

Contents

Preface ix

Acknowledgments xi

About the Authors xiii

CHAPTER 1

Introduction 1

How to Use This Manual 1

Transitioning Piston Pilots 1

Transitioning Military Aviators 2

Crew Resource Management 2

Training by Civilian Employers 3

Civilian Aircraft and Civilian Aviation

Terminology 3

Aircraft Systems 3

Contemporary Issues in the Aviation Industry 3

About Your Civilian Counterparts 4

CHAPTER 2

General Preparations 5

Training 5

Limitations, Systems, and Procedures 5

Indoctrination Training 6

Simulator and Flight Training 6

Preparing for New-Hire Training 6

Preparing for Ground School 7

Preparing for Simulator and Flight Training 7

Preparing for the Flight Line 8

Computers 8

Contemporary Issues in the Aviation Industry 8

Crew Resource Management and Teamwork 8

Unions 9

Driving under the Influence 9

Discrimination and Harassment 9

Air Rage 9

CHAPTER 3

Turbine Engine and Propeller Systems 11

Introduction to Gas Turbine Engines 11

Centrifugal-Flow and Axial-Flow Compressors 14

Multistage Compressors 15

Multispool Engines 15

Core Turbine Engine (Gas Generator) 15

Turbojets, Turbofans, and Turboprops 17

Turbojet Engine 17

Turbofan Engine 18

Geared Turbofan Engine (GTF) 18

Turboprop Engine 20

Thrust versus Power 22

Engine Operating Parameters 23

Turbine Engine Controls in the Cockpit 25

Fuel Control Units 25

- Turbine Engine Starting 26
- Turbine Engine Thrust or Power Terms 29
- Turbine Engine Characteristics in Flight 31
- Turbine Engine In-Flight Malfunctions 31

Thrust Reversers 33

- Thrust Reversers on Jets 33
- Reverse Thrust on Turboprops 34
- Use of Reversers 35

Turboprop Propeller Systems 35

- Propeller Governors 36
- Beta Range 37
- Propeller Auto-Feather Systems 37
- Propeller Synchronizers and Synchrophasers 39

Propeller Supplement for Transitioning Military Jet Pilots 39

- Propeller Terminology 39

CHAPTER 4

Turbine Aircraft Power Systems 45

Basics of Aircraft Power Systems 45

- Depiction of Aircraft Systems in Pilot Training 45
- Understanding Aircraft Power Systems: 46
- The Reference Waterwheel 46
- Comparing Aircraft Power Systems to the Reference Waterwheel System 46

Electrical Power Systems 48

- Electrical Power Sources 48
- Control Devices 54
- Circuit Protection 55
- Reading an Airplane Electrical Diagram 57
- Troubleshooting 58
- Emergency Electrical Power Generation 65

Hydraulic Power Systems 65

- Benefits of Hydraulic Power in Large Airplanes 66
- Hydraulic Systems and Components 66
- Hydraulic System Characteristics 71

Pneumatic Power Systems 72

- High-Pressure Bleed Air 72
- Low-Pressure Air 72
- Bleed Hazards and Protections 72

Auxiliary Power Units 74

CHAPTER 5

Major Aircraft Systems 77

Flight Controls 77

- Control Surfaces 77
- Flight Control System Redundancy 82
- Flight Control Surface Position Indicating Systems 82
- Fly-by-Wire Control Systems 83

Pressurization 83

- Pressurization Indicators and Controls 84
- Electrically Driven Air Compressors 86
- Pressurization System Safety Features 86
- Loss of Cabin Pressure in Flight 87

Environmental Systems 91

- Heat Exchangers 91
- Air and Vapor Cycle Machines 91
- Aircraft Environmental System 94

Fuel Systems 94

- Fuel Tanks 94
- Fuel Pumps 95
- Fuel Control Unit 97
- Fuel Valves 97
- Fuel Heaters 97
- Fuel Quantity Measurement Systems 97
- Fuel Quantity Measuring Sticks 98
- Fuel Vents 98
- Fuel Management 98

CHAPTER 6

Dedicated Aircraft Systems 101

Ice and Rain Protection 101

- In-Flight Structural Icing 101
- Engine Icing 104
- Fuel System Icing 106
- The Role of the Pilot 106
- Automatic Ice Protection Systems 106
- Rain Protection 106

Landing Gear Systems 106

- Landing Gear Squat Switch 107
- Brakes 107
- Nosewheel Steering 110
- Tailskid 110

Annunciator and Warning Systems	111
Annunciator or Advisory Panels	111
Audio Advisory and Warning Annunciation	113
Electronic System Monitoring and Display	113
Summary of Various Cockpit System Warnings, Cautions, and Advisories	114
Fire Protection Systems	116
Fire Detection and Extinguishing Systems	116
Nitrogen Generating System (NGS)	117
Pilot Actions and Cockpit Controls	118
Electrical Considerations	119
Cabin and Cockpit Protection	119
Auxiliary Power Unit Fire Protection	120
Cargo Compartment Fire Protection	120
Antennas, Vanes, Probes, and Drains	121
Vanes	121
Probes	123
Drains	124
Air Data Computer (ADC)	125

CHAPTER 7

Limitations 127

Airspeeds	127
Crosswind Limitations	128
Additional Crosswind Limitations	129
Tailwind Limitations	129
Adding Gust to Limitations	130
Aerodynamic Flight Envelope Limits	130
Factor of Safety and Load Factor	130
Gust Load Limits	132
Engine Limits	132
Other System Limitations	133
Operational Limitations	135

CHAPTER 8

Normal Procedures 137

Crew Coordination	137
Captain and First Officer/Copilot	137
Pilot Flying and Pilot Monitoring	137
Crew Resource Management (CRM)	138
Optimizing Crew Communication	138
Improving Overall Flight Management	139
Development of a Team Performance Concept	139
Crew Resource Management Training	140

Leadership and Professional Development	140
Leadership	141
Authority	141
Responsibility	142
Sound Decisions	142
Situational Awareness (SA)	142
Mentoring	142
Professional Development	143

Pilot Flying (PF) and Pilot Monitoring (PM) Responsibilities 143

Pilot Monitoring (PM) Intervention Strategies	144
---	-----

Operating Manuals: AFM, AOM, FCOM, POH, and GOM 144

Checklists and Callouts 145

Checklist Procedures	145
Types of Checklists	146
Normal Checklists	147
Standard Callouts	148

Federal Aviation Administration (FAA) Safety Culture Promotion 149

Safety Management System (SMS)	149
--------------------------------	-----

Conducting Briefings 151

The Pre-Briefing "Cockpit Set-Up"	151
Standard Types of Briefings	152

CHAPTER 9

Emergency and Abnormal Procedures 159

Emergency versus Abnormal Situations	159
Emergency Procedures	159
Abnormal Procedures	161
Typical Emergency and Abnormal "Initial Memory Item" Procedures	162
General Procedures	162
Stall Prevention and Recovery Training	167
Defining a Stall	168
Stall Warning and Stall Avoidance Systems	170
Factors Leading to a Stall	172
Proper Stall Recovery Procedure	174
Upset Prevention and Recovery Training (UPRT)	175
Defining an Airplane Upset	176
Causes of Airplane Upsets	176
Preventing Airplane Upsets	178
Delayed Recovery Response	179
Upset Recovery	179

CHAPTER 10

Performance 181

- Takeoff, Climb, Landing,
and Engine-Out Performance 181
 - Takeoff and Climb Performance 182
 - Enroute Engine-Out Performance Planning 184
 - Landing Performance 185
 - Braking Performance 186
- Routine Performance Planning 186
 - TOLD Cards 186
 - Airport Analysis Tables 186
 - Cruise Performance: Fuel Planning 187
 - Temperature-Derived Reduced Thrust Takeoff 188
 - Derated Thrust 189
 - Electronic Flight Bag (EFB) and Performance
Planning 189
- Basic Principles of Energy Management 190
- Aerodynamic Performance Concepts:
Maximum Lift over Drag Ratio (Max L/D) 192
 - High Altitude/Low Energy Recovery—Speed
Reductions at High Altitude 193
- Additional Aircraft Performance Concepts 194
 - Maximum Range Airspeed (V_{BR}) and Maximum
Endurance Airspeed (V_{BE}) 196
 - Determining Maximum Range and Maximum
Endurance 197
 - Cost Index and Economy (ECON) Cruise 198
- Airplane Performance Summary 199
- Transport Airplane Performance
and Operating Limitations 199

CHAPTER 11

Weight and Balance 201

- The Weight in “Weight and Balance” 201
 - Aircraft Weight Categories 202
- Balance Considerations 202
 - CG as Percentage of MAC 202
 - Performance Benefit of an Aft CG 203
 - In-Flight CG Movement 203
- Calculating Weight and Balance
in the Real World 204
 - Average Passenger Weights 204
 - Random Loading Programs 204

CHAPTER 12

Airplane Handling, Service, and Maintenance 207

- Flight Dispatch, Flight Following, and
the Concept of Operational Control 207
 - Joint Responsibility of Aircraft Dispatcher and
PIC 208
- Operations Specifications 209
- Fueling Procedures 209
- Standard Preflight 209
 - Aircraft Documents Review 210
 - Cockpit and Emergency Equipment Checks 210
 - Exterior Preflight Check 211
 - Final Preflight Preparations 212
- Minimum Equipment List (MEL) 212
- Configuration Deviation List (CDL) 214
- Non-Essential Equipment and Furnishings
(NEF) 214
- Ground Icing 214
 - FAA Approved Ground Deicing/Anti-Icing
Programs 215
 - Holdover Time (HOT) and Holdover Tables 217
 - Ground Deice/Anti-Ice Operations Training 220
- Runway Safety and Airport Surface Navigation 220
 - Runway Incursion Prevention Techniques 221
 - Airport Movement and Non-Movement Areas 221
 - Coded Taxi Routes 222

CHAPTER 13

Navigation, Communication, and Electronic Flight Control Systems 223

- Horizontal Situation Indicator 223
- Autopilots 223
- Flight Director 225
- Electronic Flight Instrumentation Systems (EFIS) 225
- Flight Mode Annunciator (FMA) 228
- Attitude and Heading Reference System (AHRS) 229
- Inertial Reference System (IRS) 229
- Inertial Reference Unit (IRU) 229
- Head-Up Displays 230

Area Navigation (RNAV)	230
VOR/DME-Based RNAV	232
Global Positioning System (GPS)	232
Global Navigation Satellite System (GNSS)	232
Inertial Navigation System (INS)	232
Using RNAV	233
Required Navigation Performance (RNP)	233
Receiver Autonomous Integrity Monitoring (RAIM)	235
Predictive RAIM (PRAIM) Check	236
Differential Global Positioning Systems (DGPS)	236
Required Navigation Performance (RNP) Approach Types	237
Latitude and Longitude	238
Flight Management System (FMS)	238
Basic FMS Components and Operating Principles	239
Basic Operation of a Generic FMS	243
ACARS	245
SELCAL Communications	246
Flight Operational Quality Assurance (FOQA)	246
Controller-Pilot Data-Link Communications	247
Datalinked ATC Clearances	247
Automatic Dependent Surveillance-Broadcast (ADS-B)	249
Electronic Flight Bag (EFB)	250
Installed EFB	250
Portable EFB	250
Levels of Automation	250
Automation Mismanagement	251
Pilot Operations in the Glass Cockpit	252

CHAPTER 14

Hazard Avoidance Systems 253

Weather Avoidance Systems	253
Airborne Weather Radar	253
Doppler Radar	259
Combined Weather Radar and Navigation Displays	260
Electrical Discharge or Lightning Detectors	261
Traffic Alert and Collision Avoidance System (TCAS)	262
Terrain Awareness and Warning Systems	263

Airborne Wind-Shear Detection and Alerting Systems	264
Predictive Wind-Shear Warning System (PWS)	264
Reactive Wind-Shear Warning System (RWS)	265
Predictive Wind-Shear Systems (PWS) versus Reactive Wind-Shear Systems (RWS)	265
Flight Envelope Protection	265

CHAPTER 15

Operational Information 269

Aerodynamics of High-Speed/High-Altitude Aircraft	269
High-Speed Flight and the Sound Barrier	269
Indicated Airspeed, True Airspeed, Mach Number and Changeover Altitudes	269
Swept Wing Aerodynamics	278
Fixed Aerodynamic Surfaces	280
IFR Operations in Turbine Aircraft	282
Profile Descents	282
Jet Routes	282
Altimetry and IFR Cruising Altitudes at Flight Levels	283
Low-Visibility Operations	283
Category I/II/III Approaches	285
Holding	286
Extended Range Twin-Engine Operations (ETOPS)	286
International Flight Operations	287
Strategic Lateral Offset Procedure (SLOP)	288
Wake Turbulence	289
Wing Tip Vortices	289
Identifying Likely Areas of Wake Turbulence	290

CHAPTER 16

Weather Considerations for Turbine Pilots 293

Low-Altitude Weather: Wind Shear and Microbursts	293
Wind Shear	293
Microbursts	294
Effects of Microbursts on Aircraft	294
Avoidance Procedures	295
Low-Level Wind Shear Alerting Systems	296
Recognizing and Responding to Wind Shear	296
Training for Wind Shear Encounters	296

High-Altitude Weather	296
Icing	297
Wind	304
The Jetstream	305
Clear Air Turbulence (CAT)	306
Avoiding CAT	308
Crosswind Operating Techniques	308
Crosswind Takeoff Techniques	308
Crosswind Operating Techniques During Landing	310
Braking Action Reports	312
Braking Action PIREPS	312
Braking Action on Wet and Contaminated Runways	314
Turbulence Avoidance, Considerations and Mitigating Strategies	314
Weather Products Available to Turbine Pilots	316
FAA Flight Service Station	317
Additional FAA-Approved Aviation Weather Sources	317
Other Sources of Weather Information	317

APPENDIX 1

Handy Rules of Thumb for Turbine Pilots	319
--	------------

APPENDIX 2

Airline, Regional, and Business Aircraft Spotter's Guide	325
---	------------

APPENDIX 3

Transport Airplane Performance and Operating Limitations	347
---	------------

GLOSSARY

Airline and Corporate Aviation Terminology	365
---	------------

BIBLIOGRAPHY 373

INDEX 377