated by, but do not work for, the FAA.

When analyzing the overall approach to knowledge testing, the ARC members discussed the purpose and goals of the knowledge testing process.

Knowledge tests are one phase of a multistep certification process that involves training and evaluation to a minimum standard across aeronautical knowledge areas defined by Title 14 of the Code of Federal Regulations (14 CFR).[4] The airman certification process includes training and aeronautical experience requirements certified by an authorized instructor, aeronautical knowledge validated by the FAA knowledge tests and practical tests, and flight proficiency validated by the practical tests. In consideration of this, FAA knowledge tests should be considered one of the key components in the airman certification process.

The Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) believes the primary purpose of the knowledge test is to establish that applicants have obtained a satisfactory base level of knowledge before they can test for certification. The test should therefore sample from the knowledge a pilot candidate is expected to know, with reference to specific FAA guidance and documentation. Another purpose of the knowledge test is to identify deficient areas of knowledge that require additional training by the endorsing flight instructor before an applicant is allowed to proceed to the practical test.

As such, the process of knowledge testing serves as a vital communication tool to the aviation community and is the only direct contact between the FAA and the applicant. When test questions are realistic and based on current and relevant information, the test results and content communicate what is important for pilots to know and emphasize those knowledge areas most likely to impact flight safety.

Rote learning of facts may assist in understanding and is often a necessary part of learning. A 2008 European Aviation Safety Agency (EASA) study[5] concludes: "In terms of regulations and knowledge of procedures and essential flight statistics … some meaningful learning does occur with rote learning." Some areas of the test require verbatim recall of specific data and knowledge of aviation that simply has to be memorized. Surface learning is an important first step in the learning strategy to further "deep learn" materials; memorizing some information is critical for a flight student to master the wide variety of knowledge necessary to safely operate an airplane. The ARC, however, does not believe the knowledge test should stop at evaluating the applicant's rote ability; the philosophy of the test should shift to include questions to better assess what the applicant has learned about managing the risks associated with flight.

[4] See Appendix E, ICAO and 14 CFR part 61 Requirements for Knowledge Testing.
[5] Moebus Aviation Consulting (Moebus), "Impact assessment of the publication of questions of theoretical examinations for Part 66 and Part FCL" for the European Aviation Safety Agency, Research Contract EASA.2008.C52, 7 August 2009, p. 8.

The EASA study identified assessment as possibly the single most important influence on student learning, such that it informs what students learn, how they learn, and how much they learn.[6] As a result, the FAA knowledge test can and should be a powerful communication tool to directly and succinctly convey to aviators those areas of knowledge critical to safety of flight. Student pilots have multiple motivations to learn, not only to pass the knowledge test with a high score, but also to know what they need to be safe, competent pilots. Better training results in better pilots, and better tests result in better training.

The FAA should also leverage the knowledge test as a tool by which new areas of emphasis can be placed on topics important to aviation safety. As an example, the FAA could explore the feasibility of focusing question selection by conducting safety analyses of accidents and incidents as well as the National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System to ensure knowledge testing items are representative of those most likely to impact flight safety. Additionally, ongoing efforts such as the Commercial Aviation Safety Team (CAST) and the General Aviation Joint Steering Committee (GAJSC) identify areas on which to focus training and education, and may provide opportunities for targeted emphasis on certain topics.

[6] Moebus, p. 23.

RECOMMENDATIONS

RECOMMENDATIONS 1 AND 2

Recommendation 1: The ARC recommends the FAA establish by September 30, 2012, a stakeholder body or coordinated bodies of subject matter experts (SME) and relevant FAA policy offices to—

- Assist with the development and boarding of knowledge questions.
- Provide continuous review of standards.
- Undertake the review and development of handbook content.
- Assist with the review of the current bank of FAA knowledge test questions for validity and quality.

Recommendation 2: The ARC recommends the FAA revise the quality management system (QMS) process through which key policy offices, including AFS–200, AFS–300, AFS–800, AVP, and ATO[7], make recommendations to the FAA Airman Testing Standards Branch (AFS–630) about needed changes to training and testing documents.

The FAA specifically tasked the ARC with providing recommendations about establishing regular stakeholder participation in the development of test questions.

The ARC charter states "the ARC may propose standing committees, working groups, forums, or processes to vet various proposals for revised standards, handbooks, and/or tests. The ARC should also consider how to select appropriate representation for any standing committees or working groups." For the ARC charter, see appendix C to this report.

The ARC reviewed the FAA's current process for developing and reviewing knowledge test questions. The ARC's recommendations on how to expand participation of key FAA and industry stakeholders are discussed below. The ARC also conducted a review of the National Business Aviation Association's Certified Aviation Manager (CAM) certification process, in which industry successfully participates in the development and boarding of knowledge tests for the certification of aviation managers.

Overview of Current QMS Process

The ARC requested the FAA provide an overview of its current process for developing and reviewing knowledge test questions within the FAA Regulatory Support Division, Airman Testing Standards Branch (AFS–630) as well as the mechanisms for broader FAA input. The FAA presented the existing process at the ARC's first face-to-face meeting in October 2011.

[7] Air Transportation Division (AFS–200), Aircraft Maintenance Division (AFS–300), General Aviation and Commercial Division (AFS–800), Office of Accident Investigation (AVP), and Air Traffic Organization (ATO).

AFS–630 is responsible for ensuring certificated airmen have the knowledge and skills to operate safely in the National Airspace System (NAS). The branch accomplishes this by developing and updating airman certification publications including FAA orders, handbooks and manuals, knowledge test guides, knowledge test questions, and practical test standards (PTS). In total, the branch manages over 80 publications and over 12,000 knowledge test questions in the domestic FAA knowledge test item question bank (hereinafter referred to as the "question bank").[8]

AFS–630 manages 81 knowledge tests covering various airman certificates and ratings, including aircraft dispatchers, aviation maintenance technicians, and pilots. The ARC charter specifically requested the ARC focus on training, testing, and evaluation related to pilot certification. Although the ARC's deliberations focused on these topics, the presentation provided by AFS–630 and the ARC's review and recommendations are applicable to broader airman testing.

AFS–630 has a staff of 13 employees, including aviation safety inspectors (ASI) (operations and airworthiness), educational program specialists, editors, program analysts, and a statistician.[9] Over time, the branch's resources dedicated to developing and maintaining the FAA knowledge test have decreased, while resource requirements and costs for activities such as maintaining outdated technological infrastructure have increased. See recommendation 6 for a discussion of the technological infrastructure and associated limitations.

The ARC spent significant time reviewing the Airman Knowledge Test Question Development, Review, and Revision Process flowchart[10], which identifies the work between the ASIs that develops or reviews the knowledge review questions as well as the process for board review, comments, updates, and editorial changes.

The multistep process begins by identifying the need for a new question, or reviewing an existing question, and progresses after development to a point where the question is subject to a review by an internal board. The board has the discretion to concur with the question or provide comments and suggest changes. This is followed by an editorial review of the question and, after approval, activation of the question in the next cycle roll. Cycle roll updates of the active database occur three times per calendar year.

The FAA also receives external feedback through a post-test survey and a feedback process managed by the Designee Standardization Branch (AFS–640).

[8] The FAA maintains approximately 11,000 questions in an international bank contracted to select foreign civil aviation authorities.

[9] In 1997, AFS–630 had 23 employees, 15 of which were ASIs. Between 1997 and 2005, AFS–630 lost 5 ASIs, reducing the branch to 18 employees. Since then, the branch lost has lost an additional ASI every year except 2008, with only 6 ASIs remaining (2 in airworthiness and 4 in operations).

[10] See Appendix D, AFS 600–005. The FAA process for airman knowledge test development and review is maintained in AFS 600–005, Airman Knowledge Test Question Development, Review and Revision, a seven-page document that was provided to the ARC for review. AFS 600–005 was originally established in 2004; the branch currently works with a 2009 version.

Establishment of Stakeholder Participation

The ARC believes a stakeholder group should be established to bolster the test question development process. The ARC focused its initial discussions about the FAA process on two areas: the mechanism for identifying priorities and the use of expertise outside of AFS–630 to review and develop test questions and handbooks. The term "stakeholder" in this report includes representatives of the broader aviation community with subject matter expertise that will support the FAA's efforts to enhance aviation safety through better testing and training. Specific segments of the aviation community the ARC views as appropriate for engagement include but are not limited to—

- Academia,
- Training professionals,
- Manufacturers,
- Examiners, and
- Providers of aviation training materials.

Use of FAA Expertise External to AFS–630 in the Development of Knowledge Tests

Currently, AFS–630 is exclusively responsible for developing, reviewing, and updating knowledge test questions. Although the branch interacts with other FAA offices, such as AFS–800, AFS–300, and ATO, the ARC has identified these interactions as mostly informal in nature.

The ARC believes a more formal process is needed through which other FAA offices can provide input on focus areas and topics subject to testing. As an example, the ARC discussed the recent emphasis on runway safety and prevention of loss-of-control in GA at policy offices in AFS–800 and AVP respectively. The ARC noted that AFS–630 funds work related to both runway safety and loss-of-control, but the initiation of this work primarily resulted from informal interactions between offices as opposed to a specific triggering event.

Use of Aviation Community Expertise in the Development of Knowledge Tests

The ARC discussed implementing a more formal policy that would define a triggering event at key FAA policy offices in which current activities could drive engagement with AFS–630 on revised or updated test questions.

Additionally, the aviation community has firsthand experience with the use of knowledge and practical testing in the training environment and can provide expertise about safety issues, training practices, research findings, and current testing processes. Although stakeholders can submit recommendations for changes through an existing mechanism[11], they receive no feedback about adoption of the proposed changes, and no structured working environment exists through which industry stakeholders can interact with and provide expertise to the FAA about safety issues, training practices, and research findings.[12]

One of the primary tasks in the ARC charter is to recommend—

> *Methods for regular industry participation in the planning, development, production, and review of technical information (e.g., training handbooks, knowledge test guides and supplements) intended to convey the elements of the knowledge standard.*[13]

The material on which the FAA tests applicants through the knowledge test is retained in several FAA handbooks. For a student to be tested on a question, the material must be maintained in both a supporting handbook and handbook source material such as the Aeronautical Information Manual (AIM) or advisory circulars (AC). As a result, the update of a knowledge test depends on a similar update of its supporting handbooks. See figure 1 below.

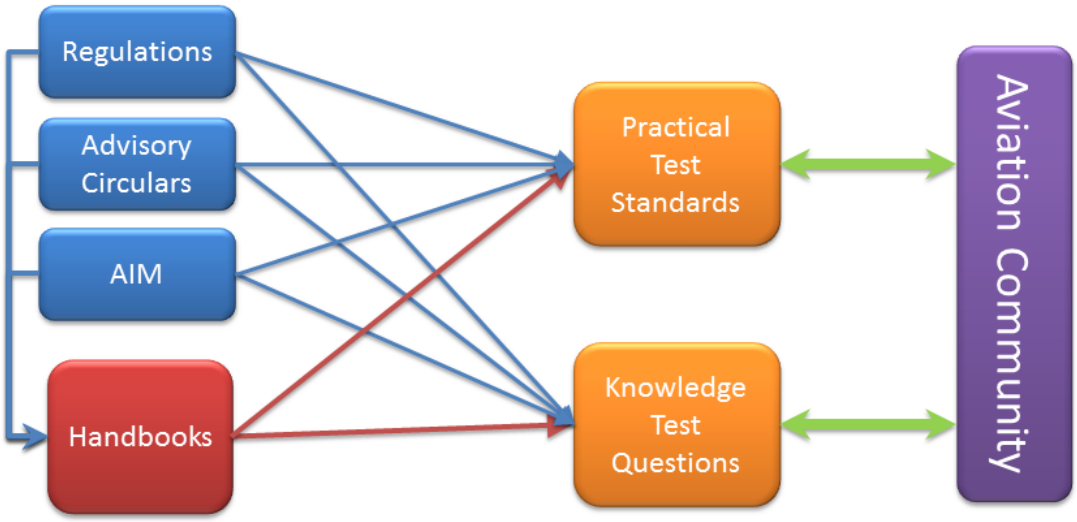


Figure 1—Sources of Testing Content

[11] AFS–630 has established an email inbox at afs630comments@faa.gov through which input is collected. The address is made available in the preamble to each document.
[12] AFS–630 holds an annual stakeholder meeting during which key offices' changes are presented, but this is not a formally chartered activity and does not provide a "working environment" for discussion and review of specific questions.
[13] Airman Testing Standards and Training ARC charter, paragraph 3.c.

The ARC determined four primary areas in which broader involvement by both FAA and industry stakeholders would improve the products and result in a better training environment:

1. The establishment and review of standards for knowledge and practical tests;
2. The development and review of key handbooks used for airman training;
3. The development and review, through boarding, of knowledge test questions; and
4. Concise, consistent, and timely communication with the aviation community.

Based on job task analysis, the ARC believes the cycle for introducing changes in training or subject areas must occur in a logical sequence, beginning with new standards. (See Appendix F, Advanced Qualification Program, and Appendix G, Certified Aviation Manager Exams.) Applicable guidance material should then be introduced, followed by the introduction of new knowledge test questions.

Stakeholder Role in Establishment and Review of Standards for Knowledge and Practical Tests

The requirements for obtaining an airman certificate are based on regulations that are further defined through FAA ACs, handbooks, and PTSes. As an example, the requirements for a private pilot certificate are in 14 CFR part 61, subpart E, including aeronautical knowledge (§ 61.105), flight proficiency for training (§ 61.107), and the required aeronautical experience (§ 61.109). The FAA has further defined the aeronautical knowledge through handbooks (such as FAA–H–8083–3A, Airplane Flying Handbook, and FAA–H–8083–25A, Pilot's Handbook of Aeronautical Knowledge), ACs (such as AC 00–45, Aviation Weather Services, and AC 91–74, Pilot Guide Flight in Icing Conditions), test guides (FAA–G–8082–17A), and learning statement codes (LSC). The FAA has defined the required flight proficiency through PTS.

The ARC recognizes that a number of existing groups provide feedback to the FAA regarding aviation safety and training, including CAST, the GAJSC, and numerous other ARCs. The ARC believes these groups can lend valuable expertise to any newly established standards for airman training and testing.

Currently, the FAA serves as the testing arm of the airman certification process, while the aviation industry provides the corresponding training. Involving the aviation community in establishing and reviewing standards for the tests provides a more integrated and comprehensive process that would result in enhanced training and testing products. Further, a more cohesive process will result in safer pilots and a more efficient and effective training and certification environment.

Stakeholder Role in the Development and Review of Key Handbooks Used for Airman Training

The inventory of handbooks is the baseline for guiding day-to-day training in the GA industry. The FAA currently reviews handbooks every 3 years per FAA Order 1320.1E. However, in-house FAA resources allocated to this task have consistently declined over the last 15 years, and corresponding costs have increased. This has resulted in large delays in the review and production process associated with handbook development, with handbooks now revised every

3 to 30 years, depending on the subject. This delayed development and unpredictable release schedule for new editions has a direct effect on training innovations, as FAA handbooks define the standards on which all curriculums are based. Private industries are reluctant to invest in training innovations because "pending" FAA standards may nullify the investment with unanticipated changes. Therefore, the aviation industry responds with new training innovations only after pending FAA documents are released.

Handbook review begins with establishing a set of requirements for the requested changes. As an example, the FAA recently decided to amend the Pilot's Handbook of Aeronautical Knowledge to include separate chapters related to loss-of-control and runway safety. The FAA then either undertakes the development of new text or contracts the development to the aviation industry. Following the development of new draft text, the updated handbook is coordinated per FAA Order 8900.1 by the Technical Information and Communications Programs Branch (AFS–140), which incorporates comments from key offices and collects senior-level endorsements, and the new handbook is published. The ARC believes the aviation industry must stay involved and, more importantly, be informed when changes to documents are released so these changes can be implemented in training curriculums. In the case of the runway safety and loss-of-control addition, industry only learned about this change through the ARC. Without a policy in place to notify the intended reader, it is difficult, if not impossible to ensure applicants, instructors, and training providers include the requirements or new topics as the FAA intended.

Additionally, to address the timeline for the FAA's internal review of the handbook, the ARC believes the FAA should review how each office conducts its internal handbook review, including its priority among other documents subject to internal coordination. Although FAA Order 1320.1E requires policy and procedures be reviewed every 3 years, many of the FAA handbooks are long overdue for revision. The industry segments with knowledge of current training practices and equipment in use can help with prioritization, along with other agencies such as NASA, the National Transportation Safety Board (NTSB), and other branches within the FAA.

Case Study: Working with Industry Can Achieve Positive Results

In the early 2000s, the GA industry faced a substantial change to the type of piston-engine-powered airplanes sold to customers and in use at flight schools because of the introduction of fully or partially integrated electronic cockpits, or "glass cockpits." At that time, the FAA handbooks did not address glass cockpit technology because aviators did not encounter it until they started operating more sophisticated turbine airplanes. A representative of the aviation industry stated in January 2005[14] —

> *With the introduction of new technology—specifically integrated "glass" cockpits in piston airplanes … [industry] believes that it is important that FAA's training and testing standards also reflect this change. As [the FAA] knows, by summer 2005 all piston airplanes coming off of the production line will either*

[14] See January 27, 2005, letter from the General Aviation Manufacturers Association to Robert Wright, Manager, General Aviation and Commercial Division, FAA. http://www.gama.aero/files/GAMA_Letter_to_AFS-800_-_01282005.pdf Accessed April 10, 2012.

come standard with an integrated cockpit or have it as an option. Therefore, we believe that:

1. *Training materials for integrated "glass" cockpits need to be included in the FAA Instrument Flying Handbook, which currently does not address the topic properly.*
2. *Relevant testing standards should be included in the practical test standards.*

In response to a petition from the aviation industry, the FAA chartered the GAJSC to establish a working group to review the handbooks, PTS, and knowledge test questions. The working group included representatives from the Aircraft Owners and Pilots Association; General Aviation Manufacturers Association; Cessna Aircraft Company; Garmin; AeroTech, Inc.; Eclipse Aircraft; Small Aircraft Manufacturers Association; and several universities including Embry-Riddle Aeronautical University, University of North Dakota, and Western Michigan University. The working group provided its recommendations to the FAA in December 2005 and the FAA published the resulting change to the Instrument Flying Handbook in 2007.

Participants learned the following lessons from the GAJSC process:

- The working group reviewed the Instrument Flying Handbook because of a specific system change (the introduction of glass cockpits). A more systematic and continuous engagement between key stakeholders and the FAA would lend itself to continued improvement of the handbook documents.
- The work on changing the handbook to address glass was fortuitous in that it occurred when the Instrument Flying Handbook was already scheduled for review. It is not clear if the FAA would have been in a position to reprogram its schedule for this handbook to address the aviation industry's recommendations.
- The GAJSC provided an effective forum for interaction between the FAA and the aviation industry, but at that time the working group did not have any official standing or role in updating the handbook. At times, this resulted in a strained engagement between the working group, the FAA, and the contractors involved, because expectations varied as to what would be produced in support of the rewrite.
- The proposed rewrite was based on a significant technology change and the FAA benefited from the presence of the aviation industry to explain several of the unique features of glass cockpit avionics, including how events such as equipment failure should be taught to new pilots.
- The GAJSC provided its input upfront, but was not part of the follow-on review of handbook draft versions. The review, internal to the FAA, was done by key offices and it is unclear to the ARC the degree of priority the handbook review was given for each person's work assignments or it fell into "other duties as assigned."

Aviation industry engagement in the review process benefitted the FAA in several ways. The volunteer industry representatives brought direct experience from using the existing handbook in day-to-day flight training and introduced means by which material could be more effectively presented. The main part of the change involved technology; manufacturers brought in the principal avionics engineers involved with the development of the devices as well as the training staff of each manufacturer to discuss the correct way to demonstrate and train for use of the equipment.

Overall, the ARC believes the interaction that occurred for the Instrument Flying Handbook in 2005 was positive and can be used to build a more formal process to make changes to handbooks. A similar process was attempted in the follow-on updates of the Aviation Instructor Handbook (in February 2006) and the Pilot's Handbook of Aeronautical Knowledge (in May 2007), but these occurred in a less structured way and did not result in the same level of engagement.

Stakeholder Role in the Development and Review, through Boarding, of Knowledge Test Questions

The ARC has extensively discussed whether the FAA should return the question bank to the public domain or attempt to keep the question bank nonpublic. A detailed review of public versus nonpublic questions can be found under recommendation 5 and appendix G to this report.

Independent of the public or nonpublic nature of the question bank, the ARC believes the involvement of technical experts from the aviation industry in the development and review of questions would improve their quality.

The current process, as depicted by the AFS 600–005 process flowchart in appendix D to this report, lays out the steps the FAA takes to identify a trigger that forces a question to be developed or revised through review, first by an ASI, then by an internal AFS–630 board, and finally by an editor. The question is then activated in the question bank as a question out for validation. It is not included in the applicant's overall score but instead is used to alert the AFS–630 ASI of how the question performs on the test. For example, if the question performs poorly on a test where the applicant is consistently scoring highly, the problem may lie in the way it is worded or interpreted. Any question that perform poorly must be sent back to the ASI that developed it. If that ASI determines the question is "good" regardless of its performance, it may be activated on a live exam and put into the question bank. The problem with this is that depending on how applicants interpret a question based on their personal experience, it may read differently than the ASI intended. It is therefore ideal for multiple individuals from multiple backgrounds with aviation expertise to review questions and suggest wording changes to clarify these poor performing questions.

The ARC reviewed multiple processes used by industries to develop and board questions. The ARC identified the CAM certification process, through which CAMs participate as experts in the development and boarding of questions as an applicable example. See appendix F to this report. The ARC strongly believes this process applies to the development and boarding of airman test questions.

The ARC sees an opportunity for specific aviation industry involvement at two points in the existing QMS process:

- Triggering the need to develop a new question or review an existing question (see QMS step 1.1) and its follow-on work when the question is developed (see QMS step 1.2.1.2.1). See appendix D to this report.
- Adding multiple industry experts to participate in the board review (see QMS step 1.4) of the new, existing, or revised question.

The recruitment of a volunteer committee of SMEs will result in input to the question development and boarding process at very little cost to the FAA. In fact, the total cost of this change could result in a savings and allow the FAA to leverage the aviation industry as a resource. Over the last 15 years, AFS–630 has seen a decrease in SME personnel while costs associated with maintaining the tests have increased. This increase in costs is related to—

- Maintaining increasingly obsolete technologies and
- Attempting to maintain multiple-item databanks, such as—
    - Form tests consisting of active questions,
    - A reservoir of questions to be implemented into the tests as form tests change, and
    - The public database used to correlate training to testing.

The FAA should review other processes for testing, such as the CAM certification process, as a potential framework for establishing a forum and process for the development and boarding of questions.

RECOMMENDATION 3

Recommendation 3: The ARC recommends the FAA transition to a single testing standards document, the airman certification standards (an update to the PTS), to include—

- Knowledge,
- Skills, and
- Risk management.

The ARC proposes a schedule for transitioning to the airman certification standards for each certificate in the following order:

- Certificated flight instructor (CFI) (develop and publish by March 31, 2013; with an effective date within 6 months),
- Private pilot (develop and publish by September 30, 2013; with an effective date within 6 months),
- Instrument rating (develop and publish by March 31, 2014; with an effective date within 6 months), and
- Commercial pilot (develop and publish by September 30, 2014; with an effective date within 6 months).

The current airman certification process references multiple documents including test guides and LSCs for the FAA knowledge exam and the PTS for the practical test. The proposed airman certification standards correlate all of these documents into a single source. The airman certification standards integrate knowledge training with the practical test. The ARC provides two examples below of how the FAA should structure the proposed airman certification standards.

The ARC drew from the effective Advanced Qualification Program (AQP) process in which the knowledge, skills, and attitudes (KSA) required for successful completion of a given objective are derived, and testing, followed by training programs, are constructed to meet those KSAs. See appendix F to this report. Creating airman certification standards from which to derive both the knowledge and practical tests will—

- Improve the knowledge test by linking the LSCs to the airman certification standards.
- Increase the perceived relevance of the knowledge test.
- Improve the testing process by defining the applicable LSCs that drive more relevant test questions.

- Reduce the number of LSCs the FAA must manage.
- Help the applicant and CFI to understand the LSC in the appropriate context, allowing the CFI to provide meaningful retraining.
- Enable the examiner to more effectively evaluate deficient areas on the Airman Knowledge Test Report.

Developing the airman certification standards for the two example tasks was not a particularly difficult or time-consuming process, and significantly simplifies the issue of what questions to write for the knowledge test.

The ARC recognizes adopting a single testing standards document will result in a significant change to the training system, and therefore recommends the development of an aggressive joint FAA/industry communication and deployment plan. The communication plan must include outreach to DPEs, flight instructors, and training organizations. The logic of prioritizing the CFI is to train the trainer first.

To accomplish this transition, the FAA should use the private pilot testing standards demonstration examples on pages 17–19 of this report as framework for the changes.

The ARC created the proposed airman certification standards by doing the following:

- Reorganizing the two current PTS tasks into three sections:
  - Knowledge,
  - Skills, and
  - Risk management.[15]

  These three areas comprise the airman certification standards and the attributes a pilot must possess to safely operate in the NAS. The ARC selected the "Weather Information" and "Normal and Crosswind Takeoff and Climb" tasks from the Private Pilot–Airplane PTS for the examples below because the weather task is primarily achieved by academic learning whereas the takeoff task is primarily learned by physical practice.
- Incorporating information from the test guides (FAA–G–8082 documents) into the introduction.
- Applying current LSCs to the knowledge section of the specific PTS tasks (these remain in the knowledge section of the sample airman certification standards provided below).[16]
- Combining or deleting redundant or irrelevant LSCs.

[15] The FAA, in other training guidance, uses "aptitude," "attitude," or "attribute," but the ARC has elected to use the terminology "risk management" to capture the same concept. It refers to the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities.

[16] The LSCs served as the bridge between the current testing system and what the ARC proposes should be the next generation of knowledge testing. The LSCs can be viewed as the legacy of decades of flight training and testing, and have grown with a certain amount of guidance at various points in their development, but with no apparent general oversight. This is evident when LSCs are reviewed for repetition, cogency, and cohesion.

- Refining language in the remaining LSCs for clarity.
- Adding new LSCs needed for the specific PTS task.
- Removing acronyms with no practical value (such as TWEB (Transcribed Weather Broadcast), WFO (Weather Forecast Office), and TCP (Tropical Cyclone Public Advisory)).
- Reorganizing the PTS objectives to include knowledge, skills, and risk management as appropriate, instead of what is currently described broadly as "skills."
- Making minor additions to skills (see examples).
- Adding the "risk management" section to outline tasks that support conservative attitudes and behaviors, and risk management awareness and application.

Example 1

Task: Weather Information (ASEL and ASES).

References: 14 CFR part 91, AC 00–6, AC 00–45, AC 61–23/FAA–H8083–25, AC 61–84, and AIM.

Objective. To determine the applicant has the knowledge, skills, and risk management required to gather and use the available weather information for purposes of assessing the meteorological situation affecting the planned flight, and making a go/no-go as well as en route flight decisions.

Knowledge: (Reduced from 68 possible LSCs.)

Demonstrates practical understanding of—

- Atmospheric adiabatic process.
- Isobars/associated winds.
- Aviation Routine Weather Report (METAR)/Non-routine (Special) Aviation Weather Report (SPECI).
- Pilot Report (PIREP).
- Radar Summary Product.
- Significant Meteorological Information (SIGMET.)
- Significant Weather Prognostic Product.
- Convective Outlook Product.
- Surface Analysis Product.
- Terminal Aerodrome Forecast (TAF).
- Weather Depiction Product.
- Winds and Temperatures Aloft Forecast Product.
- Automatic Terminal Information Service (ATIS), Automated Weather Observation System (AWOS), and Automated Surface Observation System (ASOS) product.
- Weather associated with frontal activity and air masses.
- Weather conditions: temperature, moisture, and dewpoint.
- Weather services available inflight.
- How temperature affects weather formations.
- Squall lines: formation, characteristics, resulting weather.
- Thunderstorms: types, characteristics, formation, hazards.
- Fog: formation, characteristics.
- Icing: formation, characteristics.
- Microbursts: formation, characteristics.
- Turbulence: types, characteristics, reporting, and minimizing its effects.

Skills: Exhibits knowledge of the elements related to weather information by analyzing weather reports, charts, and forecasts from various sources with emphasis on—

- METAR, TAF, and Area Forecast (FA).
- Surface Analysis chart.
- Radar Summary chart.
- Winds and Temperature Aloft chart.
- Significant Weather Prognostic charts.
- Convective Outlook chart.
- ATIS, AWOS, and ASOS reports.

Makes a competent "go/no-go" decision based on available weather information.

Risk Management: Demonstrates the ability to identify and manage risks associated with—

- The limitations of weather reports and forecasts,
- The need to continually update weather information, and
- Resources available.

Example 2

Task: Normal and Crosswind Takeoff and Climb

Note: If a crosswind condition does not exist, the applicant's knowledge of crosswind elements shall be evaluated through oral testing.[17]

Objective: To determine the applicant has the knowledge, skills, and risk management required for safe completion of this task.

Knowledge: Demonstrates practical understanding of—

- The elements related to a normal and crosswind takeoff, climb operations, and rejected takeoff procedures;
- Calculations of takeoff and climb performance[18];
- Procedures for normal takeoff;
- Procedures for crosswind takeoff;
- Calculating crosswind and headwind components;
- Crosswind takeoff control technique;
- Rejected takeoff procedures; and
- Selecting the most conservative performance values for existing conditions.

[17] FAA–H–8083–3; POH/AFM.
[18] For example, selecting the most conservative data when using a chart that requires interpolation. This tests the applicant's application of the data instead of simple calculation. This assumption is made with any performance calculation required in related tasks.

Skills: Demonstrates the ability to safely complete a normal takeoff and landing through the following:

- Briefs takeoff procedures and actions in the event of engine failure during and after rotation.
- Taxies into the takeoff position and aligns the airplane on the runway center/takeoff path.
- Advances the throttle smoothly to takeoff power.
- Aborts the takeoff if performance parameters are not achieved.
- Establishes and maintains the most efficient liftoff attitude.
- Lifts off at the recommended airspeed and accelerates to V_Y.
- Establishes a pitch attitude that will maintain V_Y +10/-5 knots.
- Retracts the landing gear and flaps after a positive rate of climb is established.
- Maintains takeoff power and V_Y +10/-5 knots to a safe maneuvering altitude.
- Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
- Completes the appropriate checklist.

Risk Management: Demonstrates the ability to identify and manage risks associated with—

- Calculating takeoff performance,
- Calculating climb performance,
- Crosswind component,
- Engine failure after takeoff,
- Wind condition on taking the runway,
- Landing gear retraction,
- Flap retraction,
- Altitude and airspeed for maneuvering,
- Voluntary noise abatement procedures, and
- Use of checklists.

Priority for Executing Transition to Airman Certification Standards

The FAA specifically asked the ARC which certificates or ratings should be the highest priority when work commences to change the process for developing standards, handbooks, and test questions, as well as the proposed airman certification standard.

Based on feedback from ARC members and their constituents, the following priority of certificate focal areas was agreed on: certificated flight instructor, private pilot, instrument rating, and commercial pilot.

The order of priority for consideration was initially chosen based on training the trainer, followed by (1) the overall volume of tests given for each certificate and the sequential order in which applicants typically train, (2) direct applicability to the overall training process, (3) variety of the question material base, and (4) impact on the overall pilot training process.

RECOMMENDATION 4

Recommendation 4: The ARC recommends the following concerning the philosophy of question development:

- The FAA should maintain discretion to write questions that reference multiple documents such that applicants must correlate data.
- Although questions must refer to specific FAA guidance documents, the FAA should not use exact quotes from specific passages unless testing specific required rote knowledge.
- Test questions should be written to be pertinent to safe operations and necessary for sound airmanship.
- Tests should incorporate scenario-based questions that assess the applicant's ability to manage the many risks of flying.
- Test questions should not only be relevant to the way pilots operate in the real world, utilizing current technologies both in and outside the cockpit, but also test how those technologies can be used to facilitate proper risk management skills.
- The FAA should adopt a continuous review process to ensure test questions are relevant to the current technology used in aviation, with priority given to removing obsolete information from the tests.

Current Knowledge Test Question Development Process

The Federal Aviation Regulations mandate the aeronautical subject knowledge required of airmen, which is tested by the FAA knowledge test. The test is a required step in the certification process for all airmen, and its questions must be defendable by reference to FAA documents. The FAA assigns an LSC to all FAA knowledge test questions; these LSCs are intended to identify both the subject and the associated supporting FAA references. The LSCs are printed on the Airman Knowledge Test Report the applicant receives on completion of the FAA knowledge test to identify the subjects missed on the test. The applicant is required to obtain an endorsement from an authorized instructor certifying the applicant has demonstrated satisfactory knowledge of the subject areas in which the applicant was deficient on the airman knowledge test.

Instructors must be able to accurately identify the knowledge deficiencies to perform their role in the certification process. The ARC has determined that the process by which the test is created and managed, in which LSCs are assigned to the questions, has resulted in problems with test effectiveness.

Currently, LSCs can apply to multiple reference documents and multiple subjects.[19] In some instances, the correct answer to a question will change depending on the reference. As a result, LSCs do not provide enough guidance for the flight instructor to accurately assess inadequate knowledge and provide the required endorsement, nor are they effective for the DPE to understand where emphasis should be placed on the practical test to integrate the knowledge test into the certification process.[20]

In addition, the ARC has determined the questions used on the knowledge exams do not accurately assess an airman's knowledge of a given subject. Airmen can be very knowledgeable about a particular subject but not demonstrate this on the knowledge exam. Alternatively, applicants can demonstrate poor knowledge during the practical test but show complete subject mastery during the knowledge exam, due largely to the questions not targeting the specific knowledge needed to be a safe and effective pilot.

While many questions in the FAA knowledge test bank are valid, relevant, and good indicators of an applicant's ability to correlate information, many other questions are written to be an exact lift of a specific passage from an FAA document, without direct application to safety of flight or necessary airman knowledge. This requires the applicant to train with an emphasis on rote memorization rather than understanding the big picture and application to operations. It also is used in place of scenario-based questions that would require an applicant to correlate information from multiple resources and apply that information to multiple subjects. This test item from the private pilot question bank provides an example:

> How many satellites make up the Global Positioning System (GPS)?
>
> A – 25.
>
> B – 22.
>
> C – 24.

The correct answer is "C." This question has no practical value to a pilot because it is merely a direct lift from the AIM 1–1–19 a.7. Additionally, the "correct" answer is not necessarily accurate because new satellites are launched and existing satellites are decommissioned regularly.

The ARC acknowledges that after several years of input, this GPS satellite constellation question has, according to the FAA, been removed. The remaining frustration, however, is that its removal has not been formally communicated to the aviation training industry, and therefore the topic is still included in training programs. The ARC believes that relating knowledge test questions to the proposed airman certification standards will assist in eliminating questions such as this that do not have practical relevance.

[19] For example, Private Pilot Airplane (FAA–G–8082–17E), "PLT141" refers to 14 CFR part 91, AIM and the Airplane Flying Handbook (FAA–H–8083–3A).

[20] For example, Private Pilot Airplane (FAA–G–8082–17E), "PLT147" refers to Regulations/14 CFR part 91/Airport Operations, Aircraft Operations/Lighting/PAPI (and VASI).

Information specific to what the FAA is testing on knowledge exams is insufficient. For example, only 22 sample representative questions currently exist for the private pilot knowledge test (compared with 805 sample questions in 2005 and 650 sample questions in 2008), and only 26 sample questions exist for the commercial pilot knowledge test. In addition, much of the public information is inaccurate, driving the training community to spend time in areas less relevant to key aviation knowledge that could otherwise be focused on knowledge pilots should attain. This insufficient public information is due in part to the limitations associated with the current software used to manage test data (see recommendation 6 of this report).

Also, many test questions require the applicant to train with an emphasis on discerning the FAA's intent rather than the application to actual flight operations. This question from the airline transport pilot knowledge test question database provides an example:

> What is the trip time corrected for wind under Operating Conditions Z-1?
>
> A - 58.1 minutes.
>
> B - 51.9 minutes.
>
> C - 54.7 minutes.

The correct answer is "B." The answer choices in this question are so close together they misrepresent how this information is gathered and used in actual operations. Many of the flight planning questions currently on the knowledge tests require an unrealistic level of precision to arrive at the correct answer, which may also suggest to the applicant this method of cutting it close is safe or advised.

Questions such as this encourage rote memorization and do not reflect an accurate assessment of training and critical thinking skills. As such, they compromise the significance of learning important aeronautical knowledge required for effective and safe operations.

Clearly some required aeronautical information must be committed to memory and in these cases, rote testing is appropriate. The following question from the private pilot question bank is an example of appropriate rote testing:

> If the control tower uses a light signal to direct a pilot to give way to other aircraft and continue circling, the light will be—
>
> A - Flashing red.
>
> B - Steady red.
>
> C - Alternating red and green.

The correct answer is "B." Although information such as the above light-gun signal example is suitable for rote testing, it could still be incorporated into a scenario-based question requiring that knowledge for a correct response.

The following is an example of a question in the private pilot bank that would normally test important memorized knowledge (in this case, visual flight rules (VFR) transponder beacon code) but becomes tricky and is frequently missed because it throws in both an obscure term and a "red herring" term that might "sound right":

> When operating under VFR below 18,000 feet MSL, unless otherwise authorized, what transponder code should be selected?
>
> A – Mode 3/A code 1200.
>
> B – Mode F code 1200.
>
> C – Mode 3/A code 7700.

The correct answer is "A." This is inappropriate rote testing. The first choice is the correct answer, but no value to risk management and safe operations exists that requires a pilot to know the transponder they set in a four-digit code is mode 3/A and not mode F. Testing with questions such as this reinforces the impression that the test is a barrier and not an important assessment. The tests should be purged of any questions that (1) only discern whether the applicant memorized a specific passage from a specific FAA publication, (2) contain a correct answer that is subjective to how the question is interpreted, or (3) are based on obscure or trivial information.

The following example question from the instrument rating database also demonstrates an exact lift and requires memorization of obscure information found in AC 120-58.[21]

> Test data indicate that ice, snow, or frost having a thickness and roughness similar to medium or coarse sandpaper on the leading edge and upper surface of an airfoil can
>
> A – Reduce lift by as much as 50 percent and increase drag by as much as 50 percent.
>
> B – Increase drag and reduce lift by as much as 25 percent.
>
> C – Reduce lift by as much as 30 percent and increase drag by 40 percent.

The correct answer is "C." From AC 120–58: "Test data indicate that ice, snow, or frost formations having a thickness and surface roughness similar to medium or coarse sandpaper on the leading edge and upper surface of a wing can reduce wing lift by as much as 30 percent and increase drag by 40 percent."

Information in publications widely considered primary training guidance such as the Pilot's Handbook of Aeronautical Knowledge, Airplane Flying Handbook, Instrument Flying Handbook, and AIM describe the effects of frost, snow, or ice as decreasing lift and increasing drag, but specific numbers are not provided.

[21] AC 120–58, *Pilot Guide Large Aircraft Ground Deicing*, issued in September 1992.

More recently, questions were introduced to test human factors on the Aviation Maintenance Technician–General test. These questions required the applicant to memorize exact passages from FAA guidance to know which answer was "correct." Without this rote memorization of the passage, multiple choices could be "right" given basic understanding of the subject.
For example—

> The "SHEL" model is another human factors tool, the goal is to determine not only what the problem is, but also—
>
> A – Where and why it exists.
>
> B – How we prevent the problem.
>
> C – How many factors contribute to the error.

Answer "A" is correct. However, answer "B" is also a plausible choice given information found throughout other parts of the same FAA guidance document.

> The three types of human error are—
>
> A – Mental, situational, and physiological.
>
> B – Active, latent, and stressor.
>
> C – Omission, commission, and extraneous.

Answer "C" is correct. While answer "C" refers to the FAA's focus on human factors research and investigation, it is not a particular error model. Answers "A" and "B" are both plausible answers as well, but do not reflect the errors specifically noted in the FAA guidance document.

For many years, the FAA weather briefing sources provided plain-language versions for those not nurtured on the obscure and outdated teletype-brevity codes. Interpretation of weather information is an essential skill for risk management, but decoding basic METARs and TAFs is not. Weather interpretation is best tested in scenarios in the knowledge test and the flight planning portion of a practical test. Because METAR and TAF codes are unnecessary in practical operations, new pilots are no more likely to choose to learn them than they are to learn Morse code. If a practical test applicant chooses to use the FAA basic format, they should be able to decode the reports and forecasts, but it makes no sense to test every applicant on them.

The following is an example of a TAF question in the private pilot question bank:

> (Refer to figure 15.) What is the forecast wind for KMEM from 1600Z until the end of the forecast?
>
> A – Variable in direction at 4 knots.
>
> B – No significant wind.
>
> C – Variable in direction at 6 knots.
>
> Figure 15 excerpt:
>
> KMEM 121720Z 121818 20012KT 5SM HZ BKN030 PROB40 2022 1SM TSRA OVC008CB
> FM2200 33015G20KT P6SM BKN015 OVC025 PROB40 2202 3SM SHRA
> BECMG 1012 00000KT 3SM BR SKC TEMPO 1214 1/2SM FG
> FM1600 VRB06KT P6SM SKC=

The correct answer is “C”. While this information is not particularly difficult for pilots to learn, it is unnecessary because most weather briefings are now accomplished without codes.

In many instances, multiple answer choices could be correct or partially correct, and the only way for an applicant to know which answer choice is “right” is to know how these questions historically have been graded. The following two questions provide examples:

Which is true regarding flight operations to or from a satellite airport, without an operating control tower, within the Class C airspace area?

A – Prior to entering that airspace, a pilot must establish and maintain communication with the ATC serving facility.

B – Aircraft must be equipped with an ATC transponder.

C – Prior to takeoff, a pilot must establish communication with the ATC controlling facility.

The correct answer is “A.” However, the question is not specific with regard to the meaning of “Class C airspace area.” Does this mean the airport is in the surface area, under the shelf area, or within the outer area? The question is not explicitly clear. Any of the answer choices could be correct depending on where the airport is located within the Class C airspace. This question is unanswerable without additional information.

Which is true regarding pilot certification requirements for operations in Class B airspace?

A – The pilot in command must hold at least a private pilot certificate with an instrument rating.

B – The pilot in command must hold at least a private pilot certificate.

C – Solo student pilot operations are not authorized.

The correct answer is “B.” While answer “A” may be easily disregarded as incorrect, the remaining two choices are both valid responses. Because the stem refers to “Class B airspace” rather than “primary airport in Class B airspace,” applicants must assume student pilot operations would be acceptable with an instructor endorsement. With that in mind, both answers “B” and “C” are equally correct, and the applicant must guess between two correct options as to what the actual correct answer is.

These types of questions do not accurately assess an applicant’s knowledge. An applicant can be well-versed in airspace and still get these types of questions wrong because the answer choices are dependent on the test writer’s discernment of what the correct response should be.

It is the consensus of the ARC that knowledge testing is not keeping pace with current practices in training including the technology available for preflight planning and reference materials available in the cockpit.

Scenario-based training (SBT) emphasizes the development of critical thinking and flight management skills, rather than focusing solely on traditional maneuver-based skills. The goal of this training philosophy is the accelerated acquisition of higher-level risk management skills. Such skills are necessary to prevent pilot-induced accidents.

Research has proven that learning is enhanced when training is realistic. In addition, the underlying skills needed to make good judgments and decisions are teachable. Both the military and commercial air carriers have embraced these principles through the integration of line oriented flight training (LOFT) and crew resource management (CRM) training into their qualification programs. Both LOFT and CRM lessons mimic real-life scenarios as a means to expose pilots to realistic operations and critical risk management opportunities. The most significant shift in these programs has been the movement from traditional maneuver-based training to the incorporation of SBT.[22]

Many flight training providers are incorporating the use of SBT into their syllabi. For example, the Cessna Flight Training System implements SBT and a scenario-based syllabus throughout the course for both the sport/private certificate and the instrument rating applicants. Redbird Flight Simulations, in cooperation with King Schools, also has a scenario-driven syllabus. Many additional flight schools have gained FAA/Industry Training Standards (FITS) acceptance of their scenario-based syllabi. A number of approved 14 CFR part 141 schools have also deployed scenario-based syllabi in their training programs by using the FITS-accepted curriculums. These syllabi include risk management and other single-pilot resource management (SRM) elements, as well as training for proper use of technology and automation.

Whereas the practical test has contained a scenario-based element for some time, the knowledge test currently does not. The FAA has previously cited difficulties preparing scenario-based questions for the knowledge exam due to the requirement to use a specific reference and questions applying to a single subject. If the knowledge test is to be viewed as relevant, encouraging best practices in training and evaluating risk management skills, the test must incorporate scenario-based questions. See table 1 below for examples.

Even flight schools that do not incorporate the use of SBT in their syllabi encourage the use of current technologies in gathering "all available information" required for proper preflight planning. Anyone with a computer can now access numerous Web sites providing weather and flight planning programs. The need to test an applicant's ability to interpret coded METARs and TAFs becomes increasingly obsolete, as weather reports and forecasts are readily available in decoded plain English format. For pilots without access to a computer, a phone call to 1–800–WXBRIEF yields a briefer who speaks in English, not code. Despite these advances, applicants are still tested on teletype technology.

It follows that testing should be used to determine the applicant's ability to use the information obtained in a weather briefing or online to make a viable go/no-go decision, rather than the ability to merely decipher coded reports.

[22] Managing Risk through Scenario Based Training, Single Pilot Resource Management, and Learner Centered Grading, FAA 2007.

Table 1—Enhancing Knowledge Exam Questions

Current sample FAA test question	Revised questions emphasizing scenario-based, risk management, and critical to safety of flight
[Refer to METAR.] What are the wind conditions at Wink, Texas (KINK)?	[Refer to standard briefing.] What runway should you anticipate landing on at Wink, Texas (KINK)?
[Refer to TAF report.] What is the valid period for the TAF for KMEM?	[Refer to TAF report.] What kind of visibilities can you expect around 1830Z?
How should the 500-pound weight be shifted to balance the plank on the fulcrum? (Note: the answer to this question is "1 inch to the left.")	Where should the golf clubs be placed to ensure the airplane remains balanced? (Note: the answer to this question should require the applicant to decide between baggage compartment and back seat.)
Determine the density altitude for these conditions.	Will aircraft takeoff and climb performance be better or worse than standard given these conditions?

Many Web sites provide flight planning services that are capable of computations exceeding most pilots' abilities, yielding highly accurate flight logs, including FAA Direct User Access Terminal Service (DUATS) providers[23], yet the knowledge test fails to test an applicant's knowledge of these services.

It is difficult at times for the aviation education industry to keep pace with rapid advancements in technology. For example, the iPad, in a little over 1year, has revolutionized not only the way information is gathered, but also the availability of this information in the cockpit. Electronic flight bags are quickly replacing paper. The advancement of glass panels (few, if any, new airplanes are delivered with "legacy" instrumentation) and Wide Area Augmentation System (WAAS)-enabled, certified GPS units, along with corresponding autopilots, have now made this equipment the norm.

Unfortunately the knowledge test lags far behind in the testing of not only the proper use of this equipment, but more importantly an applicant's ability to compile data gained through all the available technology into meaningful pieces of information and use the acquired knowledge to apply it to accomplish the planned flight (that is, what are the risks on the flight, what affect will they have, and how can they be mitigated?). Proper SRM mandates the use of all available tools. Virtually all flight training now incorporates as much of this new technology as possible, from panel-mounted, certified equipment to handheld devices. The knowledge test should begin testing the use of these tools and removing references to obsolete technologies. Doing so will make it a more effective assessment tool. The knowledge test will verify training and correlate the required knowledge to the practical test if it tests applicants on the same knowledge they must learn to become safe and effective pilots in the aircraft they operate.

[23] Provided by Computer Sciences Corporation (CSC) at www.duats.com and Data Transformation Corporation (DTC) at www.duat.com. Accessed April 11, 2012.

Most fatal accidents are a result of poor or nonexistent risk management. Current training trends incorporate SBT to teach pilots the skills necessary to manage the risks of flying. If the fatal accident rate is to be reduced, the knowledge test must be part of this process and reinforce these risk management skills through scenario-based questions when possible and are in part predicated on the modern technological tools currently available to all pilots.

RECOMMENDATION 5

Recommendation 5: The FAA should return the knowledge test item question bank to the public domain by December 31, 2012, in a way that maintains the integrity of questions requiring calculations or interpolations in accordance with the guidance below:

- Remove numbers from questions that require calculations or interpolations.
- For scenario-based questions testing risk management skills, remove any facts and numbers that determine the appropriate course of action, such as wind direction.
- For questions that appropriately test rote knowledge, provide a sufficient number and variety of questions to ensure broad knowledge (such as airspace requirements, regulations, and airport signage and markings).

After 3 to 5 years, the FAA should determine whether it is appropriate to make the question bank, completely or in part, nonpublic, provided the following conditions have been met:

- The advisory group identified in recommendation 1 has been operating for a minimum of 3 years and will continue to operate for knowledge tests for every certificate or rating.
- The advisory group has reviewed all test questions in use.
- Correlation between knowledge tests and practical tests indicates that the new testing system has not been effective in creating airmen who demonstrate improved knowledge and risk management skills.

Proposal for Public Question Bank

The FAA historically had a public question bank. Before computer-based testing, the complete bank of test questions was available for purchase from the Government Printing Office as an AC, and later as an FAA question book (FAA–T–8080–XX). This question book later evolved to the FAA computer testing supplements (FAA–CT–8080–XX), to include the question figures, with the database of questions being published on an FAA Web site. Over time, this public database has not been maintained and is no longer an accurate reflection of the knowledge exams currently being issued, due in part to the limitations of the software used to manage the tests (see recommendation 6 of this report). The public data deteriorated without a process in place to maintain a correlation between training and testing. Returning the question bank to the public domain will assist students learning facts and materials exclusively by rote, but several mitigating factors can be used to discourage rote learning as the focus of study.

Students who employ rote learning strategies will do so whether questions are public or not. The risks of a closed test far outweigh the benefits, and the benefits of an open test far outweigh the risks. Flashcards, study guides, and memory aids are all established techniques of learning in any educational environment. Accurate study is more important than guessing the content of a test, and a quality test is more important than a statistically valid one.

Based on the state of the tests and the FAA's recent history of question development, returning the question bank to the public domain is the fastest, most cost-efficient, and effective way to realign training with testing and establish a quality control process. The ARC believes the realignment of testing and training is an immediate need solved by returning the question bank to the public domain. As the FAA implements other ARC recommendations, process improvements may allow for alternative long-term solutions.

Returning the question bank to the public domain does not eliminate the ability to use it for assessment. The immediate benefit of releasing the question bank is that it ensures applicants have an integrated training process that retains the required aeronautical knowledge in the context of the rest of the training curriculum. Releasing the question bank also ensures applicants are not wasting efforts studying the wrong material, which is the result when information is gathered through hearsay rather than an official public release. Releasing the question bank will allow a joint FAA/industry effort to identify and revise questions to meet the overall testing philosophy described in recommendation 4.

The examiner will then be able to accurately review the Airman Knowledge Test Report in correlation with the public question bank to determine exactly where the weak areas lie. This will result in a more sound practical test.

One of the most detailed debates among ARC members related to whether or not the question bank should return to the public domain. The ARC considered five options:[24]

- Alternative 1: The FAA should continue to attempt to keep the question bank nonpublic.
- Alternative 2: The FAA should return the question bank to the public domain, but replace all numbers with an "X" in questions requiring calculations to derive the answers. SMEs who are known to the public should help create and evaluate questions.
- Alternative 3: The FAA should return the question bank to the public domain. SMEs who are known to the public should help create and evaluate questions.
- Alternative 4: The FAA should make public a sample of each category of questions actually used on the test. SMEs who are known to the public should help create and evaluate questions.
- Alternative 5: The FAA should make public only example questions not used on the test. SMEs who are known to the public should help create and evaluate questions.

An overview of the pros and cons of each alternative can be found in Appendix H, Discussion of Pros and Cons of Each Alternative.

[24] Alternatives 2 through 5 require an expert group nondisclosure agreement.

After significant debate, the ARC recommends the FAA return the question bank in its entirety to the public domain in a way that maintains the integrity of questions requiring calculations or interpolations, at least in the near term.

FAA knowledge tests should ensure pilots have the knowledge needed to properly assess and manage risk. Unfortunately, it is the opinion of the ARC that the tests are not fully achieving that objective. The knowledge test should sample the effectiveness of the training and the knowledge each applicant has achieved. The test composition should not focus exclusively on assessing study habits or confirming an applicant read all the required handbooks, but instead communicate what is critical to safe flight.

Many of the knowledge test questions require applicants to regurgitate obscure or trivial knowledge, including the previously discussed GPS constellation question. Additionally, the knowledge test includes questions that are out of context as to how the knowledge will be used to manage the risks of flight, such as "The term angle of attack is defined as the angle…" The test also contains questions that may be adverse to safety. For example, the test may include a question regarding takeoff performance that requires interpolations, suggesting to the applicant a level of precision that could lead to unsafe risk management. Similarly, questions on icing require test takers to know an exact percentage of lift degradation and drag increase from a coating of frost, suggesting flight might be acceptable if one can compensate for these factors. The ARC believes these types of questions diminish the applicant's view of the FAA evaluation process, and the FAA is missing an opportunity to provide guidance to pilots about what is safe when operating an aircraft.

Per the previous section, the ARC has considered a number of options for how to approach test questions. It is the ARC's position that at least in the short term, the question bank should return to the public domain because of the concerns regarding reliability and validity of the current question bank. Once a better system of test development, validation, implementation, and correlation with training can be established, the FAA should reevaluate the option of "closing" the question bank. As long as testing standards are well developed and state clear learning objectives, a closed test could be beneficial.

The ARC is concerned that the current knowledge tests are not an effective assessment of required aeronautical knowledge because they contain questions that are not relevant to managing real-world risks applicants will face. The reasons for this are—

- In the recent past, the FAA has removed questions from the public domain.
- Previously all of the questions in the question bank were available in the public domain and many are still being published on Web sites and in courses.
- New questions are reported by the test takers to their flight instructors, who are seeking to understand exactly what their students did not know, and to course producers, who wish to better prepare their students.
- Officially removing the questions from the public domain has deprived the FAA test writers of input from the aviation community, and does not allow for open dialogue for fear of revealing question content.

Returning the question bank to the public domain will allow for the establishment of correlation and accountability between training and testing, and develop a means to provide and process feedback on the test from the aviation community.

The ARC recommends masking numbers and figures required for calculations and interpretation to avoid rote memorization.

Example 1: Masking Numbers Requiring Calculation

> An aircraft is loaded XXXX pounds over maximum certificated weight. If fuel (gasoline) is drained to bring the aircraft weight within limits, how much fuel should be drained?

"XXXX" is used instead of numbers so applicants perform the calculation instead of memorizing the answer.

Example 2: Masking Specific Location to Require Interpretation

> The wind direction and velocity at XXXX is from:

The figure to be provided with this example question would include multiple locations. Using "XXXX" in place of a specific airport identifier will ensure applicants study the complete figure instead of memorizing a specific location.

Example 3: Masking Details

> When approaching Lincoln Municipal from the XXXX at noon for purposes of landing, initial communications should be with:

In this example, "XXXX" represents the direction from which the aircraft is arriving.

Rationale

The ARC's key proposal is to involve stakeholders in the boarding of questions, a direct response to one of the FAA assignments to the ARC. The aviation industry has considered several approaches or mechanisms through which this can be accomplished, and one key issue is the FAA's ability to share questions with a small group of people. After significant debate, the ARC recommends the FAA release all questions in the manner specified above for a 3-year period at minimum, during which the questions would be in the public domain and reviewed in detail by the expert group identified in recommendation 1. Following that time, the FAA must meet the set of criteria established in recommendation 5; if met, the FAA could consider, with input from the aviation industry, evolving to a semi-nonpublic question bank that maintains the integrity of the correlation between training and testing.

The ARC's critique of the quality of the questions is not a negative reflection of the FAA test writers' abilities, but the attempt at secrecy deprives the test writers the benefit of aviation industry input that could improve the quality and relevance of the questions. Returning the question bank to the public domain allows qualified SMEs to participate in developing questions and providing feedback without a conflict of interest. Writing insightful, meaningful, relevant questions that reinforce the critical tools pilots need to manage risks is difficult. Expecting a

handful of test writers to write relevant questions that reflect the philosophies in recommendation 4, without collaboration with instructors who are actively teaching and flying is not practical.

Similar feedback is a critical component of Safety Management Systems and AQP, which are widely used in the aviation industry.

Precedents for a public question bank include the FAA knowledge exams until the recent past, Federal Communications Commission radio operator certification, and the U.S. citizenship naturalization test. Appendix I, Review of Non-Aviation Testing includes examples of both public and nonpublic question banks and how these tests are developed and maintained by governments and other industries.

Where the current test may ask, "The angle of attack at which an airplane wing stalls will…" for which the applicant should answer, "remain constant regardless of gross weight," the new and improved test could include insightful and life-saving questions such as, "Shortly after takeoff, the pilot sees a thin, low-level cloud layer ahead. What is a primary consideration in determining the appropriate climb angle while trying to maintain VMC?" For this question, the applicant should answer, "the critical angle of attack."

The ARC believes the improvement in question quality and the focus on risk management will save lives that otherwise would be needlessly lost.

RECOMMENDATION 6

Recommendation 6: The ARC recommends the FAA urgently allocate additional resources to AFS–630 for an improved computer system (including both hardware and software) for development, maintenance, and delivery of knowledge tests that can—

- Randomly generate tests that include all required knowledge areas (instead of manually created form tests).
- Display onscreen images with regularly updated figures in place of FAA computer testing supplements.
- Improve data management.
- Be updated and maintained as technology improves.

Necessary Technological Changes to Implement ARC Recommendations and Modernize Airman Testing

The knowledge test is administered through FAA-designated organizations using software developed in 1992 through the Airman Knowledge Test Delivery (AKTD) system, which delivers exams using an outdated technology. Currently, only one person within AFS–630 can manage the data in the system. The AKTD is not compatible with current hardware, resulting in testing sites either keeping old computers to administer FAA knowledge tests, or choosing not to offer FAA knowledge tests anymore. The ARC views this as a major concern.

AFS–630 currently uses Item Bank Solutions (IBS) to develop and manage test items and form tests. IBS provides the FAA with the means to develop, review, revise, and maintain airman knowledge test questions and exams. The application is comprised of a structured query language (SQL) server back-end and a Visual Basic 6.0 front-end. IBS provides the following functions:

- Question maintenance,
- Form test maintenance,
- Site management,
- Cycle change administration,
- Question review, and
- Statistical output.

One of the many limitations of the current system is its inability to display graphs, which forces individual test centers to use printed paper test supplements, slowing the ability to update these supplements regularly. Being limited to printed test supplements greatly constrains the FAA's ability to develop advanced questions and provide questions built around multiple scenarios. More complex test supplements also limit applicants' ability to memorize material).

Another limitation of the current system is the FAA's inability to provide accurate information to the training community about the tests being administered. As discussed in recommendations 4 and 5 of this report, the information provided to the public for correlating training and testing is limited, inaccurate, and not current to the tests being given. The data available to the public through the FAA Web site is not a true representation of the test composition.

The ARC believes upgrading the knowledge testing systems to use current technology can significantly improve knowledge test development and administration, provide the aviation community a better correlation between training and testing, and improve presentation of supplementary material (currently printed FAA–CT–8080 documents) to applicants. Investing in modern testing capabilities will reduce long-term costs and simplify the way the tests are reviewed and updated.

Not only is new technology rapidly changing the way risk is managed in aviation, but it also provides significantly better methods of testing applicant knowledge for all certificates and ratings. For example, FAA–CT–8080 documents are issued at the testing centers and allow applicants to view the figures referenced in questions in the FAA knowledge test. These documents include illustrations, charts, and pictures, and are used to supplement the knowledge tested in the questions. However, these documents are currently provided in a printed format and many are grossly outdated, especially in light of the technological advancements changing the way flights are planned and executed.

Beginning as early as 2004, the FAA department responsible for the tests and FAA–CT–8080 documents stated the information contained in the supplements would be reviewed and moved to an online depiction of the figures, reducing the need for the printed FAA–CT–8080 files. As of 2012, this process has not been completed. The FAA continues to state the supplements are in revision with the goal of moving as many question figures as possible to an online depiction; however, most of the FAA–CT–8080 documents have not been updated extensively for years and contain obsolete information. Table 2 below shows the most recent updates. This means the knowledge test applicant is required to study obsolete information for purposes of passing this step in the certification process. The FAA cites limited resources as the reason these FAA–CT–8080 documents cannot be updated in a more timely fashion.

For the aforementioned reasons, AFS–630 is pursuing the purchase of a more robust and technologically up to date item banking and test delivery system. However, it does not have the resources to realize this goal. The ARC concluded the FAA needs to allocate additional resources.

Table 2—Updates to Computer Testing Supplements

Computer Testing Supplement	Last Updated
Aviation Mechanic, CT–8080–4E	2005
Sport Pilot, Sport Instructor, CT–80801–10A	2005
Private and Recreational Pilot, CT–800–2E	2004
Instrument Rating, CT–8080–3E	2005
Commercial Pilot, CT–8080–1C	2005
Flight and Ground Instructor, CT–8080–5E	2001
Flight Engineer, CT–8080–6A	1999
Airline Transport Pilot, Aircraft Dispatcher, CT–8080–7C[25]	2005

New technologies can also be used in the way form tests are created and reviewed, reducing the costs and associated man-hours needed to achieve this. The FAA testing system currently relies on form tests, which are manually created by the in-office ASIs. For each FAA knowledge test, between 8 and 11 form tests exist, which are issued through the computer testing centers. This is a labor-intensive process, requiring the ASIs to manually review each form test any time a change is needed. This also limits the number of questions used on the tests from the complete question bank. The ability to use onscreen images is limited.

Additionally, applicants retain the ability to request a "hand score" any time they believe there is a problem with the test, such as "bad" questions or improper test composition; this process is not automated and takes the ASI an average of 4 hours for each hand score request. When a change in regulations, procedures, or technology is made, the ASI must manually update all form tests and associated public data and update as necessary or remove the obsolete information. At a time when budgets are constrained, the FAA must use current technologies to evolve to a testing system that is sustainable for the existing resources and can grow for improved assessment.

[25] Supplemental figures released June 2011.

RECOMMENDATION 7

Recommendation 7: The ARC recommends the FAA improve the feedback mechanism subsequent to knowledge testing by June 30, 2013, by—

- Providing the applicant and instructor the specific missed questions to identify the deficient knowledge by review of the Airman Knowledge Test Report.
- Publishing the aggregate results of knowledge testing failure areas to provide a mechanism through which training organizations, providers, and publishers can improve and better target their instruction.
- Reviewing the benefit of integrating the results of aggregate knowledge testing into the Aviation Safety Information Analysis and Sharing (ASIAS) system.

Review of LSCs and Their Use to Enhance Training and Development of National Statistics on Testing

Currently, one of the primary feedback processes to applicants and instructors is the listing of LSCs[26], sometimes referred to as "failure codes," on the airman test report. Following the administration of a knowledge test, the applicant will review the LSCs with their instructor as mandated by the PTS, which state "An applicant … is required by 14 CFR part 61 to … have an endorsement certifying that the applicant has demonstrated satisfactory knowledge of the subject areas in which the applicant was deficient on the airman knowledge test."

Some of the LSCs are generic in nature and do not communicate the applicant's specific knowledge deficiency for the instructor to ensure knowledge is sufficient before issuing the endorsement for the practical test. As an example, "PLT001 Calculate a course intercept" is specific in nature, whereas "PLT014 VOR" is too broad to determine where the applicant's knowledge is deficient.

The FAA testing of airmen and applicants for airman certification is accomplished through several data systems including the FAA knowledge and practical tests. Often referred to as the "check ride," the practical test consists of two components—the oral test and the practical flight test. This three-pronged testing system involves a system of checks and balances: the CFI manages training and endorsements, the FAA issues the FAA knowledge test, and the DPE issues the practical test. The certification process is effective and depends on the successful correlation between training and testing.

[26] See Learning Statement Reference Guide for Airman Knowledge Testing, AFS–600 Regulatory Support Division, October 17, 2011, at http://www.faa.gov/training_testing/testing/airmen/media/LearningStatementReferenceGuide.pdf. Accessed April 11, 2012.

Additionally, although the FAA administers tens of thousands of knowledge tests each year, no direct feedback loop exists for training providers about areas in which all applicants for airman certification have high degrees of failure.

This information was previously available from the FAA. During the 1960s and 1970s, the FAA released "Exam-O-Grams" for both VFR and instrument flight rules pilots. These documents stated—

> *Exam-O-Grams are brief and timely explanations of important aeronautical knowledge items. These items include concepts and procedures that are critical to aviation safety, common misconceptions among airman applicants, and areas which cause difficulty in written tests … Exam-O-Grams are developed on a continuing basis, only as needs arise, and not on a regularly scheduled basis. They are distributed free to airman applicants, pilots, ground and flight instructors, educational institutions, airman training centers, flying clubs, and other interested groups and individuals. Exam-O-Grams may be reproduced without further permission from [the] FAA.*[27]

The FAA written test was first published in ACs, then in question books (FAA–T–8080s), and then evolved into the electronically issued knowledge test, while the Exam-O-Grams were replaced with the public database available on the FAA Web site. As a result, there is no longer a reliable source of information from the FAA that gives training providers the information they need to meet their obligations to the applicant.

Correlation of Training and Testing

The FAA is evolving into a safety management-driven organization. As part of this effort, the FAA is working to identify additional data, specifically incident data opportunities that can help proactively prevent accidents and improve pilots' training and education. The aggregate results of the failure areas for each certificate and rating identify areas where potential common issues exist with training and instruction at the national or local level. This data, however, is not made available to training providers.

The aviation training industry sees benefit in better understanding the areas of failure to help continuously improve training and instruction. This understanding is critical for flight instructors to meet their responsibilities, with the endorsement certifying the applicant has demonstrated satisfactory knowledge of the missed subject areas. This information is also critical to the DPE to conduct effective practical tests. The distribution of de-identified data regarding commonly failed subject areas for each certificate and rating would provide another opportunity to make these changes, similar to the way AQP methods of evaluation and feedback have become crucial to improvements in training at air carriers.

Additionally, the FAA is expanding the ASIAS system, which provides a mechanism for integration, analysis, and sharing of aviation safety data and information. The ASIAS system, if it does not already integrate the results of failure data, should evolvee to also capture knowledge testing results.

[27] FAA. "VFR Pilot Exam-O-Grams." Available at http://www.birdbird.org/aviation/examogram/index.html. Accessed April 11, 2012.

RECOMMENDATION 8

Recommendation 8: The ARC recommends the FAA establish and continuously communicate a schedule for publishing standards, handbooks, and knowledge test questions by June 30, 2013.

To communicate new important safety information while adhering to the publication schedule, the ARC recommends the FAA establish a process through which high priority topics are identified and communicated to stakeholders by use of "hot sheets" that provide time-sensitive information critical to flight safety between scheduled publication dates.

As discussed in recommendation 1, the publication schedule is important to the aviation training industry in developing testing and training material. Currently, however, a number of handbooks have been in internal FAA coordination for several months. No formal process exists to notify stakeholders of impending changes to handbooks and other source document materials.

The ARC recommends the FAA establish a process for notifying the public about new standards, handbooks, and knowledge test questions, such as a Web-based subscriber list.

One issue that seems to occur frequently is that as the FAA approaches the deadline for publication of a new handbook or document, issues arise, resulting in the delay of a number of new training materials.

The ARC recognizes these new topics are important to quickly and effectively communicate to the aviation training industry, but believes the delay of handbook publication fails to achieve the timely communication of other issues. The ARC proposes a two-pronged approach to making changes:

1. The FAA should publish the publication schedule for standards, handbooks, and test questions.
2. When new issues emerge during the publication cycle, the FAA should issue targeted "hot sheets" to address these issues and communicate them to the aviation training industry. These hot sheet topics would then be integrated into the next scheduled revision cycle of the relevant source documents.

Issuing hot sheets provides the additional benefit of allowing two-way communication between the FAA and the aviation community through which the topic area can be further vetted and developed before implementation and inclusion in the next publication cycle for the relevant source documents.

RECOMMENDATION 9

Recommendation 9: The ARC recommends the FAA continue to administer a single knowledge test for each certificate or rating and not transition to testing and scoring individual required subject areas.

Consideration of Subtesting and Its Inclusion on FAA Pilot Knowledge Tests

In addition to a consideration of the passing score percentage threshold,[28] the ARC reviewed requests for minimum subtest scores on topics within FAA pilot knowledge tests. This discussion was undertaken outside the scope of the specific tasks listed in the ARC charter in consideration of the recommendations that have been made by the NTSB and others in the aviation community. A 2005 NTSB recommendation addressed this topic:

> *The Safety Board also notes that, unlike the practical test standards in which failure of one "area of operation" is grounds for failure of the entire test, no minimum number of questions must be answered correctly within a given "knowledge area" on the knowledge test. For example, an average of 12 out of 60 questions on the private pilot certification knowledge test are weather-related. A pilot could answer all 12 questions incorrectly and still receive a score as high as 80 percent, which is well above the minimum passing score of 70 percent. The Safety Board concludes that a pilot can incorrectly answer all questions relating to weather on an airman knowledge test and still receive a passing score on the test.*
>
> *The Safety Board believes that a basic understanding of aviation weather is an important prerequisite to obtaining any pilot certificate or rating. Therefore, the Safety Board recommends that the FAA establish a minimum number of weather-related questions that must be answered correctly in order to pass FAA airman knowledge tests. The establishment of such requirements will further ensure that pilots who pass a knowledge test will have demonstrated a basic understanding of aviation weather.*[29]

Below is one of the six weather-related safety recommendations set forth in the NTSB recommendation.

> *Establish a minimum number of weather-related questions that must be answered correctly in order to pass Federal Aviation Administration airman knowledge tests.*[30]

[28] See Appendix J, Consideration of Passing Score Percentage Threshold, and Appendix O, Percentage of Correct Responses by Topic for Selected Knowledge Tests.
[29] Weather-Related GA Accidents, dated October 12, 2005 (refer to A–05–24 through A–05–029). Available at http://www.ntsb.gov/doclib/recletters/2005/A05_24_29.pdf. Accessed April 10, 2012.
[30] A–05–026.

The ARC considered minimum subtest scoring in its overall deliberation of airman testing standards and training, with the objective of increasing pilot knowledge, competency, and risk management skills to reduce GA accident rates. It is the view of the ARC that the FAA should devote its resources to improving the overall pilot knowledge testing process, rather than divert to a system centered on minimum subtest scores. Although it is possible for an applicant to miss every question on a given subject, all areas of deficiency must be reviewed and retrained to a satisfactory level of knowledge before proceeding with the certification process.

Although the ARC members agree that knowledge in each testing subject area is important, the ARC maintains its position that the purpose of a knowledge test is to sample overall knowledge. The instruction and learning process should then address areas of deficiency found on the knowledge test, followed by a final testing process that ends with the practical test.

Subtesting may seem to enhance the ability of the testing environment to better analyze an applicant's knowledge, but the practical application of this testing approach may not be feasible in the current pilot training and testing system. The ARC raised concerns about completing specific subject matter testing because of (1) the need for a valid subset in each subject area, (2) the selection process for each knowledge area, (3) the need for additional questions and a process for managing each test, and (4) the limitation subtesting imposes on the use of scenario-based questions as outlined here.

Valid Subset for Each Subject Matter

If the tests are to be kept at their current lengths, the ARC believes it unlikely that an appropriate number of subset topics could be included and still allow for valid sampling of an applicant's knowledge of each subject area.

Currently, the private pilot knowledge test contains between 1 and 12 questions in each of the 13 topics for a total of 60 questions. See Appendix N, Private Pilot Knowledge Test Topics for the question count for each topic and test. Transitioning to subtesting would require tests to contain more questions for each subtest to be statistically valid and to ensure it adequately samples an applicant's knowledge of each subject area. Developing more questions would require the FAA to focus resources on increasing the quantity of questions in the item bank rather than developing quality questions.

Selection Process for Each Knowledge Area

If the FAA transitioned to subtesting, great care would have to be taken in framing the scope of each subject area and balancing that topic against the importance of other subject areas. As an example, if the subject area is too broad, such as "weather," critical knowledge may be perceived to be missed in the testing process. If the subject area is too focused, it is necessary to create too many subject areas to effectively test all knowledge areas. Breaking up the broad "weather" subject area may require creating sub-subject areas for "types of clouds," "weather fronts," "sources of aviation weather," "reading aviation weather charts," "thunderstorms," and "fog."

The length of the test would again come into question, as would the need for a required passing grade for each sub-subject area. Additionally, the use of subject or sub-subject areas raises the question of how to determine which subgroups to include in the test. Balancing the priorities of

multiple safety areas and their scoring would likely become difficult to manage. The authors of a NASA report noted civil aviation authorities that have adopted the use of subtesting have transitioned to multiple exams with increased time and expense required to obtain a rating without a clear benefit to safety.[31]

Need for Additional Questions and a Process for Managing Each Test

Adopting subtesting would drive the FAA to expand its question bank for each test area to ensure multiple questions and types of questions are available. The ARC believes additional resources and infrastructure would likely be required to manage the subtesting processes for each test.

Scenario-based Questions versus Targeted Knowledge

The ARC recommends the FAA shift from questions that test rote knowledge in a single subject area to scenario-based questions, requiring applicants to apply knowledge from a broad set of subject areas. The ARC believes subtesting will require placing each question into a single category, which is contrary to the scenario-based testing concept.

Due to these and other concerns, the ARC is concerned that the overall effect on testing would be to drastically increase both the length of the tests and the workload of the test developers and maintenance staff without any quantifiable increase in overall safety or knowledge base in the pilot applicants.

It is the opinion of the ARC that the overall goal of pilot knowledge tests is to sample the overall knowledge base a pilot has developed to allow them to advance in their training and testing process. This approach does not require each specific subject area to be tested in detail to test the overall aptitude of the applicant. In this approach to testing, subtesting requirements for performance are not necessary to evaluate overall applicant knowledge and performance.

[31] Stephen M. Casner, Karen M. Jones, Antonio Puentes, and Homi Irani, "FAA Pilot Knowledge Test: Learning or Rote Memorization?" *NASA/TM-2004-212814* (January 2004), 12.

APPENDIX A—ARC MEMBERS, SUBJECT MATTER EXPERTS, AND PRESENTERS

AIRMAN TESTING STANDARDS AND TRAINING ARC CHAIRMAN

Mr. Jens Hennig, General Aviation Manufacturers Association (GAMA)

AIRCRAFT OWNERS AND PILOTS ASSOCIATION, (AOPA)

Ms. Kristine Hartzell

AVIATION ACCREDITATION BOARD INTERNATIONAL (AABI)

Mr. Gary Kiteley

AVIATION SUPPLIES & ACADEMICS (ASA)

Ms. Jackie Spanitz

CESSNA PILOT CENTER

Mr. Kirby Ortega

GLEIM PUBLICATIONS

Dr. Irv Gleim

Mr. Garret Gleim

JEPPESEN

Ms. Julie Filucci

Mr. David Wright

KING SCHOOLS

Mr. John King

Mr. John "Mac" McWhinney

NATIONAL AIR TRANSPORT ASSOCIATION (NATA)

Ms. Rebecca Mulholland

NATIONAL ASSOCIATION OF FLIGHT INSTRUCTORS (NAFI)

Mr. Jason Blair

REDBIRD FLIGHT SIMULATIONS

Mr. Roger Sharp

SOCIETY OF AVIATION AND FLIGHT EDUCATORS (SAFE)

Mr. Doug Stewart

SPORTYS ACADEMY

Mr. Eric Radtke

UNIVERSITY AVIATION ASSOCIATION (UAA)

Capt. Carmen "Corkey" Romeo

Mr. B.J. Galloway

SUBJECT MATTER EXPERTS

Mr. Jay Evans, National Business Aviation Association (NBAA)

Mr. Lou Nemeth, CAE

Dr. Doug Farrow, FAA

Mr. Larry Culver, FAA

PAI CONSULTING

Mr. Scott Harper

Mr. Brian Boardman

Mr. Jeff Hayes

Mr. David Binswanger

FEDERAL AVIATION ADMINISTRATION

Ms. Susan Parson, Designated Federal Official, AFS–003

Mr. Van Kerns, AFS–600

Mr. Stanley Roberts, AFS–600

Mr. Jeffrey Smith, AFS–800

Ms. Sabrina Jawed, Attorney, Office of the Chief Council Regulations Division

APPENDIX B—ACRONYMS

AC	advisory circular
AFS	FAA Flight Standards Service
AIM	Aeronautical Information Manual
AKTD	Airman Knowledge Test Delivery
AQP	Advanced Qualification Program
ARC	Aviation Rulemaking Committee
ASI	aviation safety inspector
ASIAS	Aviation Safety Information Analysis and Sharing
ATO	FAA Air Traffic Organization
AVP	FAA Office of Accident Investigation
CAM	Certified Aviation Manager
CAMGB	CAM Governing Board
CAST	Commercial Aviation Safety Team
CFI	certificated flight instructor
CFR	Code of Federal Regulation
CRM	crew resource management
DPE	designated pilot examiner
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
FITS	FAA/Industry Training Standards
FTD	flight training device
GA	general aviation
GAJSC	General Aviation Joint Steering Committee
GPS	Global Positioning System

IBS	Item Bank Solutions
ICAO	International Civil Aviation Organization
ICE	Institute for Credentialing Excellence
ISD	Instructional Systems Design
JTA	job task analysis
KSA	knowledge, skills, and attitudes
LOFT	line oriented flight training
LSC	learning statement code
METAR	Aviation Routine Weather Report
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NBAA	National Business Aviation Association
NCCA	National Commission for Certifying Agencies
NTSB	National Transportation Safety Board
OE	operating experience
PTS	practical test standards
QMS	quality management system
SBT	scenario-based training
SME	subject matter expert
SMT	Schroeder Measurement Technologies
SRM	single-pilot resource management
TAF	terminal aerodrome forecast
VFR	visual flight rules

APPENDIX C—ARC CHARTER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Effective Date: Sept. 21, 2011

SUBJ: Airman Testing Standards and Training Aviation Rulemaking Committee (ARC)

1. PURPOSE. This document establishes the Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) according to the Administrator's authority under Title 49 of the United States Code (49 U.S.C.), section 106(p)(5).

2. BACKGROUND.

a. The FAA Flight Standards Service (AFS) promotes safety by educating and advising users through the development, implementation, analysis and distribution of technical information. Among other responsibilities, AFS plans, develops, and maintains materials related to airman certification training and testing. These materials include airman knowledge and skill tests, computer testing supplements, knowledge test guides, practical test standards, training handbooks, and computer testing sites listing. Stakeholders include the public, private industry, and other components of AFS.

b. To carry out the FAA's safety mandate, AFS must ensure that the technical information related to airman knowledge and skill tests, computer testing supplements, knowledge test guides, practical test standards, and training handbooks is regularly updated. These updates must enhance safety and meet the needs of stakeholders by incorporating the most current and relevant standards, policies, procedures, and techniques for airman certification, training, and testing. To that end, the FAA is chartering the Airman Testing Standards and Training ARC to make recommendations on the content, planning, development, production, and review of the aforementioned technical information.

3. OBJECTIVES AND SCOPE OF THE ARC. The Airman Testing Standards and Training ARC will provide a forum for the U.S. aviation community to offer its experience and expertise in the elements of aeronautical knowledge and aeronautical experience required for safer operation in today's National Airspace System (NAS). Specifically, the ARC will develop and recommend:

a. A prioritized list of up to five pilot and/or instructor certificates and/or ratings its work will address.

b. An aeronautical knowledge standard for the selected certificates and ratings. The aeronautical knowledge standard for each certificate and/or rating should set forth the overall precepts that will conceptually frame, guide, and justify its specific technical subject areas.

c. Methods for regular industry participation in the planning, development, production, and review of technical information (e.g., training handbooks, knowledge test guides, and supplements) intended to convey the elements of the knowledge standard.

d. Precepts for development and appropriate review of updated knowledge tests that will accurately and reliably measure the airman's mastery of the aeronautical knowledge standard. This task should include recommendations on types of questions to be included.

The ARC's initial session should address how its recommendations will be accomplished. For example, the ARC may propose standing committees, working groups, forums, or processes to vet various proposals for revised standards, handbooks, and/or tests. The ARC should also consider how to select appropriate representation for any standing committees or working groups.

Within sixty (60) days of its initial meeting, the ARC will complete the prioritized list described in 3(a) and submit it to the Associate Administrator for Aviation Safety for approval. The ARC will submit a report of its final recommendations on Tasks 3(b)-3(e) within 12 months of its initial meeting.

4. ARC PROCEDURES.

The ARC provides advice and recommendations to the Associate Administrator for Aviation Safety. The committee acts solely in an advisory capacity

The ARC will discuss and present information, guidance, and recommendations that its members consider relevant in addressing the objectives.

5. ORGANIZATION, MEMBERSHIP, AND ADMINISTRATION.

a. The FAA will establish an ARC representing the aviation community, including industry associations, universities, training providers, and professional associations.

i. The ARC will consist of no more than 20 representatives.

ii. The FAA will invite selected organizations and individuals to participate as a member in the ARC.

iii. The FAA will identify the number of ARC members that each organization may select to participate. The FAA will then request that each organization name its representative(s). Only the representative for the organization will have authority to speak for the organization or group that he or she represents.

iv. The ARC may establish specialized work groups that will include at least one committee member and invited subject matter experts from industry and Government, as necessary.

v. Active participation and commitment by members will be essential for achieving the committee objectives and for continued membership on the ARC.

vi. Although not required, committee meeting quorum is desirable.

a. The Associate Administrator for Aviation Safety will receive the committee recommendations and reports.

b. The Associate Administrator for Aviation Safety is the sponsor of the ARC and will select an industry chair from its membership. Also, the Associate Administrator will select the FAA-designated representative(s) for the committee. Once appointed, the chair will:

i. Determine, in coordination with the other members of the ARC, when a meeting is required.

ii. Arrange notification to ARC members of time and place for each meeting.

iii. Draft an agenda for each meeting and conduct the meeting.

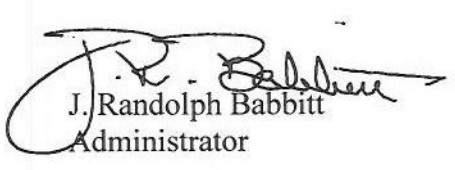
iv. Ensure that a Record of Discussions of ARC meetings is kept.

6. PUBLIC PARTICIPATION. The Airman Testing Standards and Training ARC meetings are not open to the public. Persons or organizations that are not members of this ARC and are interested in attending a meeting must request and receive approval before the meeting from the chair or the designated Federal representative.

7. AVAILABILITY OF RECORDS. Consistent with the Freedom of Information Act, 5 U.S.C. § 522, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the ARC will be available for public inspection and copying at the FAA Flight Standards Service, 800 Independence Avenue SW, Washington, DC 20591. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations part 7.

8. PUBLIC INTEREST. Forming the Airman Testing Standards and Training ARC is determined to be in the public interest to fulfill the performance of duties imposed on FAA by law.

9. EFFECTIVE DATE AND DURATION. This ARC is effective upon issuance. The ARC will remain in existence for a period not to exceed eighteen months unless sooner terminated or extended by the Administrator.



J. Randolph Babbitt
Administrator

APPENDIX D—AFS 600–005

	AVS Quality Management System	QPM # AFS 600-005	Revision 6
Title: Airman Knowledge Test Question Development, Review and Revision		Effective Date: August 26, 2009	Page 1 of 7

AFS 600 – 005

Airman Knowledge Test Question Development, Review and Revision

Purpose: This process documents how the Airman Testing Standards Branch (AFS-630) develops, reviews, revises, and maintains airman knowledge test questions. This includes airman knowledge tests for the following certification areas: Aircraft Dispatcher, Airline Transport Pilot, Aviation Mechanic, Commercial Pilot, Designated Mechanic Examiner, Designated Parachute Rigger Examiner, Flight Engineer, Flight Instructor, Flight Navigator, Ground Instructor, Inspection Authorization, Instrument Rating, Military Competency, Parachute Rigger, Pilot Examiner, Private Pilot, Recreational Pilot, and Sport Pilot.

Scope: This process applies to all branch employees (both government and contract) who are responsible for the conduct and support of airman knowledge testing activities. This process is accomplished in accordance with applicable FAA policies and guidance and Work Instruction AFS-600-005-WI01.

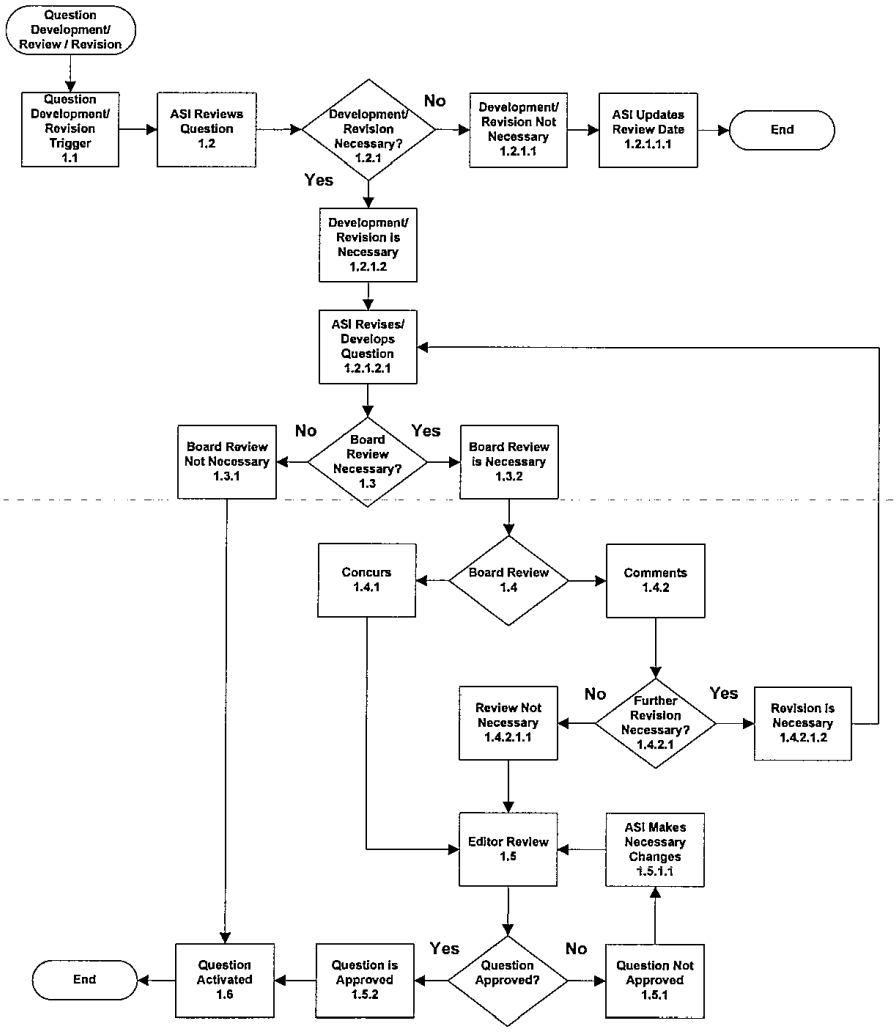
Approval: Debra J. Entricken
Acting Manager, Regulatory Support Division

REVISION HISTORY		
Rev	**Description of Change**	**Effective Date**
0	Original	07/07/04
1	Renamed & revised AFS-630 Business Product 1	12/29/04
2	Made editorial changes	02/09/05
3	Revised flowchart & made editorial changes	08/23/05
4	Revised process & flowchart	06/20/06
5	Revised process & flowcharts	08/10/06
6	4/15/09: Converted format to most recent AVS QMS process template. Rearranged decision point paragraphs, as needed for consistency, in sections 1.0 and 2.0. Rewrote par. 2-1 to list triggers for test question revision/development. Revised flowcharts as needed to correspond with minor changes and rearrangement of text. Added Customer Satisfaction, Process Performance, and Product Conformity Measures throughout process, including Measures paragraph on last page. Added References paragraph on last page. 8/7/09: Renamed process. Added acronyms section on page 2. Removed section 1.0. Removed "References" section. Document reduced from 12 to 7 pages.	08/07/09

ACRONYMS

AFS-630	Airman Testing Standards Branch
AOD	Analysis of Data
ASI	Aviation Safety Inspector
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
IAW	In Accordance With
LAN	Local Area Network
SOW	Statement of Work

Airman Knowledge Test Question Development, Review, and Revision Process Flow Chart



1.0 Airman Knowledge Test Question Development, Review, and Revision

Airman knowledge test question development and revision is an ongoing, continual improvement process. It is a completely automated process accomplished through an application called "ItemBank", which is a sophisticated, interactive software tool for managing a large test development and delivery environment. All phases of test question development, review, revision, and other actions taken are conducted, recorded, and maintained electronically in ItemBank. A variety of data regarding test questions, including reference sources, relevant regulations, topic/ content/specific categories, notes, and statistics on the performance of the question are also maintained in the application, and are readily available to the ASI in charge of each certification area/bank.

1.1 Test question development/revision is initiated by one or more of the following triggers: quarterly review of applicant survey comments regarding FAA test questions; statistical analysis of active test question performance and validation test question performance; biennial review of questions; and/or a variety of non-scheduled outside sources, such as technological advances in aviation, updated references, changes to the CFR, and public feedback.

1.2 The responsible ASI reviews the question(s) identified via the trigger(s). (Test question/bank assignments are based on information contained in Form AFS-600-005-F02, ASI Certification Area of Responsibility.)

1.2.1 The ASI determines if development/revision is necessary using the edit question screen in ItemBank, the Item Writing and Evaluation Guidelines, and applicable aviation publications.

1.2.1.1 If revision is not necessary:

1.2.1.1.1 The ASI updates the "review date" in ItemBank to reflect that the question was reviewed and left unchanged. Review dates will be monitored on a quarterly basis to ensure that all questions are reviewed at least every 2 years. **(Process Performance Measure)**

1.2.1.2 If development/revision is necessary:

1.2.1.2.1 The ASI develops a new question or revises the existing question. (AFS-600-005-WI01)

1.3 The ASI determines if a board review of the question is necessary. All new questions and major changes (as defined in AFS-600-005-WI01) require board review. **(Product Conformity Measure)**

1.3.1 If a board review is not necessary, the revised question will be activated with the next cycle roll. (Proceed to step 1.6.)

1.3.2 If a board review is necessary, the question will be forwarded to the board.

1.4 Members of the review board will conduct their review and concur or make comments.

1.4.1 If the board concurs with the developed/revised question, the assigned ASI will forward the question to the Editor.

1.4.2 If the board has comments on the developed/revised question:

1.4.2.1 The assigned ASI will determine if further revision is necessary using the edit question screen in ItemBank, the Item Writing and Evaluation Guidelines, and applicable aviation publications.

1.4.2.1.1 If further revision is not necessary, the question is forwarded to the Editor.

1.4.2.1.2 If further revision is necessary, the question is revised and boarded again. (Return to step 1.2.1.2.1.)

1.5 The Editor will conduct an editorial review to determine approval of the question.

1.5.1 If the Editor does not approve due to comments, the question is returned to the ASI.

1.5.1.1 The ASI makes the necessary changes and forwards the question back to the Editor. This process will be repeated until the Editor approves the question.

1.5.2 If the Editor approves the question, the question becomes available for use in the test bank and on a form test(s).

1.6 The approved question may be activated during the next cycle roll. (Cycle rolls for new and updated questions and form tests are processed three times per calendar year. A new cycle roll updates the active database with question and form test changes made since the last scheduled cycle roll completion.)

End of Airman Knowledge Test Question Development, Review, and Revision Process.

Measures:

AFS-630's stakeholders include: academia and aviation industry representatives; 14 CFR parts 61 and 65 operators; 14 CFR part 141 and 147 schools; students and airman applicants; private company, military-based, and alternate arrangement test providers; international entities, and numerous other internal and external customers. Customer feedback regarding airman knowledge test questions may be captured through several sources:

- Responses to airman applicant surveys (offered at the close of the knowledge test administration process);
- Responses to customer satisfaction surveys (returned from contacts documented in the "ScratchPad" application);
- Comments received in AFS-630's email inbox (afs630comments@faa.gov);
- Comments submitted on Form AVS-001-003-F1, AVS Stakeholder/Customer Feedback.

Customer satisfaction, process performance, and product conformity is continuously monitored. The branch Statistician analyzes and reports on customer satisfaction in the quarterly AOD meetings. Examples of measures which may be reported in the AOD meetings are: airman applicant survey results, customer satisfaction survey results, customer comments and stakeholder feedback, and test question biennial review/development/revision activity.

APPENDIX E—ICAO AND 14 CFR PART 61 REQUIREMENTS FOR KNOWLEDGE TESTING

Both the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA) address knowledge test requirements by certificate type, and the methods of both organizations have many parallels.

For each certificate, ICAO provides standards in which the following "knowledge" requirement paragraph appears, followed by a list of topics:

> *The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of … [a] pilot license and appropriate to the category of aircraft intended to be included in the license, in at least the following subjects.*[32]

The standard ICAO prescribes for private pilot applicants[33] requires the applicant demonstrate knowledge in at least the following areas:

- Air law;
- Aircraft general knowledge for airplanes;
- Airship, helicopters, and powered lifts;
- Flight performance;
- Planning and loading;
- Human performance;
- Meteorology;
- Navigation;
- Operational procedures;
- Principles of flight; and
- Radio telephony.

In comparison, the FAA private pilot knowledge areas are—

- Applicable Federal Aviation Regulations of this chapter that relate to private pilot privileges, limitations, and flight operations;
- Accident reporting requirements of the National Transportation Safety Board;
- Applicable portions of the FAA Aeronautical Information Manual and FAA advisory circulars;

[32] Annex 1 to the Convention on International Civil Aviation, Tenth Edition. Montreal, Canada. July 2006, paragraph 2.3.1.2

[33] Annex 1 to the Convention on International Civil Aviation, Tenth Edition. Montreal, Canada. July 2006, paragraph 2.3.1.2.

- Aeronautical charts for visual flight rules navigation using pilotage, dead reckoning, and navigation systems;
- Radio communication procedures;
- Recognition of critical weather situations from the ground and in flight, windshear avoidance, and the procurement and use of aeronautical weather reports and forecasts;
- Safe and efficient operation of aircraft, including collision avoidance and wake turbulence recognition and avoidance;
- Effects of density altitude on takeoff and climb performance;
- Weight and balance computations;
- Principles of aerodynamics, powerplants, and aircraft systems;
- Stall awareness, spin entry, spins, and spin recovery techniques for the airplane and glider category ratings;
- Aeronautical risk management and judgment; and
- Preflight action that includes—
    - How to obtain information on runway lengths at airports of intended use, data on takeoff and landing distances, weather reports and forecasts, and fuel requirements; and
    - How to plan for alternatives if the planned flight cannot be completed or delays are encountered.

ICAO does not prescribe the method for evaluating whether applicants have the required knowledge. It delegates the method to member states:

> *An applicant for any pilot license or rating shall demonstrate, in a manner determined by the Licensing Authority, such requirements for knowledge and skill as are specified for that license or rating.*[34]

No conflicts or potential conflicts exist between the Aviation Rulemaking Committee's recommendations and ICAO requirements, current FAA knowledge testing, or changes to FAA knowledge testing.

[34] Annex 1 to the Convention on International Civil Aviation, Tenth Edition. Montreal, Canada. July 2006, paragraph 2.1.1.3.1.

APPENDIX F—ADVANCED QUALIFICATION PROGRAM

Overview of Advances in Training

The Airman Testing Standards and Training Aviation Rulemaking Committee (ARC) discussed a number of advances that have occurred in aviation training outside the area of issuance of new certificates, including the Advanced Qualification Program (AQP) for air carriers and the Certified Aviation Manager (CAM) process used for corporate aviation managers. This appendix and appendix G to this report provide an overview of AQP and CAM.

Overview of AQP and the Applicability of Its Best Practices

From the mid-1970s to the 1980s, the Federal Aviation Administration (FAA) investigated ways to redesign air carrier training programs to manage the increasing complexity of cockpit human factors. In 1987, the Joint Government-Industry Task Force on Flightcrew Performance was formed to address the issue with consultation from representatives of major air carriers, air carrier associations, flight crewmember associations, manufacturers, and government organizations. One of the issues the task force discussed was flight crewmember performance. This meeting led to the creation of the Joint Government-Industry Task Force on Flightcrew Performance. The three areas of focus were man/machine interface, flight crewmember training, and operating environment.[35]

Recommendations from this task force became the foundation on which the FAA developed the AQP.

AQP—Job Task Analysis, Qualification Standards, and Proficiency Objectives

AQP is a systematically developed, continuously maintained, and empirically validated proficiency-based training system. They allow for the systematic analysis, design, development, implementation, progressive evaluation, and maintenance of self-correcting training programs that include integrated crew resource management, improved instructor/evaluator standardization, scenario-based evaluation, and a comprehensive data-driven quality assurance system.[36]

AQP is a process that incorporates task analysis, training, testing, and evaluation, plus a feedback loop to produce a systems approach to flight training. Although new in concept to the general aviation (GA) community, AQP has been in use within the FAA Title 14, Code of Federal Regulations part 121 environment since the early 1990s.

AQP takes a systems design approach to training and evaluation and has its roots within the U.S. Air Force Instructional Systems Design (ISD), dating back to the late 1940s. ISD is the practice of creating "instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing."[37] In ISD, qualification standards and associated curriculum content should be based on a documented analysis of the job tasks, skills, and knowledge required for job proficiency.

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[35] FAA Advisory Circular (AC) 120–54A.
[36] FAA AC 120–54A.
[37] Merrill, M. D., Drake, L., Lacy, M. J., Pratt, J., & ID2_Research_Group. (1996). Reclaiming instructional design. Educational Technology, 36(5), 5–7.

First, the objective "task" is defined. The task is broken down into its elements, which are then analyzed for the knowledge, skills, and attitudes (KSA) or objectives for each task or elements. This process is defined as the job task analysis (JTA) within AQP. The final result is determined first (this is, what KSA level the pilot should meet for each task) and then the training is developed based on the tasks and KSA level defined for each. There is much debate concerning GA's conventional training model as to whether or not "training to the test" is appropriate, though in some respects this is exactly how AQP is developed. The KSA objectives are developed first and the training is designed to meet those KSAs.

A qualification standard is a job task proficiency objective linked to an evaluation strategy. A certificate holder's qualification standards define the requirements of mastery for specific duty positions and replace the practical test standards (PTS) for certification under AQP. The qualification standards document is the single most important part of any AQP. It provides the complete proficiency baseline for all duty positions and serves as the basis for curriculum development for both the Qualification Curriculum and Continuing Qualification Curriculum. The first step in the development of qualification standards is the development of proficiency objectives from the JTA.[38]

In GA, the PTS is the qualification standard for the maneuvers required in the practical test. However, the FAA does not currently publish qualification standards for the required knowledge tasks.

Maneuvers Training and Scenario-Based Training

AQP implements a system of phases that build on each other in training. First is the systems training and systems knowledge validation. The intent of the systems knowledge validation session is to ensure an individual's systems knowledge is at an appropriate level before progressing into the next training phase. Next is procedures training and procedures validation, which is an assessment of an individual's systems integration knowledge and skill. This validation addresses the individual's ability to assimilate system and procedural knowledge into the appropriate execution of procedures. This validation session typically takes place in a flight training device (FTD) before beginning simulator training. Evaluation is often made through a written test and/or an oral test. The next phase is maneuvers training, which is very similar to the conventional training in GA. Each maneuver is trained to proficiency and is not necessarily taught in context of a flight "scenario." This phase is completed with a maneuvers validation before moving on to the line-oriented flight scenarios. Line oriented flight training (LOFT) and line oriented evaluation is the final phase of training and evaluation before an air carrier pilot flies in revenue service. They then begin operating experience (OE), which provides hands-on experience in performing all the duties of a newly assigned position under the supervision of a current and qualified evaluator (check airman). Captain candidates must complete a line check at the completion of the OE phase.

[38] FAA AC 120–54A.

In GA training, phased training concepts should be incorporated into revisions of the training and checking of knowledge and skills. Many flight training providers are beginning to incorporate some of these concepts into training through use of computer-based training software, FTDs, and simulators in the initial phase of training. It would be beneficial to also incorporate scenario-based (or FAA/Industry Training Standards) training into the final stages of training after mastery of the individual maneuvers has been achieved.

Evaluation and Revision of Training and Testing Criteria

During the entire AQP training process the applicant is evaluated, but more importantly the training system is evaluated as well. The results of data collected along the entire process is then analyzed, and information gleaned is returned to the course developers who in turn revise the training curriculum and the whole process begins again, providing constant improvement. The development of the KSAs of each element, data collection, and feedback loop is what makes AQP such a unique training process.

Applying AQP Principles to General Aviation

GA training, testing, and evaluation has not kept up with advanced concepts in flight training and evaluation. The methods of teaching, learning, and evaluating have changed little over the years and are very similar to methods used since World War II. Although some aspects of AQP may not be practically implemented in GA, the objectives of AQP relate directly to the objectives that GA should aspire to. The FAA defines AQP objectives as—

- Supporting safe operations by continuously improving training and evaluation.
- Remaining responsive to continuing changes in the industry, including new aircraft technology, changing operational environments, and new training methods and equipment.
- Remaining responsive to continuing changes and best practices relative to training and evaluation.[39]

These objectives are certainly relevant to GA.

In GA terms, the FAA written test is AQP's systems evaluation. The FAA recommendation ride is the AQP's first look. The maneuvers validation happens when an examiner has the applicant perform to PTS standards the maneuvers necessary for the rating sought. When the examiner asks the applicant to veer from the planned exercise, the applicant is performing the LOFT portion of the evaluation. The only item not completed is the feedback loop. Currently the examiner does not formally evaluate the training system, and weak areas are only identified to the applicant, which does not allow for continuous improvement. Additionally, the training system is never analyzed in depth to understand the whats, whys and hows (KSAs) of what the FAA is asking of the applicant.

[39] FAA AC 120–54A, section 1–2

An AQP-style process can address the shortfalls within the GA training, testing, and evaluating environment. First, it would establish all the necessary tasks an applicant must know for the rating sought. Those tasks would then be analyzed by a subject matter expert for their individual components (KSAs) and a JTA would be completed.

1. Ground Operations
2. Takeoff
    - 2.1 Perform Normal Takeoff
        - 2.1.1 Assess Performance and Environmental Factors
        - 2.1.2 Perform Takeoff Roll
        - 2.1.3 Perform Rotation and Liftoff
            - 2.1.3.1 Rotate Aircraft at VR to Target Pitch Angle [PF]
            - 2.1.3.2 Observe Barometric/ADC Altimeter Increase [PF]
            - 2.1.3.3 Call Out Positive Rate [PM]
            - 2.1.3.4 Retract Gear [PF, PM]
            - 2.1.3.5 Establish Climb Speed [PF]
    - 2.2 Perform Instrument Takeoff
    - 2.3 Perform Engine Failure After V1 Takeoff
    - 2.4 Perform Rejected Takeoff
3. Climb Operations
4. Cruise Operations
5. Descent Operations
6. Approach Operations
    - 6.1 Perform Approach
        - 6.1.1 Perform Visual Approach
        - 6.1.2 Perform Nonprecision Approach Procedures (VOR, NDB, LOC, LOC/BC, LDA, SDF, ASR, RNav/FMS, GPS)
        - 6.1.3 Perform Cat II ILS
        - 6.1.4 Perform Cat IIIb ILS
        - 6.1.5 Perform Coupled Autopilot Approach and Autoland Procedures
    - 6.2 Perform One Engine Inoperative Cat I ILS Approach and Landing
    - 6.3 Perform One Engine Inoperative Missed Approach
    - 6.4 Perform Visual Approach and Rejected Landing
7. Landing Operations
    - 7.1 Normal Configuration
    - 7.2 Auto Land
    - 7.3 No-flap
8. After Landing Operations
9. Aircraft Systems Operations
10. Abnormals and Emergency Procedures
11. Supplementary Procedures

Figure F–1—Sample Pilot Job Task Listing

Each individual element has an associated knowledge, skill, or attitude. From this view it is easily apparent if the element is a KSA item. This information would then determine where and how that individual task needs to be trained, how standards should be set, and how and where the task would be evaluated. Although labor-intensive at first, the end result is a single source document from which the student, instructor, and evaluator can work. The end result is a more standardized approach to training, testing, and evaluation that incorporates a feedback loop into training, thereby increasing the system's overall capabilities and efficiency.

Scenario-Based Training and Evaluation

Most accidents are caused by a chain of errors that build up over the course of a flight and which, if undetected or unresolved, may result in a fatal error. Traditional training programs, with their maneuver-based training and evaluation, artificially segment simulation events in such a way as to prevent the realistic buildup of the error chain. Under AQP, both training and evaluation are scenario-based, simulating more closely the actual flight conditions known to cause most fatal carrier accidents.

APPENDIX G—CERTIFIED AVIATION MANAGER EXAMS

The National Business Aviation Association (NBAA) briefed the Aviation Rulemaking Committee (ARC) on the process it has employed through consultation with Schroeder Measurement Technologies (SMT) and the standards developed by the Institute for Credentialing Excellence (ICE) for writing, reviewing, and revising its Certified Aviation Manager (CAM) exams.

ICE is a nonprofit, 501(c)(3) organization dedicated to providing educational, networking, and advocacy resources for the credentialing community. ICE's accrediting body, the National Commission for Certifying Agencies (NCCA), evaluates certification organizations for compliance with the NCCA Standards for the Accreditation of Certification Programs. The NCCA standards exceed the requirements set forth by the American Psychological Association and the U.S. Equal Employment Opportunity Commission.

SMT is a company that assists its clients in applying the most appropriate technologies, methodologies, and psychometric models in developing credentialing programs. To accomplish this, its staff first works with each client to thoroughly understand the organization's values, business practices, and procedures.

The CAM Governing Board (CAMGB) oversees the development and direction of NBAA's CAM program. The program identifies qualified flight department leaders though a testing process that measures proficiency in five subject areas: leadership, human resources, operations, technical and facilities services, and business management. The CAMGB is composed of flight department professionals, who are CAMs themselves, and representatives from the education community.

Writing valid, reliable, written, multiple-choice exams is a complex process. Different people, with differing experiences and backgrounds interpret questions and answer choices in different ways. All members of the CAMGB testing committee must participate in a training session provided through SMT to ensure they have the skills to write exam questions. The CAMGB testing committee members are provided reference material that directs them to—

- Review a question or issue to ensure it is relevant to the duties under the certification being sought, and if if it is not, write a new question.
- Ensure the question fits into the Job Analysis
- Ensure the correct answer to the question can be found in reference material.
- Take detailed notes of each question's references and how they are used, to assist reviewers checking the question's accuracy.
- Make the question an "application or analysis" level of learning. (That is, a problem to solve based on real world issues. It may include a scenario requiring problem solving.)
- Reference other questions that have been vetted and approved as guidance when writing new questions.

After being trained in test writing, CAMGB testing committee members are mentored through participation in various item writing groups in the testing committee.

The CAMGB testing committee has two face-to-face meeting per year; these are typically 3 days long. Participation in these meetings is mandatory for all qualified members. Beyond the face-to-face meetings, NBAA's CAMGB testing committee conducts a conference call/Web meeting once a month as part of an online item writing process.

The CAMGB testing committee uses secure software that allows the entire test writing and review process to be conducted online at any time. Drafting and initial review takes place online before the conference calls and face-to-face meeting so that time is spent most productively during meetings.

CAMGB testing committee members log on to a secure Web site managed by SMT to write test questions using the online item writing method. Each CAMGB testing committee member is issued a unique password to access the Web site. An initial question is marked as a draft question and the CAMGB testing committee member who wrote the draft is tasked with tracking it throughout the review process. When the original author feels the draft is ready for review, they tag it "Ready for Review," which alerts another CAM to review it and provide feedback. In addition, the CAMGB testing committee can review questions and provide feedback on its monthly conference call. Once the first review is finished, the question status becomes "Reviewed by One" and then "Accepted." Once accepted, it is ready to go to the next CAMGB testing committee face-to-face meeting. Each question will be reviewed by at least four other CAMs, including a small group to check the questions accuracy.

After the CAMGB testing committee has fully evaluated and edited a question, it is inserted into the current exam as a "pretest question," which is not scored, but statistically evaluated. A report is generated to grade each question's performance and whether or not it meets the standards required to be deemed a valid and relevant question.

Finally, all questions on all exams are scheduled for periodic review and revision. Any question up for review goes through a process similar to initial question development.

APPENDIX H—DISCUSSION OF PROS AND CONS OF EACH ALTERNATIVE

ALTERNATIVE 1

The Federal Aviation Administration (FAA) should continue to attempt to keep the knowledge test questions nonpublic.

Pros

- Effective secrecy prevents applicants from memorizing the answers to questions.
- The FAA maintains the public perception of test integrity and efficacy.
- The concept that all questions are not available might provide an incentive for applicants to study the whole topic rather than just the specific questions thought to be on the test.
- Secrecy enables use of more discriminating questions to provide a bell curve.
- Fewer questions are needed to ensure a broad understanding.

Cons

- Attempting to keep the tests nonpublic is ineffective and means that large-volume course preparers have an advantage due to feedback from their students.
- Trivial "gotcha" questions appear unfair to the applicant and provide a powerful incentive to applicants to share questions to remedy the perceived unfairness.
- Attempted secrecy deprives the FAA of its most powerful communications tool.
    - The FAA knowledge tests are an enormously effective instrument for aviation safety and regulation compliance.
    - Most FAA communications to pilots are filtered through a flight school or instructor, or delivered by an advisory circular (AC) which pilots may or may not read.
    - Knowledge tests, on the other hand, provide a standardized, direct, unfiltered means of communication requiring active student involvement.
        - They are a way to ensure items that might otherwise be overlooked in the normal course of instruction are thoroughly learned by students.
        - Including an item on the knowledge test implies, with a powerful impact that no other method has, that a particular topic is one the FAA considers extremely important.
    - The result is a high level of learning focused on vitally important issues with active student participation required.
- Attempted secrecy cuts the safety chain of communications (accident → National Transportation Safety Board (NTSB) investigation → NTSB report → FAA AC → FAA test questions → instructors and course preparers → applicants).
    - The knowledge tests are a vital link in that chain and are only fully effective when the test questions are public.

        - An ARC member, who is a flight instructor and aviation educator, observed his role in the communication chain was more effective when questions were made public than when he was deprived of the details of the questions.
        - The ARC member also observed the vague feedback he received when the test questions were not in the public domain led him to misdirect students because the questions were not related to training practices and educators had to speculate on what the tests were trying to ask.
    - It makes no sense to isolate safety and enforcement issues of highest importance, write well-focused, incisive questions about them, and then keep them nonpublic.
- Without public oversight, the quality of questions deteriorates, tending to focus on trick questions and insignificant or obscure distinctions.
    - Applicants are then being tested on specific material for which they have not had an opportunity to prepare. Because the applicants are blindsided, they have not studied this material and miss these questions.
    - Some questions have answer choices where multiple provided answers could be correct. Answers to questions are subjective; the only way an applicant can get a question "right" is if they know how the question has historically been graded.
- Because the FAA is attempting to keep the questions nonpublic, it does not provide the question after the session so students can study it.
    - Further, when students get their test results, they are not told specifically which questions they missed, so they do not have an opportunity to go back and make sure they understand the point of the questions.
    - The net result is that these applicants still do not know what they should about the subject.
- Irrelevant questions reduce the respect of the applicant for the FAA and its rules and regulations and tend to place applicants and instructors in an adversarial, rather than cooperative, role with the FAA.

ALTERNATIVE 2

The FAA should return the question bank to the public domain, but replace all numbers with "X"s in questions requiring calculations to derive answers when they are released to the public.

Subject matter experts (SME) who are known to the public should help create and evaluate questions. (Requires expert group nondisclosure agreement (NDA).)

Pros

- All the cons of alternative 1 are remedied (attempting secrecy).
- Applicants are prevented from memorizing the answers to questions requiring numbers in their answers.

- Feedback from the public to the SMEs and their participation will greatly improve question quantity, quality, and relevance.
- A dramatic increase in the number of questions will force applicants to study the whole topic rather than just the few questions that are thought to be on the test.
- With relevant, insightful, life-saving questions, having an applicant know all the questions except those requiring calculations to derive answers would be desirable.

Cons

- More test questions are required to ensure a broad understanding than if all questions were nonpublic
- Coordination with SMEs is required.

ALTERNATIVE 3

The FAA should return the question bank to the public domain. SMEs who are known to the public should help create and evaluate questions. (Requires expert group NDA.)

Pros

- All the pros of alternative 2 still apply (questions are public except for those requiring calculations to derive the answer) except that questions requiring calculations to derive the answer could still be memorized.
- Eliminates all the cons of alternative 1 (attempted secrecy).

Cons

- If there is not a sufficient number of questions, the questions (including those requiring calculations to derive answers) could be memorized.

ALTERNATIVE 4

The FAA should make public a sample of each category of questions actually used on the test. SMEs who are known to the public should help create and evaluate questions. (Requires expert group NDA.)

Pros

- Feedback from the public to the SMEs and their participation will greatly improve question quantity, quality, and relevance.
- All the pros from alternative 1 (attempted secrecy) still apply.

Cons

- Loss of secrecy on the sample questions means that occasionally applicants will be given a question they are familiar with.
- Except for the sample questions, all the cons from alternative 1 (attempted secrecy) still apply.

- Historically, sample questions have not provided a true representation of the other questions on the test.

ALTERNATIVE 5

The FAA should only make public example questions not used on the test. SMEs who are known to the public should help create and evaluate questions. (Requires expert group NDA.)

Pros

- All the pros of alternative 4 (sample questions) still apply.

Cons

- All the cons of alternative 4 (sample questions) still apply except for loss of secrecy of sample questions.

APPENDIX I—REVIEW OF NON-AVIATION TESTING

Table I–1—Non-Aviation Testing Data

	Test	Cost	Test Results in Certification	Public Database	Format	Environment	Pass/Fail Criteria
Pilots	FAA Knowledge Exam	$150	No; more testing required	No.	Computerized, multiple-choice form tests	Testing center	≥70%
Air Traffic Controllers	AT–SAT	Free	No; more testing required	No.	Seven cognitive, one non-cognitive, variety of formats, computerized	Pre-established testing locations	≥70%
Doctors	USMLE	$535	No; more testing required	No	Multiple choice		A score of 188 is needed to pass the test
Nurses	NCLEX	$200 or more	No; more testing required	No	Primarily multiple choice, but also includes image identification, performing calculations, fill-in		
Lawyers	Multi-State Bar	$585 (WA) $375 (VA)	No; more testing required	No	Paper and pencil, multiple choice (4 answer choices)	Large classroom or hall with 50 to 5000 testing at once	Varies from 70 to 75%
Teachers	Praxis 1	$50 registration $80 each test $130 all tests	Varies by state	No	Computer or paper		Varies by state
Accountants	Uniform CPA Examination	$575–$800 For all four sections	Yes, provided all other required training has been completed	No	Computer		
Coast Guard	20 different ratings[40]	Issued by the service; not available to the public	No; more testing required	No[41]	Multiple choice, computer, and paper (where Internet is not available)	Issued via Internet or paper by approved testing facilities	≥ 80%

[40] Including Rating Advancement Test (RAT), marine science technician, aviation electronics technician, aviation survival technician, aviation machinery technician, and operations specialist.

[41] However, this test is open book (reference materials used on the job may be used during test). Also, the test objective is very specific, so although the actual test questions are not public, applicants who can successfully perform each required performance qualification should be able to answer the associated test items on the RAT. Answers to the RAT questions can be found in the RPQs or associated references.

PILOTS

Description of test

The Federal Aviation Administration (FAA) knowledge exam is required before final testing for certification. There is no public database. Tests are administered at a designated testing center at a desk or cubicle-type environment. A passing grade is 70 percent or better.

FAA Flight and Ground Instructor Knowledge Test Guide:
http://www.faa.gov/training_testing/testing/airmen/test_guides/media/FAA-G-8082-7f.pdf

How to prepare for the exam

Limited information is provided by the FAA at:
http://www.faa.gov/training_testing/testing/airmen/test_questions/

Commercial products are also available.

AIR TRAFFIC CONTROLLERS

The AT–SAT exam is required testing for most who enter this program. Tests are administered at a pre-established testing location, and consist of seven tests ranging from multiple choice to computerized aptitude exercises. A passing grade is 70 percent or better.

Bureau of Labor Statistics: Occupational Outlook—Air Traffic Controllers:
http://www.bls.gov/oco/ocos108.htm

How to prepare for the exam

Commercial products are available.

DOCTORS[42]

There is a three-part exam.

How are the test questions created, and who creates them?

> *Examination committees composed of medical educators and clinicians prepare the examination materials. Committee members broadly represent the teaching, practicing, and licensing communities across the United States. At least two of these committees critically appraise each test item or case. They revise or discard any materials that are in doubt.*[43]

[42] United States Medical Licensing Examination. http://www.usmle.org Accessed April 10, 2012.
[43] Examination Committees, USMLE Web site. Available at http://www.usmle.org/bulletin/overview/#examcontent. Accessed April 10, 2012.

Cost of exam

Step 1	*$535*	*Three month eligibility periods beginning November 1, 2011 through January 31, 2012 and ending October 1, 2012 through December 31, 2012*
Step 2 Clinical Knowledge (CK)	*$535*	
Step 1 and 2CK	*$65*	*Eligibility Period Extension (requests received starting January 1, 2012)*
Step 2 Clinical Skills (CS)	*$1,140*	*For completed applications received starting January 1, 2012.*

How to prepare for the exam

The United States Medical Licensing Examination (USMLE) helps candidates pass the exam. Commercial products are also available.

USMLE Step 1: U.S. medical students usually take Step 1 at the end of the second year of medical school. It is an 8-hour computer-based exam consisting of 322 multiple-choice questions (MCQs) divided into 7 blocks each consisting of 46 questions.

USMLE Step 2: Two separate exams:

- USMLE Step 2 CK is designed to assess clinical knowledge through a traditional, multiple-choice examination. It is a 9-hour exam consisting of 8 blocks of 44 questions each. One hour is given for each block of questions. The subjects included in this exam are clinical sciences such as medicine, surgery, pediatrics, psychiatry and obstetrics and gynecology.
- USMLE Step 2 CS is designed to assess clinical skills through simulated patient interactions, in which the examinee interacts with standardized patients portrayed by actors. Each examinee faces 12 Standardized Patients (SPs) and has 15 minutes to complete history taking and clinical examination for each patient, and then 10 more minutes to write a patient note describing the findings, initial differential diagnosis list and a list of initial tests. Administration of the Step 2 CS began in 2004. The examination is only offered in five cities across the country.

USMLE Step 3 is the final exam in the USMLE series designed to assess whether a medical school graduate can apply medical knowledge and understanding of biomedical and clinical science essential for the unsupervised practice of medicine. Graduates of U.S. medical schools typically take this exam at the end of the first year of residency. Foreign medical graduates can take Step 3 before starting residency in about 10 U.S. states. Connecticut is frequently chosen for such purpose because it does not require simultaneous application for licensure, unlike New York.

Step 3 is a16-hour examination divided over 2 days. Each day of testing must be completed within 8 hours. The first day of testing includes 336 multiple-choice items divided into 7 blocks, each consisting of 48 items. Examinees must complete each block within 60 minutes.

The second day of testing includes 144 multiple-choice items, divided into 4 blocks of 36 items. Examinees are required to complete each block within 45 minutes. Approximately 3 hours are allowed for these multiple-choice item blocks. Also on the second day are nine Clinical

Case Simulations, where the examinees are required to "manage" patients in real-time case simulations. Examinees enter orders for medications and/or investigations into the simulation software, and the condition of the patient changes accordingly. Each case must be managed in a maximum of 25 minutes of actual time.

Approximately 45 minutes to an hour is available for break time on each of the 2 days of testing.

LAWYERS[44]

The Multistate Bar Examination (MBE) contains 200 multiple-choice questions, 190 of which are scored. The 10 unscored questions are evaluated for future use. The database is not public, though the National Conference of Bar Examiners (NCBE) publishes study aids containing questions that have been retired from use.

Testing takes place in a large classroom or hall with a number of applicants, with as many as 5000 testing at once. Test format is multiple choice using computer-scanned answer sheets.

Development of the MBE

MBE questions are developed by drafting committees composed of recognized experts in the various subject areas. Before a test question is selected for inclusion in the MBE, it undergoes a multistage review process over the course of several years. Besides intensive review by the drafting committee members and testing specialists, each test question is reviewed by other national and state experts. All test questions must successfully pass all reviews before they are included in the MBE. After an MBE is administered, the performance of each test question is reviewed and evaluated by content and testing experts. This final review is conducted to ensure that the exam is graded fairly, particularly with regard to any questions affected by recent changes in the law.

How to prepare for the exam

The NCBE publishes retired questions from the exam. It also sells practice exams. The NCBE provides the Multistate Bar Examination Information Booklet available at http://www.ncbex.org/assets/media_files/Information-Booklets/MBEIB2012.pdf.

Commercial products are also available.

NURSES[45]

The NCLEX–RN examination can be anywhere from 75 to 265 items. Of these items, 15 are pretest items that are not scored. Regardless of the number of items administered, the time limit for this examination is 6 hours.

The NCLEX–PN examination can be anywhere from 85 to 205 items. Of these items, 25 are pretest items that are not scored. The time limit for this examination is five hours.

[44] Multistate Bar Examination. http://www.ncbex.org/multistate-tests/mbe/. Accessed April 10, 2012.
[45] National Council of State Boards of Nursing. https://www.ncsbn.org/. Accessed April 10, 2012.

How to prepare for the exam

The National Council of State Boards of Nursing provides detailed test plans for candidates and educators at https://www.ncsbn.org/1287.htm.

Commercial products for study are also available.

Cost of exam

The exam costs $200, plus other licensure fees required by the board of nursing in the jurisdiction in which the applicant is applying.

How the tests are created

New questions to these exams undergo a great deal of review before they are included in a test. See https://www.ncsbn.org/2324.htm for NCLEX exam development frequently asked questions.

ACCOUNTANTS[46]

The CPA Exam is comprised of four sections: Auditing and Attestation (AUD), Business Environment and Concepts (BEC), Financial Accounting and Reporting (FAR), and Regulation (REG). All four sections contain multiple-choice questions (MCQs). AUD, FAR, and REG sections have an additional portion for task-based simulation (TBS) questions; BEC has a portion for written communication questions, but no TBS questions.

How tests are created

Method—adaptive testing

The Uniform CPA exam is administered using a modified adaptive testing model. Each CPA candidate begins the exam with a multiple-choice item testlet of moderate difficulty, after which an ability estimate based on item response theory is made. If the candidate's ability estimate is sufficiently high, the second testlet administered is more difficult. If the estimate fails to meet that threshold, another moderately difficult testlet is administered. After completing the second testlet, a new ability estimate is computed. If that estimate exceeds a predetermined threshold, a difficult testlet is administered as the third testlet. If not, a moderately difficult testlet is administered. On sections that contain simulations, these are administered after the third multiple-choice testlets. The simulations are *not* administered adaptively. That is, there is no relationship between a candidate's ability estimate and the simulations administered to the candidate.

[46] The Professional Accounting Society of America. http://www.thepasa.org/news/cpa-exam-insider-information.html. Accessed April 10, 2012.

Informing candidates of changes

It has proven challenging to prepare candidates for change. Candidates often do not take seriously their responsibility to review program materials, tutorials, and practice tests. They rely more on word of mouth and information provided by review course providers. As a result, each time a change is introduced, candidate complaints increase and often there is a perception that there are errors in the exam. The amount of confusion caused will be less if changes are introduced sequentially, but, as with the risk exposure, overall the confusion will be of longer duration.

Each time change is introduced, it can require revisions to candidate materials. Depending on the change, revisions may be required to candidate bulletins, notices to schedule, the American Institute of CPAs (AICPA) tutorial and practice test, and websites maintained by the AICPA, National Association of State Boards of Accountancy, state boards, and review course providers. Course materials used in preparatory reviews offered by review course providers and academic institutions may also require revision. The lead time for revisions to some of these publications may be as long as a year.

How to prepare for the exam

Commercial products are available.

TEACHERS[47]

> *The tests are developed by educators for educators. Advisory committees of distinguished teachers, teacher educators, key administrators and professional organizations help determine test content and review, revise and approve all questions and exercises. The Praxis Series is grounded in current research, including a comprehensive analysis of the most important tasks and skills required of beginning teachers and extensive surveys to confirm test validity.*[48]

Each state sets its own teaching exam requirements and determines the scores needed to become a certified teacher.

Praxis 1—Computer Delivered

Test	*Fee*	*Number of Questions*	*Testing Time*
Reading	*$80*	*46*	*75 minutes*
Mathematics	*$80*	*46*	*75 minutes*
Combined Test – Break (Optional)	*$130*	*-*	*15 minutes*
Writing (2 sections)	*$80*	*44*	*38 minutes*
		1 essay	*30 minutes*

[47] Educational Testing Service. The Praxis Series Information Bulletin, 2011–12. Available at http://www.ets.org/Media/Tests/PRAXIS/pdf/01361.pdf. Accessed April 10, 2012.
[48] Educational Testing Service. "Frequently Asked Questions about the Praxis Tests." Available at http://www.ets.org/praxis/institutions/faq. Accessed April 10, 2012.

Praxis 1—Paper Delivered

Test	*Fee*	*Number of Questions*	*Testing Time*
Reading	*$40*	*40*	*60 minutes*
Mathematics	*$40*	*40*	*60 minutes*
Writing (2 sections)	*$40*	*38*	*30 minutes*
		1 essay	*30 minutes*

How to prepare for the exam

Commercial products are available.

APPENDIX J—CONSIDERATION OF PASSING SCORE PERCENTAGE THRESHOLD

In considering the purpose of the Federal Aviation Administration (FAA) knowledge test, the Aviation Rulemaking Committee (ARC) decided to also review minimum passing scores, which have been discussed in other forums. The current threshold for passing knowledge tests is a score of 70 percent. The ARC discussed both the issue of subtesting and the possibility of creating a higher threshold for passing.

The ARC does not know what reasoning or logic the FAA used to establish the minimum passing score of 70 percent; however, without clear evidence or data indicating that raising the passing threshold would enhance safety or the learning process, modifying the minimum threshold offers no advantage. Although the ARC recognizes that some minimum proficiency level must be established, it does not have a measurable means to indicate that the current 70 percent level is inappropriate or any corollary data to indicate that lower scoring pilots have a greater propensity for accidents or incidents historically than those who scored highly on their knowledge tests. The ARC instead focused, as seen in its recommendations, on strengthening the process of developing individual questions and enhancing the questions' relevance to assessing applicant knowledge.

Additionally, although the minimum passing threshold is 70 percent, all candidates are trained to proficiency before certification in the current system. Candidates who meet the minimum passing threshold of 70 percent but do not score 100 percent are certified by the endorsing flight instructor before the practical test as having been trained in all knowledge areas identified as deficient on the knowledge testing report. These deficient knowledge areas can be further evaluated by the examiner during the practical test, who will also have access to the knowledge testing report.

As an overview of passing score percentages, the ARC reviewed data from the 2010 FAA knowledge test statistics. The statistical data on all tests given in 2010 can be found in Appendix K, 2010 Airman Knowledge Tests. Table J–1 contains a review of high-volume tests for pilots and the performance of the applicants.

Table J–1—High-Volume Airman Knowledge Tests

	Total Volume	Pass Rate	Average Score	Volume Score 70-79	Percent of Total Volume 70-79	Volume Score 80-100	Percent of Total Volume 80-100
Air Transport Pilot Airplane (CFR 121)	4,925	96%	87	692	14%	4,049	82%
Air Transport Pilot Airplane (14 CFR part 135)	692	94%	84	135	20%	515	74%
Commercial Pilot Airplane	7,693	97%	87	1,148	15%	6,283	82%
Flight Instructor Airplane	3,127	94%	84	713	23%	2,221	71%
Flight Instructor Instrument Airplane	2,731	96%	85	499	18%	2,117	78%
Fundamentals of Instructing	4,271	97%	88	470	11%	3,656	86%
Instrument Rating Airplane	11,692	85%	80	3,252	28%	6,742	58%
Private Pilot Airplane	23,737	92%	84	4,580	19%	17,216	73%
Sport Pilot Airplane	743	97%	87	94	13%	625	84%

The last two columns indicate the total percentage of applicants who scored below the current passing score of 70 percent and what that percentage would be if the passing score was raised to 80 percent. The change in passing threshold would represent a statically significant change in the pass rate for tests, but without further data correlation the effect on knowledge or pilot quality is unclear based solely on these statistical data points.

The ARC also reviewed the testing practices of other professions, including the U.S. Coast Guard, air traffic controllers, nurses, doctors, lawyers, teachers, and accountants. In most of these cases it was found that a passing threshold for their testing requirements was similar to the 70 percent threshold used in FAA testing. Each of these tests has different study materials used in preparation; they vary in delivery mechanism (paper or electronic) and the test guidance documents available. In some cases, the tests were open book and others have a public database of test questions. The ARC notes that professional tests with nonpublic databases have established a correlation between training and testing in the development and boarding of questions before they are entered into question banks, as shown in the ARC's review of non-aviation tests per appendix I to this report. In some professions the tests were the final hurdle before certification or authorization to serve in the profession, but others also required additional testing. For example, the U.S. Coast Guard test is both developed and conducted by the Coast Guard, which helps ensure that training and testing remain aligned.

Although the ARC does not recommend a change in the passing threshold, it noted the quality of the test questions is most important to the overall knowledge base of applicants who test. The ARC believes significant time should be spent developing high-quality test questions based on material intended to improve the overall quality of applicants for ratings and certificates. The ARC believes industry collaboration in the development and review of testing questions can be a positive process that improves the overall quality of testing material, resulting in improved knowledge quality of applicants who complete knowledge tests. In effect, the ARC posits improving test content quality will increase applicant knowledge more than modifying the passing score threshold.

The ARC members agree that if data indicates a correlation between higher knowledge testing scores and increased performance on pilot practical tests or an enhancement to safety, the FAA should consider increasing the passing score threshold. Absent that data, the ARC believes simply changing the passing score in a system that already requires a satisfactory level of knowledge would not equate to enhanced safety or knowledge transfer in applicants. The ARC indicates that other areas of greater impact can be addressed without an arbitrary change for perceived value.

Dissenting Opinion from Jeppesen, SAFE, and AABI: Proposal to Raise Passing Grade for Flight Instructor Knowledge Test to 80 percent

Of all pilot certificates, none carries greater accountability than the flight instructor certificate. The flight instructor bears the burden of teaching safe and prudent operating procedures to their clients, as well as ensuring their clients have all the requisite knowledge necessary to operate in the National Airspace System as safe, responsible pilots.

Because the rule of primacy in learning is immutable, and it is the flight instructor that builds the foundation on which every pilot establishes their knowledge and skill, this places the flight instructor in a position of high responsibility. Thus it becomes imperative that the flight instructor be able to demonstrate a level of knowledge that exceeds the minimums required for other certificates. In many ways, a flight instructor certificate can be equated with a graduate degree in other areas of education.

Under current regulations, "[the] administrator shall specify the minimum passing grade for the knowledge test,"[49] the passing grades for the knowledge test for all certificates and ratings has traditionally been 70 percent. However, the FAA states in the introduction to every practical test standards (PTS) that "[b]ecause of the impact of their teaching activities in developing safe, proficient pilots, flight instructors should exhibit a high level of knowledge, skill, and the ability to impart that knowledge and skill to students." As a result, a minority position was provided that recommends raising the minimum passing score to 80 percent for the knowledge tests complying with § 61.185(a) (1) through (3) of Title 14 of the Code of Federal Regulations (14 CFR).

Although it is true that any applicant for any practical test must "have an endorsement certifying that the applicant has demonstrated satisfactory knowledge of the subject areas in which the applicant was deficient on the airman knowledge test,"[50] the phrase "satisfactory knowledge" is subjective and totally dependent on the endorsing instructor's understanding and integrity. It is, however, quite possible for an applicant for a flight instructor practical test to *not* receive the requisite training to correct for the deficiencies to the "high level of knowledge" mandated by the PTS.

"2010 Knowledge Test Results," a document created by the FAA Airman Testing Standards Branch (AFS–630), reported that 23 percent of applicants for the Flight Instructor, Airplane; Flight Instructor, Airplane (Added Rating); and Flight Instructor Sport Airplane (the three instructor ratings that teach entry-level student pilots, where the rule of primacy would have the greatest impact) certificates scored between 70 and 79 percent. Raising the passing grade to 80 percent would effectively prevent applicants receiving scores between 70 and 79 percent from slipping through the cracks that result from the subjectivity of the "satisfactory knowledge" endorsement requirements of 14 CFR § 61.39(a)(6)(iii).

Raising the minimum passing score to 80 percent for these flight instructor knowledge tests would have multiple benefits:

- It would reinforce the PTS statement requiring flight instructors to have a "high" level of knowledge. A higher passing score could be equated with higher levels of knowledge.
- It would bring the passing grade to a level of parity with graduate-level degrees.
- Flight instructors with higher levels of knowledge, and the tools to impart that knowledge, would be better prepared to educate their clients, thus raising the level of knowledge and safety throughout the pilot ranks.

[49] Title 14, Code of Federal Regulations (14 CFR) § 61.35(b).
[50] 14 CFR part 61.

Raising the minimum passing score for flight instructor certificates does not require any regulatory change and can easily be accomplished at any time at the discretion of the administrator.

A flight instructor certificate can be easily equated to a graduate degree. In all of academia, any grade at the graduate level less than a "B" is a failing grade. Raising the minimum passing score to 80 percent for all of the flight instructor knowledge tests puts the passing grade on par with all other graduate degrees, and provides an inherent message to aspiring flight instructor candidates that the FAA does not accept a "C" grade as a passing level for this advanced rating. Holding the flight instructor to a higher standard of knowledge and skill is vitally important to reduce the fatal accident rate and improve flight safety. Moving to a minimum passing score of 80 percent would advance the achievement of this goal.

Additionally, the Aviation Accreditation Board International (AABI), a specialized accreditor that accredits collegiate flight education programs, has over its 20-plus-year history raised the bar for its 30 accredited flight programs by requiring institutions to provide AABI visiting teams evidence of what students learn beyond what is taught. FAA knowledge test scores are considered a baseline and many AABI-accredited programs have chosen to require 80 percent or more for awarding academic credit or, because FAA knowledge test questions are public, the majority of programs administer their own tests to determine credit and grade.

The value of AABI accreditation was recognized by the First Officer Qualifications ARC final report, which gives the highest non-military flight hour credit (350) toward qualification of first officers for FAA hiring requirements for completion of a 4-year aviation university/college accredited flight training program. This recognition was based on empirical data provided by the *2010 Pilot Source Study* of 2,300 pilots hired by regional air carriers and their performance as a new hire.

However, the proposal to raise the passing grade on the flight instructor exams to 80 percent is only valid if certain other ARC recommendations are accepted—particularly those establishing airman certification standards (recommendation 3), increasing industry participation in the creation and boarding of questions (recommendations 1 and 2), and updating question creation philosophy (recommendation 4), which would improve the quality of the test questions on the knowledge exam. Without a more relevant knowledge exam to assess, raising the minimum passing score becomes moot.

APPENDIX K—2010 AIRMAN KNOWLEDGE TESTS

Total Volume: 96,746

	Total Volume	Pass Rate	Average Score	Volume Score 70-79	Percent of Total Volume 70-79	Volume Score 80-100	Percent of Total Volume 80-100
Air Transport Pilot Airplane (Title 14, Code of Federal Regulations (14 CFR) part 121)	4,925	96%	87	692	14%	4,049	82%
Air Transport Pilot Airplane (14 CFR part 135)	692	94%	84	135	20%	515	74%
Aircraft Dispatcher	961	82%	79	262	27%	523	54%
Airline Transport Pilot Airplane (14 CFR part 135) (Added Rating)	14	93%	86	2	14%	11	79%
Airline Transport Pilot Canadian Conversion	103	94%	83	21	20%	76	74%
Airline Transport Pilot Helicopter (14 CFR part 135)	430	99%	88	35	8%	389	90%
Airline Transport Pilot Helicopter (14 CFR part 135) (Added Rating)	48	94%	82	16	33%	29	60%
Aviation Mechanic Airframe	6,921	93%	84	1,570	23%	4,841	70%
Aviation Mechanic General	7,678	93%	84	1,517	20%	5,637	73%
Aviation Mechanic Powerplant	6,637	91%	82	1,789	27%	4,257	64%
Commercial Pilot Airplane	7,693	97%	87	1,148	15%	6,283	82%
Commercial Pilot Airship	1	100%	88	0	0%	1	100%
Commercial Pilot Balloon - Hot Air	55	98%	88	2	4%	52	95%
Commercial Pilot Canadian Conversion	83	89%	84	13	16%	61	73%
Commercial Pilot Glider	51	98%	90	1	2%	49	96%
Commercial Pilot Gyroplane	2	100%	84	1	50%	1	50%
Commercial Pilot Helicopter	997	96%	88	129	13%	833	84%
Flight Engineer Reciprocating Engine (Added Rating)	0	0%	0	0	0%	0	0%
Flight Engineer Reciprocating Engine (Basic)	7	100%	87	1	14%	6	86%
Flight Engineer Turbojet (Added Rating)	0	0%	0	0	0%	0	0%
Flight Engineer Turbojet (Basic)	226	99%	94	7	3%	217	96%
Flight Engineer Turboprop (Added Rating)	1	100%	80	0	0%	1	100%
Flight Engineer Turboprop (Basic)	19	100%	87	2	11%	17	89%
Flight Instructor Airplane	3,127	94%	84	713	23%	2,221	71%

Flight Instructor Airplane (Added Rating)	57	82%	82	13	23%	34	60%
Flight Instructor Glider	35	100%	87	5	14%	30	86%
Flight Instructor Glider (Added Rating)	76	92%	85	13	17%	57	75%
Flight Instructor Gyroplane	2	100%	88	0	0%	2	100%
Flight Instructor Gyroplane (Added Rating)	7	100%	83	3	43%	4	57%
Flight Instructor Helicopter	601	97%	87	92	15%	491	82%
Flight Instructor Helicopter (Added Rating)	89	98%	89	10	11%	77	87%
Flight Instructor Instrument Airplane	2,731	96%	85	499	18%	2,117	78%
Flight Instructor Instrument Airplane (Added Rating)	68	93%	86	7	10%	56	82%
Flight Instructor Instrument Helicopter	486	97%	85	98	20%	375	77%
Flight Instructor Instrument Helicopter (Added Rating)	49	92%	87	7	14%	38	78%
Flight Instructor Sport Airplane	39	92%	84	9	23%	27	69%
Flight Instructor Sport Glider	1	100%	87	0	0%	1	100%
Flight Instructor Sport Gyroplane	2	100%	81	0	0%	2	100%
Flight Instructor Sport Powered Parachute	7	86%	79	3	43%	3	43%
Flight Instructor Sport Weight-Shift-Control	11	100%	89	0	0%	11	100%
Flight Navigator	2	50%	74	0	0%	1	50%
Fundamentals of Instructing	4,271	97%	88	470	11%	3,656	86%
Ground Instructor (Advanced)	1,079	97%	87	148	14%	895	83%
Ground Instructor (Basic)	72	86%	80	20	28%	42	58%
Ground Instructor Instrument	811	95%	85	148	18%	623	77%
Inspection Authorization	1,090	84%	81	265	24%	655	60%
Instrument Rating Airplane	11,692	85%	80	3,252	28%	6,742	58%
Instrument Rating Canadian Conversion	40	90%	83	6	15%	30	75%
Instrument Rating Foreign Pilot	200	84%	81	36	18%	131	66%
Instrument Rating Helicopter	784	92%	83	193	25%	526	67%
Military Competence Airplane	1,335	100%	93	20	1%	1,310	98%
Military Competence Helicopter	1,532	99%	90	76	5%	1,443	94%

Military Competence Instructor	2,044	99%	93	58	3%	1,974	97%
Parachute Rigger	185	84%	78	51	28%	104	56%
Parachute Rigger Military Competence	75	87%	86	6	8%	59	79%
Private Pilot Airplane	23,737	92%	84	4,580	19%	17,216	73%
Private Pilot Airplane/Recreational Pilot - Transition	22	95%	86	2	9%	19	86%
Private Pilot Airship	1	100%	83	0	0%	1	100%
Private Pilot Balloon - Hot Air	87	89%	83	21	24%	56	64%
Private Pilot Canadian Conversion	98	91%	84	18	18%	71	72%
Private Pilot Glider	255	94%	87	42	16%	197	77%
Private Pilot Gyroplane	2	100%	94	0	0%	2	100%
Private Pilot Helicopter	1,438	95%	86	235	16%	1,137	79%
Private Pilot Helicopter/Recreational Pilot - Transition	3	100%	91	0	0%	3	100%
Private Pilot Powered Parachute	4	100%	76	3	75%	1	25%
Private Pilot Weight-Shift-Control	1	0%	67	0	0%	0	0%
Recreational Pilot Airplane	75	88%	81	17	23%	49	65%
Recreational Pilot Helicopter	1	100%	84	0	0%	1	100%
Sport Pilot Airplane	743	97%	87	94	13%	625	84%
Sport Pilot Glider	2	50%	78	0	0%	1	50%
Sport Pilot Gyroplane	8	100%	86	2	25%	6	75%
Sport Pilot Lighter-Than-Air (Balloon)	0	0%	0	0	0%	0	0%
Sport Pilot Powered Parachute	73	95%	86	10	14%	59	81%
Sport Pilot Weight Shift Control	52	100%	90	3	6%	49	94%

APPENDIX L—HISTORY

At times in the past, the Federal Aviation Administration (FAA) knowledge test item question banks have been available in the public domain, including availability through the Government Printing Office as advisory circulars, and then FAA question books (FAA-T-8080–XX). These question books were later replaced with FAA computer testing supplements (FAA–CT–8080–XX) for the question figures and an online database of the questions. A 2004 National Aeronautics and Space Administration report[51] included concerns that releasing test questions may encourage students to focus their study on memorizing test questions. In addition, the FAA noted knowledge test questions were being answered in seconds on the actual test, with applicants completing the entire 60-to-100-question test in under 10 minutes in some instances. According to the Aviation Instructor's Handbook:

> *While test preparation materials may be effective in preparing students for FAA tests, the danger is that students may learn to pass a given test, but fail to learn other critical information essential to safe piloting and maintenance practices. In addition, FAA inspectors and designated examiners have found that student applicants often exhibit a lack of knowledge during oral questioning, even though many have easily passed the FAA knowledge test. A major shortcoming of test preparation materials is that the emphasis is on rote learning, which is the lowest of all levels of learning.*
>
> *Test preparation materials, as well as instructors, that dwell on teaching the test are shortchanging student applicants. All instructors who use test preparation publications should stress that these materials are not designed as stand-alone learning tools. They should be considered as a supplement to instructor-led training.*[52]

These facts resulted in a concerted effort by the FAA to focus on the integrity and validity of the assessment process. Beginning in 2004, the FAA began removing question bank items from the public domain, theoretically preventing applicants from memorizing the questions and protecting the FAA's estimated $6 million investment in the database itself. For example, there were 819 questions published in 2004 for the Private Pilot Knowledge Test; this number has decreased each test cycle, with the public data set for this question bank in 2012 including only 22 sample test questions. As editorial changes were made to the test, new content was added, and other content was removed, more information about these changes could have been communicated to the training industry. The public data was removed without putting in place a mechanism to maintain a correlation between training and testing. More emphasis was placed on statistical analysis than on test quality, correlation to training, or the impact this would have on parties involved in the certification process.

Although the FAA remains focused on increasing the size of the question bank for purposes of test validity and integrity, none of the tests have been rewritten in their entirety. As the question bank moved to a closed test, the industry noted a marked decrease in the quality of questions.

[51] Stephen M. Casner, Karen M. Jones, Antonio Puentes, and Homi Irani, "FAA Pilot Knowledge Test: Learning or Rote Memorization?" *NASA/TM-2004-212814* (January 2004).
[52] Aviation Instructor's Handbook (2008 Edition, FAA–H–8083–9A).

Test questions became more irrelevant and obscure, but with the inability to accurately convey problems with specific test questions, industry was no longer able to provide feedback to the FAA for improvements. The FAA currently relies on test statistics, in-house review, and feedback from the test applicants themselves to establish and maintain test quality with no external vetting of questions, quality, or content.

As the tests continued to evolve without collaboration with the training community, curriculums placed a separate emphasis on test preparation materials to ensure students could pass the test with the grades expected by high-achieving applicants. Test preparation materials are therefore no longer accurately aligned with the actual knowledge test, as the "bad" fundamentals of instructing questions removed from the test are still covered in training, detracting from the learning objective. Despite this, students are required to "learn the test" for fear of failing. Rote learning test preparation materials used *in context* will facilitate learning; acquiring the aeronautical knowledge required to successfully complete the FAA knowledge test as part of an integrated training program is the most efficient and effective learning process, for a knowledgeable, safe pilot. The European Aviation Safety Agency has stated that—

> *In terms of regulations and knowledge of procedures and essential flight statistics, both the literature review as well as the experimental study support the conclusion that some meaningful learning does occur with rote learning. … If students believe that they will have to connect and apply the material to be learned they are going to engage in meaningful learning, and as has been shown, rote learning helps to store the information in long-term memory.*[53]

Without a correlation between training and testing, however, test preparation is typically a separate, non-integrated step for applicants, thus preventing the knowledge to be learned in context.

[53] Moebus Aviation Consulting, "Impact assessment of the publication of questions of theoretical examinations for Part 66 and Part FCL" for the European Aviation Safety Agency, Research Contract EASA.2008.C52, 7 August 2009.

APPENDIX M—FAA HANDBOOKS—UPHOLDING CONTENT

The Federal Aviation Administration (FAA) Regulatory Support Division, Airman Testing Standards Branch (AFS–630) publishes FAA handbooks related to airman certification training and testing. These handbooks detail the techniques and procedures associated with the standards established by the FAA. The handbooks are public domain and are printed and distributed throughout the aviation industry. Although nearly all handbooks list the FAA as the author, a wide discrepancy of quality and content exists between the various printed and eBook versions. In some instances, the information in what appears to be an official FAA handbook can be missing, modified, or obsolete (replaced by newer editions by the FAA) without any discernible way for the reader to know they are not reading the official information as it was originally published by the FAA.

Because these handbooks are in the public domain, the FAA historically has not responded to what is essentially a misrepresentation of its original book. However, with more companies printing public domain documents and the trend toward electronic publications, the misrepresentation of these FAA handbooks is becoming more of a safety-of-flight issue, without any way for the reader to know they do not, in fact, have the "official" FAA content. An Aviation Rulemaking Committee (ARC) member searched popular online bookstores and found several examples of what appear to be FAA publications, but are instead reprints by other organizations. Customer reviews indicate some vendors' reprints may be unreadable or incomplete.

It is the ARC's view that FAA resources should not be spent trying to police the publishing or printing industry, as the industry's use and distribution of these important training documents should not be hindered. However, it is critical to safety of flight for the FAA to uphold the content of its publications as they originally were intended. This may be accomplished through a variety of methods, including a letter of agreement with those publishing public domain documents (where, once approved, an "official seal" may be used) or "official list of accepted reprints" on the FAA Web site (in which publishers must submit a printed copy to receive approval). The FAA would remain responsible for maintaining the original electronic distribution of its publications, with a policy in place to support further distribution of these titles through nonpublic channels (whether in printed or electronic form) and a method for readers to identify "official" content versus modified variations.

APPENDIX N—PRIVATE PILOT KNOWLEDGE TEST TOPICS

Number of Questions	Topic Name	Content Name
1	Aerodynamics	Load Factor
1	Aerodynamics	Principles of Flight
1	Air Traffic Control Procedures	En Route
1	Aircraft Performance	Atmospheric Effects
2	Aircraft Performance	Computations
4	Aircraft Systems	Flight Instruments
3	Aircraft Systems	Powerplant
1	Airport Operations	Lighting
2	Airport Operations	Marking/Signs
2	Airport Operations	Taxiing
1	Airport Operations	Uncontrolled
1	Airspace	Controlled
1	Airspace	Special Use
1	Flight Operations	Night
1	Flight Operations	Wake Turbulence
1	Human Factors	Aeromedical Factors
9	Navigation	Pilotage
2	Navigation	Radio
1	Publications	Airport Facility Directory
1	Regulations	14CFR Part 1
1	Regulations	14CFR Part 61
1	Regulations	14CFR Part 71
7	Regulations	14CFR Part 91
1	Regulations	NTSB Part 830
1	Weather	Aeronautical Weather Forecasts
3	Weather	Aeronautical Weather Reports
1	Weather	Charts/Maps
7	Weather	Meteorology
1	Weight and Balance	Center of Gravity

APPENDIX O—PERCENTAGE OF CORRECT RESPONSES BY TOPIC FOR SELECTED KNOWLEDGE TESTS

Data is from Cycle Year 2011

Topic	Content	% Correct PVT	% Correct IRA	% Correct COM	% Correct CFI[54]
Aerodynamics	Airspeed	100%	-	66%	50%
Aerodynamics	Flight Characteristics	-	60%	-	93%
Aerodynamics	Load Factor	81%	-	84%	78%
Aerodynamics	Performance	-	-	88%	-
Aerodynamics	Principles of Flight	94%	86%	84%	87%
Aerodynamics	Stability / Control	87%	-	83%	84%
Aerodynamics	Stall / Spins	93%	-	-	95%
Air Traffic Control Procedures	Approach	-	86%	-	-
Air Traffic Control Procedures	Arrival	-	86%	-	-
Air Traffic Control Procedures	Communications	89%	93%	-	-
Air Traffic Control Procedures	En Route	96%	-	-	-
Aircraft Performance	Atmospheric Effects	91%	-	94%	81%
Aircraft Performance	Charts	96%	-	81%	66%
Aircraft Performance	Computations	84%	-	85%	85%
Aircraft Performance	Density Altitude	-	-	91%	87%
Aircraft Performance	Limitations	-	-	88%	82%
Aircraft Systems	Avionics	86%	94%	95%	99%
Aircraft Systems	De-Icing / Anti-Icing	-	48%	85%	80%
Aircraft Systems	Electrical	75%	-	-	99%
Aircraft Systems	Environmental	-	-	99%	80%
Aircraft Systems	Flight Controls / Primary	97%	-	92%	90%
Aircraft Systems	Flight Controls / Secondary	94%	-	82%	79%
Aircraft Systems	Flight Instruments	84%	83%	94%	82%
Aircraft Systems	Fuel/Oil	93%	-	92%	92%
Aircraft Systems	Landing Gear	-	-	94%	-
Aircraft Systems	Pitot / Static	96%	87%	21%	85%
Aircraft Systems	Powerplant	88%	-	93%	86%
Aircraft Systems	Propeller	81%	-	90%	85%
Aircraft Systems	Rotor	-	-	95%	92%
Aircraft Systems	Structures	100%	-	-	93%
Aircraft Systems	Transmission	-	-	95%	93%
Airport Operations	Communications	74%	-	-	85%
Airport Operations	LAHSO	96%	-	77%	-
Airport Operations	Lighting	83%	86%	90%	90%
Airport Operations	Marking/Signs	84%	82%	82%	81%
Airport Operations	Preflight	95%		100%	-
Airport Operations	Runway Conditions	-	92%	-	69%
Airport Operations	Taxiing	82%	-	-	86%
Airport Operations	Tower Controlled	94%	-	-	84%
Airport Operations	Traffic Patterns	100%	-	87%	92%
Airport Operations	Uncontrolled	84%	89%	-	-

[54] Private Pilot (PVT), Instrument Rating – Airplane (IRA), Commercial Pilot (COM), Certificated Flight Instructor (CFI).

Topic	Content	% Correct PVT	% Correct IRA	% Correct COM	% Correct CFI[54]
Airport Operations	Wake Turbulence	94%	-	-	93%
Airspace	Cloud Clearances / Visibility	-	-	85%	-
Airspace	Communications	100%	-	-	98%
Airspace	Controlled	79%	87%	90%	88%
Airspace	Other	85%	-	-	-
Airspace	Procedures	93%	-	35%	98%
Airspace	Special Use	81%	85%	82%	88%
Airspace	Uncontrolled	74%	90%	77%	98%
Flight Operations	Approach	89%	83%	95%	87%
Flight Operations	Climb	81%	47%	92%	-
Flight Operations	Collision Avoidance	81%	-	94%	89%
Flight Operations	Cruise	91%	-	100%	93%
Flight Operations	Descent	-	-	100%	-
Flight Operations	Emergency Procedures	91%	87%	92%	88%
Flight Operations	Landing	81%	85%	95%	89%
Flight Operations	Launch Procedures	93%	-	91%	77%
Flight Operations	Maneuvers	94%	-	92%	79%
Flight Operations	Night	93%	-	90%	-
Flight Operations	Normal Procedures	85%	-	-	-
Flight Operations	Positive Aircraft Control	-	-	-	80%
Flight Operations	Soaring Techniques	93%	-	96%	90%
Flight Operations	Takeoff	97%	-	95%	87%
Flight Operations	Wake Turbulence	86%	91%	89%	-
Flight Operations	X-C	87%	-	-	-
Fundamentals of Instruction	Critique/Evaluation	-	-	85%	65%
Fundamentals of Instruction	Effective Communication	-	-	95%	92%
Fundamentals of Instruction	Human Behavior	-	-	90%	75%
Fundamentals of Instruction	Instructional Aids	-	-	94%	-
Fundamentals of Instruction	Instructor Responsibilities	-	-	94%	-
Fundamentals of Instruction	Learning Process	-	-	87%	65%
Fundamentals of Instruction	Planning Instructional Activity	-	-	83%	77%
Fundamentals of Instruction	Professionalism	-	-	93%	-
Fundamentals of Instruction	Teaching Methods	-	-	94%	96%
Fundamentals of Instruction	Teaching Process	-	-	78%	-
Fundamentals of Instruction	Techniques-Flight Instruction	-	-	93%	66%
Human Factors	ADM	80%	-	88%	89%
Human Factors	Aeromedical Factors	91%	81%	93%	90%
Instructional Guidelines	Critique / Evaluation	-	-	-	76%
Instructional Guidelines	Effective Communication	-	-	-	79%
Instructional Guidelines	Human Behavior	-	-	-	77%
Instructional Guidelines	Instructional Aids / Training Technologies	-	-	-	82%
Instructional Guidelines	Instructor Responsibilities / Professionalism	-	-	-	80%
Instructional Guidelines	Learning Process	-	-	-	79%
Instructional Guidelines	Planning Instructional Activity	-	-	-	83%
Instructional Guidelines	Teaching Methods	-	-	-	86%
Instructional Guidelines	Teaching Process	-	-	-	91%
Instructional Guidelines	Techniques-Flight Instruction	-	-	-	73%
Instrument Procedures	Air Traffic Control	-	80%	-	-

Topic	Content	% Correct PVT	% Correct IRA	% Correct COM	% Correct CFI[54]
Instrument Procedures	Approach Procedures	-	75%	85%	-
Instrument Procedures	Attitude Instrument Flying	-	80%	-	93%
Instrument Procedures	Basic Flight Instruments	-	82%	-	97%
Instrument Procedures	Communications	90%	83%	96%	-
Instrument Procedures	Departure	-	79%	100%	-
Instrument Procedures	En Route	-	82%	100%	-
Instrument Procedures	Flight Planning	-	78%	92%	-
Instrument Procedures	Radar Operations	-	99%	-	-
Instrument Procedures	Terminal Area Operations	-	75%	-	-
Navigation	Dead Reckoning	65%	-	87%	73%
Navigation	Pilotage	82%	-	84%	82%
Navigation	Radio	73%	77%	84%	81%
Publications	Advisory Circulars	81%	-	-	-
Publications	Aeronautical Charts	85%	83%	-	97%
Publications	AIM	86%	80%	-	-
Publications	Airport Facility Directory	93%	70%	-	98%
Publications	NOTAMs	64%	-	-	-
Regulations	14CFR Part 1	81%	-	86%	93%
Regulations	14CFR Part 39	100%	-	-	-
Regulations	14CFR Part 43	87%	-	-	-
Regulations	14CFR Part 61	85%	79%	89%	85%
Regulations	14CFR Part 71	82%	-	-	-
Regulations	14CFR Part 91	86%	85%	85%	89%
Regulations	14CFR Part 97	-	67%	-	-
Regulations	14CFR Part 119	-	-	93%	-
Regulations	NTSB Part 830	81%	93%	90%	87%
Regulations	Additional Category Ratings	-	-	-	85%
Regulations	Aircraft Inspections	-	-	-	73%
Regulations	Aircraft Lights	-	-	-	91%
Regulations	Aircraft Maintenance	-	-	-	89%
Regulations	Airspace Classes	-	-	-	84%
Regulations	Alcohol / Drugs	-	-	-	96%
Regulations	Class B Airspace	-	-	-	79%
Regulations	Class D Airspace	-	-	-	90%
Regulations	Commercial Pilot	-	-	-	85%
Regulations	Documentation	-	-	-	69%
Regulations	Eligibility	-	-	-	75%
Regulations	Equipment	-	-	-	84%
Regulations	FAA Certificates	-	-	-	92%
Regulations	Flight Altitude	-	-	-	76%
Regulations	Flight Instructor	-	-	-	80%
Regulations	Flight Review	-	-	-	94%
Regulations	Flight Training	-	-	-	84%
Regulations	Fuel	-	-	-	85%
Regulations	Knowledge / Practical Test	-	-	-	97%
Regulations	Medical Certificate	-	-	-	92%
Regulations	Minimum Safe Altitude	-	-	-	88%
Regulations	Operating Pressurized Aircraft	-	-	-	99%
Regulations	Operational Procedures	-	-	-	90%

Topic	Content	% Correct PVT	% Correct IRA	% Correct COM	% Correct CFI[54]
Regulations	Pilot in Command	-	-	-	94%
Regulations	Pre-Flight	-	-	-	91%
Regulations	Pressure Altitude	-	-	-	82%
Regulations	Private Pilot	-	-	-	98%
Regulations	Second in Command	-	-	-	99%
Regulations	Student Certificate	-	-	-	89%
Regulations	Student Pilot	-	-	-	91%
Regulations	Type Rating	-	-	-	97%
Regulations	Universal Signals	-	-	-	81%
Regulations	VFR Flight Plan	-	-	-	94%
Regulations	Weather Minimums	-	-	-	80%
Weather	Aeronautical Weather Forecasts	89%	79%	88%	85%
Weather	Aeronautical Weather Reports	90%	81%	88%	89%
Weather	Charts/Maps	74%	81%	83%	78%
Weather	Hazardous	57%	64%	90%	88%
Weather	Meteorology	84%	83%	89%	86%
Weight and Balance	Aircraft Loading	90%	-	84%	82%
Weight and Balance	Center of Gravity	82%	-	90%	86%

FAA Action

As a result of the Airman Testing Standards and Training ARC's recommendations, the FAA tasked the Aviation Rulemaking Advisory Committee (ARAC) to establish the Airman Testing Standards and Training (ATSTWG) Working Group. The task published in the Federal Register on 9/12/2012 (77 FR 56251).