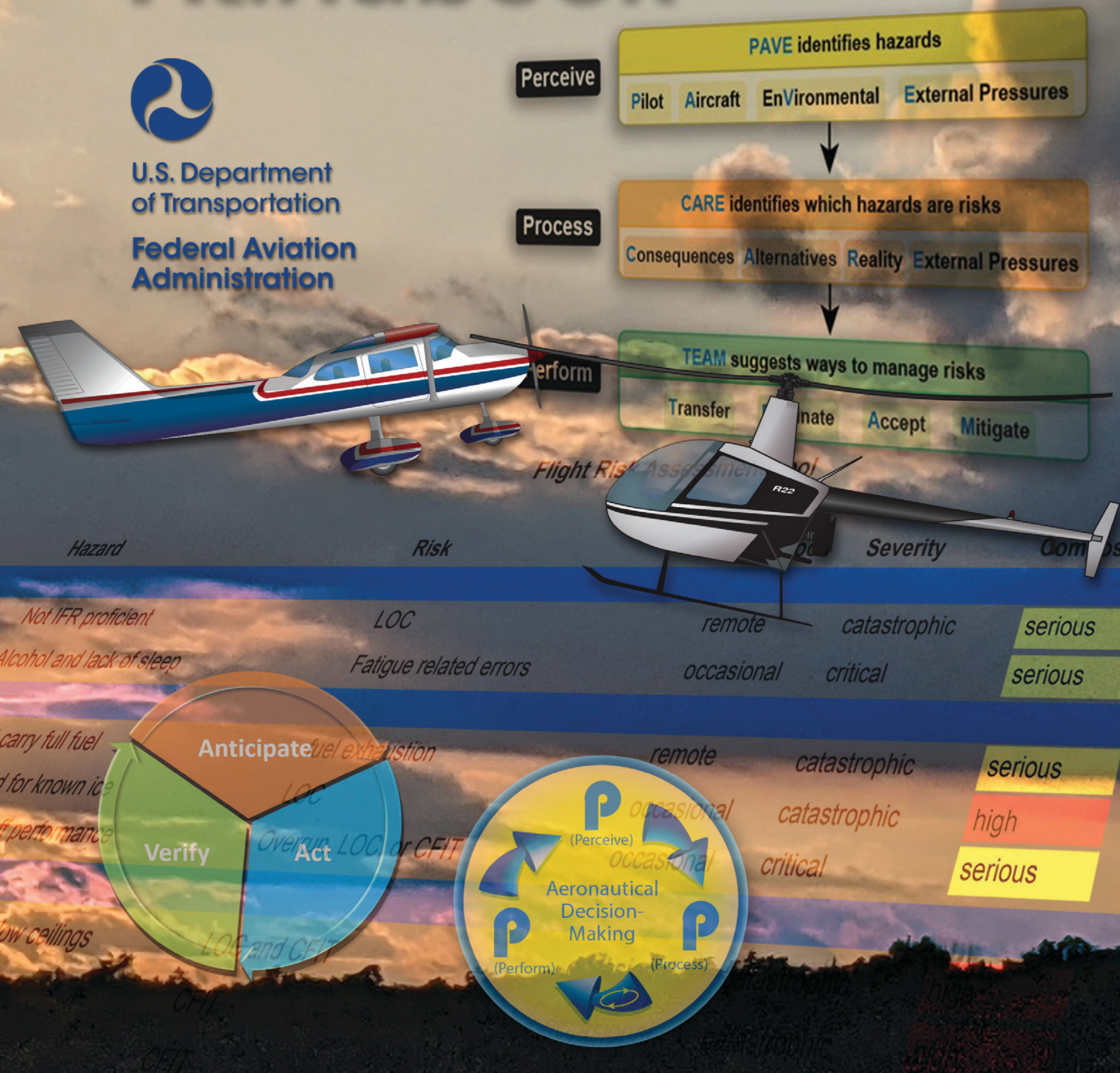
FAA-H-8083-2A

Risk Management Handbook

U.S. Department of Transportation

Federal Aviation Administration



Risk Management Handbook

2022

U.S. Department of Transportation
Federal Aviation Administration
Flight Standards Service

Preface

This handbook is a tool designed to help recognize and manage risk. It provides a higher level of training to the pilot in command (PIC) who wishes to aspire to a greater understanding of the aviation environment and become a better pilot. This handbook is for pilots of all aircraft from weight-shift control (WSC) to a Piper Cub, a Twin Beechcraft, or a Boeing 747. A pilot's continued interest in building skills is paramount for safe flight and can assist in rising above the challenges which pilots of all backgrounds and experience levels face.

Some basic tools are provided in this handbook for developing a competent evaluation of one's surroundings that allows for assessing risk and thereby managing it in a positive manner. Risk management is applied by identifying, monitoring, and managing potential components that affect risk thereby allowing the pilot to be better prepared to mitigate risk.

The pilot's work requirements vary depending on the phase of flight. As for a driver transitioning from an interstate onto the city streets of New York, the tasks increase significantly during the landing phase, creating greater risk to the pilot and warranting actions that require greater precision and attention. This handbook attempts to bring forward methods that a pilot can use in managing workload, making the environment safer for the pilot and the passengers.

Occasionally, the word "must" or similar language is used where the desired action is deemed critical. The use of such language is not intended to add to, interpret, or relieve a duty imposed by Title 14 of the Code of Federal Regulations (14 CFR).
This handbook is available for download, in PDF format, from www.faa.gov.

This handbook is published by the United States Department of Transportation, Federal Aviation Administration, Airman Testing Standards Branch, P.O. Box 25082, Oklahoma City, OK 73125.

Comments regarding this publication should be emailed to afs630comments@faa.gov.

Introduction

According to the National Transportation Safety Board (NTSB) statistics, in the last 20 years, approximately 85 percent of aviation accidents have been caused by "pilot error." Many of these accidents are the result of the tendency to focus flight training on the physical aspects of flying the aircraft by teaching the student pilot enough aeronautical knowledge and skill to pass the written and practical tests. In this scenario, risk management is ignored, which can potentially lead to fatal results. The certificated flight instructor (CFI) who integrates risk management into flight training teaches aspiring pilots how to proactively identify safety-related hazards pertaining to the flight and mitigating the associated risks of the identified hazards.

A key element of risk decision-making is determining if the risk is justified. The risks involved with flying are quite different from those experienced in daily activities. Managing these risks requires a conscious effort and established standards (or a maximum risk threshold). Pilots who practice effective risk management have predetermined personal minimums and have formed habit patterns and checklists to incorporate them.

If the procedures and techniques described in this handbook are taught and employed, pilots will have tools to identify potential hazards of a flight and successfully mitigate the risks associated with the identified hazards. The goal is to reduce the general aviation accident rate involving poor risk management. Pilots who make a habit of using risk management tools will find their flights considerably more enjoyable and less stressful for themselves and their passengers. In addition, some aircraft insurance companies reduce insurance rates after a pilot completes a formal risk management course.

This Risk Management Handbook makes available recommended tools for identifying hazards and assessing risk in order to conduct the safest flight possible with the least amount of risk. The appendices at the end of this handbook contain checklists and scenarios to aid in risk management consideration, flight planning, and training.

Major Enhancements

- This version of the handbook reorganizes risk management concepts in a sequence that pilots use in real world flying.
- Chapter 1 explains the difference between risk management exercised by pilots versus a global corporate risk management system, defines the role of the FAA and NTSB, and acknowledges limits in which regulatory compliance can influence safety. This leads to the discussion of personal minimums.
- The discussion of personal minimums moved from chapter 8 to chapter 2 and is now the subject of that chapter. Since the handbook cites personal minimums throughout, the initial presentation of this concept comes earlier.
- Chapter 2 also briefly discusses the FAA's WINGS program and has a video link that explains the advantages.
- Several FAASTeam video links are included throughout the book, which explain and summarize the concepts presented.
- A unified scenario in chapters 3, 4, and 5 shows how to apply risk management concepts before flight begins and explains and demonstrates the use of a flight risk assessment tool (FRAT) in combination with the PAVE checklist.
- The discussion of identification of hazards, risk analysis, and risk mitigation has been separated into three chapters (instead of two) to clarify each step and preserve the difference between hazard and risk.
- The chapter on hazard identification (chapter 3) discusses pilot attitudes and that discussion continues throughout the book, where relevant.
- Chapter 6 begins the discussion of risk as pilots encounter it during actual flying, in terms of threat and error management, with detailed definitions and examples, and an explanation of defenses.
- Chapter 7 takes a classic look at what automation is and does, and how pilots should anticipate, act, and verify when using automation. The chapter also includes discussion of flight path management.
- Chapter 8 specifically describes ADM training. This chapter focuses on the 3P risk analysis system while in flight and moves more complex models to the appendices. This chapter also contains a real example of naturalistic decision-making and addresses CRM and SRM in more detail.
- The appendices describe and analyze accident scenarios and some provide for the reader to make an analysis.
- The appendices contain instructions for how readers may use them for maximum benefit.
- Specific descriptions of makes and models were removed since a generic description broadens the applicability of concepts presented throughout the book.

Table of Contents

Chapter 1: Introduction to Risk Management

Introduction

Pilots experience the joy of taking an aircraft and passengers on flights that are visually pleasing and productive. However, most pilots also know people who have had accidents or died while flying.

By following the principles discussed in this handbook, pilots can:

- Make safety of flight their top priority.
- Fly with confidence.
- Enjoy each trip to the fullest extent possible.

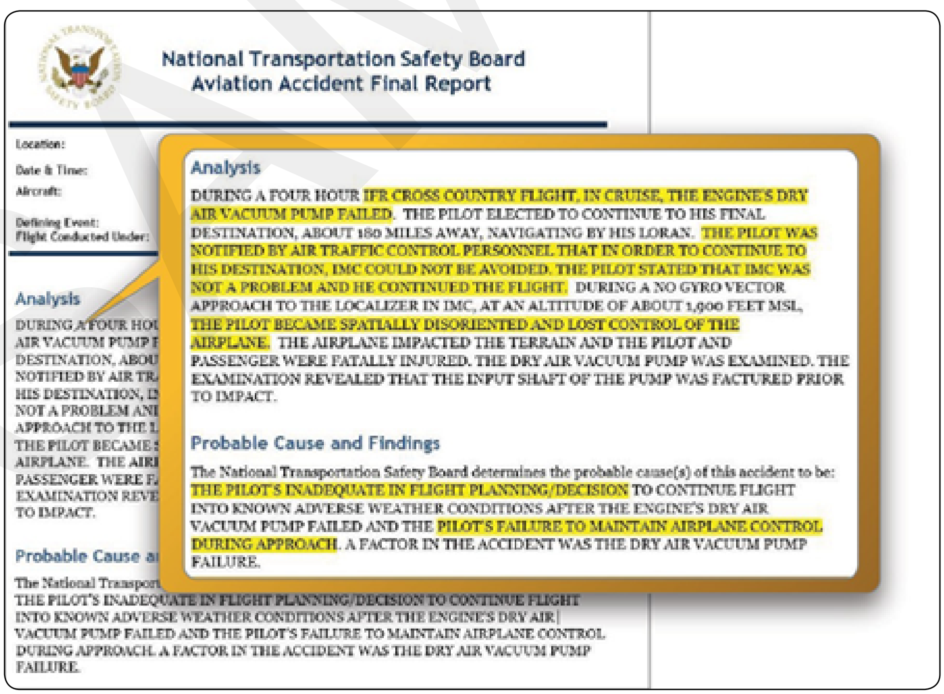
Safety Management Systems in Aviation

This Risk Management Handbook focuses on the individual and not on safety management systems (SMS). SMS addresses risk management from an organizational perspective as an ongoing activity. Interested persons may obtain information about SMS here.

Accident Causality & Responsibility

Both the National Transportation Safety Board (NTSB) and the Federal Aviation Administration (FAA) investigate aviation accidents. The NTSB determines the probable cause(s) of accidents and makes recommendations, while the FAA determines if accidents reveal deficiencies in pilot training, aircraft certification, air traffic control, or other areas of FAA responsibility. During accident investigations, the two government entities usually receive assistance from other interested parties, such as aircraft manufacturers and operators.

A review of the following accident report illustrates the role of the NTSB. The sidebar in *Figure 1-1* is an excerpt from an NTSB final report of a fatal accident involving a single-engine airplane with a reciprocating engine.



National Transportation Safety Board
Aviation Accident Final Report

Location:
Date & Time:
Aircraft:
Defining Event:
Flight Conducted Under:

Analysis

DURING A FOUR HOUR IFR CROSS COUNTRY FLIGHT, IN CRUISE, THE ENGINE'S DRY AIR VACUUM PUMP FAILED. THE PILOT ELECTED TO CONTINUE TO HIS FINAL DESTINATION, ABOUT 180 MILES AWAY, NAVIGATING BY HIS LORAN. THE PILOT WAS NOTIFIED BY AIR TRAFFIC CONTROL PERSONNEL THAT IN ORDER TO CONTINUE TO HIS DESTINATION, IMC COULD NOT BE AVOIDED. THE PILOT STATED THAT IMC WAS NOT A PROBLEM AND HE CONTINUED THE FLIGHT. DURING A NO GYRO VECTOR APPROACH TO THE LOCALIZER IN IMC, AT AN ALTITUDE OF ABOUT 1,900 FEET MSL, THE PILOT BECAME SPATIALLY DISORIENTED AND LOST CONTROL OF THE AIRPLANE. THE AIRPLANE IMPACTED THE TERRAIN AND THE PILOT AND PASSENGER WERE FATALLY INJURED. THE DRY AIR VACUUM PUMP WAS EXAMINED. THE EXAMINATION REVEALED THAT THE INPUT SHAFT OF THE PUMP WAS FACTURED PRIOR TO IMPACT.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: THE PILOT'S INADEQUATE IN FLIGHT PLANNING/DECISION TO CONTINUE FLIGHT INTO KNOWN ADVERSE WEATHER CONDITIONS AFTER THE ENGINE'S DRY AIR VACUUM PUMP FAILED AND THE PILOT'S FAILURE TO MAINTAIN AIRPLANE CONTROL DURING APPROACH. A FACTOR IN THE ACCIDENT WAS THE DRY AIR VACUUM PUMP FAILURE.

Figure 1-1. *Sample NTSB final report.*

Key findings of the NTSB aviation accident final report, highlighted above in yellow, emphasize the pilot's inadequate in-flight planning/decision to continue flight into known adverse weather conditions after the engine's dry air vacuum pump failed and the pilot's failure to maintain airplane control during approach. The NTSB report, available here, also contains information about this pilot's decision-making and risk management.

Many incidents and accidents occur as a result of poor risk management. The following accident review illustrates the importance of risk-based decision-making, as a means to prevent a negative outcome.

Risk Management Analysis Using the PAVE Checklist

The accident described above contains risk factors included in the PAVE checklist. As shown in *Figure 1-2*, the acronym "PAVE" represents hazards that relate to the pilot, the aircraft, the environment, and external pressures. The sample analysis below describes how PAVE items may relate to the accident.

Pilot

- A pilot must continually make decisions about competency, condition of health, mental and emotional state, level of fatigue, and many other variables. For example, a pilot may be called early in the morning to make a long flight. If a pilot has had only a few hours of sleep and is concerned that the sinus congestion being experienced could be the onset of a cold, it would be prudent to consider if the flight could be accomplished safely.
- A pilot had only 4 hours of sleep the night before being asked by the boss to fly to a meeting in a city 750 miles away. The reported weather was marginal and not expected to improve. After assessing fitness as a pilot, it was decided that it would not be wise to make the flight. The boss was initially unhappy, but was later convinced by the pilot that the risks involved were unacceptable.

Aircraft

- A pilot frequently bases decisions on evaluation of the airplane, such as performance, equipment, or airworthiness.
- During a preflight, a pilot noticed a small amount of oil dripping from the bottom of the cowling. Although the quantity of oil seemed insignificant at the time, the pilot decided to delay the takeoff and have a mechanic check the source of the oil. The pilot's good judgment was confirmed when the mechanic found that one of the oil cooler hose fittings was loose.

EnVironment

- The environment encompasses many elements that are not pilot or airplane related, including such factors as weather, air traffic control (ATC), navigational aids (NAVAIDS), terrain, takeoff and landing areas, and surrounding obstacles. Weather is one element that can change drastically over time and distance.
- A pilot was landing a small airplane just after a heavy jet had departed a parallel runway. The pilot assumed that wake turbulence would not be a problem since landings had been performed under similar circumstances. Due to a combination of prevailing winds and wake turbulence from the heavy jet drifting across the landing runway, the airplane made a hard landing. The pilot made an error when assessing the flight environment.

External Pressures

- The interaction between the pilot, airplane, and the environment is greatly influenced by the purpose of each flight operation. The pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical it is to maintain the schedule, and if the trip is worth the risks.
- On a ferry flight to deliver an airplane from the factory, the pilot calculated the groundspeed and determined he would arrive at the destination with only 10 minutes of fuel remaining. A check of the weather revealed he would be flying into marginal weather conditions. By asking himself whether it was more critical to maintain the schedule or to arrive with an intact aircraft, the pilot decided to schedule a refuel stop even though it would mean he would not be able to keep to the schedule. He chose not to "stretch" the fuel supply in marginal weather conditions which could have resulted in an emergency landing.

Figure 1-2. *The PAVE checklist.*

The pilot reported to air traffic control (ATC) that the vacuum pump failed while in visual meteorological conditions (VMC). As a result, the attitude indicator and directional gyro became inoperative. Rather than divert to an airport while in VMC, the pilot decided to continue toward the destination and into instrument meteorological conditions (IMC). This elevated the risks associated with an "A" hazard because of the inoperative instruments and a "V" hazard because of the IMC. After the vacuum pump failure, the pilot communicated with ATC that IMC would not be a problem, which may indicate a hazardous attitude or "P" hazard. It is unknown if an external pressure or "E" hazard factored in the pilot's apparent desire to get to the destination.

In this case, the pilot had the opportunity to change the outcome of the flight by diverting to an airport while still in VMC. Several reasons explain why pilots do not make appropriate decisions. Pilot error often results from an over-estimate of capability, a lack of preparation for flight, or a failure to prioritize safety. Varying levels of risk tolerance, or even intentional disregard of risk, may be a factor.

Risk management training includes a variety of measures that change the way pilots perceive and deal with hazards both before and during a flight. This handbook will emphasize using risk management as a process to avoid situations and decisions that might lead to an aircraft accident.

Chapter Summary

Poor risk management is a cause of many accidents. Accordingly, pilots should emphasize risk management in all types of operations, from recreational flying to using aircraft for business.

Chapter 2: Personal Minimums

Introduction

Federal regulations that apply to aviation do not cover every situation nor do they guarantee safety. For example, a pilot may legally fly in marginal VFR conditions at night even though low visibility and night hazards increase the risk for an incident or accident. Therefore, pilots should consider non-mandatory self-regulation in the form of personal minimums.

Personal Minimums

Pilots who understand the difference between what is "smart" or "safe" based on pilot experience and proficiency establish personal minimums that are more restrictive than the regulatory requirements. The following six steps allow pilots to establish a set of personal minimums in order to reduce risk and fly with greater confidence.

Step 1—Review Weather Flight Categories

Establishing personal minimums normally begins with weather, and pilots should know the range of ceiling and visibility that defines each category. [*Figure 2-1*]

Category	Ceiling		Visibility
Visual Flight Rules **VFR**	Greater than 3,000 feet AGL	**and**	Greater than 5 miles
Marginal Visual Flight Rules **MVFR**	1,000 to 3,000 feet AGL	**and/or**	3 to 5 miles
Instrument Flight Rules **IFR**	500 to below 1,000 feet AGL	**and/or**	1 mile to less than 3 miles
Low Instrument Flight Rules **LIFR**	below 500 feet AGL	**and/or**	less than 1 mile

Figure 2-1. *Weather category values for ceiling and visibility.*

Step 2—Assess Experience and Comfort Level

Pilots should also take a few minutes to complete the certification, training, and experience summary in *Figure 2-2* by filling in the right column. Some pilots fly different aircraft categories and classes and may develop different personal minimums based on the specific aircraft flown. For example, many pilots will have a different set of personal minimums when flying a single-engine airplane versus a multiengine airplane. Depending on pilot experience, the minimums in a multiengine airplane could be higher than the single-engine airplane minimums. Pilots may use the information entered in *Figure 2-2* to set personal minimums for a variety of situations using tables in *Figure 2-3*, *Figure 2-4*, and *Figure 2-5*.

Certification, Training, and Experience Summary	
Certification Level	
Certificate level (e.g., private, commercial, ATP)	
Ratings (e.g., instrument, multiengine)	
Endorsements (e.g., complex, high performance, high altitude)	
Training Summary	
Flight review (e.g., certificate, rating, wings)	
Instrument Proficiency Check	
Time since checkout in aircraft 1	
Time since checkout in aircraft 2	
Time since checkout in aircraft 3	
Variation in equipment (e.g., GPS navigators, autopilot)	
Experience	
Total flying time	
Years of flying experience	
Recent Experience (last 12 months)	
Hours	
Hours in this aircraft (or identical model)	
Landings	
Night hours	
Night landings	
Hours flown in high density altitude	
Hours flown in mountainous terrain	
Crosswind landings	
IFR hours	
IMC hours (actual conditions)	
Approaches (actual or simulated)	

Figure 2-2. *Certification, training, and experience summary.*

The tables in *Figure 2-3*, *Figure 2-4*, and *Figure 2-5* layout a sample assessment. *Figure 2-3* shows how entries might look in the Experience & Comfort Level Assessment VFR & MVFR table. Suppose a pilot's flying takes place in a part of the country where clear skies and visibilities of 30 miles or more are normal. The entry might specify the lowest VFR ceiling as 7,000 feet, and the lowest visibility as 15 miles. A pilot may never experience MVFR conditions and would leave the dash in place. However, in this example and as shown in *Figure 2-3*, the pilot regularly flies in an area where normal summer flying involves hazy conditions over relatively flat terrain and is more experienced and comfortable in MVFR. The pilot used the MVFR column to record personal minimums of a 2,500-foot ceiling and 4 miles visibility for daytime operations.

For night flight, a ceiling under 3,000 feet or visibility less than 5 miles may create an unnecessary risk, so the pilot decided to record a 5,000-foot ceiling and 8 miles visibility in the VFR column.

Experience and "Comfort Level" Assessment VFR & MVFR		
Weather Condition	VFR	MVFR
Ceiling	> 3,000	1,000–3,000
Day	—	2,500
Night	5,000	—
Visibility	> 5 miles	3–5 miles
Day	—	4 miles
Night	8 miles	—

Figure 2-3. *A sample pilot experience and comfort level assessment for VFR and MVFR.*

For IFR, *Figure 2-4* shows how a pilot recorded the lowest IFR conditions recently and regularly experienced. Although a pilot may have successfully flown in low IFR (LIFR) conditions, it does not mean the pilot was "comfortable" in these conditions. In this example, the pilot did not fill in the LIFR boxes for known "comfort level" in instrument meteorological conditions (IMC) after deciding to avoid flight in those conditions.

Experience and "Comfort Level" Assessment IFR & LIFR		
Weather Condition	IFR	LIFR
Ceiling	500–999	< 500
Day	800	—
Night	999	—
Visibility	1–3 miles	< 1 mile
Day	1 mile	—
Night	3 miles	—

Figure 2-4. *A sample pilot experience and comfort level assessment for IFR and LIFR.*

If combined into a single table, the summary of a pilot's known "comfort level" for VFR, MVFR, IFR, and LIFR weather conditions might appear as shown in *Figure 2-5*.

Experience and "Comfort Level" Assessment Combined VFR & IFR		
Weather Condition	VFR / MVFR	IFR / LIFR
Ceiling		
Day	2,500	800
Night	5,000	999
Visibility		
Day	4 miles	1 mile
Night	8 miles	3 miles

Figure 2-5. *Experience and comfort level assessment for combined VFR and IFR.*

Step 3—Consider Other Conditions

Pilots should also have personal minimums for wind and turbulence and record the most challenging wind conditions comfortably experienced during the last six to twelve months. As shown in *Figure 2-6*, a pilot may record these values for category and class, or for a specific aircraft.

Risk Management Handbook

FAA-H-8083-2A

U.S. Department of Transportation
Federal Aviation Administration

This FAA handbook provides tools to help pilots recognize and manage risk and presents definitive practical guidance on how to implement and conduct the "identify, assess, and mitigate" tasks identified in the Airman Certification Standards (ACS). Pilots who practice effective risk management have predetermined personal standards and have formed habit patterns and checklists to incorporate them. This handbook presents methods that pilots of all types of aircraft can use to manage the workloads associated with each phase of flight, resulting in a safer, more enjoyable, and less stressful experience for both themselves and their passengers.

In the last 20 years, approximately 85 percent of aviation accidents have been caused by "pilot error," which can result from focusing primarily on the physical aspects of flying the aircraft. The certificated flight instructor (CFI) who integrates risk management into flight training teaches aspiring pilots how to be more aware of the potential risks in flying, clearly identify those risks, and manage them successfully—building a solid understanding of how to avoid the most common pilot errors and supporting a safety culture in aviation.

An important component to airman certification, risk management is applied by identifying, monitoring, and managing potential components that affect risk, thereby allowing the pilot to be better prepared to mitigate risk. This full-color manual covers subjects such as an introduction to risk management, personal minimums, identifying hazards and associated risks, assessing risk, mitigating risk, threat and error management, automation and flight path management, and aeronautical decision-making in flight. Appendices contain additional risk management training and tools, accident case studies, and risk management exercises applicable to small general aviation training aircraft, helicopters, and large turbine-powered aircraft. Helpful tools include chapter-end summaries, glossary, index, and internet resources throughout for additional resources and information.

Aviation Supplies & Academics, Inc. – Since 1940
Quality and Service You Can Depend On.

asa™

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, Washington 98059 USA
425-235-1500 | asa2fly.com

ASA-8083-2A

TRANSPORTATION USD $19.95

ISBN 978-1-64425-271-0

51995 >

9 781644 252710