## Table of Contents

Prefaceiii	Limitations:	1-17
	Private Pilot	1-17
Acknowledgmentsv	Commercial Pilot	
•	Airline Transport Pilot	
Table of Contentsvii	Selecting a Flight School	
	How To Find a Reputable Flight Program	
Chapter 1	How To Choose a Certificated Flight	
Introduction To Flying1-1	Instructor (CFI)	1-19
Introduction1-1	The Student Pilot	1-20
History of Flight1-2	Basic Requirements	1-20
History of the Federal Aviation Administration (FAA) 1-3	Medical Certification Requirements	
Transcontinental Air Mail Route1-4	Becoming a Pilot	1-21
Federal Certification of Pilots and Mechanics1-4	Knowledge and Skill Tests	
The Federal Aviation Act of 19581-6	Knowledge Tests	
Department of Transportation (DOT)1-6	When To Take the Knowledge Test	
ATC Automation1-6	Practical Test	
The Professional Air Traffic Controllers	When To Take the Practical Test	
Organization (PATCO) Strike1-6	Who Administers the FAA Practical Tests?	
The Airline Deregulation Act of 19781-7	Role of the Certificated Flight Instructor	
The Role of the FAA1-7	Role of the Designated Pilot Examiner	
The Code of Federal Regulations (CFR)1-7	Chapter Summary	
Primary Locations of the FAA1-8	Chapter Summary	1 2-7
Field Offices1-8	Chapter 2	
Aviation Safety Inspector (ASI)1-9	Aeronautical Decision-Making	2-1
FAA Safety Team (FAASTeam)1-9	Introduction	
Obtaining Assistance from the FAA1-9	History of ADM	
Aeronautical Information Manual (AIM)1-9	Risk Management	
Handbooks1-10	Crew Resource Management (CRM) and Single-	2
Advisory Circulars (ACs)1-10	Pilot Resource Management	2-4
Flight Publications1-11	Hazard and Risk	
Pilot and Aeronautical Information1-12	Hazardous Attitudes and Antidotes	
Notices to Airmen (NOTAMs)1-12	Risk	2-6
Safety Program Airmen Notification System	Assessing Risk	2-6
(SPANS)1-14	Mitigating Risk	
Aircraft Classifications and Ultralight Vehicles1-14	The PAVE Checklist	
Pilot Certifications1-16	P = Pilot in Command (PIC)	
Privileges:	A = Aircraft	
Limitations:1-17	V = EnVironment	
Recreational Pilot	E = External Pressures	
Privileges:1-17		
1 11 7 11 0 5 0 0	Human Factors	2-10

Human Benavior	2-11	Chapter 3	
The Decision-Making Process	2-12	Aircraft Construction	3-1
Single-Pilot Resource Management (SRM)	2-13	Introduction	3-1
The 5 Ps Check	2-13	Aircraft Design, Certification, and Airworthiness	3-2
The Plan	2-14	A Note About Light Sport Aircraft	3-2
The Plane	2-14	Lift and Basic Aerodynamics	3-2
The Pilot	2-14	Major Components	3-3
The Passengers	2-14	Fuselage	3-3
The Programming		Wings	
Perceive, Process, Perform (3P) Model		Empennage	
PAVE Checklist: Identify Hazards and		Landing Gear	
Personal Minimums	2-15	The Powerplant	
CARE Checklist: Review Hazards and		Subcomponents	
Evaluate Risks	2-16	Types of Aircraft Construction	
TEAM Checklist: Choose and Implement		Truss Structure	
Risk Controls	2-16	Semimonocoque	
The DECIDE Model	2-18	Composite Construction	
Detect (the Problem)	2-20	History	
Estimate (the Need To React)	2-20	Advantages of Composites	
Choose (a Course of Action)		Disadvantages of Composites	
Identify (Solutions)		Fluid Spills on Composites	
Do (the Necessary Actions)		Lightning Strike Protection	3-11
Evaluate (the Effect of the Action)		The Future of Composites	3-12
Decision-Making in a Dynamic Environment		Instrumentation: Moving into the Future	3-12
Automatic Decision-Making		Control Instruments	3-13
Operational Pitfalls		Navigation Instruments	
Stress Management		Global Positioning System (GPS)	
Use of Resources		Chapter Summary	3-13
Internal Resources		0	
External Resources		Chapter 4	
Situational Awareness		Principles of Flight	
Obstacles to Maintaining Situational Awareness.		Introduction Structure of the Atmosphere	
Workload Management		Air is a Fluid	
Managing Risks		Viscosity	
Automation			
Results of the Study		Friction	
Equipment Use		Pressure	
Autopilot Systems		Atmospheric Pressure	
Familiarity		Pressure Altitude	
Respect for Onboard Systems		Density Altitude	
Getting Beyond Rote Workmanship		Effect of Pressure on Density	
Understand the Platform		Effect of Temperature on Density	
		Effect of Humidity (Moisture) on Density	
Managing Aircraft Automation		Theories in the Production of Lift	
Information Management		Newton's Basic Laws of Motion	
Enhanced Situational Awareness		Bernoulli's Principle of Differential Pressure	
Automation Management		Airfoil Design	
Risk Management		Low Pressure Above	
Chapter Summary	2-32	High Pressure Below	4-8

Pressure Distribution	4-8	Weight and Balance	
Airfoil Behavior	4-8	Effect of Weight on Flight Performance	5-42
A Third Dimension	4-9	Effect of Weight on Aircraft Structure	5-42
Chapter Summary	4-9	Effect of Weight on Stability and Controllability	5-42
		Effect of Load Distribution	5-43
Chapter 5		High Speed Flight	5-44
Aerodynamics of Flight		Subsonic Versus Supersonic Flow	5-44
Forces Acting on the Aircraft	5-1	Speed Ranges	5-44
Thrust		Mach Number Versus Airspeed	5-45
Lift		Boundary Layer	5-46
Lift/Drag Ratio	5-5	Laminar Boundary Layer Flow	5-46
Drag	5-6	Turbulent Boundary Layer Flow	5-46
Parasite Drag	5-6	Boundary Layer Separation	5-46
Induced Drag	5-7	Shock Waves	5-46
Weight	5-8	Sweepback	
Wingtip Vortices	5-8	Mach Buffet Boundaries	
Formation of Vortices		High Speed Flight Controls	
Avoiding Wake Turbulence	5-9	Chapter Summary	
Ground Effect			
Axes of an Aircraft	5-12	Chapter 6	
Moment and Moment Arm	5-13	Flight Controls	6-1
Aircraft Design Characteristics	5-14	Introduction	6-1
Stability		Flight Control Systems	6-2
Static Stability	5-14	Flight Controls	6-2
Dynamic Stability		Primary Flight Controls	
Longitudinal Stability (Pitching)		Elevator	
Lateral Stability (Rolling)		T-Tail	6-6
Directional Stability (Yawing)		Stabilator	6-7
Free Directional Oscillations (Dutch Roll)		Canard	
Spiral Instability		Rudder	
Effect of Wing Planform		V-Tail	
Aerodynamic Forces in Flight Maneuvers		Secondary Flight Controls	
Forces in Turns		Flaps	
Forces in Climbs		Leading Edge Devices	
Forces in Descents			
Stalls		Spoilers	
Angle of Attack Indicators		Trim Tabs	
Basic Propeller Principles		Balance Tabs	
Torque and P-Factor		Servo Tabs	6-11
Torque Reaction		Antiservo Tabs	6-11
Corkscrew Effect		Ground Adjustable Tabs	6-11
Gyroscopic Action		Adjustable Stabilizer	6-12
Asymmetric Loading (P-Factor)		Autopilot	6-12
Load Factors		Chapter Summary	
Load Factors in Aircraft Design		•	
Load Factors in Steep Turns		Chapter 7	
Load Factors and Stalling Speeds		Aircraft Systems	7-1
Load Factors and Flight Maneuvers		Introduction	
Vg Diagram		Powerplant	
Rate of Turn		Reciprocating Engines	
Radius of Turn		Propeller	7-4
TAMEND OF INTIFFERENCE			

Fixed-Pitch Propeller	7-5	Fuel Gauges	7-26
Adjustable-Pitch Propeller	7-6	Fuel Selectors	7-26
Propeller Overspeed in Piston Engine Aircraft	7-7	Fuel Strainers, Sumps, and Drains	7-27
Induction Systems		Fuel Grades	7-27
Carburetor Systems		Fuel Contamination	7-27
Mixture Control		Fuel System Icing	7-28
Carburetor Icing		Prevention Procedures	7-28
Carburetor Heat		Refueling Procedures	7-29
Carburetor Air Temperature Gauge		Heating System	7-29
Outside Air Temperature Gauge		Fuel Fired Heaters	7-29
Fuel Injection Systems		Exhaust Heating Systems	7-29
Superchargers and Turbosuperchargers		Combustion Heater Systems	7-29
Superchargers		Bleed Air Heating Systems	7-30
Turbosuperchargers		Electrical System	7-30
System Operation		Hydraulic Systems	7-31
High Altitude Performance		Landing Gear	7-33
_		Tricycle Landing Gear	7-33
Ignition System		Tailwheel Landing Gear	7-33
Oil Systems		Fixed and Retractable Landing Gear	7-34
Engine Cooling Systems		Brakes	7-34
Exhaust Systems		Pressurized Aircraft	
Starting System		Oxygen Systems	7-37
CombustionFull Authority Digital Engine Control (FADEC)		Oxygen Masks	
Furbine Engines		Cannula	
_		Pressure-Demand Oxygen Systems	7-38
Types of Turbine Engines  Turbojet		Continuous-Flow Oxygen System	7-38
-		Electrical Pulse-Demand Oxygen System	7-38
Turboprop		Pulse Oximeters	7-39
Turbofan		Servicing of Oxygen Systems	7-39
Turboshaft		Anti-Ice and Deice Systems	7-40
Turbine Engine Instruments		Airfoil Anti-Ice and Deice	7-40
Engine Pressure Ratio (EPR)		Windscreen Anti-Ice	7-41
Exhaust Gas Temperature (EGT)		Propeller Anti-Ice	7-41
Torquemeter		Other Anti-Ice and Deice Systems	7-41
N <sub>1</sub> Indicator	7-23	Chapter Summary	7-41
N <sub>2</sub> Indicator	7-23		
Turbine Engine Operational Considerations	7-23	Chapter 8	
Engine Temperature Limitations	7-23	Flight Instruments	
Thrust Variations	7-23	Introduction	
Foreign Object Damage (FOD)	7-23	Pitot-Static Flight Instruments	
Turbine Engine Hot/Hung Start	7-23	Impact Pressure Chamber and Lines	
Compressor Stalls		Static Pressure Chamber and Lines	
Flameout		Altimeter	
Performance Comparison		Principle of Operation	
Airframe Systems		Effect of Nonstandard Pressure and Temper	ature 8-4
Fuel Systems		Setting the Altimeter	8-5
Gravity-Feed System		Altimeter Operation	8-6
Fuel-Pump System		Types of Altitude	8-6
Fuel Primer		Instrument Check	8-7
Fuel Tanks		Vertical Speed Indicator (VSI)	
1 001 1 UIIIO	1 23	1 (	- '

Principle of Operation	8-7	Chapter 9	
Instrument Check	8-8	Flight Manuals and Other Documents	9-1
Airspeed Indicator (ASI)	8-8	Introduction	9-1
Airspeed Indicator Markings	8-9	Preliminary Pages	9-2
Other Airspeed Limitations		General (Section 1)	9-2
Instrument Check		Limitations (Section 2)	9-2
Blockage of the Pitot-Static System		Airspeed	9-2
Blocked Pitot System		Powerplant	9-3
Blocked Static System		Weight and Loading Distribution	9-3
Electronic Flight Display (EFD)		Flight Limits	9-4
Airspeed Tape		Placards	
Attitude Indicator		Emergency Procedures (Section 3)	
Altimeter		Normal Procedures (Section 4)	
Vertical Speed Indicator (VSI)		Performance (Section 5)	
Heading Indicator		Weight and Balance/Equipment List (Section 6)	
Turn Indicator		Systems Description (Section 7)	
Tachometer		Handling, Service, and Maintenance (Section 8)	
Slip/Skid Indicator		Supplements (Section 9)	
Turn Rate Indicator		Safety Tips (Section 10)	
Air Data Computer (ADC)		Aircraft Documents	
Trend Vectors		Certificate of Aircraft Registration	
Gyroscopic Flight Instruments		Airworthiness Certificate	
Gyroscopic Principles		Aircraft Maintenance	
Rigidity in Space		Aircraft Inspections	
Precession		Annual Inspection	
		100-Hour Inspection	
Sources of Power		Other Inspection Programs	
Turn Indicators		Altimeter System Inspection	
Turn-and-Slip Indicator		Transponder Inspection	
Turn Coordinator		Emergency Locator Transmitter	
Inclinometer		Preflight Inspections	
Yaw String		• •	9-5
Instrument Check		Minimum Equipment Lists (MEL) and Operations With Inoperative Equipment	0.0
Attitude Indicator		Preventive Maintenance	
Heading Indicator	8-19	Maintenance Entries	
Attitude and Heading Reference System (AHRS)			
The Flux Gate Compass System		Examples of Preventive Maintenance	
Remote Indicating Compass		Repairs and Alterations	
Instrument Check	8-22	Special Flight Permits	
Angle of Attack Indicators	8-22	Airworthiness Directives (ADs)	
Compass Systems	8-23	Aircraft Owner/Operator Responsibilities	
Magnetic Compass	8-23	Chapter Summary	9-13
Magnetic Compass Induced Errors	8-24	Chapter 10	
The Vertical Card Magnetic Compass	8-27	Chapter 10	10 1
Lags or Leads	8-27	Weight and Balance	
Eddy Current Damping	8-27	Introduction	
Outside Air Temperature (OAT) Gauge	8-28	Weight Control	
Chapter Summary		Effects of Weight	
-		Weight Changes	10-2

Balance, Stability, and Center of Gravity	10-2	Landing Charts	11-26
Effects of Adverse Balance	10-3	Stall Speed Performance Charts	11-27
Stability	10-3	Transport Category Aircraft Performance	11-28
Control	10-3	Air Carrier Obstacle Clearance Requirements	11-28
Management of Weight and Balance Control	10-4	Chapter Summary	11-28
Terms and Definitions			
Principles of Weight and Balance Computation		Chapter 12	
Weight and Balance Restrictions		Weather Theory	12-1
Determining Loaded Weight and CG		Introduction	12-1
Computational Method		Atmosphere	
Graph Method		Composition of the Atmosphere	12-2
Table Method		Atmospheric Circulation	12-3
Computations With a Negative Arm		Atmospheric Pressure	12-3
Computations With Zero Fuel Weight		Coriolis Force	12-3
Shifting, Adding, and Removing Weight		Measurement of Atmosphere Pressure	12-4
Weight Shifting		Altitude and Atmospheric Pressure	12-5
Weight Addition or Removal		Altitude and Flight	12-6
Chapter Summary		Altitude and the Human Body	12-6
Chapter Summary	10-11	Wind and Currents	12-7
Chapter 11		Wind Patterns	12-7
Aircraft Performance	11_1	Convective Currents	12-7
Introduction		Effect of Obstructions on Wind	12-8
Importance of Performance Data		Low-Level Wind Shear	12-11
Structure of the Atmosphere		Wind and Pressure Representation on Surface	
Atmospheric Pressure		Weather Maps	12-12
Pressure Altitude		Atmospheric Stability	12-12
Density Altitude		Inversion	12-13
Effects of Pressure on Density		Moisture and Temperature	12-13
Effects of Temperature on Density		Relative Humidity	12-13
Effects of Humidity (Moisture) on Density		Temperature/Dew Point Relationship	12-13
Performance		Methods by Which Air Reaches the Saturation	
Straight-and-Level Flight		Point	12-14
Climb Performance		Dew and Frost	12-15
Angle of Climb (AOC)		Fog	12-15
Rate of Climb (ROC)		Clouds	12-15
		Ceiling	12-17
Climb Performance Factors		Visibility	12-17
Range Performance		Precipitation	12-17
Region of Reversed Command		Air Masses	12-17
Takeoff and Landing Performance		Fronts	12-18
Runway Surface and Gradient	11-12	Warm Front	12-18
Water on the Runway and Dynamic	11 10	Flight Toward an Approaching Warm Front	12-19
Hydroplaning		Cold Front	12-20
Takeoff Performance		Fast-Moving Cold Front	12-20
Landing Performance		Flight Toward an Approaching Cold Front	
Performance Speeds		Comparison of Cold and Warm Fronts	
Performance Charts		Wind Shifts	
Interpolation		Stationary Front	
Density Altitude Charts		Occluded Front	
Takeoff Charts		Thunderstorms	
Climb and Cruise Charts		Hazards	
A TOSSWITTE AND DEADWING COMBONEOU CHARL	11-7.3		

Squall Line	12-23	Weather Products Age and Expiration	13-18
Tornadoes	12-23	What Can Pilots Do?	13-19
Turbulence	12-24	NEXRAD Abnormalities	13-21
Icing	12-24	NEXRAD Limitations	13-21
Hail		AIRMET/SIGMET Display	13-21
Ceiling and Visibility		Graphical METARs	
Effect on Altimeters		Data Link Weather	
		Data Link Weather Products	
Lightning		Flight Information Service- Broadcast (FIS-	
Engine Water Ingestion		Pilot Responsibility	
Chapter Summary	12-25	Chapter Summary	
Observant 40		Chapter Sammary	15 21
Chapter 13 Aviation Weather Services	12_1	Chapter 14	
Introduction		Airport Operations	14-1
		Introduction	
Observations		Airport Categories	14-1
Surface Aviation Weather Observations		Types of Airports	14-2
Air Route Traffic Control Center (ARTCC)		Towered Airport	
Upper Air Observations		Nontowered Airport	
Radar Observations		Sources for Airport Data	
Satellite		Aeronautical Charts	
Service Outlets		Chart Supplement U.S. (formerly Airport/Fac	
Flight Service Station (FSS)		Directory)	
Telephone Information Briefing Service (TIBS)	13-4	Notices to Airmen (NOTAM)	
Hazardous Inflight Weather Advisory		Automated Terminal Information Service (AT	
Service (HIWAS)	13-4	Airport Markings and Signs	
Transcribed Weather Broadcast (TWEB)	10.4	Runway Markings and Signs	
(Alaska Only)		Relocated Runway Threshold	
Weather Briefings		Displaced Threshold	
Standard Briefing			
Abbreviated Briefing		Runway Safety Area	
Outlook Briefing		Runway Safety Area Boundary Sign	
Aviation Weather Reports		Runway Holding Position Sign	
Aviation Routine Weather Report (METAR)		Runway Holding Position Marking	
Pilot Weather Reports (PIREPs)		Runway Distance Remaining Signs	14-8
Aviation Forecasts		Runway Designation Marking	14-8
Terminal Aerodrome Forecasts (TAF)		Land and Hold Short Operations (LAHSO)	14-10
Area Forecasts (FA)		Taxiway Markings and Signs	14-11
Inflight Weather Advisories		Enhanced Taxiway Centerline Markings	
AIRMET		Destination Signs	14-12
SIGMET	13-12	Holding Position Signs and Markings for an	
Convective Significant Meteorological		Instrument Landing System (ILS) Critical A	
Information (WST)		Holding Position Markings for Taxiway/Ta	
Winds and Temperature Aloft Forecast (FB)		Intersections	
Weather Charts		Marking and Lighting of Permanently Close	
Surface Analysis Chart		Runways and Taxiways	
Weather Depiction Chart		Temporarily Closed Runways and Taxiway	
Significant Weather Prognostic Charts		Other Markings	
ATC Radar Weather Displays		Airport Signs	
Weather Avoidance Assistance	13-18	Airport Lighting	
Electronic Flight Displays (EFD) / Multi-Function		Airport Beacon	
Display (MFD) Weather	13-18	mport beacon	14-10

Visual Approach Slope Indicator (VASI)   14-16     Other Glidepath Systems   14-16     Runway Lighting   14-17     Runway Edge Lights   14-17     Runway Edge Lights   14-17     Runway Lighting   14-18     Control of Airport Lighting   14-18     Taxiway Lighting   14-18     Taxiway Lighting   14-18     Taxiway Lighting   14-19     Control of Airport Lighting   14-19     Control of Airport Lighting   14-19     Clearance Bar Lights   14-19     Clearance Bar Lights   14-19     Runway Guard Lights   14-19     New Lighting Technologies   14-19     New Lighting Technologies   14-19     Wind Direction Indicators   14-20     Example: Key to Traffic Pattern Operations   14-21     Example: Key to Traffic Pattern Operations   14-22     Example: Key to Traffic Pattern Operations   14-22     Lost Communication Procedures   14-22     Lost Communication Procedures   14-22     Lost Communication Procedures   14-23     ATC Instructions   14-26     ATC Instructions   14-26     ATC Instructions   14-10     Cludamy and After-Landing   14-18     Eanfier of Materials Artesting Systems (EMAS)   14-14     Incidents   14-18     EAAS Installations and Information   14-14     Chapter Summary   14-15     Chapter Summary   14-15     Chapter Summary   14-15     Chapter Summary   14-16     Chapter Summary   14-17     Chapter Summary   14-19     Chapter Summary   14-19     Chapter Summary   14-10     Chapter Summary   14-10     Chapter Summary   14-10     Chapter Summary   14-10     Cludamic Indicators   14-10     Chapter Summary   14-10     Cludamic Indicators   14-10     Class G Airspace   15	Approach Light Systems	14-16	ATC Instructions—Explicit Runway Crossing	g 14-33
Other Glidepath Systems	Visual Glideslope Indicators	14-16	ATC Instructions—"Line Up and Wait"	
Runway Lighting	Visual Approach Slope Indicator (VASI)	14-16	(LUAW)	14-33
Runway End Identifier Lights (REIL)   14-17   Runway Edge Lights   14-17   In-Runway Lighting   14-18   In-Runway Lighting   14-18   EMAS Installations and Information   14-19   Charance Bar Lights   14-19   Charance Bar Lights   14-19   Charance Bar Lights   14-19   Charance Bar Lights   14-19   Stop Bar Lights   14-19   New Lighting Technologies   14-19   New Lighting Technologies   14-19   New Lighting Technologies   14-19   Example: Key to Traffic Pattern Operations— Single Runway   14-21   Example: Key to Traffic Pattern Operations— Single Runway   14-21   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Lost Communications   14-22   Radio Equipment   14-22   Lost Communication Procedures   14-22   Lost Communication Procedures   14-23   Air Traffic Control (ATC) Services   14-24   ATC Radar Beacon System (ATCRBS)   14-24   Transponder   14-26   Automatic Dependent Surveillance— Broadcast (ADS-B)   14-26   Radar Traffic Advisories   14-26   Vortex Generation   14-27   Vortex Behavior   14-27   Vortex Pehavior   14-28   Class Fairspace   15-26   Coordinating Rules and Pilot/Equipment   14-28   Control Identify Procedures   14-28   Control Identify Procedures   14-29   Control Identify Procedures   14-26   Coordinating Rules and Pilot/Equipment   14-27   Vortex Avoidance   14-28   Control Identify Procedures   14-29   Control Identify Procedures   14-29   Control Identify Procedures   14-29   Coordinating Rules and Pilot/Equipment   Requirements   15-20   Coordinating Rules and Pilot/Equipment   14-29   Coordinating Rules and Pilot/Equipment   14-	Other Glidepath Systems	14-16	ATC Instructions—"Runway Shortened"	14-34
Runway End Identifier Lights (REIL)   14-17   Runway Eighting   14-18   In-Runway Lighting   14-18   In-Runway Lighting   14-18   EMAS Installations and Information   14-19   Control of Airport Lighting   14-18   EMAS Installations and Information   14-19   Clearance Bar Lights   14-19   Clearance Bar Lights   14-19   Clearance Bar Lights   14-19   Stop Bar Lights   14-19   Stop Bar Lights   14-19   New Lighting Technologies   14-19   New Lighting Technologies   14-19   Wind Direction Indicators   14-20   Example: Key to Traffic Pattern Operations— Single Runway   14-21   Example: Key to Traffic Pattern Operations— Single Runway   14-21   Radio Communications   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Radio Equipment   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways   14-22   Example: Key to Traffic Pattern Operations— Parallel Runways	Runway Lighting	14-17	Pre-Landing, Landing, and After-Landing	14-34
Runway Edge Lights	Runway End Identifier Lights (REIL)	14-17		
In-Runway Lighting	Runway Edge Lights	14-17	Incidents	14-35
According   14-18   Pilot Considerations   14-19   Chapter Summary   14-20   Chapter Summary   15-20   Chapter Summary   14-20   Chapter Summary   14-20   Chapter Summary   14-20   Chapter Summary   15-20   Chapter Summary   14-20   Chapter Summary			EMAS Installations and Information	14-35
Chapter Summary   14-19			Pilot Considerations	14-36
Clearance Bar Lights			Chapter Summary	14-37
Chapter 15   Airspace   15	• •			
Airspace			Chapter 15	
Introduction	_		Airspace	15-1
Obstruction Lights         14-19         Controlled Airspace         15           New Lighting Technologies         14-19         Class B Airspace         15           Wind Direction Indicators         14-20         Class B Airspace         15           Traffic Patterns         14-20         Class D Airspace         15           Example: Key to Traffic Pattern Operations—         14-21         Class D Airspace         15           Example: Key to Traffic Pattern Operations—         14-21         Class D Airspace         15           Parallel Runways         14-21         Class G Airspace         15           Radio Communications         14-22         Radio License         14-22           Radio Equipment         14-22         Radio Equipment         14-22           Using Proper Radio Procedures         14-22         Warning Areas         15           Air Traffic Control (ATC) Services         14-24         Warning Areas         15           Air Traffic Adara Beacon System (ATCRBS)         14-24         Controlled Firing Areas (MOAs)         15           Arc Radar Traffic Advisories         14-25         Air Traffic Advisories         14-26           Wake Turbulence         14-26         Warning Areas         15           Vortex Generation         14-27<	· ·		Introduction	15-1
New Lighting Technologies			Controlled Airspace	15-2
Wind Direction Indicators.         14-20         Class S Airspace         15           Traffic Patterns         14-20         Class C Airspace         15           Example: Key to Traffic Pattern Operations—Single Runway         14-21         Loss G Airspace         15           Radio Communications.         14-22         Class G Airspace         15           Radio Communications.         14-22         Class G Airspace         15           Radio Equipment.         14-22         Example: Key to Traffic Pattern Operations—Parallel Runways         14-21         Class G Airspace         15           Radio Communications.         14-22         Loss G Airspace         15           Radio Equipment.         14-22         Waring Proper Radio Procedures         14-22         Warning Areas.         15           Lost Communication Procedures         14-23         Waring Areas.         15           Air Traffic Control (ATC) Services         14-24         Waring Areas.         15           Primary Radar.         14-24         Hareas         15           Automatic Dependent Surveillance—Broadcast (ADS-B)         14-26         Hareas         15           Wake Turbulence         14-26         Farminal Radar Service Areas (TRSAs)         15           Vortex Generation         14-27			Class A Airspace	15-2
Traffic Patterns			Class B Airspace	15-2
Example: Key to Traffic Pattern Operations—Single Runway			Class C Airspace	15-2
Example: Key to Traffic Pattern Operations—Parallel Runways		14-20	Class D Airspace	15-2
Example: Key to Traffic Pattern Operations		14-21	Class E Airspace	15-2
Parallel Runways. 14-21 Radio Communications. 14-22 Radio License. 14-22 Radio Equipment. 14-22 Radio Equipment. 14-22 Radio Equipment. 14-22 Lost Communication Procedures 14-23 Lost Communication Procedures 14-23 Air Traffic Control (ATC) Services. 14-24 Primary Radar. 14-24 Primary Radar. 14-24 ATC Radar Beacon System (ATCRBS) 14-24 Transponder. 14-25 Automatic Dependent Surveillance— Broadcast (ADS-B) 14-26 Radar Traffic Advisories 14-26 Radar Traffic Advisories 14-26 Vortex Generation 14-26 Terminal Area 14-27 Vortex Behavior 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Clearing Procedures 14-28 Clearing Procedures 14-28 Clearing Procedures 14-28 Pilot Deviations (PDs) 14-30 Runway Incursion Avoidance 14-31 Runway Confusion 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 14-30  Local Sirspace 1.15 Special Use Airspace 1.15 Prohibited Areas 1.15 Prohibited Areas 1.15 Restricted Areas 1.15 Prohibited Areas 1.15 Pactic Areas 1.15 Prohibited Areas (MOAs) 1.15 Prohibited Areas 1.15 Prohibited Areas 1.15 Prohi		17-21	Uncontrolled Airspace	15-3
Radio Communications. 14-22 Radio License 14-22 Radio Equipment 14-22 Radio Equipment 14-22 Restricted Areas 1.5 Restricted Areas (MOAs) 1.5 Alert Areas 1.5 Alert Areas 1.5 Alert Areas (CFAs) 1.5 Alert Areas (MOAs) 1.5 Ale	1 ,	14-21	<u>*</u>	
Radio License	•		Special Use Airspace	15-3
Radio Equipment 14-22 Using Proper Radio Procedures 14-22 Lost Communication Procedures 14-23 Air Traffic Control (ATC) Services 14-24 Primary Radar. 14-24 ATC Radar Beacon System (ATCRBS) 14-24 Transponder. 14-25 Automatic Dependent Surveillance-Broadcast (ADS-B) 14-26 Radar Traffic Advisories 14-26 Vortex Generation 14-26 Terminal Area 14-27 En Route 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance Procedures 14-28 Clearing Procedures 14-30 Runway Incursion Avoidance 14-31 Runway Confusion 14-31 Causal Factors of Runway Incursions 14-31 ATC Instructions 14-32  Restricted Areas 15 Warning Areas (MOAs) 15 Warning Areas (MOAs) 15 Alert Areas 15 Warning Areas (MOAs) 15 Alert Areas (MOAs) 15 Alert Areas (MOAs) 15 Alert Areas (CFAs) 15 Controlled Firing Areas (CFAs) 15 Alert Areas (CFAs) 15 Alert Areas (MOAs) 15 Alert				
Using Proper Radio Procedures 14-22 Lost Communication Procedures 14-23 Air Traffic Control (ATC) Services 14-24 Primary Radar 14-24 ATC Radar Beacon System (ATCRBS) 14-24 Transponder 14-25 Automatic Dependent Surveillance- Broadcast (ADS-B) 14-26 Radar Traffic Advisories 14-26 Vortex Generation 14-26 Terminal Area 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance 14-28 Clearing Procedures 14-28 Clearing Procedures 14-28 Clearing Procedures 14-28 Clearing Procedures 14-30 Runway Incursion Avoidance 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 15- Altert Areas (MOAs) 15 Alert Areas (CFAs) 15 Controlled Firing Areas (CFAs) 15 Alert Areas (MOAs) 15 Alert Areas (CFAs) 15				
Lost Communication Procedures 14-23 Air Traffic Control (ATC) Services 14-24 Primary Radar 14-24 ATC Radar Beacon System (ATCRBS) 14-24 Transponder 14-25 Automatic Dependent Surveillance- Broadcast (ADS-B) 14-26 Radar Traffic Advisories 14-26 Vortex Generation 14-26 Terminal Area 14-27 En Route 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance 14-28 Pilot Deviations (PDs) 14-30 Runway Incursion Avoidance 14-31 Runway Confusion 14-31 Causal Factors of Runway Incursions 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 14-32 Alert Areas (MOAS) 15 Alert Areas (MOAS) 15 Alert Areas (CFAs) 15 Other Airspace Areas (CFAs) 15 Other Airspace Areas (TRS) 15 Other Airspace Areas (TR	* *			
Air Traffic Control (ATC) Services				
Primary Radar				
ATC Radar Beacon System (ATCRBS) 14-24 Transponder				
Transponder	•		<u>*</u>	
Automatic Dependent Surveillance— Broadcast (ADS-B)				
Broadcast (ADS-B)	<u>-</u>			
Wake Turbulence 14-26 Vortex Generation 14-26 Terminal Area 14-27 En Route 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance 14-28 Pilot Deviations (PDs) 14-30 Runway Incursion Avoidance 14-30 Causal Factors of Runway Incursions 14-31 Runway Confusion 14-31 Causal Factors of Runway Confusion 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 15-3  Terminal Radar Service Areas (TRSAs) 15 National Security Areas (NSAs) 15 National Secu		14-26		
Vortex Generation 14-26 Terminal Area 14-27 En Route 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance 14-28 Pilot Deviations (PDs) 14-30 Runway Incursion Avoidance 14-30 Causal Factors of Runway Incursions 14-31 Causal Factors of Runway Confusion 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 14-32  National Security Areas (NSAs) 15 Air Traffic Control and the National Airspace System .15 Coordinating the Use of Airspace 15 Operating in the Various Types of Airspace 15 Basic VFR Weather Minimums 15 Operating Rules and Pilot/Equipment Requirements 15 Ultralight Vehicles 15-1 Unmanned Aircraft Systems 15-1 Unmanned Aircraft Systems 15-1 Chapter Summary 15-1 Chapter Summary 15-1 Chapter Summary 15-1	Radar Traffic Advisories	14-26		
Terminal Area 14-27 En Route 14-27 Vortex Behavior 14-27 Vortex Avoidance Procedures 14-28 Collision Avoidance 14-28 Clearing Procedures 14-28 Pilot Deviations (PDs) 14-30 Runway Incursion Avoidance 14-30 Causal Factors of Runway Incursions 14-31 Runway Confusion 14-31 Causal Factors of Runway Confusion 14-31 ATC Instructions 14-32  Air Traffic Control and the National Airspace System .15 Coordinating the Use of Airspace 15 Operating in the Various Types of Airspace 15 Operating Rules and Pilot/Equipment Requirements 15 Ultralight Vehicles 15-1 Unmanned Free Balloons 15-1 Chapter Summary 15	Wake Turbulence	14-26	` '	
En Route	Vortex Generation	14-26	· · · · · · · · · · · · · · · · · · ·	
Vortex Behavior	Terminal Area	14-27	- · · ·	
Vortex Avoidance Procedures	En Route	14-27		
Vortex Avoidance Procedures	Vortex Behavior	14-27		
Clearing Procedures	Vortex Avoidance Procedures	14-28		15-/
Pilot Deviations (PDs)	Collision Avoidance	14-28		15.0
Runway Incursion Avoidance	Clearing Procedures	14-28		
Runway Incursion Avoidance	_		_	
Runway Confusion 14-31 Parachute Jumps 15-1 Causal Factors of Runway Confusion 14-31 Chapter Summary 15-1 ATC Instructions 14-32	Runway Incursion Avoidance	14-30		
Runway Confusion	Causal Factors of Runway Incursions	14-31		
ATC Instructions14-32			-	
	Causal Factors of Runway Confusion	14-31	Chapter Summary	15-11
ATC Instructions—"Hold Short" 14-32	ATC Instructions	14-32		
ATC instructions— Hold Short14-32	ATC Instructions—"Hold Short"	14-32		

Chapter 16		Time and Distance Check From a Station Using	
Navigation	16-1	a RMI	16-26
Introduction	16-1	Time and Distance Check From a Station Using	
Aeronautical Charts	16-2	a CDI	16-27
Sectional Charts	16-2	Course Intercept	
VFR Terminal Area Charts	16-2	Rate of Intercept	16-27
World Aeronautical Charts	16-2	Angle of Intercept	16-27
Latitude and Longitude (Meridians and Parallels)	16-3	Distance Measuring Equipment (DME)	16-27
Time Zones	16-3	VOR/DME RNAV	16-28
Measurement of Direction	16-5	Automatic Direction Finder (ADF)	16-29
Variation	16-6	Global Positioning System	16-30
Magnetic Variation	16-7	Selective Availability	16-31
Magnetic Deviation	16-7	VFR Use of GPS	16-32
Deviation	16-8	RAIM Capability	16-32
Effect of Wind	16-8	Tips for Using GPS for VFR Operations	16-33
Basic Calculations	16-11	VFR Waypoints	
Converting Minutes to Equivalent Hours	16-11	Lost Procedures	
Time T = D/GS		Flight Diversion	16-34
Distance D = GS X T	16-11	Chapter Summary	
GS GS = D/T	16-11	•	
Converting Knots to Miles Per Hour		Chapter 17	
Fuel Consumption		Aeromedical Factors	17-1
Flight Computers		Introduction	17-1
Plotter		Obtaining a Medical Certificate	17-2
Pilotage		Health and Physiological Factors Affecting Pilot	
Dead Reckoning		Performance	17-3
Wind Triangle or Vector Analysis		Hypoxia	
Step 1		Hypoxic Hypoxia	17-3
Step 2		Hypemic Hypoxia	17-3
Step 3		Stagnant Hypoxia	17-3
Step 4		Histotoxic Hypoxia	17-4
Flight Planning		Symptoms of Hypoxia	17-4
Assembling Necessary Material		Treatment of Hypoxia	17-4
Weather Check		Hyperventilation	17-4
Use of Chart Supplement U.S. (formerly	10-17	Middle Ear and Sinus Problems	
Airport/Facility Directory)	16-17	Spatial Disorientation and Illusions	
Airplane Flight Manual or Pilot's Operating	10 17	Vestibular Illusions	
Handbook (AFM/POH)	16-17	Visual Illusions	
Charting the Course		Postural Considerations	
Steps in Charting the Course		Demonstration of Spatial Disorientation	
Filing a VFR Flight Plan		Climbing While Accelerating	
Ground-Based Navigation		Climbing While Turning	
Very High Frequency (VHF) Omnidirectional		Diving While Turning	
Range (VOR)	16-22	Tilting to Right or Left	
Using the VOR			
Course Deviation Indicator (CDI)		Reversal of Motion	
Horizontal Situation Indicator		Diving or Rolling Beyond the Vertical Plane	
Radio Magnetic Indicator (RMI)		Coping with Spatial Disorientation	
Tracking With VOR		Optical Illusions	
Tips on Using the VOR		Runway Width Illusion	1/-10

Runway and Terrain Slopes Illusion	17-10
Featureless Terrain Illusion	17-10
Water Refraction	17-10
Haze	17-10
Fog	17-10
Ground Lighting Illusions	
How To Prevent Landing Errors Due to	
Optical Illusions	17-10
Motion Sickness	17-12
Carbon Monoxide (CO) Poisoning	17-12
Stress	17-12
Fatigue	17-13
Exposure to Chemicals	17-13
Hydraulic Fluid	17-13
Engine Oil	17-14
Fuel	17-14
Dehydration and Heatstroke	17-14
Alcohol	17-15
Drugs	17-16
Altitude-Induced Decompression Sickness (DCS)	17-18
DCS After Scuba Diving	17-18
Vision in Flight	17-19
Vision Types	17-20
Photopic Vision	17-20
Mesopic Vision	17-21
Scotopic Vision	17-21
Central Blind Spot	17-21
Empty-Field Myopia	17-22
Night Vision	17-22
Night Blind Spot	17-22
Dark Adaptation	17-23
Scanning Techniques	17-23
Night Vision Protection	17-23
Self-Imposed Stress	17-25
Distance Estimation and Depth Perception	17-25
Binocular Cues	17-26
Night Vision Illusions	17-26
Autokinesis	
False Horizon	17-26
Reversible Perspective Illusion	17-26
Size-Distance Illusion	17-27
Fascination (Fixation)	17-27
Flicker Vertigo	
Night Landing Illusions	
Enhanced Night Vision Systems	
Synthetic Vision System	
Enhanced Flight Vision System	
•	17 20

Appendix A	
Performance Data for Cessna Model 172F	3
and Challenger 605	<b>A-</b> 1
Appendix B	
Acronyms, Abbreviations, and NOTAM	
Contractions	B-1
Appendix C	
Airport Signs and Markings	<b>C-</b> 1
Glossary	G-1
Index	l-1