

# **INSTRUMENT PROCEDURES HANDBOOK**

**2004**

**U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION  
Flight Procedure Standards Branch**



## PREFACE

The *Instrument Procedures Handbook* is designed as a technical reference for professional pilots who are conducting instrument flight rule (IFR) operations in the National Airspace System (NAS). Certified instrument flight instructors, instrument pilots, and instrument students may find this handbook a valuable training aid since it provides detailed coverage of instrument charts and procedures including IFR takeoff, departure, en route, arrival, approach, and landing. Safety information covering relevant subjects such as runway incursion, land and hold short operations (LAHSO), controlled flight into terrain (CFIT), and human factors issues also are included. Chapter 1 provides an overview of IFR operations in the NAS and highlights system improvement efforts being implemented by the FAA. Pilots, instructors, and flight crewmembers who are seeking only IFR procedural information may choose to begin with Chapter 2 — Takeoffs and Departures. The emphasis of this handbook applies to airplane operations. Guidelines specific to helicopter IFR operations are included in Appendix C – Helicopter Instrument Procedures.

This handbook conforms to pilot training and certification concepts established by the FAA. Where a term is defined in the text, it is shown in blue. Terms and definitions are also located in Appendix D – Glossary. There are different ways of teaching as well as performing instrument flight procedures. The discussion and explanations reflect the most commonly used instrument procedures. 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 pilots of their responsibility imposed by Title 14 of the Code of Federal Regulations (14 CFR).

It is essential for persons using this handbook to also become familiar with and apply the pertinent parts of 14 CFR and the *Aeronautical Information Manual* (AIM). The AIM is available online at <http://www.faa.gov/atpubs>. Performance standards for demonstrating instrument competence required for pilot certification are prescribed in the Instrument Rating and Airline Transport Pilot Practical Test Standards as appropriate.

This handbook introduces advanced information for IFR operations and expands upon information contained in FAA-H-8083-15, *Instrument Flying Handbook*. This publication, as well as several others including the AIM, may be purchased from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402-9325.

The current Flight Standards Service airman training and testing material and subject matter knowledge codes for all airman certificates and ratings can be obtained from the Flight Standards Service web site at <http://av-info.faa.gov>. Additional web sites that provide access to FAA technical references include <http://afs600.faa.gov>. Information regarding the purchase of FAA subscription products such as charts, *Airport/Facility Directory* (A/FD), and other publications can be accessed at <http://www.naco.faa.gov>.

Comments regarding this handbook should be sent to [afs420.iph@faa.gov](mailto:afs420.iph@faa.gov) or U.S. Department of Transportation, Federal Aviation Administration, Flight Procedure Standards Branch, AFS-420, P.O. Box 25082, Oklahoma City, OK 73125.

AC 00-2, *Advisory Circular Checklist*, transmits the current status of FAA advisory circulars and other flight information publications. This checklist is free of charge and may be obtained by sending a request to U.S. Department of Transportation, Subsequent Distribution Office, SVC-121.23, Ardmore East Business Center, 3341 Q 75<sup>th</sup> Avenue, Landover, MD 20785. The checklist is also available on the Internet at <http://www.faa.gov> under Regulatory/Advisory information.

# CONTENTS

## Chapter 1 — IFR Operations in the National Airspace System

Brief History of the National Airspace System .....	.1-2
National Airspace System Plans .....	.1-3
RNAV Plans .....	.1-4
System Safety .....	.1-5
Accident Rates .....	.1-5
Runway Incursion Statistics .....	.1-6
System Capacity .....	.1-6
Takeoffs and Landings .....	.1-6
Air Traffic Control System Command Center .....	.1-7
How the System Components Work Together .....	.1-8
Users .....	.1-8
Airlines .....	.1-8
Corporate and Fractionals .....	.1-9
General Aviation .....	.1-9
Military .....	.1-9
ATC Facilities .....	.1-9
Air Route Traffic Control Center .....	.1-10
Terminal Radar Approach Control .....	.1-10
Control Tower .....	.1-10
Flight Service Stations .....	.1-10
Flight Plans .....	.1-11
Release Time .....	.1-11
Expect Departure Clearance Time .....	.1-11
Managing Safety and Capacity .....	.1-11
System Design .....	.1-11
Application of Area Navigation .....	.1-11
Required Navigation Performance .....	.1-13
Global Positioning System .....	.1-14
GPS-Based Helicopter Operations .....	.1-15
Reduced Vertical Separation Minimums .....	.1-15
FAA Radar Systems .....	.1-15
Airport Surveillance Radar .....	.1-15
Air Route Surveillance Radar .....	.1-16
Precision Runway Monitoring .....	.1-16
Equipment and Avionics .....	.1-17
ATC Radar Equipment .....	.1-17
Automated Radar Terminal System .....	.1-17
Standard Terminal Automation Replacement System .....	.1-18
Precision Approach Radar .....	.1-18
Bright Radar Indicator Terminal Equipment .....	.1-18
Radar Coverage .....	.1-18
Communications .....	.1-18
Data Link .....	.1-19

Mode S .....	1-19
Traffic Alert and Collision Avoidance System .....	1-19
Traffic Information Service .....	1-20
Terrain Awareness and Warning System .....	1-20
Graphical Weather Service .....	1-20
Avionics and Instrumentation .....	1-20
Flight Management System .....	1-20
Electronic Flight Information System .....	1-20
Navigation Systems .....	1-21
Surveillance Systems .....	1-22
Operational Tools .....	1-22
IFR Slots .....	1-22
Ground Delay Program .....	1-23
Flow Control .....	1-23
Land and Hold Short Operations .....	1-24
Surface Movement Guidance and Control System .....	1-24
Expectation of ATC .....	1-25
Disseminating Aeronautical Information .....	1-25
Publication Criteria .....	1-25
Aeronautical Charts .....	1-26
Notice to Airmen .....	1-29
Navigation Databases .....	1-30

## **Chapter 2 — Takeoffs and Departures**

Safety in the Departure Environment .....	2-1
Surface Movement Safety .....	2-1
Airport Sketches and Diagrams .....	2-1
Airport/Facility Directory .....	2-2
Surface Movement Guidance Control System .....	2-2
Airport Signage/Lighting/Markings .....	2-3
Runway Incursions .....	2-3
Runway Hotspots .....	2-3
Standardized Taxi Routes .....	2-4
Runway Safety Program .....	2-5
Take Off Minimums .....	2-6
Takeoff Minimums for Commercial Operators .....	2-8
Operations Specifications .....	2-8
Head-Up Guidance System .....	2-8
Ceiling and Visibility Requirements .....	2-8
Runway Visual Range .....	2-8
Runway Visibility Value .....	2-9
Prevailing Visibility .....	2-9
Tower Visibility .....	2-9
Adequate Visual Reference .....	2-9
Automated Weather Observing Systems and Automated Surface Observing Systems .....	2-9
Automatic Terminal Information Service and Digital ATIS .....	2-10
IFR Alternate Minimums .....	2-11

Alternate Minimums for Commercial Operators .....	.2-12
Departure Procedures .....	.2-12
Design Criteria .....	.2-12
SID Versus DP .....	.2-14
Obstacle Departure Procedures .....	.2-16
Flight Planning Considerations .....	.2-16
Standard Instrument Departures .....	.2-17
Pilot NAV and Vector SIDS .....	.2-17
Flight Planning Considerations .....	.2-22
Procedural Notes .....	.2-22
DP Responsibility .....	.2-22
Procedures Assigned by ATC .....	.2-22
Procedures Not Assigned by ATC .....	.2-24
Departures from Tower-Controlled Airports .....	.2-24
Departures from Airports without an Operating Control Tower .....	.2-24
Ground Communications Outlets .....	.2-25
Obstacle Avoidance .....	.2-25
Climb Gradients and Climb Rates .....	.2-25
See and Avoid Techniques .....	.2-25
Area Navigation Departures .....	.2-25
RNAV Departure Procedures .....	.2-26
Pilot Responsibility for Use of RNAV Departures .....	.2-27
Radar Departure .....	.2-30
Diverse Vector Area .....	.2-31
VFR Departure .....	.2-32
Noise Abatement Procedures .....	.2-32

### **Chapter 3 — En Route Operations**

En Route Navigation .....	.3-1
Air Route Traffic Control Centers .....	.3-1
Preferred IFR Routes .....	.3-3
Substitute En Route Flight Procedures .....	.3-3
Tower En Route Control .....	.3-4
Airway and Route System .....	.3-4
Monitoring of Navigation Facilities .....	.3-4
LF Airways/Routes .....	.3-4
VHF Airways/Routes .....	.3-6
VHF En Route Obstacle Clearance Areas .....	.3-6
Primary Area .....	.3-6
Secondary Area .....	.3-8
NAVAID Service Volume .....	.3-9
Navigational Gaps .....	.3-10
Changeover Points .....	.3-11
IFR En Route Altitudes .....	.3-12
Minimum En Route Altitude .....	.3-12
Minimum Obstruction Clearance Altitude .....	.3-13
Minimum Vectoring Altitudes .....	.3-13

Minimum Reception Altitude .....	.3-13
Minimum Crossing Altitude .....	.3-13
Maximum Authorized Altitude .....	.3-16
IFR Cruising Altitude or Flight Level .....	.3-16
Lowest Usable Flight Level .....	.3-16
Operations in Other Countries .....	.3-17
Reporting Procedures .....	.3-17
Non Radar Position Reports .....	.3-17
Communication Failure .....	.3-18
Climbing and Descending En Route .....	.3-20
Pilot/Controller Expectations .....	.3-20
Aircraft Speed and Altitude .....	.3-23
Holding Procedures .....	.3-23
ATC Holding Instructions .....	.3-24
Maximum Holding Speed .....	.3-25
High Performance Holding .....	.3-26
Fuel State Awareness .....	.3-26
Diversion Procedures .....	.3-26
En Route RNAV Procedures .....	.3-27
Off Airway Routes .....	.3-27
Direct Flights .....	.3-28
Random RNAV Routes .....	.3-28
Off Route Obstacle Clearance Altitude .....	.3-29
Published RNAV Routes .....	.3-31
Composition of Designators .....	.3-32
Use of Designators in Communications .....	.3-32
RNAV Minimum En Route Altitude .....	.3-33
Minimum IFR Altitude .....	.3-33
WayPoints .....	.3-34
User-Defined Waypoints .....	.3-34
Floating Waypoints .....	.3-35
Computer Navigation Fixes .....	.3-36
National Route Program .....	.3-36
Advanced Area Navigation Routes .....	.3-37
IFR Transition Routes .....	.3-37
Required Navigation Performance .....	.3-38
Reduced Vertical Separation Minimums .....	.3-39

## **Chapter 4 — Arrivals**

Transition From En Route .....	.4-1
Top of Descent .....	.4-1
Descent Planning .....	.4-2
Cleared for Approach .....	.4-5
Radar Out of Service .....	.4-5
Present Position Direct .....	.4-5
Radar Vectors to Final Approach Course .....	.4-6
High Performance Airplane Arrivals .....	.4-11

Airspeed .....	.4-11
Controlled Flight into Terrain .....	.4-12
Sterile Cockpit Concept .....	.4-13
Arrival Navigation Concepts .....	.4-14
Standard Terminal Arrival Routes .....	.4-14
Interpreting the STAR .....	.4-16
Vertical Navigation Planning .....	.4-18
Arrival Procedures .....	.4-18
Preparing for the Arrival .....	.4-18
Reviewing the Approach .....	.4-19
Altitude .....	.4-19
RNAV STARS or STAR Transitions .....	.4-21
Special Airport Qualification .....	.4-23

## **Chapter 5 — Approaches**

Approach Planning .....	.5-1
Weather Considerations .....	.5-1
Weather Sources .....	.5-2
Broadcast Weather .....	.5-4
Automatic Terminal Information Service .....	.5-4
Automated Weather Observing Programs .....	.5-4
Center Weather .....	.5-4
Regulatory Requirements .....	.5-4
Part 91 Operators .....	.5-4
Part 135 Operators .....	.5-5
Part 121 Operators .....	.5-5
Performance Considerations .....	.5-5
Airplane Performance Operating Limitations .....	.5-6
Approach Speed and Category .....	.5-7
Operational Considerations .....	.5-7
Approach Chart Formats .....	.5-7
Approach Chart Naming Conventions .....	.5-8
Straight-In Procedures .....	.5-8
Circling Only Procedures .....	.5-8
Area Navigation Approaches .....	.5-10
Communications .....	.5-12
Approach Control .....	.5-12
Air Route Traffic Control Center .....	.5-12
Airports With an Air Traffic Control Tower .....	.5-14
Airports Without an Air Traffic Control Tower .....	.5-14
Primary NAVAID .....	.5-15
Courses .....	.5-15
Area Navigation Courses .....	.5-16
Altitude .....	.5-16
Minimum Safe Altitude .....	.5-16
Final Approach Fix Altitude .....	.5-17
Minimum Descent Altitude, Decision Altitude and Decision Height .....	.5-18

Vertical Navigation . . . . .	5-18
Wide Area Augmentation System . . . . .	5-20
RNAV Approach Authorization . . . . .	5-22
Airport/Runway Information . . . . .	5-24
Instrument Approach Procedure Briefing . . . . .	5-24
Navigation and Communication Radios . . . . .	5-24
Flight Management Systems . . . . .	5-26
Autopilot Modes . . . . .	5-26
Stabilized Approach . . . . .	5-28
Descent Rates and Glidepaths for Nonprecision Approaches . . . . .	5-28
Transition to Visual . . . . .	5-29
Missed Approach . . . . .	5-29
Example Approach Briefing . . . . .	5-33
Instrument Approach Procedure Segments . . . . .	5-35
Feeder Routes . . . . .	5-35
Terminal Routes . . . . .	5-36
DME Arcs . . . . .	5-36
Course Reversal . . . . .	5-37
Initial Approach Segment . . . . .	5-37
Intermediate Approach Segment . . . . .	5-37
Final Approach Segment . . . . .	5-38
Missed Approach Segment . . . . .	5-39
Approach Clearance . . . . .	5-39
Vectors to Final Approach Course . . . . .	5-39
Nonradar Environment . . . . .	5-40
Types of Approaches . . . . .	5-40
Visual and Contact Approaches . . . . .	5-41
Visual Approaches . . . . .	5-41
Contact Approaches . . . . .	5-41
Charted Visual Flight Procedures . . . . .	5-41
RNAV Approaches . . . . .	5-42
Terminal Arrival Areas . . . . .	5-43
RNAV Final Approach Design Criteria . . . . .	5-44
GPS Overlay of Nonprecision Approach . . . . .	5-44
GPS Stand-Alone/RNAV (GPS) Approach . . . . .	5-44
RNAV GPS Approach Using WAAS . . . . .	5-44
ILS Approaches . . . . .	5-46
ILS Approach Categories . . . . .	5-48
Category II and III Approaches . . . . .	5-48
ILS Approaches to Parallel Runways . . . . .	5-49
Parallel . . . . .	5-49
Simultaneous . . . . .	5-50
Precision Runway Monitor . . . . .	5-50
Converging . . . . .	5-52
Microwave Landing System . . . . .	5-52
VOR Approach . . . . .	5-54

NDB Approach .....	.5-57
Radar Approaches .....	.5-61
Precision Approach Radar .....	.5-61
Airport Surveillance Radar .....	.5-61
Localizer Approaches .....	.5-62
Localizer and Localizer DME .....	.5-62
Localizer Back Course .....	.5-65
Localizer-Type Directional Aid .....	.5-66
Simplified Directional Facility .....	.5-67

## **Chapter 6 — System Improvement Plans**

Fleet Improvement .....	.6-1
Electronic Flight Bag .....	.6-2
Increasing Capacity and Safety .....	.6-4
Increasing the Departure/Arrival Rate .....	.6-4
More Runways .....	.6-5
Surface Traffic Management .....	.6-5
Terminal Airspace Redesign .....	.6-5
Separation Standards .....	.6-7
Maintaining Runway Use in Reduced Visibility .....	.6-7
LAAS and WAAS Implementation .....	.6-7
Precision Runway Monitor .....	.6-7
Offset Final Approach Path .....	.6-7
Reducing En Route Congestion .....	.6-8
Matching Airspace Design to Demands .....	.6-8
Reducing Voice Communication .....	.6-9
Aircraft Communications Addressing and Reporting System .....	.6-9
Automatic Dependent Surveillance-Broadcast .....	.6-10
Mode S Extended Squitter .....	.6-10
Reducing Vertical Separation .....	.6-10
Reducing Horizontal Separation .....	.6-10
Direct Routing .....	.6-11
Accommodating User Preferred Routing .....	.6-12
Improving Access to Special Use Airspace .....	.6-12
Handling En Route Severe Weather .....	.6-13
Developing Technology .....	.6-13

## **Appendix A — Airborne Navigation Databases**

Evolution of Airborne Navigation Databases .....	.A-1
History .....	.A-1
Database Capabilities .....	.A-2
Production and Distribution .....	.A-2
The Role of the Database Provider .....	.A-2
The Role of the Avionics Manufacturer .....	.A-2
Users Role .....	.A-3
Composition of Airborne Navigation Databases .....	.A-4
The WGS-84 Reference Datum .....	.A-4
ARINC 424 .....	.A-4

Records .....	A-4
Fix Records .....	A-5
Simple Route Records .....	A-6
Complex Route Records .....	A-6
Miscellaneous Records .....	A-6
The Path/Terminator Concept .....	A-7
Operational Limitations of Airborne Navigation Databases .....	A-7
Reliance on Navigation Automation .....	A-8
Storage Limitations .....	A-10
Path/Terminator Limitations .....	A-10
Charting/Database Inconsistencies .....	A-10
Naming Conventions .....	A-10
Issues Related to Magnetic Variation .....	A-12
Issues Related to Revision Cycle .....	A-13
Evolution of RNAV .....	A-13
<b>Appendix B — Approach Chart Format Changes</b>	
Changing Formats .....	B-1
Differences Between the Formats .....	B-1
Features of the Pilot Briefing Information Chart Format .....	B-5
<b>Appendix C — Helicopter Instrument Procedures</b> .....	
Helicopter IFR Certification .....	C-1
Flight and Navigation Equipment .....	C-1
Miscellaneous Requirements .....	C-1
Stability .....	C-1
Rotorcraft Flight Manual Limitations .....	C-2
Operations Specifications .....	C-3
Minimum Equipment List .....	C-4
Pilot Proficiency .....	C-4
Helicopter VFR Minimums .....	C-5
Helicopter Takeoff Minimums .....	C-5
Helicopter IFR Alternates .....	C-6
Part 91 Operators .....	C-6
Part 135 Operators .....	C-6
Helicopter Instrument Approaches .....	C-6
Standard Instrument Approach Procedures to an Airport .....	C-6
Copter Only Approaches to an Airport or Heliport .....	C-7
Copter GPS Approaches to an Airport or Heliport .....	C-8
Special Approaches .....	C-11
Copter Approach to an IFR Heliport .....	C-12
<b>Appendix D – Acronyms and Glossary</b> .....	
Index .....	I-1

