ANSWERS TO THE ACS

PRIVATE PILOT

AIRPLANE SINGLE ENGINE LAND

VOLUME I: GROUND PORTION

REVISION 1

ADDRESSES FAA-S-ACS-6B (CHANGE 1)

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Dedication

To all those who have lost their lives in general aviation, that we may learn from their mistakes, and others, to forge a safer air transportation system.

ABOUT THE AUTHOR

Patrick Mojsak began learning to fly from his father at the age of 12. He proceeded to then earn his private, instrument, commercial, and flight instructor certificates by the age of 18, which is when he began instructing.

Patrick graduated from the University of Texas at Arlington in 2012 with a Bachelor of Science in Electrical Engineering. He then moved to Wichita, Kansas to pursue a position with Cessna Aircraft Company as an electrical engineer. Patrick began working on Cessna's single engine piston airplanes such as the Cessna TTx (formerly the Columbia 400) by performing avionics testing, supporting production flight test regarding customer training, and drafting certification documentation.

During his time there, in early 2014, the companies of Cessna and Beechcraft merged to form what is now known as Textron Aviation. Patrick was then moved to begin working on the Citation Longitude - the company's first super mid-sized business jet. Duties included FADEC integration of the Honeywell HTF 7000 engine, wire diagram development, and assisting experimental shop with assembling a functional prototype. First flight was achieved on October 8, 2016.

During his time at Textron Aviation, Patrick continued to fly by instructing at the employee's flying club and earning additional certificates and ratings such as airline transport pilot (ATP), commercial airplane single engine sea (ASES), commercial glider, and flight instructor glider.

In late 2016, Patrick left Textron Aviation to return to his home state of Texas and pursue a career with the airlines. Patrick began working for Envoy Air Inc. (formerly known as American Eagle) in January of 2017 as a first officer on the Embraer 145 regional jet. In July of 2019, Patrick upgraded to captain on the Embraer 175.

Patrick's love for teaching is his inspiration behind this book. With new, more challenging standards being imposed by the FAA, Patrick wishes to reach a wider audience by providing detailed and tangible guidance.

Individuals

Amit Alex: I would like to thank Amit Alex, flight test engineer at Gulfstream Aerospace, for his input and contributions to Briefing 3: Understanding the Risk Elements.

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I would like to thank the many individuals who contributed photographs to this work, each of whom are accredited below their respective photograph.

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DISCLAIMER

This book is intended to be a learning tool for applicants preparing for the practical test towards a pilot certificate and/or rating. The information presented herein is as accurate, complete, and authoritative as possible. However, there may be errors and omissions, both typographical and in content.

This book should not be used as the ultimate source of aeronautical information. It is designed to complement other aviation texts and formal flight instruction. For additional reading materials, refer to the extensive references at the end of each section.

The author and publisher shall not be liable or responsible to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this book. This text is not a substitute for common sense, the exercise of good judgement, or formal flight instruction.

Revision	0	Date	September 25, 2019	ACS Addressed	FAA-S-ACS-6B (Change 1)
Reason(s) for Revision	NA				

Section	Sub-Section	Change Description
All	All	None - initial issue.

Revision	1	Date	December 1, 2022	ACS Addressed	FAA-S-ACS-6B (Change 1)
Reason(s) for Revision	Compatibility with the Answers to the ACS app.				

Section	Sub-Section	Change Description
All	All	Multiple back end changes for compatibility with the Answers to the ACS app.
Front Matter	Half Title Page	Updated revision and address.
Front Matter	All	Re-formatted Front Matter section.
Front Matter	Copyright Information	Updated copyright information.
Front Matter	Revisions	Updated Revisions format.
Briefings	All	Re-formatted Briefings section.
Appendices and Addenda	All	Re-formatted Appendices and Addenda section.

BRIEFINGS
OVERVIEW

Briefings are intended to provide necessary preliminary information prior to using this book. This includes understanding the Airman Certification Standards, an overview of the Answers to the ACS book series, understanding the risk elements, the practical test process, and a description of the overall scenario used throughout this book.

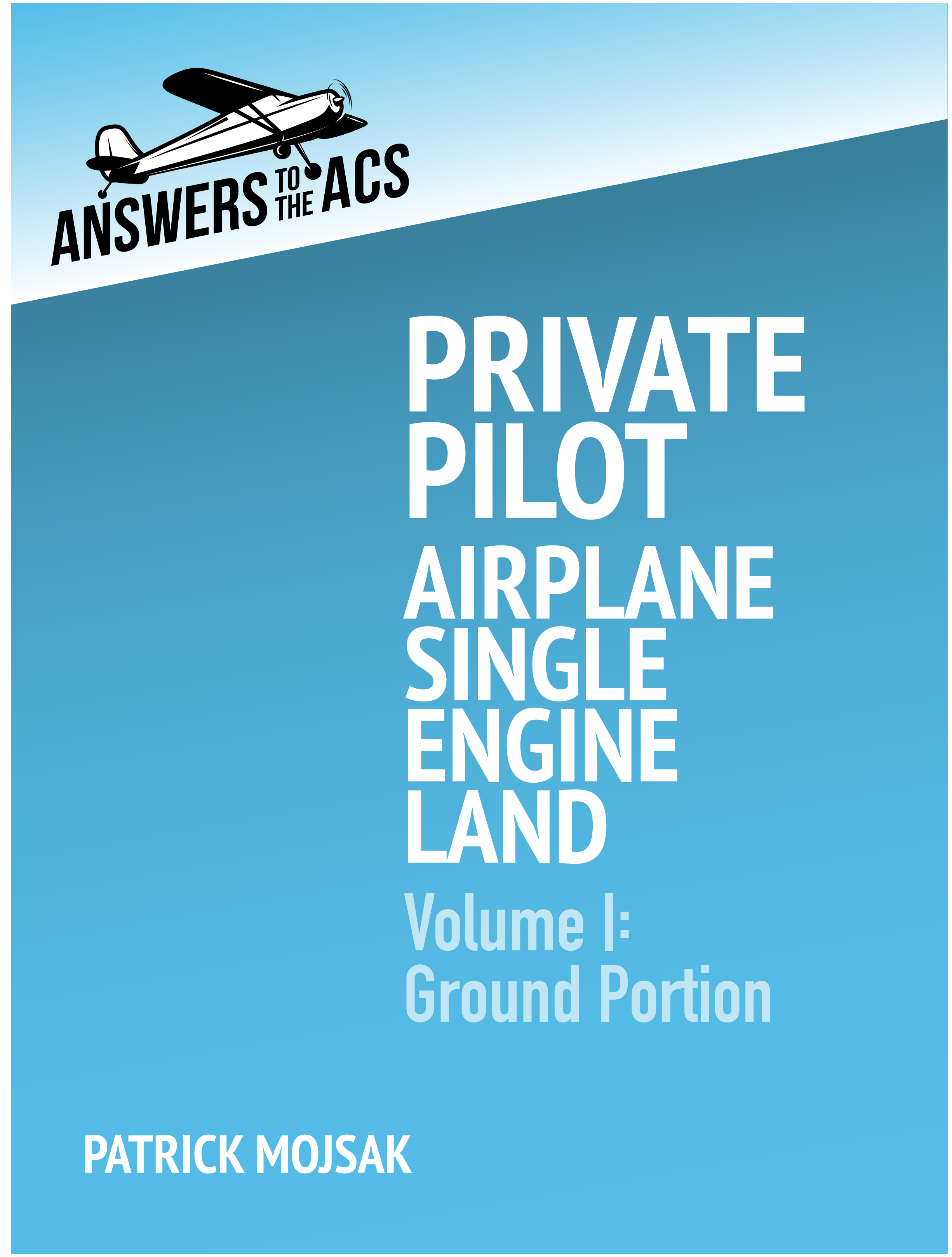
2. ABOUT ANSWERS TO THE ACS

Answers to the ACS is a book series that seeks to fully address the FAA's Airman Certification Standards (ACS) for the practical test. This briefing discusses the philosophy utilized by this book, its structure, and how to use this book.

Obsolescence of the Building Block Concept of Learning

Answers to the ACS Structure

How to Use This Book



Answers to the ACS Structure

As discussed in ***Briefing 4***, a given practical test applies to a particular pilot certificate and aircraft rating. As a result, each Answers to the ACS book addresses a particular pilot certificate and aircraft rating with the following three books in work:

Private Pilot Airplane Single Engine Land

Instrument Airplane

Commercial Pilot Airplane Single and Multiengine Land

Due to the large volume of information required by the ACS, each Answers to the ACS book is divided into two volumes. The first volume addresses the ground portion (also known as the "oral exam") of the practical test which encompasses Area of Operation I. The second volume addresses the flight portion of the practical test which encompasses Area of Operation II and on.

Elements

Although most elements are individually addressed, some are combined, and others are addressed more than once. For example, ***PA.I.D.K3a, b, and c*** are combined since these relate to interconnected concepts dealing with cross-country flight planning. PA.I.H.R1 on the other hand, *aeromedical and physiological issues*, is evaluated for each of the 12 conditions listed in PA.I.H.K1, even though it is a single risk element.

Knowledge elements are addressed in a straightforward manner by presenting the applicable information with a textual description along with visual elements such as figures and photographs as necessary. Sample oral questions and answers are provided where they are likely to be encountered during the practical test. Step-by-step instructions are also provided where necessary, such as for cross-country flight planning.

Risk elements are addressed by subdividing the element into risk identification, assessment, and mitigation. Example accidents are most often used as a starting point, but accident studies are used as well. This is discussed in further detail in ***Briefing 3***.

The addressing of skill elements differs between volumes I and II. In Volume I, skill elements largely relate to oral presentations provided to the examiner or the answering of scenario-based questions. In Volume II, pictorial profiles for flight maneuvers are provided along with a breakdown of all skill elements in sequential order with a corresponding explanation.

References

Answers to the ACS is unique in that as much information as possible is referenced to reputable sources such as the FAA including current and historical regulations, legal interpretations, and safety information. This book should serve as a starting point if more information is desired. Additionally, if you, your instructor, or your examiner questions the information from this book, locate the appropriate reference for further reading.

Revisions

Answers to the ACS is dynamic in that it stays revised to keep up with changing regulations, new information, and the ACS itself. See the Revisions section at the front of the book to check its revision status and which ACS document it addresses.

How to Use This Book

As discussed in the disclaimer at the beginning of this book, this book is not a substitute for flight or ground training from an authorized instructor. Instead, this book should serve to augment such training and allow for more targeted study.

Due to the tremendous amount of information presented herein, it is recommended that applicants obtain this book early in training, or even beforehand. Each element should be studied gradually as they are encountered in training. For example, when beginning to learn cross-country flight planning, ***Task D*** of this book should be referenced.

Once preparation for the practical test begins in earnest, which may be 1 to 2 months out, begin by studying the elements in which you feel you are weakest. Once these are solidified, and time permitting, study elements in which you are confident to reinforce them. Check each of these off by using a printout of the ACS or something similar.

To locate the desired element you wish to study, simply begin at the table of contents at the front of the book or use the dropdown navigational table of contents. Select the desired task, which will bring you to its corresponding overview page. On this page, a task table identical to that of the ACS will be presented with elements hyperlinked. Tap on the hyperlink of the desired element to view it.

About 1 week prior to the practical test, begin filling out the Checkride Prep Sheets and ensure they are completed prior to the practical test. This is discussed in detail in ***Briefing 4*** and each respective task.

All pages are organized to provide maximum situational awareness. See the following page for a breakdown of the layout of each page.

Sub-Section title: The sub-section title often correlates to a particular element. Sub-section titles can also be found in the dropdown navigational table of contents.

Section title: The section title is presented at the very top of the page and correlates to the task's title in Volume I.

Element identifier: The element identifier identifies the element type as either a knowledge (K), risk (R), or skill (S) element.

Area of operation number

Page number: Page number format is area of operation number - task letter - page number.

Task letter

3. UNDERSTANDING THE RISK ELEMENTS

One of the biggest changes to the ACS from the PTS is the addition of risk elements. Risk elements are historically common causes of accidents that the FAA wants pilot applicants to consider. For each risk element, the FAA wants pilots to identify, assess, and mitigate the associated risks.

Failure to take risks into consideration can have devastating consequences (courtesy NTSB).

Introduction

Risk assessment is understandably not very tangible to most of civil aviation. This is because if risk is deemed too high, such as due to adverse weather (thunderstorms, icing) or inadequate equipment (no supplemental oxygen, no ice protection systems), the flight is simply cancelled. However, a unique area in aviation that requires constant risk assessment is flight test.

Whenever an aircraft manufacturer seeks to develop and sell a new model of aircraft, they must undergo a certification program in which the aircraft gets approved by the FAA for sale to the customer. Part of the certification program involves a flight test campaign, in which company and FAA test pilots evaluate the aircraft's flight characteristics and normal/abnormal operating modes to ensure they are satisfactory.

Although the area of flight test is not as high-risk as it used to be, especially at the dawn of the jet age, risks are still present, and accidents still happen. Two recent examples are the Gulfstream G650 accident in Roswell, New Mexico in 2011[8] and the Bell 525 accident near Italy, Texas in 2016.[9] Due to ever-present risk and the necessity to undergo these flights, risk assessment is a requirement in flight test.

Flight test departments rate test flights in accordance with a risk level: typically low, medium, and high. Low-risk test flights often occur near the end of the flight test campaign once the aircraft's flight characteristics and limitations have been vetted. These may include minor avionics testing or function and reliability (F & R) flights. High-risk test flights often occur at the beginning and middle of the flight test campaign and may include envelope expansion or stall/spin test flights.[10]

Risk mitigation is done in a number of ways for test flights. Low risk test flights may only require that the test pilot(s) and any other crew wear Nomex/Spentex flight suits. Medium and high-risk test flights, however, may require only the minimum crew in the aircraft, wearing a helmet and parachute in addition to a flight suit, and the aircraft being equipped with provisions such as a spin chute, means for egress, and fire suppression devices.

Although risk management is not as evident in general aviation, it still must be conducted. This briefing discusses how risk identification, assessment, and mitigation is performed throughout this book and compliant with the ACS.

 Return to Briefing

Identifying Risks

Identifying risks associated with a risk element consists of identifying its consequences. In most cases this is an accident or 'crash.' However, one needs to be more specific by stating what causes the crash to happen. In the case of hypoxia and carbon monoxide poisoning for instance, risks include pilot incapacitation which then leads to loss of aircraft control, which subsequently causes a crash. In the case of a flight control failure or stall, loss of aircraft control may also result. However, not all risk elements lead to an accident necessarily. In the case of motion sickness, for instance, risks are generally mere inconvenience.

In this book, risk identification is accomplished in several ways. The most widely used method is qualitative analysis of recent accidents that are related to the risk element. Patterns are observed and used to determine what the risks associated with the risk element are. In most cases the risks are obvious, but in others they can be surprising. For instance, accident records show that the most common risk associated with rejected takeoffs is loss of directional control, not necessarily a runway overrun. Other methods include referencing accident studies by the NTSB or research and development studies by the FAA to provide a big-picture analysis.

(Courtesy FAA).

Assessing Risks

Risk assessment consists of determining the severity and likelihood of a risk element. These two factors in turn determine the level of risk as high, serious, medium, or low. Keep in mind that only a *qualitative* risk assessment is desired as opposed to a quantitative one. Qualitative simply means using words as opposed to numbers to assess risks.

Likelihood of a Risk Element

Severity of a Risk Element

Risk Level

Example Risk Assessment

Risk assessment may be necessary when facing dynamic and unpredictable factors such as weather.

Likelihood of a Risk Element

The likelihood of a risk element is the probability of its occurrence. Instead of percentages, four qualitative terms have been adopted from the FAA Risk Management Handbook and are described in Table B-3-1.[11]

Likelihood	Description
Probable	The risk element has a high likelihood of occurring.
Likely	The risk element has a moderate likelihood of occurring.
Remote	The risk element is unlikely to occur but still possible.
Improbable	The risk element is essentially impossible and probably will not occur.

Table B-3-3: Likelihood of a Risk Element

Likelihood is very case-specific and, as a result, must be evaluated on a per-flight basis. For example, for a healthy individual taking a flight at an altitude of 5,000 feet, hypoxia can be considered to be improbable. However, if the flight will be taken at an altitude of 15,000 feet, the likelihood of hypoxia is greater, even while using oxygen, since malfunctions can occur.

Severity of a Risk Element

The severity of a risk element consists of the event's effects on the aircraft's occupants and the aircraft itself. This is measured by the severity of injuries and damage as defined by the NTSB and shown in Table B-3-2.[12]

Severity	Effect on Occupants	Effect on Aircraft
Catastrophic	Fatal injuries.	Destroyed.
Critical	Serious injuries.	Substantial damage.
Marginal	Minor injuries.	Minor damage.
Negligible	No injuries.	No damage.

Table B-3-4: Severity of a Risk Element

Unlike likelihood, severity of a risk element is constant regardless of the flight. Succumbing to a low-altitude stall generally results in the aircraft being destroyed and fatalities to those onboard, for instance, while motion sickness generally leads to an inconvenience necessitating a diversion.

Risk Level

The risk level is determined from the likelihood and severity of a risk element. The purpose of the risk level is to allow the pilot to prioritize risks for a given flight. The greatest attention should be given to high risks and the least to low risks. Table B-3-3 shows the risk assessment matrix used to determine risk level based on severity and likelihood. This matrix is referenced throughout this book in all risk elements.

Likelihood	Severity			
	Catastrophic	Critical	Marginal	Negligible
Probable	High	High	Serious	Medium
Likely	High	Serious	Medium	Low
Remote	Serious	Medium	Low	Low
Improbable	Low	Low	Low	Low

Table B-3-5: Risk Assessment Matrix

Example Risk Assessment

Below is an example risk assessment for hypoxia with the format used throughout this book. The severity is first determined, followed by variables that determine its likelihood. Lastly, an example risk assessment is performed for the proposed flight for the practical test.

◇ **Severity (Catastrophic):** The severity of hypoxia has the potential to be **catastrophic**. This is due to the resulting incapacitation and loss of aircraft control, which can lead to an accident with multiple fatalities.

◇ **Likelihood:** The likelihood of hypoxia increases with altitude, especially above 12,500 feet. However, caution should be exercised even above 10,000 feet. Additional risk factors that can increase susceptibility to hypoxia include age, general health, tobacco use, alcohol use, and physical exertion at altitude.

◇ **Example:** For the proposed flight, the likelihood of hypoxia is **improbable** for the pilot since flight will be made well below 10,000 feet, and the pilot is a young healthy individual that does not smoke. However, one of the occupants is an older individual who smokes, making the likelihood of experiencing hypoxia for them **remote**. Using the risk assessment matrix, this makes hypoxia a **serious**-risk item for the flight.

Mitigating Risks

Risk mitigation is preventive measures that can be taken to minimize the probability or severity of a risk element. For hypoxia this includes carrying supplemental oxygen onboard. For motion sickness it would be carrying sick sacks onboard. For aerodynamic stalls, pilot proficiency and improved warning devices, such as angle of attack indicators. Risk mitigation measures listed throughout this book are derived from numerous resources including guidance from the FAA, AOPA, and personal and professional experience.

1 49 USC §40102(a)(8) (2018).

2 FAA. *Requirements for certificates, ratings, and authorizations*. 14 CFR §61.3(e)(3) & (4) Amdt. 60-6. (Washington, DC: U.S. Government Publishing Office, 27 June 2018).

3 FAA. "Airman Certification Standards: What's New and What's Next?" 2017. 17. https://www.faa.gov/training_testing/testing/acs/media/acs_briefing.pdf.

4 FAA. "Airman Certification Standards: What's New and What's Next?" 2017. 19.

5 FAA. "Airman Certification Standards: What's New and What's Next?" 2017. 20.

6 FAA. "Airman Certification Standards (ACS): Slow Flight and Stalls." SAFO 17009. (Washington, DC: Flight Standards Service, 30 May 2017). 2.

7 FAA. "Airman Certification Standards: What's New and What's Next?" 2017. 13.

8 NTSB. "Aircraft Accident Report: Crash During Experimental Test Flight, Gulfstream Aerospace Corporation GVI (G650), N652GD." (Washington, DC: Records Management Division, 10 October 2012).

9 NTSB. "Aviation Accident Final Report." Accident Number DCA16FA199. 16 January 2018.

10 FAA. "Safety Risk Management Policy." Order 8040.4B. (Washington, DC: Office of Accident Investigation and Prevention (AVP-1), 2 May 2017), 12 through 17.

11 FAA. *Risk Management Handbook*. FAA-H-8083-2. (Washington, DC: U.S. Government Publishing Office, 2009), 4-2.

12 NTSB. "Pilot/Operator Aircraft Accident/Incident Report." Form 6120.1. 2013. 1 through 2.

13 FAA. *Prerequisites for practical tests*. 14 CFR §61.39(a)(6) Amdt. 61-142. (Washington, DC: U.S. Government Publishing Office, 27 June 2018).

14 FAA. "Flight Standards Information Management System (FSIMS)." Order 8900.1, Volume 5, Chapter 2, Section 1, 5-220 (A). 26 August 2015. http://fsims.faa.gov/PICDetail.aspx?docId=8900.1,Vol.5,Ch2,Sec1.

15 FAA. "Flight Standards Information Management System (FSIMS)." Order 8900.1, Volume 5, Chapter 2, Section 1, 5-220 (B). 26 August 2015. http://fsims.faa.gov/PICDetail.aspx?docId=8900.1,Vol.5,Ch2,Sec1.

16 FAA. *Murphy – (2009) Legal Interpretation*. (Washington, DC: Office of the Chief Counsel, 30 June 2009). 2.

17 FAA. *Private Pilot – Airplane Airman Certification Standards*. FAA-S-ACS-6B. (Washington, DC: Flight Standards Service, June 2018), A-18.

18 FAA. *Private Pilot – Airplane Airman Certification Standards*. FAA-S-ACS-6B. A-17.

19 FAA. "Flight Standards Information Management System (FSIMS)." Order 8900.1, Volume 5, Chapter 2, Section 1, 5-220 (C).

PILOT QUALIFICATIONS

OVERVIEW

This is the first task to be evaluated during the practical test. Although there is only one skill element in this task, it contains a large amount of information that is fundamental to private pilot operations. As a result, although the examiner is only required to cover one knowledge element and one risk element, most examiners will cover significantly more than this.

The examiner will begin by verifying eligibility and certification requirements which are covered in ***Knowledge Element 1***. This includes verification of a number of pertinent documents and a thorough logbook audit to ensure that all aeronautical experience, flight training, ground training, and endorsements have been performed and documented correctly. Although this mostly consists of paperwork, it is a source of common errors on part of applicants and flight instructors and, as a result, requires significant emphasis.

Knowledge Element 2 discusses private pilot privileges and limitations. Due to the importance of understanding this subject in real-world flying, it is a near guarantee that the examiner will evaluate this.

Task	***A. Pilot Qualifications***
References	14 CFR parts 61, 68, 91; FAA-H-8083-2, FAA-H-8083-25; AC 68-1
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with airman and medical certificates including privileges, limitations, currency, and operating as pilot-in-command (PIC) as a private pilot.
Knowledge	The applicant demonstrates understanding of:
PA.I.A.K1	Certification requirements, recent flight experience, and recordkeeping.
PA.I.A.K2	Privileges and limitations.
PA.I.A.K3	Medical certificates: class, expiration, privileges, temporary disqualifications.
PA.I.A.K4	Documents required to exercise private pilot privileges.
PA.I.A.K5	Part 68 BasicMed privileges and limitations.
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.A.R1	Failure to distinguish proficiency versus currency.
PA.I.A.R2	Flying unfamiliar airplanes, or operating with unfamiliar flight display systems, and avionics.
Skills	The applicant demonstrates the ability to:
PA.I.A.S1	Apply requirements to act as PIC under Visual Flight Rules (VFR) in a scenario given by the evaluator.

PILOT QUALIFICATIONS
OVERVIEW

Knowledge Elements 3 and ***4*** cover required pilot documents to exercise private pilot privileges including medical certificates. Due to the importance and everyday use of this knowledge by pilots, this subject is also nearly guaranteed to be evaluated. ***Knowledge Element 5*** discusses this further with BasicMed, which is an alternative to conventional medical certificates for private pilots.

Risk Elements 1 and/or ***2*** will be evaluated by scenario-based evaluation. Both of these risk elements emphasize differentiating what is legal and what is safe. Although private pilots are legally allowed to fly a large number of different airplane makes and models, attempting to fly unfamiliar and significantly different airplanes requires an appropriate risk analysis. This also applies to familiar airplanes, in which a pilot must differentiate between currency and proficiency for a given operation.

Knowledge	The applicant demonstrates understanding of:
PA.I.A.K5	Part 68 BasicMed privileges and limitations.

Return to Overview

Part 68 BasicMed privileges and limitations can be found in AC 68-1A:[56]

What Are My BasicMed Privileges? *You can conduct any operation that you would otherwise be able to conduct using your pilot certificate and a third-class medical certificate, except you are limited to:*

1. Fly with no more than five passengers.

2. Fly an aircraft with a maximum certificated takeoff weight of no more than 6,000 lbs.

3. Fly an aircraft that is authorized to carry no more than 6 occupants.

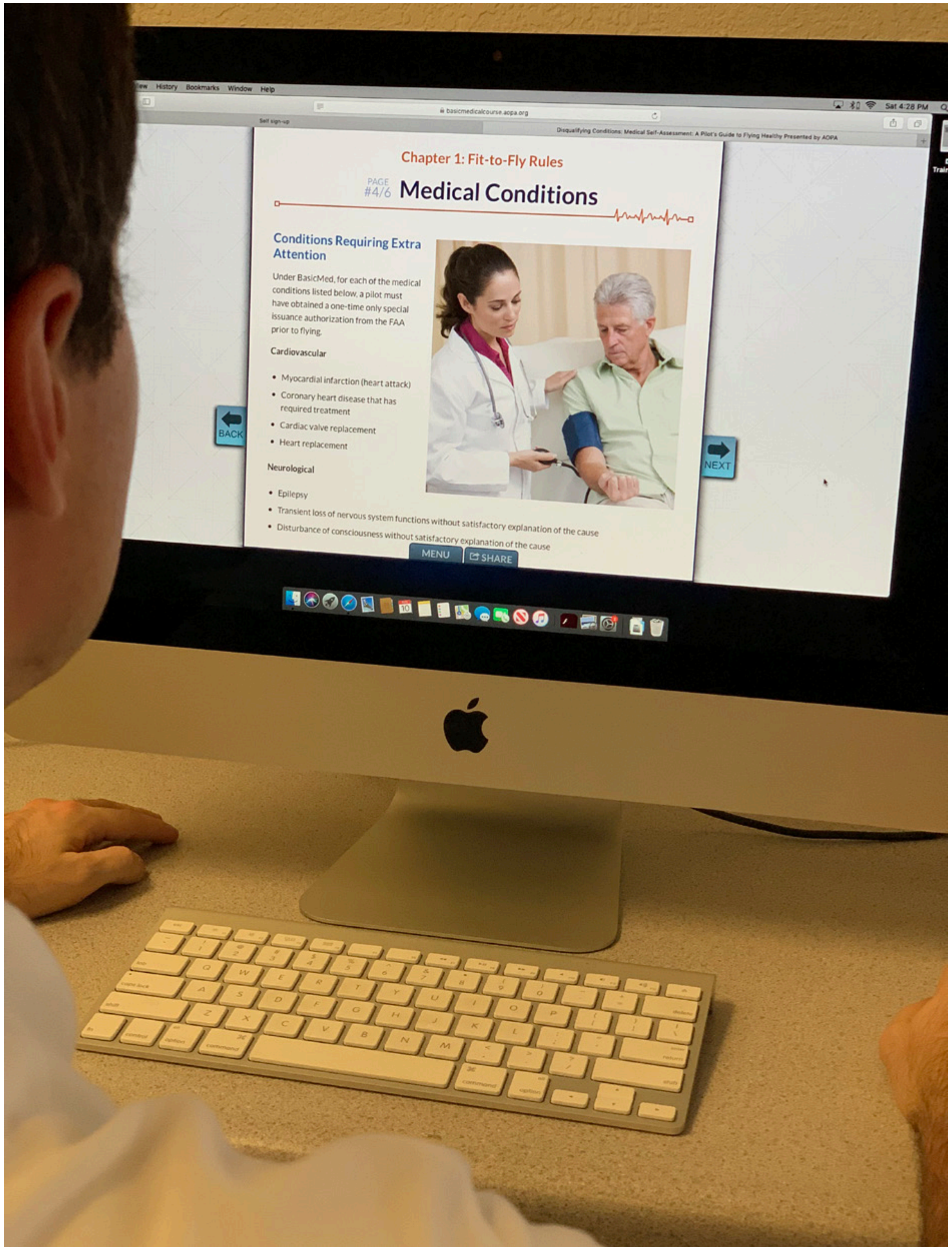
4. Flights within the United States, at an indicated airspeed of 250 knots or less, and at an altitude at or below 18,000 feet mean sea level (MSL).

5. You may not fly for compensation or hire.

BasicMed is a provision that allows pilots to fly without requiring a medical certificate. This provision has long been fought for by pilot advocate groups such as the Airplane Owners and Pilots Association (AOPA). Although the final rule fell short of what was desired, it still helps many pilots get back into the pilot's seat where previously they could not.

To be eligible for BasicMed, a pilot must hold a pilot certificate, a state-issued driver's license, and must have held at least one medical certificate in the past. Additionally, the pilot cannot have had their most recent medical certificate revoked, suspended, withdrawn, or their application denied. Pilots must visit a state-licensed physician every 48 calendar months for a medical examination in which a medical checklist is completed. It should be noted that the physician does not have to be an AME, and that the results of the examination do not get reported to the FAA.[57] The medical checklist is FAA Form 8700-2 and can be found on the FAA website. After successful completion of the examination, the completed checklist must be stored electronically or physically in the pilot's logbook so long as it can be made available to the FAA upon request.

Pilots must also complete an online aeromedical course every 24 calendar months. This course is offered by numerous organizations such as AOPA, Mayo Clinic, and King Schools. The course covers conduct of medical self-assessments, warning signs of serious medical conditions, and encourages regular medical examinations among other things.[58] At the completion of the course the pilot must take and pass a quiz, after which a certificate is provided. This certificate must also be stored electronically or physically in the pilot's logbook.



Pilots must complete an online course every 24 months to maintain BasicMed privileges.

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.A.R1	Failure to distinguish proficiency versus currency.

Return to Overview

Currency refers to recent flight experience which is discussed in ***Knowledge Element 1***. Proficiency is a different matter, however, defined as a high degree of competence or skill. FAA regulations are intended to be fairly minimalist, and, as a result, most individuals will not obtain proficiency from currency alone.

Identifying Risks

One of the most common ways failure to distinguish proficiency versus currency manifests is with landing accidents. 14 CFR §61.57(a) and (b) requires that the pilot in command perform at least 3 takeoffs and landings within 90 days prior to carrying passengers. This rule was set in place due to the fact that landing is the most challenging phase of normal flight and can differ significantly between certain airplanes (nosewheel versus tailwheel) and environmental conditions (daytime versus nighttime).

However, each year multiple accidents occur during landing in which the pilot is current and attempts to land on relatively short runways that are within the airplane's performance capabilities. The following are select accidents from 2017 alone:

- In May,[59] the pilot of a Piper PA-28-140 Cherokee attempted landing on a 2,500-foot runway in Ray, Minnesota. The pilot made multiple attempts but was too fast or too high each time. On the last attempt, the airplane touched down hard and fast halfway down the runway. The airplane overran the runway and struck trees and a tractor. The airplane suffered substantial damage, and the pilot was seriously injured.

- In October,[60] the pilot of a Piper PA-32R-301T Turbo Saratoga along with one passenger attempted landing on a 2,500-foot runway in Block Island, Rhode Island. Due to an excessive approach speed, the airplane was unable to stop on the runway, and the pilot attempted a go-around. The airplane overran the runway and struck a fence. The pilot and passenger received minor injuries, and the airplane was destroyed.

PILOT QUALIFICATIONS
FAILURE TO DISTINGUISH PROFICIENCY VERSUS CURRENCY

It should be noted that small airplanes are capable of extremely short landing distances. However, published performance data is determined via flight test by a test pilot who is highly proficient in the airplane. Additionally, minimum landing distances are desired by the manufacturer for competition and advertising purposes.

These points bring to light the fact that proficiency is variable while currency is not. A pilot is either current or not current depending on whether they have satisfied the legal requirements. However, a pilot may be proficient for less demanding situations but not proficient for more demanding situations. For instance, a pilot may be proficient in landing on a 6,000-foot paved runway but not proficient in landing on a 2,000-foot grass runway.

Image of accident airplane in Ray, Minnesota with struck tractor (courtesy NTSB).

Assessing Risks

◇ **Severity (Catastrophic):** Although the landing phase is the most common example, failure to distinguish proficiency versus currency is not restricted to landing only. This may also apply to the general flying of any airplane, in which currency consists of satisfying a biennial flight review, and lack of proficiency may lead to a stall or loss of control of the airplane, leading to a catastrophic accident.

◇ **Likelihood:** Likelihood of an accident due to lack of proficiency is dependent on multiple factors, including flight time in the airplane and time since last flown but most importantly the quality of training or practice performed.

◇ **Example:** For the proposed flight, the likelihood of an accident due to lack of proficiency is **improbable** since the pilot has recently completed their private pilot flight training in the airplane. This training goes above and beyond a typical airplane checkout in that tighter tolerances are required of demanding maneuvers, and in-depth knowledge is required regarding the airplane. Additionally, the flight will be day VFR, utilizing long paved runways at both the departure and destination airports. Using the ***risk assessment matrix***, this makes failure to distinguish proficiency versus currency a **low**-risk item.

Mitigating Risks

Risk mitigation measures for failing to distinguish proficiency versus currency consist of setting personal minimums. This is due to the variable nature of proficiency in that a pilot may be proficient for a less demanding operation in the airplane but not proficient for a more demanding one regardless of currency. Personal minimums in effect limit the pilot from performing more demanding operations that they might not be proficient for. Regarding landing specifically, this consists of designating a minimum runway length taking into consideration the airplane, performance factors, and density altitude. For more details on setting personal minimums, see ***PA.I.H.S2***.

Skills	The applicant demonstrates the ability to:
PA.I.A.S1	Apply requirements to act as PIC under Visual Flight Rules (VFR) in a scenario given by the evaluator.

Return to Overview

This skill element is the first to be evaluated during the oral portion of the practical test. The examiner will begin with an evaluation of certification requirements to ensure that you are eligible to take the test. Following this, scenario-based oral evaluation will be conducted to test your knowledge on private pilot privileges and limitations, required documents, and recent flight experience and record keeping along with appropriate risk assessment.

Certification Requirements

Private Pilot Privileges and Limitations

Required Documents

Recent Flight Experience and Recordkeeping

An FAA ramp inspection is a common scenario used to evaluate applicants on pilot qualifications.

Private Pilot Privileges and Limitations

Private pilot privileges and limitations discussed in ***Knowledge Element 2*** will be evaluated by scenario-based oral examination.

Legal Scenario

Illegal Scenario

Risk Assessment - Flying Unfamiliar Airplanes

Legal Scenario

Examiner: *"You plan to attend a family get together in Tyler, Texas with your mother, father, and little brother. You offer to fly them there in a rental airplane and split the cost of the flight three ways. Can you legally do this?"*

You: *"Yes. Since I intend to pay no less than the pro rata share of the operating expenses of the flight, which is one-third, and have a common purpose with my passengers for the trip, I can legally make this flight."*

Commentary: This question evaluates ***Knowledge Element 2***. If a private pilot wishes to share the operating expenses of a flight with passengers, two requirements must be met: First, the pilot cannot pay less than the pro rata share of the operating expenses of the flight. Second, they must have a bona fide common purpose with their passengers for making the trip.

Examiner: *"What specific operating expenses can you share in this scenario?"*

You: *"The rental fee of the airplane, which includes fuel and oil. If there is a tie-down fee at Tyler this can be included as well."*

Commentary: This question also evaluates ***Knowledge Element 2***. The 4 specific operating expenses that the FAA allows to be shared are fuel, oil, airport expenditures, and rental fees. For most rental airplanes, fuel and oil are included in the rental fee. A common example of airport expenditures are tie-down (parking) fees. At smaller airports these often only apply if leaving the airplane overnight, and even then can be waived with a fuel purchase.

Illegal Scenario

Examiner: *"Suppose that your mother and father offer to cover the cost of the flight entirely. Could you legally do this?"*

You: *"No. Under no circumstances can I pay less than pro rata share of the operating expenses of the flight."*

Commentary: This question evaluates ***Knowledge Element 2***. As innocent as it may seem, having family or friends cover the cost of such a flight is illegal.

Examiner: *"Suppose that instead of a family get together your father wanted to attend a business meeting in which you had no need of going. He agrees to split the cost of the flight two ways. Could you legally do this?"*

You: *"No. Since I do not have a bona fide common purpose with my father for making this flight, sharing any expenses at all is viewed as compensation and therefore illegal."*

Commentary: This question also evaluates ***Knowledge Element 2***. The only way a private pilot can legally fly a passenger somewhere that the pilot has no need of going is to cover the cost of the flight themselves in its entirety.

Risk Assessment – Flying Unfamiliar Airplanes

Examiner: *"Suppose that the rental airplane was a G1000 Piper Archer in which you have no experience. How would you perform a risk assessment for this scenario?"*

You: *"Although I could legally fly this airplane, flying unfamiliar airplanes presents significant risk that has historically resulted in a large number of accidents. Accidents involving pilots flying unfamiliar airplanes have led to catastrophic results, and likelihood of such an accident would be elevated in this scenario since I have no experience with the airplane or avionics, making this a high-risk activity. To mitigate these risks, I would either obtain a checkout from an experienced instructor in advance of the flight, choose a different familiar airplane, or defer the flight until I can take a familiar airplane."*

Commentary: This question evaluates ***Risk Element 2***. Having no experience in an airplane and flying it without proper training can easily be considered high-risk. Risk mitigation would include either deferring the flight until a familiar airplane is available or obtaining a checkout in the airplane and building necessary experience. It should also be kept in mind that flight schools and FBOs almost always require a checkout in their airplanes for insurance purposes.

Airplanes with glass cockpits present significant differences from their analog counterparts.

REFERENCES

1 FAA. *Eligibility requirements: General*. 14 CFR §61.103(a) Amdt. 61-124. (Washington, DC: U.S. Government Publishing Office, 20 October 2009).

2 FAA. *Prerequisites for practical tests*. 14 CFR §61.39(a)(5) Amdt. 61-130B. 24 December 2013.

3 FAA. *Eligibility requirements: General*. 14 CFR §61.103(c) Amdt. 61-124.

4 FAA. *Eligibility requirements: General*. 14 CFR §61.103(j) Amdt. 61-124.

5 FAA. *Eligibility requirements: General*. 14 CFR §61.103(e) Amdt. 61-124.

6 FAA. *Recreational Pilot and Private Pilot Knowledge Test Guide*. FAA-G-8082-17. (Oklahoma City, OK: FAA Airman Testing Standards Branch, February 2017), 1.

7 FAA. *Eligibility requirements: General*. 14 CFR §61.103(h) Amdt. 61-124.

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9 FAA. *Eligibility requirements: General*. 14 CFR §61.103(d) Amdt. 61-124.

10 FAA. *Aeronautical experience*. 14 CFR §61.109(a)(4) Amdt. 61-142. 27 July 2018.

11 FAA. *Prerequisites for practical tests*. 14 CFR §61.39(a)(6)(i) Amdt. 61-130B.

12 FAA. *Eligibility requirements: General*. 14 CFR §61.103(f) Amdt. 61-124.

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14 Lynch, John D. "Frequently Asked Questions 14 CFR, Part 61 Arranged by Section." (General Aviation and Commercial Division, AFS-800, 12 October 2004), 286.

15 Stewart, Doug. "Shedding Light on Night Flight." *FAA Aviation News*. (Washington, DC: U.S. Government Publishing Office, November/December 2008). 4.

16 FAA. *Private Pilot Certification Course*. 14 CFR §141 Appendix B (2) Amdt. 141-18. 12 May 2016.

17 FAA. *Private Pilot Certification Course*. 14 CFR §141 Appendix B (3)(a)(1) Amdt. 141-18.

18 FAA. *Flight review*. 14 CFR §61.56(c) Amdt. 61-131. 15 November 2013.

19 FAA. *Flight review*. 14 CFR §61.56(d)(1) Amdt. 61-131.

20 FAA. *Recent flight experience: Pilot in command*. 14 CFR §61.57(a) Amdt. 61-142. 27 July 2018.

21 FAA. *Recent flight experience: Pilot in command*. 14 CFR §61.57(b) Amdt. 61-142.

22 FAA. *Pilot logbooks*. 14 CFR §61.51(a)(1) Amdt. 61-142. 27 July 2018.

AIRWORTHINESS REQUIREMENTS

OVERVIEW

As the oral portion of the practical test progresses, the examiner will begin asking questions relating to general airworthiness as well as that of the airplane used for the practical test. This will primarily be evaluated via a continuation of the scenario utilized in ***Task A***. However, this task focuses on the airplane instead of the pilot.

At some point the examiner will have you present the airplane's maintenance records to prove to them that the airplane is airworthy. It is critical that the airplane's maintenance records be thoroughly reviewed in advance of the practical test. This includes verifying that all required inspections have been performed. A popular recommendation is to place temporary tabs in all pertinent maintenance logbooks to mark the location of applicable inspections. This will allow for quick verification with the examiner.

Although this task is almost completely evaluated during the oral portion of the practical test, one exception is ***Skill Element 2***, which is evaluated during the preflight inspection of the airplane.

Task	***B. Airworthiness Requirements***
References	14 CFR parts 39, 43, 91; FAA-H-8083-2, FAA-H-8083-25
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with airworthiness requirements, including airplane certificates.
Knowledge	The applicant demonstrates understanding of:
PA.I.B.K1	General airworthiness requirements and compliance for airplanes, including:
PA.I.B.K1a	a. Certificate location and expiration dates
PA.I.B.K1b	b. Required inspections and airplane logbook documentation
PA.I.B.K1c	c. Airworthiness Directives and Special Airworthiness Information Bulletins
PA.I.B.K1d	d. Purpose and procedure for obtaining a special flight permit
PA.I.B.K2	Pilot-performed preventive maintenance.
PA.I.B.K3	Equipment requirements for day and night VFR flight, to include:
PA.I.B.K3a	a. Flying with inoperative equipment
PA.I.B.K3b	b. Using an approved Minimum Equipment List (MEL)
PA.I.B.K3c	c. Kinds of Operation Equipment List (KOEL)
PA.I.B.K3d	d. Required discrepancy records or placards
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.B.R1	Inoperative equipment discovered prior to flight.
Skills	The applicant demonstrates the ability to:
PA.I.B.S1	Locate and describe airplane airworthiness and registration information.
PA.I.B.S2	Determine the airplane is airworthy in a scenario given by the evaluator.
PA.I.B.S3	Apply appropriate procedures for operating with inoperative equipment in a scenario given by the evaluator.

AIRWORTHINESS REQUIREMENTS
KINDS OF OPERATION EQUIPMENT LIST (KOEL)

K

Knowledge	The applicant demonstrates understanding of:
PA.I.B.K3	Equipment requirements for day and night VFR flight, to include:
PA.I.B.K3c	c. Kinds of Operation Equipment List (KOEL)
	Return to Overview

A kinds of operation equipment list (KOEL) specifies the kinds of operations (e.g., visual flight rules (VFR), instrument flight rules (IFR), day, or night) in which the aircraft can be operated and indicates the installed equipment that may affect any operating limitation.[47] Simply put, a KOEL is a list that indicates whether certain equipment is required for certain operations. This greatly simplifies the decision-making process for inoperative equipment described in ***Knowledge Element 3a*** by providing a one-stop shop similar to an MEL but for smaller airplanes that do not have a MEL. It must be kept in mind that the pilot is *technically* required to verify all four sources of required equipment (KOEL/equipment list, certification regulations, ADs, and operational regulations), but since aircraft manufacturers cover themselves by verifying all of these sources prior to producing the KOEL, it can normally be assumed that the KOEL has all of the other sources covered as well.

Not all airplanes will have a KOEL. The regulation that is today §91.213 was only issued in 1988.[48] Prior to this, if the airplane was not operated under an MEL, *all* equipment was required to be operational prior to flight. After this regulation was issued, however, pilots were allowed to follow the rather complex process to defer equipment. To help simplify this process, aircraft manufacturers began furnishing KOELs more widely. As a result, relatively newer airplanes will have a KOEL while older ones may not.

If an airplane has a KOEL, it can normally be found in Section 2 (Operating Limitations) of a modern POH/AFM (see ***Appendix 2***). A KOEL is formatted to list equipment, applicable kinds of operations, and remarks. The kinds of operations are normally VFR day, VFR night, IFR day, and IFR night. However, additional operations such as known icing may be included. For each piece of equipment, the number that must be operative will be listed under each operation.

Figure I-B-23 shows an example of a typical KOEL. In this example, a dash (-) indicates that none of the respective equipment are required to be operative, an asterisk (*) indicates that there are remarks, and a number specifies the amount that must be operative. As an example, no position lights are required to be operative for VFR day or IFR day operations. However, all three position lights must be operative for VFR night or IFR night operations.

SYSTEM	VFR DAY	VFR NIGHT	IFR DAY	IFR NIGHT	REMARKS
FLIGHT CONTROLS					
ATA 27					
ELEVATOR TRIM INDICATOR	1	1	1	1	
FLAP MOTOR	1	1	1	1	
FLAP POSITION INDICATOR	1	1	1	1	
STALL WARNING	1	1	1	1	
FUEL					
ATA 28					
ENGINE DRIVEN FUEL PUMP	1	1	1	1	
AUXILIARY FUEL PUMP	1	1	1	1	
FUEL QUANTITY INDICATOR	2	2	2	2	
FUEL FLOW INDICATOR	1	1	1	1	
ICE AND RAIN PROTECTION					
ATA 30					
ALTERNATE STATIC SOURCE	-	-	1	1	
PITOT HEAT	-	-	1	1	
LIGHTS					
ATA 33					
POSITION LIGHTS	-	3	-	3	
BEACON	-	1	-	1	
STROBE LIGHT SYSTEM	1	1	1	1	
TAXI LIGHT	-	-	-	-	
LANDING LIGHT	-	*	-	*	*IF OPERATED FOR HIRE
INSTRUMENT LIGHTS	-	*	-	*	*ALL MUST BE OPERATIVE
COURTESY LIGHT	-	-	-	-	
NAVIGATION					
ATA 34					
ALTIMETER	1	1	1	1	
AIRSPEED INDICATOR	1	1	1	1	
MAGNETIC COMPASS	1	1	1	1	
ATTITUDE INDICATOR	-	-	1	1	
HEADING INDICATOR	-	-	1	1	

Figure I-B-23: Example KOEL

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.B.R1	Inoperative equipment discovered prior to flight.

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Identifying Risks

Risks
Failing to follow, or following incorrectly, the procedure for deferring inoperative equipment leading to either a legal violation or compromising safety of flight.

If equipment is discovered to be inoperative before flight, a pilot can elect to cancel the flight outright or follow the procedures to defer the equipment discussed in ***Knowledge Element 3a*** and make the flight, assuming the equipment is not required. Unfortunately, some pilots are not even aware of this procedure and may depart regardless as to what equipment is inoperative. This leads to two possible risks: legal violation and compromising safety of flight.

In 1993, a pilot operating a Piper Cherokee attempted to follow this procedure when the airplane's glideslope indicator was inoperative.[51] The pilot placarded the Omni Bearing Indicator (OBI) indicating that only the glideslope function did not work but did not deactivate it. Note that in a typical OBI, the glideslope function cannot be separately deactivated. It's all or nothing, and the pilot wished to retain the VOR function for situational awareness. During a ramp inspection, an FAA inspector noticed the placard and investigated. They found out that the instrument was not deactivated and imposed a $5,000 fine on the pilot. The irony was that the pilot's operations were VFR only (which would not require the glideslope indicator) and that the FAA inspector would not have known about the issue had the pilot not made a good faith effort to comply with the regulation.[52]

In 1987, a pilot flew with carburetor heat deactivated on their Cessna 150.[53] The pilot believed that carburetor heat was not required since it is not indicated in Part 91 operational regulations but was not aware that it was required by certification regulations. Additionally, the mechanic who deactivated the carburetor heat was also not aware that it was required (however, the pilot is ultimately responsible for this decision). The FAA placed a 30-day suspension on their pilot certificate. Although knowledge of aircraft certification regulations is seemingly beyond the scope of what a pilot should know, the FAA disagrees.

Assessing Risks

◇ **Severity (Catastrophic):** Although the previous examples did not result in catastrophic accidents, this is possible depending on what equipment is inoperative.

◇ **Likelihood:** Likelihood of discovering inoperative equipment before a given flight depends on numerous factors including aircraft age, quality of maintenance, the thoroughness of the pilot's preflight, and how often the pilot flies the airplane in question. Likelihood of improper deferral of inoperative equipment is dependent on the pilot's familiarity of §91.213(d), which, due to the complexity of the regulation, many unfortunately are not familiar.

◇ **Example:** For the proposed flight, the likelihood of the risk element in question is **remote**, since although the pilot regularly flies the airplane and is familiar with §91.213(d) due to checkride preparation, the airplane is a few decades old and a number of equipment may become inoperative at any time. Using the ***risk assessment matrix***, this makes inoperative equipment discovered before flight a **serious**-risk item.

Mitigating Risks

The following are risk mitigation measures for inoperative equipment discovered before flight:

- First and foremost, conduct a thorough preflight inspection including referencing the appropriate checklist and reviewing any squawk sheets to ensure that any equipment that is inoperative is actually discovered.

- Have a thorough understanding of what equipment is required and the procedure by which to defer inoperative equipment that is not required. If you do not feel you have a thorough understanding of these procedures or are unsure whether the equipment is required, take a different airplane or have the equipment fixed. Keep in mind that maintenance personnel may also not know whether the equipment is required, and the pilot in command is ultimately responsible, so simply deferring this decision to maintenance may not be wise.

Skills	The applicant demonstrates the ability to:
PA.I.B.S1	Locate and describe airplane airworthiness and registration information.

Return to Overview

This skill element is evaluated during the flight portion of the practical test and requires familiarity with the information shown on an airworthiness (Figure I-B-26) and registration (Figure I-B-27) certificate. While performing the preflight inspection, be able to show the examiner on both certificates that the aircraft registration, make and model, and serial number match the aircraft. The aircraft registration is just the tail number, painted on the aircraft. The make and model and serial number can be verified with the maintenance records or the airplane's data plate. On the registration certificate, be able to verify the aircraft owner (yourself, another individual, flight school, etc.) and that the date of issue is not more than three years old (unexpired).

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION-FEDERAL AVIATION ADMINISTRATION
STANDARD AIRWORTHINESS CERTIFICATE

1 NATIONALITY AND REGISTRATION MARKS	2 MANUFACTURER AND MODEL	3 AIRCRAFT SERIAL NUMBER	4 CATEGORY
N123AB	PIPER PA-28-161	28-1234567	Normal

5 AUTHORITY AND BASIS FOR ISSUANCE
This airworthiness certificate is issued pursuant to the Federal Aviation Act of 1958 and certifies that, as of the date of issuance, the aircraft to which issued has been inspected and found to conform to the type certificate therefor, to be in condition for safe operation, and has been shown to meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention on International Civil Aviation, except as noted herein.
Exceptions:

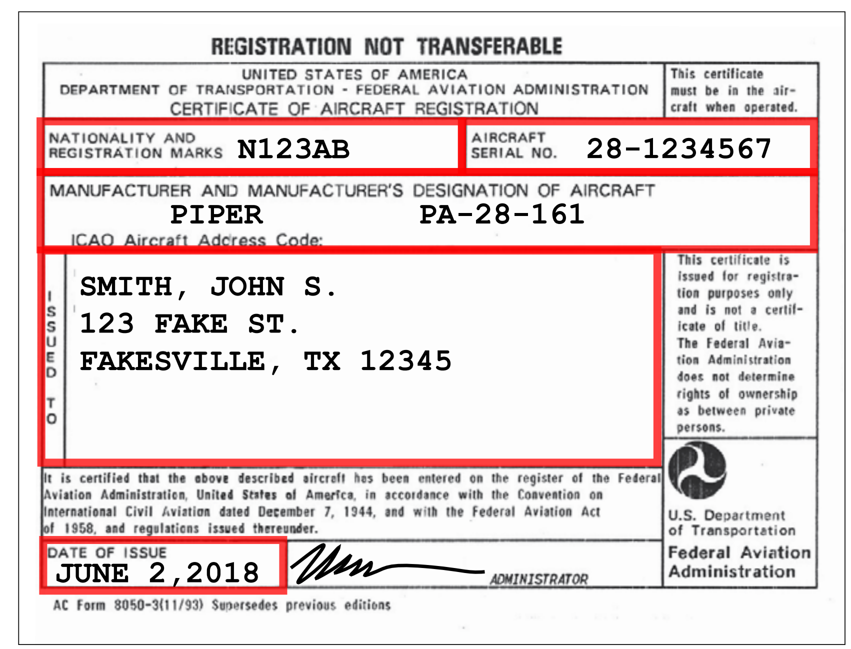
None

6 TERMS AND CONDITIONS
Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, this airworthiness certificate is effective as long as the maintenance, preventative maintenance, and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION NUMBER
01/20/00	M.S. STEVENS	SW-FSDO-OKC

Any iteration, reproduction, or misuse of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years or both.
THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.
FAA Form 8100-2 (04-11) Supersedes Previous Edition

Figure I-B-26: Items to Verify on an Airworthiness Certificate



REGISTRATION NOT TRANSFERABLE
UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION
CERTIFICATE OF AIRCRAFT REGISTRATION

This certificate must be in the aircraft when operated.

NATIONALITY AND REGISTRATION MARKS N123AB
AIRCRAFT SERIAL NO. 28-1234567

MANUFACTURER AND MANUFACTURER'S DESIGNATION OF AIRCRAFT
PIPER PA-28-161
ICAO Aircraft Address Code:

ISSUED TO
SMITH, JOHN S.
123 FAKE ST.
FAKESVILLE, TX 12345

This certificate is issued for registration purposes only and is not a certificate of title. The Federal Aviation Administration does not determine rights of ownership as between private persons.

It is certified that the above described aircraft has been entered on the register of the Federal Aviation Administration, United States of America, in accordance with the Convention on International Civil Aviation dated December 7, 1944, and with the Federal Aviation Act of 1958, and regulations issued thereunder.

DATE OF ISSUE
JUNE 2,2018
ADMINISTRATOR

U.S. Department of Transportation
Federal Aviation Administration

AC Form 8050-3(11/93) Supersedes previous editions

Figure I-B-27: Items to Verify on a Registration Certificate

AIRWORTHINESS REQUIREMENTS
REFERENCES

1 FAA. "Airworthiness Certificates Overview." Last modified 24 October 2017. https://www.faa.gov/aircraft/air_cert/airworthiness_certification/aw_overview/.

2 FAA. *Issue of standard airworthiness certificates for normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; and special classes of aircraft*. 14 CFR §21.183(a), (b), & (c) Amdt. 21-17. (Washington, DC: U.S. Government Publishing Office, 28 October 1967).

3 FAA. *Civil aircraft: Certifications required*. 14 CFR §91.203(b) Amdt. 91-388. 16 December 2015.

4 FAA. *Duration*. 14 CFR §21.181(a)(1) Amdt. 21-85. 27 July 2004.

5 FAA. *Registration required*. 14 CFR §47.3(b)(1) Amdt. 47-30. 21 December 2015.

6 FAA. *Civil aircraft: Certifications required*. 14 CFR §91.203(a)(2) Amdt. 91-388.

7 FAA. *Registration expiration and renewal*. 14 CFR §47.40(b) Amdt. 47-29. 1 October 2010.

8 FAA, DOT. *Re-Registration and Renewal of Aircraft Registration*. 75 FR 41968. (Washington, DC: U.S. Government Publishing Office, 20 July 2010).

9 FAA. Inspections. 14 CFR §91.409(a)(1) Amdt. 91-282. 27 July 2004.

10 FAA. *Scope and Detail of Items (as Applicable to the Particular Aircraft) To Be Included in Annual and 100-Hour Inspections*. §43 Appendix D. 6 July 1964.

11 FAA. *Inspection authorization: Privileges and limitations*. 14 CFR 65.95(a)(2) Amdt. 65-41. 27 April 2001.

12 FAA. *Inspections*. 14 CFR §91.409(c) & (e) Amdt. 91-350.

13 FAA. *Inspections*. 14 CFR §91.409(b) Amdt. 91-350.

14 FAA. *Inspections*. 14 CFR §91.409(d) Amdt. 91-350.

15 FAA. *Emergency locator transmitters*. 14 CFR §91.207(d) Amdt. 91-265. 22 December 2000.

16 FAA. *Emergency locator transmitters*. 14 CFR §91.207(c) Amdt. 91-265.

17 FAA. "Installation and Inspection Procedures for Emergency Locator Transmitters and Receivers." AC 91-44A CHG 1. (Washington, DC: U.S. Government Publishing Office, 1 February 2018), 10.

18 FAA. *Emergency locator transmitters*. 14 CFR §91.207(f)(3), (9), & (10) Amdt. 91-265.

19 FAA. *ATC transponder tests and inspections*. 14 CFR §91.413(a) Amdt. 91-269. 6 August 2001.

20 FAA. *ATC Transponder Tests and Inspections*. 14 CFR §43 Appendix F Amdt. 43-31. 18 August 1989.

21 Cirrus Design Incorporated. "Airworthiness Limitations." Airplane Maintenance Manual For the Cirrus Design SR22. 13773-001. (Duluth, MN: Cirrus Design Incorporated, July 2001), 2.

OPERATION OF SYSTEMS
OVERVIEW

This task evaluates the applicant's knowledge regarding the airplane's systems. It should be noted that the applicant will only be tested on the systems installed on the airplane used for the practical test. As a result, use Form PA-I-G-1 to record the airplane's systems configuration for focused studying of this task. Skill Element 1 requires that the examiner evaluate at least three of the systems listed in Knowledge Elements 1a through 1l.

Knowledge Element 2 refers to emergency procedures with respect to a particular system. This knowledge element is distributed throughout Knowledge Elements 1a through 1l describing emergency procedures for each of these systems.

In order to produce a successful outcome in the event of a system failure, the pilot must first detect the failure and then properly manage it as described in the emergency procedures. Failure to do either of these may result in an accident. Risk Elements 1 and 2 address risks associated with failing to do either of these things.

Risk Element 3 for private pilots often refers to misuse of the autopilot due to lack of training and familiarity. This risk element will be emphasized for pilots taking their practical test in airplanes equipped with autopilots and modern avionics.

Task	***G. Operation of Systems***
References	FAA-H-8083-2, FAA-H-8083-3, FAA-H-8083-23, FAA-H-8083-25; POH/AFM.
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with the safe operation of systems on the airplane provided for the flight test.
Knowledge	The applicant demonstrates understanding of:
PA.I.G.K1	Airplane systems, to include: ***Note:*** *If K1 is selected, the evaluator must assess the applicant's knowledge of at least three of the following sub-elements.*
PA.I.G.K1a	a. Primary flight controls
PA.I.G.K1b	b. Secondary flight controls
PA.I.G.K1c	c. Powerplant and propeller
PA.I.G.K1d	d. Landing gear
PA.I.G.K1e	e. Fuel, oil, and hydraulic
PA.I.G.K1f	f. Electrical
PA.I.G.K1g	g. Avionics
PA.I.G.K1h	h. Pitot-static, vacuum/pressure, and associated flight instruments
PA.I.G.K1i	i. Environmental
PA.I.G.K1j	j. Deicing and anti-icing
PA.I.G.K1k	k. Water rudders (ASES, AMES) (omitted)
PA.I.G.K1l	l. Oxygen system
PA.I.G.K2	Indications of and procedures for managing system abnormalities or failures. *(See Knowledge Elements 1a through 1l).*
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.G.R1	Failure to detect system malfunctions or failures. *(See Knowledge Elements 1a through 1l).*
PA.I.G.R2	Improper management of a system failure. *(See Knowledge Elements 1a through 1l).*
PA.I.G.R3	Failure to monitor and manage automated systems.
Skills	The applicant demonstrates the ability to:
PA.I.G.S1	Operate at least three of the systems listed in K1a through K1l above appropriately. *(See Knowledge Elements 1a through 1l).*
PA.I.G.S2	Use appropriate checklists properly.

Skill Element 1 also refers to normal system operation. Like Knowledge Element 2 and Risk Elements 1 and 2, this is distributed throughout all systems. This aspect of Skill Element 1 will be evaluated throughout the flight portion of the practical test as the applicant operates the airplane and all of its systems.

Lastly, ***Skill Element 2*** discusses proper checklist use. Checklist use differs between normal and emergency procedures. This skill element discusses these differences as well as philosophies for use during single-pilot operations in small airplanes.

System Description

Emergency Procedures

Failure to Detect System Failures

Improper Management of a System Failure

System Operation

System Description

Knowledge	The applicant demonstrates understanding of:
PA.I.G.K1	Airplane systems, to include:
PA.I.G.K1f	f. Electrical

Return to Overview

Examiner: *"Explain the electrical system in your airplane."*

You: *"The electrical system is a 28-Volt system consisting of a single 60-Amp alternator, 24-Volt main battery, and 24-Volt standby battery. An alternator control unit regulates system voltage and provides over-voltage protection and field-short protection."*

"Electrical busses include two primary busses connected by a cross feed bus, two avionics busses, and an essential bus. The primary busses power high-current items such as lights, flaps, and the fuel pump and are powered by the alternator and main battery whenever the master switch is on. The avionics busses power the avionics including all G1000 components and are powered off of the primary busses whenever the respective avionics master switch is on. The essential bus powers essential avionics such as the PFD, engine instruments, and comm radio 1, and is powered by either the alternator, main battery, or standby battery." – ***Cessna 172SP Skyhawk***

Simple, direct-current (DC) electrical systems are installed on small airplanes, similar to cars. All major components are connected in parallel. An airplane electrical system normally consists of a main battery, alternator or generator, voltage regulator or alternator control unit (ACU), ammeter or loadmeter, master switch, and the load. The load is simply any electrical component that is powered by the electrical system. Loads are powered off of electrical busses which will be arranged in a particular layout.

Main Battery

Power Generation

Voltage Regulation

Instruments

Controls

Bussing

Load

Power Generation

Power generation is accomplished by either a generator or alternator that is geared to the engine which provides electrical power continuously, as long as the engine is running, to charge the battery and power all electrical components. Older airplanes have generators, while newer airplanes have alternators. The aircraft industry transitioned from generators to alternators behind the automobile industry throughout the 1970s.

Due to their simpler and sturdier design, alternators are able to generate higher voltages and currents at lower RPM than generators since they can be spun faster – a typical gear ratio for generators is under 2:1, while for alternators it is over 3:1. As a result, alternators often produce system voltage as low as 600 RPM, while generators require upwards of 1200 to 1500 RPM to produce system voltage.

Alternators, such as the one shown here, are most common on modern small airplanes.

Improper Management of a System Failure

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.I.G.R2	Improper management of a system failure.
	Return to Overview

Unlike many other systems, electrical systems have the potential to be very different with significantly varying procedures between airplanes. As a result, it can be very easy for the pilot to reference the incorrect procedure when dealing with an electrical system failure.

Identifying Risks

Risks
Inability to restore the electrical system due to not utilizing the correct procedure, as well as an unnecessary forced landing.

In 2011,[24] the pilot of a Cessna P210N Centurion along with one passenger attempted flight from Barnes Municipal Airport (KBAF) in Westfield, Massachusetts to Hancock County-Bar Harbor Airport (KBHB) in Bar Harbor, Maine. During the initial climb, the airplane experienced a loss of electrical power. The pilot unsuccessfully attempted to restart the alternators by cycling the on/off switches. The airplane was in instrument meteorological conditions (IMC), and when he saw a clearing in the clouds, the pilot spiraled down through it. After exiting the clouds, he found a suitable place to land. During the approach, the airplane started to porpoise and eventually struck the top of a tree before impacting the ground. The airplane received substantial damage, and the pilot and passenger received serious injuries.

A post-accident interview with the pilot revealed that he attempted to energize the alternator's field utilizing the POH procedure for a single alternator system. The dual alternator system emergency procedure was a supplement for the POH, and the checklist that was located in the airplane did not contain the normal or emergency procedures which were required. The emergency procedure for the dual system stated to depress the ALT RESTART switch; the pilot stated that he did not know about the ALT RESTART switch. The number 1 alternator was tested and examined; it functioned for 5 minutes during the test before it stopped producing power. It showed signs of excessive heat consistent with overloading when examined internally. Internal examination of the number 2 alternator revealed burnt windings.

It is likely that the number 2 alternator failed at an unknown time, which resulted in the entire electrical system feeding off of the number 1 alternator. The number 1 alternator subsequently overloaded and failed, and the airplane's battery was unable to sustain the electrical system's demand. If the BEFORE TAKEOFF checklist for a dual alternator equipped airplane had been completed, the pilot could have detected that the airplane's electrical charging system was not working correctly.

Assessing Risks

- **Severity (Critical):** Loss of all electrical equipment during flight under VFR may result in an unnecessary forced landing that results in some damage to the airplane and injuries but rarely fatalities.
- **Likelihood:** Likelihood of improper management of an electrical system failure is dependent on pilot training, familiarity with the emergency procedures specific to the airplane, and sound decision making when it comes to a diversion.
- **Example:** For the proposed flight, the likelihood of improper management of an electrical system failure is **improbable** since the pilot has recently completed private pilot training, is familiar with the airplane's emergency procedures, and exercises sound decision making regarding diversions. Using the ***risk assessment matrix***, this makes improper management of an electrical system failure a **low**-risk item.

Mitigating Risks

The following are risk mitigation measures for improper management of an electrical system failure:

- Unlike many other systems, electrical systems have the potential to be very different with significantly varying procedures between airplanes. As a result, the manufacturer's checklist must always be referenced when dealing with an electrical system failure.
- Be wary of airplane's with aftermarket modifications to their electrical systems, also known as supplemental type certificates (STCs). These will often require procedures different to that of the original airplane, which will be contained in separate supplements to the POH/AFM. Ensure that these supplements, if applicable, are readily available in the airplane.
- Understand that an electrical system failure under VFR is not necessarily a significant emergency requiring immediate action. A diversion should be made to a suitable airport. If the diversion airport is controlled, ensure that you are familiar with light gun signal procedures.

Skills	The applicant demonstrates the ability to:
PA.I.G.S2	Use appropriate checklists properly.

Return to Overview

This skill element discusses general proper use of normal and emergency procedures checklists, each of which are different. Use of these checklists for each specific phase of flight or emergency is discussed in Volume II.

Two general methods of checklist use in single pilot airplanes are the 'do list' and 'done list' methods. The 'do list' method consists of reading each step of the checklist and then checking that item individually, treating the checklist as a 'to-do list.' This method is appropriate at certain times but inappropriate at others. The preflight inspection, for instance, is an appropriate time to use this method since it is not time-critical and numerous items must be checked that can easily be forgotten, while after takeoff and before landing would be inappropriate times. Additionally, all emergency procedures checklists should be accomplished using this method due to their criticality and non-routine nature.

The 'done list' method consists of performing the procedure from memory, such as using a flow, and then following up later by reviewing the checklist, treating it as a 'done list' instead of a 'to-do list.' This method is required at certain times and optional at others. The after takeoff and before landing checklists, for instance, require this method due to the task intensive and time-critical nature of these operations. This is optional for the preflight inspection, however. Although the 'do list' method may be preferred by a pilot who is not familiar with the airplane, the 'done list' method may be preferred by a pilot who *is* familiar with the airplane to increase the efficiency of this operation.

Use of Normal Procedures Checklists

Use of Emergency Procedures Checklists

Use of Normal Procedures Checklists[38]

Normal procedures are procedures expected to be performed every flight. This includes the phases of preflight inspection, engine start, taxi, takeoff, climb, cruise, descent, landing, and shutdown and securing. Three techniques that augment and facilitate normal checklist use are flow patterns, touch-verification, and verbalization.

Flow Patterns

Touch-Verification

Verbalization

Touch verification is one of several ways that normal procedures checklists can be augmented.

Flow Patterns

Flow patterns, also known as 'flows,' are the accomplishment of a procedure in a particular sequence of motor and eye movements without referencing the checklist while doing so. After the flow is completed, the checklist is then reviewed at an appropriate time to ensure that all items have been accomplished. This concept takes advantage of an individual's recognition memory and muscle memory to more efficiently perform a given procedure. Appendix 6: Safety of Flight in the ACS insinuates the use of flows for applicants during the practical test:

> *In a single-pilot airplane, the applicant should demonstrate the crew resource management (CRM) principles described as single-pilot resource management (SRM). Proper [checklist] use is dependent on the specific Task being evaluated. The situation may be such that the use of the checklist while accomplishing elements of an Objective would be either unsafe or impractical in a single-pilot operation. In this case, a review of the checklist after the elements have been accomplished is appropriate.*[39]

Designing flows for various procedures are dependent on the specific airplane (make, model, and even serial number) since flows are based on the spatial positioning of cockpit controls and instruments. A proper flow should accomplish all items for a given checklist by sweeping the cockpit in a certain direction (i.e. left to right or up to down) and hitting each item in the order they are encountered without skipping. Recognition memory is used since as the pilot encounters each item it reminds them of the next item similar to links in a chain of events. Muscle memory is also used as the pilot performs a familiar routine of physical motions.

It should be noted, however, that flows should only be used in airplanes that are regularly flown. If a pilot flies an airplane seldomly or flies many different types of airplanes, flows can become a hinderance as either recognition or muscle memory may not be available or confused with other airplanes. It is for this reason that many operators, especially airlines, often restrict pilots to flying one or a small number of airplanes at a time.

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HUMAN FACTORS
OVERVIEW

This task consists of an evaluation of human factors with an emphasis on aeromedical/physiological issues encountered in flight. Skill Element 1 requires at least 3 of the conditions listed in Knowledge Element 1 to be evaluated. Although not stated directly, it is highly likely that the examiner will want you to evaluate the risks associated with each of these conditions in addition to technical knowledge as implied by Risk Element 1. As a result, Risk Element 1 is dispersed throughout each of the conditions listed in Knowledge Element 1.

Skill Element 2 requires the performance of a self-assessment which includes fitness for flight and personal minimums. Each of these are done as presentations to the examiner and can be with reference to the proposed scenario flight, actual flight of the checkride, or both. Forms are provided to assist in the performance of these presentations.

Task	***H. Human Factors***
References	FAA-H-8083-2, FAA-H-8083-25; AIM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with personal health, flight physiology, aeromedical and human factors, as it relates to safety of flight. ***Note:*** *See Appendix 6: Safety of Flight.*
Knowledge	The applicant demonstrates understanding of:
PA.I.H.K1	The symptoms (as applicable), recognition, causes, effects, and corrective actions associated with aeromedical and physiological issues including:
PA.I.H.K1a	a. Hypoxia
PA.I.H.K1b	b. Hyperventilation
PA.I.H.K1c	c. Middle ear and sinus problems
PA.I.H.K1d	d. Spatial disorientation
PA.I.H.K1e	e. Motion sickness
PA.I.H.K1f	f. Carbon monoxide poisoning
PA.I.H.K1g	g. Stress
PA.I.H.K1h	h. Fatigue
PA.I.H.K1i	i. Dehydration and nutrition
PA.I.H.K1j	j. Hypothermia
PA.I.H.K1k	k. Optical illusions
PA.I.H.K1l	l. Dissolved nitrogen in the bloodstream after scuba dives
PA.I.H.K2	Regulations regarding use of alcohol and drugs.
PA.I.H.K3	Effects of alcohol, drugs, and over-the-counter medications.
PA.I.H.K4	Aeronautical Decision-Making (ADM).
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks encompassing:
PA.I.H.R1	Aeromedical and physiological issues. (see knowledge elements K1a through K1l)
PA.I.H.R2	Hazardous attitudes.
PA.I.H.R3	Distractions, loss of situational awareness, or improper task management.
Skills	The applicant demonstrates the ability to:
PA.I.H.S1	Associate the symptoms and effects for at least three of the conditions listed in K1a through K1l above with the cause(s) and corrective action(s). (see knowledge elements K1a through K1l)
PA.I.H.S2	Perform self-assessment, including fitness for flight and personal minimums, for actual flight or a scenario given by the evaluator.

Description

Risk Factors

Exhaust gasses entering the cockpit are the cause of carbon monoxide poisoning in small airplanes.

CARBON MONOXIDE POISONING

K

Description

Knowledge	The applicant demonstrates understanding of:
PA.I.H.K1	The symptoms (as applicable), recognition, causes, effects, and corrective actions associated with aeromedical and physiological issues including:
PA.I.H.K1f	f. Carbon monoxide poisoning
	Return to Overview

Causes

Symptoms

Effects

Recognition

Corrective Action

Examiner: *"Explain carbon monoxide poisoning."*

You: *"Carbon monoxide poisoning is the attaching of carbon monoxide – a colorless and odorless gas – to the hemoglobin in the blood which prevents it from carrying oxygen. Carbon monoxide is normally caused by damaged exhaust manifold heaters in airplanes but may also be due to leaks in the firewall. Symptoms include progressively worsening headache, drowsiness, dizziness, nausea, and even blurred vision. Effects include loss of consciousness which can result in loss of control of the aircraft. Recognition includes identifying these symptoms, especially while using the exhaust manifold heater or smelling exhaust fumes in the cockpit. Corrective action includes turning off the heater, if it is being used, and opening any vents or windows."*

Causes

The cause of carbon monoxide poisoning is the attaching of carbon monoxide (CO) to the hemoglobin in the blood which prevents it from carrying oxygen to the cells, resulting in hypemic hypoxia. In small piston engine airplanes, carbon monoxide poisoning is typically the result of damage to exhaust manifold heaters allowing exhaust fumes to enter the cabin. It is important to understand that carbon monoxide is a colorless and odorless gas and that the smell of exhaust may not necessarily accompany it.

Hypemic hypoxia occurs when the blood is not able to take up and transport a sufficient amount of oxygen to the cells in the body. This can also be caused by reduced blood volume, such as after a blood donation, or a result of certain blood diseases such as anemia.

Symptoms[19]

Symptoms vary with blood saturation of carbon monoxide, measured in percent carboxyhemoglobin (COHb). This correlates to the percent concentration of carbon monoxide in the air that is breathed, which is measured as either parts per million (ppm) or as a percentage. The rate at which symptoms progress depends on concentration of carbon monoxide in the air:

Early Symptoms

- Early symptoms occur with a blood saturation of 10-20%. Symptoms primarily include a slight headache.

Mid Stage Symptoms

- Mid stage symptoms occur with a blood saturation of 20-40%. Symptoms include shortness of breath, strong headache, dizziness, nausea, blurred vision, and drowsiness.

Late Stage Symptoms

- Late stage symptoms occur with a blood saturation of over 40%. Symptoms include severe headache, confusion, marked shortness of breath, marked drowsiness, and increasing blurred vision.

These symptoms eventually result in loss of consciousness and even death. Loss of consciousness occurs at a blood saturation of 46.5% and death at 67.5%. Table I-H-3[20] shows times to loss of consciousness for given concentrations of carbon monoxide in air at *sea level*. It is important to understand that higher altitudes increase susceptibility to carbon monoxide poisoning due to the reduced partial pressure of oxygen as discussed in ***Knowledge Element 1a***. As a result, these times will be lower at higher altitudes.

Carbon Monoxide Concentration		Time to Loss of Consciousness
%	**PPM**	**Minutes**
0.05	500	220
0.10	1000	110
0.20	2000	55
0.30	3000	37
0.60	4000	27
0.50	5000	22

Table I-H-3: Time to Incapacitation from CO Poisoning

Effects

Carbon monoxide has the potential to incapacitate an individual quite rapidly which would result in loss of control. As a result, carbon monoxide poses a detrimental effect to safety of flight.

Recognition

If the previously listed symptoms are experienced while utilizing an exhaust manifold heater, or there is an exhaust odor, carbon monoxide poisoning is very likely. However, it must be kept in mind that carbon monoxide itself is a colorless and odorless gas. Although exhaust fumes are the vehicle by which carbon monoxide travels, exhaust odor may not necessarily accompany it.

Corrective Action

Corrective action includes the following actions that should be taken *immediately*:

- Turning off the heater (if an exhaust manifold heater or combustion heater).
- Opening air vents or windows, if possible (no matter how cold it is outside).
- Use supplemental oxygen, if available. This will in effect buy more time by reducing the severity of symptoms and delay loss of consciousness.

After accomplishing these items, land as soon as practical. After landing, ensure that the airplane is squawked and others notified so that no one attempts to fly it, and *seek medical attention*. Depending on carbon monoxide levels in the bloodstream, hyperbaric oxygen therapy may be necessary.

Corrective action for carbon monoxide poisoning includes turning off the heater, if in use, and opening all available vents and windows.

Risk Factors

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks encompassing:
PA.I.H.R1	Aeromedical and physiological issues.

Return to Overview

Identifying Risks

Risks
Incapacitation due to carbon monoxide poisoning leading to loss of aircraft control and in-flight breakup or impacting terrain.

Risks of carbon monoxide poisoning include incapacitation which can lead to loss of aircraft control. The most common cause by far is a defective exhaust muffler. Table I-H-4[21,22,23,24] analyzes four accidents, all of which were caused by cracked exhaust mufflers leading to incapacitation and loss of control.

Year	Airplane	Occupants	CO Blood Saturation
1997	PA-28-236	2	43%, 69%
1998	PA-28-160	2	26.5%, 13.2%
2005	C-170B	1	50%
2016	7AC	1	40%

Table I-H-4: Occupant CO Blood Saturation in Select Accidents

As can be seen in the table, carbon monoxide (CO) levels have the potential to be extremely high, in some cases fatal. It should be noted that in the 1997 accident the passenger radioed ATC a mere 25 minutes into the flight stating that the pilot was extremely sick. Flight times of the other three accidents ranged from one to three hours.

Although the majority of accidents are due to cracked exhaust mufflers, some are due to inadequate sealing of the firewall. In 1996,[25] the pilot of a Mankovich Sonerai became incapacitated by carbon monoxide leaking from the engine compartment through the firewall and into the cabin. The pilot subsequently lost control and was fatally injured.

However, not all instances of carbon monoxide poisoning of the pilot result in fatal accidents or even accidents at all. In 1994,[26] a student pilot completed a round-robin cross-country flight in a Cessna 150 even after smelling exhaust fumes and experiencing significant carbon monoxide symptoms during the first leg. By the time the student completed the flight, they were experiencing severe symptoms but drove home. The student had not been trained regarding carbon monoxide, and only sought medical attention when the operator discovered the damaged exhaust muffler and called the pilot four hours later. The pilot's CO level was 17.5%.

In 1997,[27] a pilot of a Piper PA-24 Comanche inbound to Topeka, KS lost consciousness over Herrington, KS due to CO poisoning. The airplane overflew Topeka, ran out of fuel, and miraculously landed in a field in Cairo, MO over 200 miles away. The pilot received no injuries from the landing, woke up, and walked to a nearby house where an ambulance was called. The pilot's CO level at the time blood was taken was 26.8%. It was likely much higher when the engine was running.

Assessing Risks

- **Severity (Catastrophic):** The fact that carbon monoxide poisoning has the potential to rapidly incapacitate and result in loss of aircraft control makes the severity of this risk element **catastrophic**.
- **Likelihood:** The likelihood of CO poisoning is highest when using exhaust manifold heaters or combustion heaters. This encompasses most general aviation airplanes and is likely to occur during the winter months. Additional factors include maintenance and aircraft age.
- **Example:** For the proposed flight, the likelihood of carbon monoxide poisoning is **remote** since it is a cold winter day, and the airplane is equipped with an exhaust manifold heater that is intended be used. Using the ***risk assessment matrix***, this makes carbon monoxide poisoning a **serious**-risk item.

Mitigating Risks

The following are risk mitigation measures for carbon monoxide poisoning:

- Understand the causes, symptoms, effects, recognition, and corrective action for carbon monoxide poisoning.
- Place a carbon monoxide detector in the airplane. These are small, inexpensive devices that can provide life-saving information.

If symptoms are experienced in flight, understand that *immediate* action is required. Carbon monoxide from damaged exhaust mufflers has the potential to incapacitate in minutes.

Carbon monoxide detectors such as this one are extremely inexpensive and can provide life-saving information.