Instrument Quick Reference V1

Compiled from FAR/AIM, and other reliable resources

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Contents

1 Regulations and Requirements

1.1 Instrument Rating Requirements (FAR §61.65)

- **PIC Time:** 50 hours cross-country PIC time (10 hours in an aircraft).
- **Instrument Time:** 40 hours actual or simulated instrument time.
  - 15 hours with a CFII.
  - One cross-country flight, including:
    - 250 NM distance, along airways/directed routing.
    - An instrument approach at each airport.
    - 3 different types of approaches.
    - Using a filed IFR flight plan.
  - 3 hours in the last 2 calendar months before the checkride.

1.2 Safety Pilot Requirements

- Must possess a Private Pilot certificate (or higher) with ratings for the **same category and class** of aircraft.
- Must have a current medical certificate.
- Adequate vision forward and to each side.
- Aircraft must have a dual-control system.

2 Equipment and Preflight

2.1 Documents Required on Board (ARROW)

- **A** - Airworthiness Certificate
- **R** - Registration Certificate
- **R** - Radio License (if international)
- **O** - Operating Handbook (POH)
- **W** - Weight and Balance Data

2.2 IFR Required Equipment (GRAB CARD)

- **G** - Generator/Alternator
- **R** - Radios (for navigation and communication)
- **A** - Attitude indicator
- **B** - Ball (slip/skid indicator)
- **C** - Clock (with sweep second hand or digital equivalent)
- **A** - Adjustable Altimeter (sensitive altimeter)
- **R** - Rate of turn indicator
- **D** - Directional gyro (Heading indicator)

2.3 Preflight Information Required (RAW FAT)

- **R** - Runway lengths
- **A** - Alternates available
- **W** - Weather reports and forecasts
- **F** - Fuel requirements
- **A** - ATC delays/Traffic advisories
- **T** - Takeoff and landing distance data

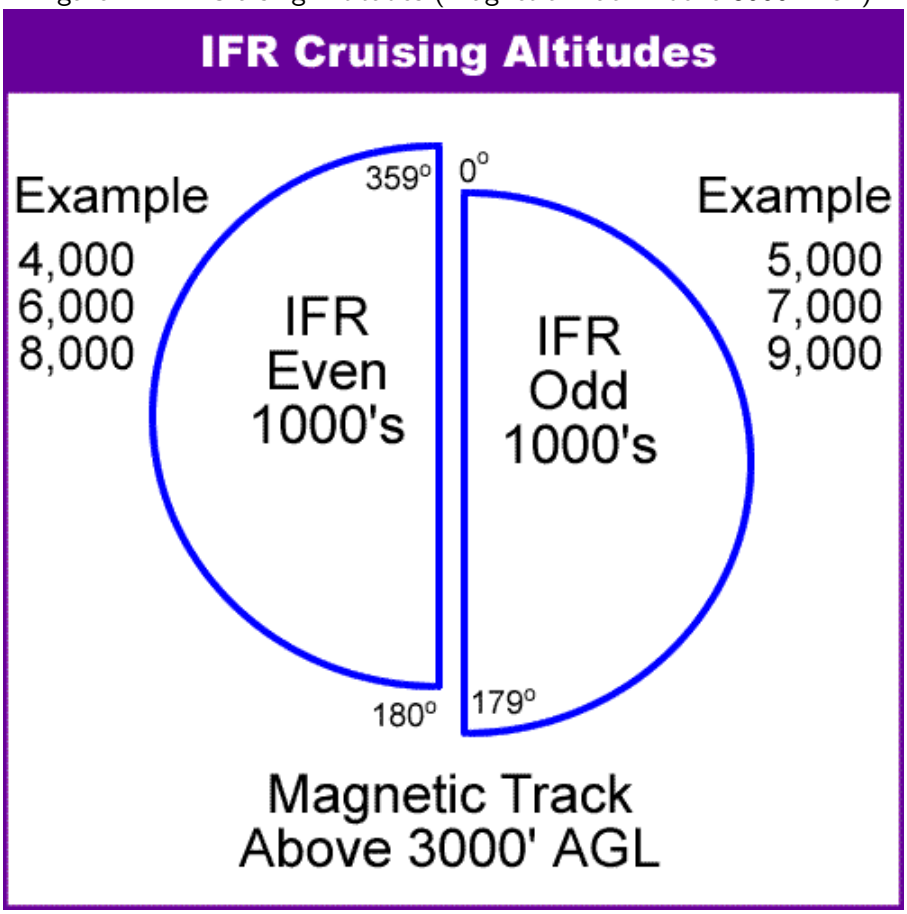
2.4 Alternate and Fuel Requirements (FAR §91.167 & §91.169)

- **Fuel:** Enough fuel to reach the destination, then the alternate (if required), plus **45 minutes** reserve at normal cruise.
- **Alternate Required:** If the destination airport's forecast weather ± 1 hour of ETA is less than:
  - $2000\,\text{ft}$ ceiling
  - 3 SM visibility

3 IFR Operations, Clearances, and Procedures

3.1 IFR Cruising Altitudes (FAR §91.179)

Figure 1: IFR Cruising Altitudes (Magnetic Track Above 3000' AGL)



3.2 Descent Planning and Approach Rules

- **Descent Planning (3:1 Rule):** For a 3° glideslope, multiply the altitude to lose (in thousands of feet) by 3 to get the distance (NM) to start descent.
- **Descent Planning (300-to-1 Rule):** To calculate when to start your descent, divide the altitude you need to lose (in feet) by 300. This is the distance in NM.
- **Descent Rate (FPM):** To find the approximate vertical speed needed for a 3° glideslope, use the rule: Airspeed (KIAS) $\times 5$ (or Airspeed/2, then add a zero).

$$\text{VS (FPM)} \approx \text{KIAS} \times 5$$

- *Example: At* 120 *KIAS, target VS is* $120 \times 5 = 600$ *FPM.*
- **Go-Around Criteria:** Initiate a missed approach if you are not on the correct glideslope, airspeed, or runway alignment at **200 feet above the ground**.
- **ILS Dot Deflection:** When on final approach, a half-dot localizer deflection corresponds to approximately half the runway width at the threshold.

3.3 General Navigational and Turn Rules

- **The 1 in 60 Rule:** A 1-degree error in heading or track will cause you to be off course by 1 nautical mile for every 60 miles flown.
- **Crosswind Estimation:** For a quick estimate of the crosswind component:
  - 60 degrees off: Crosswind is equal to the total wind speed.
  - 45 degrees off: Crosswind is approximately 75% of the total wind speed.
  - 30 degrees off: Crosswind is approximately 50% of the total wind speed.
- **Standard Rate Turn:** Requires a bank angle of approximately 15 degrees for a 3-degree per second turn.
- **Leveling Off:** Lead the level-off by 50 feet to avoid overshooting your target altitude.

3.4 Magnetic Compass Errors

- **Variation:** Difference between True North and Magnetic North.
- **Deviation:** Error caused by aircraft magnetism (electronics, metal parts).
- **Oscillation:** Erratic movement during turbulence.
- **Acceleration Error (ANDS - Northern Hemisphere):**
  - **A**ccelerate $\rightarrow$ **N**orth
  - **D**ecelerate $\rightarrow$ **S**outh
- **Turning Error (UNOS - Northern Hemisphere):**
  - **U**ndershoot $\rightarrow$ **N**orth
  - **O**vershoot $\rightarrow$ **S**outh

3.5 Other Important Reminders

- **Command Authority:** Maintain control of the aircraft and the flight at all times.
- **Stay Ahead of the Aircraft:** Don't just react; anticipate and plan your next actions.
- **Fuel Planning:** Ensure your fuel will be sufficient for the entire flight, including reserves, before departure.

3.6 IFR Position Report (IPTAFNNR)

Use when not in radar contact.

- **I** - Aircraft **I**D
- **P** - **P**osition (Name of facility, fix, or point)
- **T** - **T**ime (minutes past the hour)
- **A** - **A**ltitude (or flight level)
- **F** - **F**light type (IFR/VFR)
- **N** - **N**ext report's place and time
- **N** - **N**ext next report (optional)
- **R** - **R**emarks

3.7 Flight Clearance (CRAFTS)

- **C** - **C**learance Limit
- **R** - **R**outing
- **A** - **A**ltitude
- **F** - **F**requency (departure, etc.)
- **T** - **T**ransponder Code (Squawk)
- **S** - **S**pecial Instructions

4 Control and Performance

4.1 Primary/Secondary Instruments (Control and Performance)

The designation (Primary/Secondary) changes based on the maneuver being performed (e.g., during a constant airspeed climb, the Airspeed Indicator is Primary for Pitch).

Table 1: Basic Control and Performance Instrument Scan

Control Input	Primary (P)	Secondary (S)	Control Instrument
Pitch	Attitude Indicator	Altimeter / VSI	Yoke (Elevator)
Bank	Attitude Indicator	Heading / Turn Coordinator	Yoke (Aileron)
Power	Tachometer/MP	Airspeed Indicator	Throttle

Figure 2: Detailed Primary/Supporting Instruments for Maneuvers

Maneuver	Primary			Supporting		
	Pitch	Bank	Power	Pitch	Bank	Power
Straight and Level	Altimeter	Heading Indicator	Airspeed Indicator	Vertical Speed Indicator, Attitude Indicator	Turn Coordinator Attitude Indicator	Tach or MP
Standard-Rate Turn Establishing	Altimeter	Attitude Indicator then Turn Coordinator	Airspeed Indicator	Attitude Indicator Vertical Speed Indicator	Turn Coordinator, Attitude Indicator	Tach or MP
Standard-Rate Turn Turning	Altimeter	Turn Coordinator	Airspeed Indicator	Vertical Speed Indicator Attitude Indicator	Turn Coordinator, Attitude Indicator	Tach or MP
Constant Speed Climb or Descent **Entry**	Attitude Indicator	Heading Indicator	Tach or MP	Vertical Speed Indicator	Turn Coordinator Attitude Indicator	Airspeed Indicator
Constant Speed Climb or Descent **Stabilized**	Airspeed Indicator	Heading Indicator	Tach or MP	Vertical Speed Indicator	Turn Coordinator Attitude Indicator	Airspeed Indicator
Constant Rate Climb or Descent **Entry**	Attitude Indicator	Heading Indicator	Tach or MP	Vertical Speed Indicator	Turn Coordinator Attitude Indicator	Airspeed Indicator
Constant Rate Climb or Descent **Stabilized**	Vertical Speed Indicator	Heading Indicator	Airspeed Indicator	Attitude Indicator	Turn Coordinator Attitude Indicator	Tach or MP
Changing Airspeed In Turns	Altimeter	Turn Coordinator	Tach or MP, then Airspeed Indicator	Vertical Speed Indicator, Attitude Indicator	Attitude Indicator	

5 Weather Concepts and Calculation

5.1 IFR Weather Conditions

- **MVFR (Marginal VFR):** Ceiling $\mathbf{1,000}$ to $\mathbf{3,000}$ ft AGL, Visibility **3** to **5** SM.
- **IFR (Instrument Flight Rules):** Ceiling $< \mathbf{1,000}$ ft AGL **and/or** Visibility $<$ **3** SM.

5.2 Cloud Base Computation (Estimate)

- **Formula:**
$$\text{Cloud Base (AGL)} = \frac{\text{Temp} - \text{Dew Point}}{4.4} \times 1,000 \text{ ft}$$
- **Convergence Rate (CR):** $4.4°$F per $1,000$ feet. (Unsaturated air cools at $5.4°$F per $1,000'$, Dew point decreases at $1°$F per $1,000'$)
- *Example:* $85°F$ *Temp,* $71°F$ *Dew Point* $\rightarrow (85 - 71)/4.4 \times 1,000 = 3,180$ *ft AGL.*

5.3 Common Conversion Formulas

- **Knots to Miles Per Hour (MPH):**
$$\text{MPH} \approx \text{Knots} \times 1.15$$
Fahrenheit to Celsius:
$$°\text{C} = (°\text{F} - 32) \times \frac{5}{9}$$
- **UTC Time Conversion:** Universal Coordinated Time (ZULU) is often required for official flight documentation and weather. Local time conversion will depend on the timezone (e.g., Pacific Standard Time (PST) is UTC-8).

5.4 Basic VFR Weather Minimums (FAR §91.155)

Table 2: VFR Weather Minimums

Airspace	Flight Visibility	Distance From Clouds
Class B	3 SM	Clear of Clouds
Class C/D	3 SM	$1,000'$ Above, $500'$ Below, $2,000'$ Horizontal (**152**)
Class E ($< 10,000'$ MSL)	3 SM	**152**
Class E ($\geq 10,000'$ MSL)	5 SM	$1,000'$ Above, $1,000'$ Below, 1 SM Horizontal (**111**)
Class G (Day, $\leq 1,200'$ AGL)	1 SM	Clear of Clouds
Class G (Night, $\leq 1,200'$ AGL)	3 SM	**152**

6 Physiological Factors

6.1 Oxygen Requirements (FAR §91.211)

Table 3: Supplemental Oxygen Requirements

Altitude	Requirement
$12,501'$ to $14,000'$	Crew must use supplemental O_2 for periods of flight **over 30 minutes**.
$14,000'$ to $15,000'$	Crew must use supplemental O_2 for **entire flight time** at these altitudes.
$\geq 15,000'$	**Each occupant** must be provided with supplemental O_2.

6.2 Hypoxia Types

- **Hypoxic Hypoxia:** Insufficient oxygen in the air (e.g., high altitude).
- **Hypemic Hypoxia:** Blood unable to carry sufficient oxygen (e.g., carbon monoxide poisoning).
- **Histotoxic Hypoxia:** Body tissues unable to use oxygen (e.g., alcohol/drugs).
- **Stagnant Hypoxia:** Blood not flowing to a body tissue (e.g., excessive G-force, shock).

6.3 Hyperventilation

- Excessive CO_2 is eliminated due to breathing too rapidly.
- Symptoms are similar to hypoxia.
- Recovery aids: Breathing into a paper bag or talking aloud.

7 IFR Currency Summary

7.1 The 6-6-HITS Rule (FAR §61.57(c))

To act as pilot in command (PIC) under IFR, or in weather conditions less than the minimums for VFR, a pilot must meet the recent flight experience requirements defined in 14 CFR 61.57(c). This is often remembered as "6-6-HITS":

- **6** calendar months preceding the month of the flight, the pilot must have performed:
- **6** instrument approaches.
- **H**olding procedures and tasks.
- **I**ntercepting and **T**racking courses through the use of navigational electronic systems.

7.2 Grace Period and IPC

- **Grace Period:** An additional six months is granted. To become current again within this second 6-month period, the pilot must complete the requirements with a safety pilot, flight instructor, or examiner.
- **IPC:** Instrument Proficiency Check required if currency lapses beyond the 12-month period. The IPC must be administered by an authorized instructor or examiner.

8 The Six T's Mnemonic

The "Six T's" is a mnemonic used by IFR pilots to establish a standardized mental flow when reaching a holding fix, non-holding fix, or making a turn on an approach or en-route clearance. It is commonly used for managing holding patterns and other tasks. The sequence helps the pilot stay ahead of the aircraft by completing necessary tasks in an orderly fashion.

- **T**urn: Turn to the correct heading (e.g., holding entry, course intercept).
- **T**ime: Time the legs of the hold or approach segment.
- **T**wist: Twist the OBS to the new course or set the navigation display.
- **T**hrottle: Throttle back to holding or approach speed.
- **T**alk: Talk to ATC if required (e.g., report time and altitude over a fix).
- **T**rack: Track your progress and make corrections as needed.

9 Instrument Approach Types

Instrument approach procedures are broadly categorized by the guidance they provide:

1. **Precision Approach (PA)**: Provides both lateral (course) and electronic vertical (glidepath/glideslope) guidance. The decision height (**DH**) or decision altitude (**DA**) is used as the minimum altitude.
2. **Non-Precision Approach (NPA)**: Provides only lateral guidance. A minimum descent altitude (**MDA**) is used as the minimum altitude.
3. **Approach with Vertical Guidance (APV)**: Provides both lateral and vertical guidance but does not meet the ICAO/FAA precision approach standards. LPV and LNAV/VNAV are classified as APVs, and they use a DA.

9.1 Common Approach Types

- **ILS (Instrument Landing System)**: The most common and accurate PA, using ground-based radio beacons for localizer (lateral) and glideslope (vertical) guidance.
- **VOR (VHF Omnidirectional Range)**: An NPA using ground-based VOR signals to track a radial to the airport.
- **NDB (Non-Directional Beacon)**: An older NPA using a low-frequency radio beacon.
- **LOC (Localizer)**: An NPA utilizing only the localizer component of an ILS (e.g., when the glideslope is out of service).
- **RNAV (Area Navigation)**: A set of approaches based on GPS (GNSS) or FMS (Flight Management System) capability.
  - **LNAV (Lateral Navigation)**: The basic RNAV NPA, providing lateral guidance only. It is flown to an **MDA**.
  - **LP (Localizer Performance)**: An NPA that uses WAAS for highly accurate lateral guidance. It is flown to an **MDA**.
  - **LPV (Localizer Performance with Vertical Guidance)**: An APV that is functionally very similar to an ILS, using WAAS for high-precision lateral and vertical guidance. It is flown to a **DA**.
  - **LNAV/VNAV (Lateral Navigation/Vertical Navigation)**: An APV providing lateral guidance and approved vertical guidance, often from WAAS or barometric VNAV (Baro-VNAV). It is flown to a **DA**, but usually has higher minimums than LPV.
- **LDAP (Localizer Type Directional Aid with Glideslope)**: An approach similar to a Localizer, but the course may be offset from the runway centerline. If a glideslope is provided, it is classified as an APV.

10 Reading Instrument Approach Plates

An Instrument Approach Procedure (**IAP**) chart, or "plate," is the pilot's detailed roadmap for executing an approach into an airport. It is typically divided into four primary sections:

1. **Briefing Strip (Header)**: Contains critical, quick-reference data.
    - **Frequencies**: Lists all communication and navigation frequencies in the likely order of use (e.g., **ATIS**, Approach, Tower, Ground).
    - **Notes**: Important restrictions, limitations, or required equipment. Symbols like the "A in a triangle" (**Non-Standard Alternate Minimums**) or "T in a triangle" (**Non-Standard Takeoff Minimums**) are found here.
    - **Missed Approach Text**: A concise textual description of the missed approach procedure.
2. **Plan View**: A top-down, bird's-eye map of the procedure.
    - **Approach Course**: The course and navigation source for the final segment.
    - **IAFs and Feeder Routes**: Shows the Initial Approach Fixes (**IAF**) and the routes that lead to the intermediate segment.
    - **Minimum Safe/Sector Altitudes (MSA)**: Provides obstacle clearance within a specific radius (usually 25 NM) of a primary NAVAID for emergency use.
    - **Obstacles and Terrain**: Depicts high terrain and obstacles with their maximum Mean Sea Level (**MSL**) elevation.
3. **Profile View**: A side view that details the vertical path of the approach.
    - **Final Approach Fix (FAF)**: The point where the final approach segment begins.
    - For Precision Approaches (**PA**), it is depicted by a lightning bolt symbol.
    - For Non-Precision Approaches (**NPA**), it is a Maltese cross symbol.
    - **Altitudes**: Altitudes at fixes are shown with specific notations:
        - **Underscore** (e.g., $\underline{3000}$): Fly **at or above** this altitude (*No Lower Than*).
        - **Overscore** (e.g., $\overline{4000}$): Fly **at or below** this altitude (*No Higher Than*).
        - **Both** (e.g., $\overline{\underline{3500}}$): A **mandatory** altitude (*Must Maintain*).
    - **Visual Descent Point (VDP)**: Chaired as a bold 'V', this is a point on a non-precision approach from which a normal descent to the runway is possible if the runway environment is in sight.
    - **Missed Approach Point (MAP)**: The point where the missed approach procedure must be initiated if the runway environment is not in sight.
4. **Minimums Section**: Lists the lowest authorized altitudes and visibilities for the approach, broken down by Aircraft Approach Category (**A**, **B**, **C**, **D**).
    - **DA/DH**: Decision Altitude/Height for PA and APV procedures (e.g., ILS, LPV, LNAV/VNAV).
    - **MDA**: Minimum Descent Altitude for NPA procedures (e.g., LNAV, VOR, LOC).
    - **Visibility**: Required flight visibility, usually in Statute Miles (**SM**) or Runway Visual Range (**RVR**).

11 Common Acronyms and Mnemonics

Table 4: Essential Instrument Acronyms

Acronym	Meaning
ATC	Air Traffic Control
METAR	Meteorological Aerodrome Report
TAF	Terminal Aerodrome Forecast
NOTAM	Notice to Air Missions
ILS	Instrument Landing System
RVR	Runway Visual Range
RVV	Runway Visibility Value
IMC	Instrument Meteorological Conditions
DME	Distance Measuring Equipment
VOR	VHF Omnidirectional Range
GPS	Global Positioning System
VDP	Visual Descent Point
FAF	Final Approach Fix