

Area of Operation **VI** - Task **E**

Constant Rate of Climb and Descent (Instrument)

Content

1. Introduction
2. Instruments Overview
3. Learning Method: Control & Performance
4. Learning Method: Primary & Supporting
5. General Procedure
6. Crosscheck and Interpretation
7. Constant Rate Climb
8. Constant Rate Descent
9. Partial Panel (Descent)
10. Common Errors



Key References:

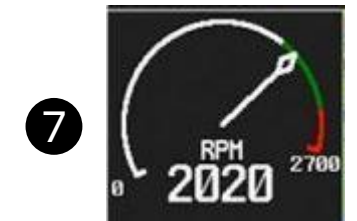
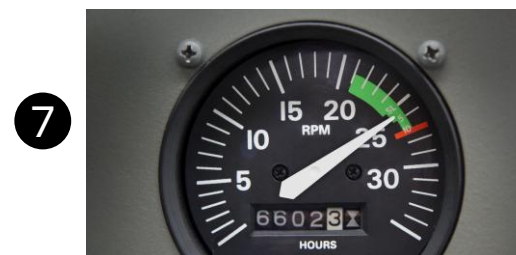
- Instrument Flying Handbook

1. Introduction

- **What:** Attitude instrument flying is the control of an aircraft's spatial position by using instruments rather than outside visual references
- **Why:** Attitude instrument flying is the basis for flying under IMC
- **Attitude Instrument Flying:**
 - **Your Senses Cannot be Trusted** → human perception is misleading without visual references
 - **Do not fly VFR into IMC** → If it happens, you should make an 180° turn and return to visual conditions
 - **Trust your Instruments** if no visual conditions
- **Standard (ACS):**
 - ➔ ○ Altitude **±100ft**, Heading **±10°**, Airspeed **±10 kts**, Bank **±5°**



2. Instruments Overview



3. Learning Method: Control & Performance

Attitude + Power → Drives Performance

1. Control

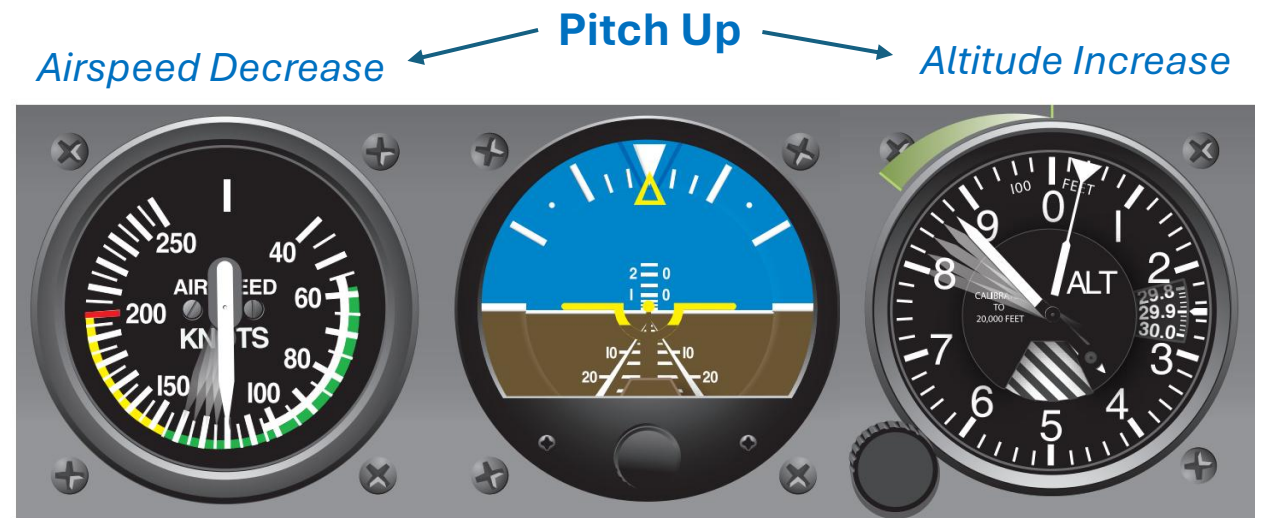
- Attitude Indicator (Pitch + Bank)
- Power Indicator (Tachometer/Manifold)

2. Performance

- Airspeed Indicator
- Altimeter
- Vertical Speed Indicator
- Heading Indicator
- Turn Coordinator

3. Navigation

- Course, Range, Glide Slope → GPS, VOR, DME, ILS



4. Learning Method: Primary & Supporting

- **Primary Instrument** → the one that gives **the most pertinent information** for a particular maneuver
 - **Pitch:** Attitude Indicator, Altimeter, Airspeed Indicator, Vertical Speed Indicator
 - **Bank:** Attitude Indicator, Heading Indicator, Turn Coordinator
 - **Power:** Airspeed Indicator, Tachometer
- Primary and Supporting instruments changes depending on the maneuver

Maneuver		Pitch		Bank		Power	
		Primary	Supporting	Primary	Supporting	Primary	Supporting
Straight and Level	Adjusting Speed	Alt	Attitude, VSI	Heading	Attitude, TC	Tachometer	Airspeed
	Maintain					Airspeed	Tachometer
Climbs/Descent	Entry	Attitude	Airspeed, Alt, VSI	Heading	Attitude, TC	Tachometer	
	Maintain Speed	Airspeed					
	Maintain Rate	VSI	Air, Att, Alt				
Turns	Entry	Alt	Attitude, VSI	Attitude	TC, Heading	Airspeed	Tachometer
	Maintain			TC	Attitude, Hdg		

5. General Procedure

1. Establish

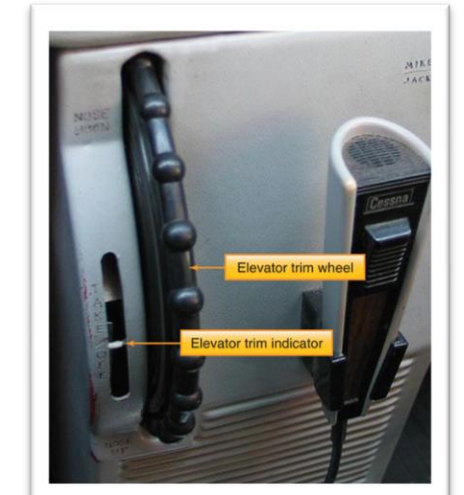
- Attitude Indicator for **Pitch + Bank**
- Throttle for **Power**

2. Trim

- Trim until control pressures are neutralized
- Do not attempt to control pitch using trim, use yoke first, then add Trim to release pressure

3. Crosscheck & Adjust

- Crosscheck the performance instruments to determine if the desired performance is being obtained
- Repeat/correct it until almost no control inputs are needed
 - ✓ Restrict pitch changes to 1 bar or ½ bar width movements
 - ✓ Use a bank angle that approximates the degrees to turn, not to exceed 30°



6. Crosscheck and Interpretation

- **Crosscheck:** Continuous logical observation of instruments for attitude and performance information
 - Most popular: “Select Radial Crosscheck” → **Attitude indicator** is the **Hub** and is checked before each instrument
- **Interpretation:** Based on what you see, understand what is happening w/ the aircraft and take proper actions



Glass Cockpit



Classic 6-Pack

7. Constant Rate Climb

- 1 Apply desired **power** (full power) and adjust the airplane **attitude** (nose up $\sim 10^\circ$). Right Rudder (left turning tendencies)
- 2 Verify performance instruments (scan all). **Primary** instruments will mostly be used to **Maintain Climb**

Establish

- Per above

Trim

Maintain Pitch

- Pitch = Nose Up
- Altitude = Climbing
- VSI = Positive (desired rate)
- Airspeed = Constant Climb

Maintain Bank

- Bank = Wings level (*)
- Heading = Constant (*)
- TC = Coordinated

Cross check & Adjust

Level Off

- Lead the altitude by 10% of VSI



(*) = Or desired bank / heading changing to the desired direction

8. Constant Rate Descent

- 1 Reduce **power** (desired performance), when desired airspeed adjust the airplane **attitude** (about 3° nose down)
- 2 Verify performance instruments (scan all). **Primary** instruments will mostly be used to **Maintain Descent**

Establish

- Per above

Trim

Maintain Pitch

- Pitch = Nose Down
- Altitude = Descending
- VSI = Negative (desired rate)
- Airspeed = Constant Descent

Maintain Bank

- Bank = Wings level (*)
- Heading = Constant (*)
- TC = Coordinated

Cross check & Adjust

Level Off

- Lead altitude by 50ft (if 500fpm) to level off at descent speed



(*) = Or desired bank / heading changing to the desired direction

9. Partial Panel

Loss of Gyroscopic / AHRS Instruments

- Still have Altimeter, Airspeed Ind, Turn Coordinator (maybe), VSI and Magnetic Compass

If backup available, use backup, otherwise:

- **Same as normal, except**
 - No Attitude Indicator
 - Replace Heading with the Compass
 - Use gentle pressures
 - Wait for results as VSI lags



10. Common Errors

1. Errors during instrument cross-check
 - **Fixation:** staring at a single instrument
 - **Omission:** skipping an instrument from the crosscheck (e.g. slip/skid indicator)
 - **Emphasis:** spending more time in a single instrument (bias towards a specific instrument)
2. Improper instrument interpretation
3. Improper control applications
4. Failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections
5. Improper entry or level-off procedure
6. Faulty trim procedure

Appendix: Constant Rate Climb – G1000

Objective: Maintain a specific rate of climb on the VSI, while controlling airspeed

- Generally used for short climbs, within 1,000' of your altitude

Procedure

- Set the approximate pitch/bank attitude
- Advance power
- Pitch up until desired VS is achieved
- When VS stabilizes, fine tune the climb rate
 - Low VS: Increase back pressure
 - High VS: Reduce back pressure
 - *Remember VSI lags... don't chase it*
- Adjust power for Airspeed then Trim
- Level off when altitude at 10% of VSI
 - *Decrease power, pitch down, VSI to zero*



Figure 7-65. Constant rate climbs.

Appendix: Constant Rate Descent – G1000

Objective: Maintain a specific rate of descent on the VSI, while controlling airspeed

- Particularly important for a stable approach

Procedure

- Set the approximate pitch/bank attitude
- Reduce power
- Pitch down until desired VS is achieved
- When VS stabilizes, fine tune descent rate
 - Low VS: Reduce back pressure
 - High VS: Increase back pressure
 - *Remember VSI lags... don't chase it*
- Adjust power for Airspeed then Trim
- Level off when altitude at 10% of VSI
 - *Increase power, pitch up, VSI moves to zero*



Figure 7-65. Constant rate climbs.

Questions?

