

VI.A-E. Basic Attitude Instrument Flight – Control & Performance

References: [Instrument Flying Handbook](#) (FAA-H-8083-15)

Objectives	The student should develop knowledge of the elements related to basic attitude instrument flight and have the ability to smoothly and steadily control the airplane without the use of outside references. The student will be able to perform this as required in the PTS / ACS.
Key Elements	<ol style="list-style-type: none">1. Pitch + Power = Performance2. Trim3. Crosscheck4. Adjust
Elements	<ol style="list-style-type: none">1. Control and Performance2. Establish3. Trim4. Crosscheck5. Adjust6. Straight-and-Level Flight7. Constant Airspeed Climbs8. Constant Airspeed Descents9. Constant Rate Climbs10. Constant Rate Descents11. Turns to Headings
Schedule	<ol style="list-style-type: none">1. Discuss Objectives2. Review material3. Development4. Conclusion
Equipment	<ol style="list-style-type: none">1. White board and markers2. References
IP's Actions	<ol style="list-style-type: none">1. Discuss lesson objectives2. Present Lecture3. Ask and Answer Questions4. Assign homework
SP's Actions	<ol style="list-style-type: none">1. Participate in discussion2. Take notes3. Ask and respond to questions
Completion Standards	The student can smoothly and steadily control the airplane by reference to the instruments only. He or she will be able to establish and maintain a thorough crosscheck and make the required adjustments to the flight attitude.

Instructors Notes:

Introduction:

Attention

Interesting fact or attention-grabbing story

Overview

Review Objectives and Elements/Key ideas

What

Attitude instrument flying may be defined as the control of an aircraft's spatial position by using instruments rather than outside visual references.

Why

Flying without visual reference is dependent on the instruments. Your ability to fly IFR will depend on this.

Note

This lesson focuses on Basic Attitude Instrument Flight and the **Control and Performance method**. It combines the PTS tasks required in section VI.A-E into a single lesson. Each lesson is then broken down individually, while focusing specifically on the PTS requirements and the Primary and Supporting Method.

How:

1. Control and Performance

- A. Performance is achieved by controlling attitude and power
 - i. Pitch + Power = Performance
- B. The three general categories of instruments are control, performance, and navigation instruments
 - i. Control – Used to set Pitch and Power (Attitude indicator and power indicators)
 - a. Display immediate attitude and power indications and permit precise adjustments
 - ii. Performance – Indicate the aircraft's actual performance
 - a. Determined by the Altimeter, Airspeed Indicator, VSI, Heading Indicator, Turn Coordinator
 - iii. Navigation - Indicate position in relation to a selected navigation facility or fix
 - a. Determined by course indicators, range indicators, glide-slope indicators and bearing pointers
- C. Procedural Steps
 - i. *Establish* - attitude / power setting on the control instruments to obtain the desired performance
 - a. Known or computed attitude changes and approximate power settings can reduce workload
 - ii. *Trim* - until control pressures are neutralized.
 - a. Trimming is essential for smooth, precise control and allows attention to be diverted elsewhere
 - iii. *Crosscheck* –performance instruments to determine if the desired performance is being obtained
 - a. If a deviation is noted, determine the correction necessary

- iv. *Adjust* – the attitude and/or power settings on the control instruments as necessary
- 2. Establish**
 - A. The control instruments are used to establish the necessary pitch, bank attitude, and power
 - i. Set the approximate pitch, bank, and power settings for the desired performance
 - B. Pitch and Bank Control
 - i. Accomplished using the Attitude Indicator
 - a. Provides an immediate, direct, and corresponding indication of any change in pitch or bank
 - b. Set the approximate pitch and bank required, and then fine tune
 - ii. Pitch attitude is changed by precise amounts in relation to the horizon
 - iii. Bank attitude is changed by precise amounts in relation to the bank scale
 - iv. **Common Error** – Applying control inputs without reference to the Attitude Indicator
 - C. Power Control
 - i. Accomplished with throttle adjustments and reference to the power indicators
 - ii. Set the approximate throttle position, check the indicator(s), and then fine tune the setting
 - a. Don't fixate on the indicator(s) while setting the power
 - b. Once set, little attention is necessary to ensure the power setting remains constant
- 3. Trim**
 - A. Trim the plane for hands off flight
 - i. Trim to relieve control pressures - once close, fine tune with small trim changes
 - B. **Common Error** – Faulty Trim Procedures
 - i. Not trimming at all, or over/under controlling with trim
 - ii. Trim should be used to relieve control pressures, not to fly the airplane
- 4. Crosscheck**
 - A. The continuous and logical observation of instruments for attitude and performance information
 - B. It is impossible to establish an attitude and have performance remain constant for a long period of time
 - i. Necessary to constantly monitor the instruments and make appropriate changes
 - C. Different Crosschecks
 - i. Select Radial Crosscheck (Most common crosscheck. Based off the Attitude Indicator)
 - a. Scan an instrument, return to the attitude indicator, scan the next instrument, return to the attitude indicator, scan the next instrument, etc.
 - b. The only crosscheck discussed in the Instrument Flying Handbook for glass cockpit displays



- ii. Inverted V Crosscheck (shown to the right)
 - a. Eyes move from the Attitude Indicator to the Turn Coordinator, up to the Attitude Indicator, to the VSI, and back to the Attitude Indicator
- iii. Rectangular Crosscheck (shown below, right)



- a. Move across the top three instruments, then drop down to scan the bottom three
- b. Gives equal weight to each instrument, regardless of the maneuver
- c. Increases the time for your eyes to return to a maneuver's critical instrument

- D. Crosscheck and Bank
 - i. Once established, check the Heading Indicator and Turn Coordinator to ensure performance
- E. Crosscheck and Pitch
 - i. Once established, check the Altimeter, VSI and Airspeed Indicator to ensure performance



- F. Crosscheck Errors
 - i. **Common Error** - Fixation
 - a. Staring at a single instrument (bank during a turn, altimeter during a climb/descent, etc.)
 - b. Eliminates the crosscheck of other pertinent instruments
 - ii. **Common Error** - Omission
 - a. Omitting an instrument from the crosscheck
 - b. Whether forgetting to look at it, or not realizing its importance to the maneuver
 - iii. **Common Error** – Emphasis
 - a. Putting emphasis on a single instrument, instead of the necessary combination of instruments
 - b. You may naturally tend to rely on the instrument most understood
- G. Instrument Interpretation
 - i. Understanding the instrument's operating principles and applying this to aircraft performance
 - a. Basically, different aircraft have different pitch / power settings to obtain desired performance
 - ii. For each maneuver, learn what performance to expect and the combination of instruments to interpret to control the aircraft
 - a. For pitch, use: the Airspeed Indicator, Altimeter, VSI and Attitude Indicator
 - b. For bank, use: the Heading Indicator, Turn Coordinator, and Attitude Indicator

5. Adjust

- A. Make small, precise adjustments to the pitch and power instruments to obtain the desired performance
 - i. Restrict the Attitude Indicator's displacement to ½ - 1 bar width movements up or down

- ii. Use a bank angle that approximates the degrees to turn, not to exceed 30°
 - a. Or, estimate standard rate turns: $TAS/10 + 5$
- iii. Fine tune power settings for the desired performance
- B. **Common Error** – Incorrect interpretation of instruments and improper controls to correct
 - i. Ex: Using rudder to fix heading
 - ii. Understand each instrument’s operation, and how it impacts the desired maneuver/performance

6. ***Straight-and-Level Flight**

Pitch + Power = Desired Performance			
Nose on Horizon + Cruise Power = Straight and Level			
Control		Performance	
Pitch	On Horizon	Altimeter	Constant
Bank	Constant	VSI	0 fpm
Power	Cruise	Airspeed	Constant
		Heading	Constant
		Turn Coord	Level / Coordinated

- A. Establish – Attitude Indicator: establish a no bank, level flight attitude; Power: set cruise power setting
- B. Trim – Trim to relieve the control pressures
- C. Crosscheck – consistent scan to recognize deviations from the desired performance
- D. Adjust – Correct any performance errors, retrim the airplane, continue the crosscheck

7. ***Constant Airspeed Climbs**

Pitch + Power = Desired Performance			
10° Nose Up + Full Power = Constant Airspeed Climb			
Control		Performance	
Pitch	10° Nose Up	Altimeter	Climbing
Bank	Level	VSI	Positive Climb
Power	Climb Power	Airspeed	Constant
		Heading	Constant
		Turn Coord	Level / Coordinated

- A. Establish
 - i. Raise the nose to the approximate pitch attitude for the desired climb speed
 - ii. As the airspeed approaches the climb speed, set the power to the climb setting (full)
- B. Trim – Trim to relieve the control pressures
- C. Crosscheck – consistent scan to recognize deviations from the desired performance
- D. Adjust – Correct any performance errors as necessary and retrim the airplane, then crosscheck again
 - i. Adjust the pitch attitude to maintain the desired climb airspeed (½ to 1 bar width movements)
- E. Leveling Off
 - i. Lead the altitude by 10% of the vertical speed (Ex: 500 fpm climb is led by 50')
 - ii. Use the same procedure to level off the plane
 - a. Establish – Reduce power and apply smooth steady elevator pressure toward a level attitude
 - b. Crosscheck – VSI, Altimeter, and Attitude Indicator should show level flight
 - c. Trim the airplane and maintain straight-and-level flight

8. *Constant Airspeed Descents

Pitch + Power = Desired Performance			
3° Nose Down + Descent Power = Constant Airspeed Descent			
Control		Performance	
Pitch	3° Nose Down	Altimeter	Descending
Bank	Level	VSI	Negative Climb
Power	Descent Power	Airspeed	Constant
		Heading	Constant
		Turn Coord	Level / Coordinated

- A. Establish
 - i. Reduce/set power for the descent, maintain straight-and-level as airspeed decreases
 - ii. As the desired airspeed approaches, lower the nose to descend at that speed
- B. Trim – Trim to relieve the control pressures
- C. Crosscheck – consistent scan to recognize deviations from the desired performance
- D. Adjust – Correct any performance errors, retrim the airplane, then crosscheck again
- E. Leveling Off
 - i. Lead the altitude by 10% of the vertical speed (Ex: 500 fpm descent is led by 50')
 - ii. Use the same procedure to level off the plane
 - a. Establish – Introduce power and apply smooth steady elevator pressure toward a level attitude
 - b. Crosscheck – VSI, Altimeter, and Attitude Indicator should show level flight
 - c. Trim the airplane and maintain straight-and-level flight

9. Constant Rate Climbs

Pitch + Power = Desired Performance			
5-10° Nose Up + Full Power = Constant Rate Climb			
Control		Performance	
Pitch	5-10° Nose Up	Altimeter	Climbing
Bank	Level	VSI	Desired fpm
Power	Climb Power	Airspeed	Varies w climb rate
		Heading	Constant
		Turn Coord	Level / Coordinated

- A. Establish
 - i. Raise the nose to the approximate pitch attitude for the desired climb rate
 - a. 5-10° is an estimate, vary as required
 - ii. Simultaneously, smoothly set the power to the climb setting (full)
- B. Trim – Trim to relieve the control pressures
- C. Crosscheck – consistent scan to recognize deviations from the desired performance
- D. Adjust – Correct any performance errors as necessary and retrim the airplane, then crosscheck again
 - i. Adjust the pitch attitude to maintain the desired climb airspeed (½ to 1 bar width movements)
- E. Leveling Off
 - i. Lead the altitude by 10% of the vertical speed (Ex: 500 fpm climb is led by 50')
 - ii. Use the same procedure to level off the plane
 - a. Establish – Reduce power and apply smooth steady elevator pressure toward a level attitude
 - b. Crosscheck – VSI, Altimeter, and Attitude Indicator should show level flight
 - c. Trim the airplane and maintain straight-and-level flight

10. Constant Rate Descents

Pitch + Power = Desired Performance			
1-3° Nose Down + Descent Power = Constant Rate Descent			
Control		Performance	
Pitch	1-3° Nose Down	Altimeter	Descending
Bank	Level	VSI	Desired FPM
Power	Descent Power	Airspeed	Varies w descent rate
		Heading	Constant
		Turn Coord	Level / Coordinated

- A. Establish
 - i. Reduce power for the descent
 - ii. Lower the nose to descend at the desired rate
 - a. 1-3° is an estimated, vary as required
- B. Trim – Trim to relieve the control pressures
- C. Crosscheck – consistent scan to recognize deviations from the desired performance
- D. Adjust – Correct any performance errors, retrim the airplane, then crosscheck again
- E. Leveling Off
 - i. Lead the altitude by 10% of the vertical speed (Ex: 500 fpm descent is led by 50')
 - ii. Use the same procedure to level off the plane
 - a. Establish – Introduce power and apply smooth steady elevator pressure toward a level attitude
 - b. Crosscheck – VSI, Altimeter, and Attitude Indicator should show level flight
 - c. Trim the airplane and maintain straight-and-level flight

11. *Turns to Headings

Pitch + Power = Desired Performance			
Wings Banked/Nose Slightly High + Cruise Power = Turn to Heading			
Control		Performance	
Pitch	Nose Slightly High	Altimeter	Constant
Bank	Wings Banked	VSI	0 fpm
Power	Cruise	Airspeed	Constant
		Heading	Turning
		Turn Coord	Banked/Coordinated

- A. Prior to beginning, determine which direction the turn will be made and the angle of bank required
 - i. Generally, use an angle of bank equal to the number of degrees to turn, not to exceed 30°
 - ii. For a standard rate turn, estimate the bank angle using the following: $TAS/10 + 5$
- B. Establish – establish the desired bank (coordinate aileron and rudder) and pitch on the attitude indicator
 - i. If standard rate, set the estimated bank angle, and double check it against the Turn Coordinator
 - ii. Adjust pitch (small increase) to maintain level flight
- C. Trim – Trim the airplane
- D. Crosscheck – consistent scan to recognize deviations from the desired performance
- E. Adjust – Correct any performance errors, retrim the airplane, then crosscheck again
- F. Rolling Out
 - i. Apply coordinated rudder and aileron pressure to level the wings on the Attitude Indicator
 - a. Depending on the amount of turn, rollout about 10° before the desired heading
 - Or, use ½ the bank angle or less for small turns

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- ii. During the rollout reduce pitch to return to level flight
 - a. Increase the scan when coordinating two movements (roll and pitch)

Common Errors:

- “Fixation,” “Omission,” and “Emphasis” errors during instrument crosscheck
- Improper instrument interpretation
- Improper control applications
- Failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections
- Faulty trim procedure

Conclusion:

Brief review of the main points