XII.A-D. Basic Attitude Instrument Flight

References: FAA-H-8083-3; FAA-8083-3-15

Objectives  The student should develop knowledge of the elements related to attitude 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.

Key Elements  1. Pitch + Power = Performance
               2. Trim
               3. Crosscheck
               4. Adjust

Elements  1. Control and Performance
           2. Procedural Steps
           3. Establish
           4. Trim
           5. Crosscheck
           6. Adjust
           7. Straight-and-Level Flight
           8. Constant Airspeed Climbs
           9. Constant Airspeed Descents
           10. Turns to Headings

Schedule  1. Discuss Objectives
           2. Review material
           3. Development
           4. Conclusion

Equipment  1. White board and markers
            2. References

IP’s Actions  1. Discuss lesson objectives
              2. Present Lecture
              3. Ask and Answer Questions
              4. Assign homework

SP’s Actions  1. Participate in discussion
              2. Take notes
              3. 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
As you’re flying along you can see that the weather ahead looks like it might be getting worse. You think you can ‘scud run’ the rest of the way but lo and behold you unexpectedly enter a cloud and need to get out safely.

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
In the instance that you mistakenly fly into adverse weather it is important to be comfortable flying the airplane without outside references.

How:
1. Control and Performance
   A. Aircraft performance is achieved by controlling the aircraft attitude and power (AOA and thrust to drag) to produce the desired performance
      i. Pitch + Power = Performance
   B. The three general categories of instruments are control, performance, and navigation instruments
      i. Control – Display immediate attitude and power indications and are permit precise adjustments
         a. Control is determined by reference to the AI and power indicators
      ii. Performance – Indicate the aircraft’s actual performance
         a. Performance is determined by reference to the Altimeter, ASI, VSI, HI, and TC
      iii. Navigation - Indicate the position in relation to a selected nav facility or fix
         a. Determined by course indicators, range indicators, glide-slope indicators and bearing points

2. Procedural Steps
   A. Establish - an attitude/power setting on the control instruments resulting in the desired performance
      i. Known or computed attitude changes and approximate power settings will help reduce workload
   B. Trim - until control pressures are neutralized.
      i. Trimming is essential for smooth, precise control and allows attention to be diverted elsewhere
   C. Crosscheck – the performance instruments to determine if the desired performance is being obtained
      i. Involves seeing and interpreting
      ii. If a deviation is noted, determine the magnitude and direction of correction necessary
   D. Adjust – the attitude or power setting on the control instruments as necessary

3. ESTABLISH
   A. The control instruments are used to set up whatever pitch and bank attitudes are necessary
      i. Aircraft attitude control is accomplished by properly using the AI
         a. Provides an immediate, direct, and corresponding indication of any change in pitch or bank
   B. Pitch Control
      i. Changes are made by changing the pitch attitude by precise amounts in relation to the horizon
         a. Changes are measured in degrees or bar widths
b. The amount of deviation from that desired will determine the magnitude of correction

C. Bank Control
   i. Changes are made by changing the bank attitude by precise amounts in relation to the bank scale
      a. Normally use a bank angle that does not exceed 30°

D. Power Control
   i. Made by throttle adjustments and reference to the power indicators
      a. Little attention is necessary to ensure the power setting remains constant
   ii. From experience, you know how far to move the throttles to change the power a given amount
      a. Make power changes primarily by throttle movement and then crosscheck the indicators
         • DON’T FIXATE on the indicators while setting the power

E. CE – Applying control inputs without reference to the AI

4. Trim
   A. Trim the plane out for hands off flights
   B. CE – Not trimming or over/under controlling but not so much flying with the trim in the DA20
   C. CE – Frequently and in small amounts

5. Instrument Crosscheck
   A. The continuous and logical observation of instruments for attitude and performance information
      i. The pilot maintains an attitude by reference to instruments that will give the desired performance
   B. It is impossible to establish an attitude and have performance remain constant for a long period of time
      i. It is therefore necessary to constantly check the instruments and make appropriate changes
   C. Different Crosschecks
      i. Select Radial Crosscheck
         a. Based off the AI
         • Eyes never travel directly between the flight instruments, but move by way of the AI
         b. Begin with the AI, scan an instrument and return to the AI before moving to another
      ii. Inverted V Crosscheck
         a. Moving your eyes from the AI to the TC, up to the AI, to the VSI, and back to the AI
      iii. Rectangular Crosscheck
         a. Move your eyes across the top three instruments and drop down to scan the bottom three
         b. This gives equal weight to each instrument, regardless of its importance to the maneuver
         c. But, this method lengthens the time for your eyes to return to a maneuver’s critical instrument
   D. Crosscheck and Bank
      i. After establishing, check the HI and TC to ensure the airplane is performing as desired
   E. Crosscheck and Pitch
      i. After establishing, check the Altimeter, VSI and ASI to ensure the airplane is performing as desired
   F. Crosscheck Errors
      i. CE - Fixation
         a. Staring at a single instrument (AI is the most common)
         b. This occurs for a variety of reasons and eliminates the crosscheck of other pertinent instruments
      ii. CE - Omission
         a. Omitting an instrument from the crosscheck
         b. May be caused by failure to anticipate major instrument indications following attitude changes
      iii. CE – Emphasis (VSI-chasing- is common or emphasizing pitch or bank instruments)
         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
a. Understanding each instrument’s construction and operating principles and applying this
b. CE - Tendency to chase the VSI thinking it’s an instantaneous reading (but it’s a lag instrument)

ii. As the performance capabilities of the aircraft are learned, the instrument indications will be interpreted appropriately in terms of the attitude of the aircraft
   a. If the pitch is to be determined, the ASI, Alt, VSI and AI provide the necessary information
   b. If the bank attitude is to be determined, the HI, TC, and AI must be interpreted

iii. For each maneuver, you will learn what performance to expect and the combination of instruments to interpret to control the aircraft

6. Adjust
   A. Make the adjustments necessary in relation to the AI then go through the process again
      i. The amount of deviation from the desired performance will determine the magnitude of correction
         a. Restrict the AI’s displacement to 1 bar or ½ bar width up or down
         b. Use a bank angle that approximates the degrees to turn, not to exceed 30°
   B. CE – Incorrect interpretation of instruments and improper controls to correct (EX: rudder to fix heading)

7. Straight-and-Level Flight

<table>
<thead>
<tr>
<th>Pitch + Power = Desired Performance</th>
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<tbody>
<tr>
<td>Nose on Horizon + Cruise Power = Straight and Level</td>
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</table>

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Bank</th>
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<tbody>
<tr>
<td>A/I</td>
<td>On Horizon</td>
</tr>
<tr>
<td>Alt</td>
<td>Constant</td>
</tr>
<tr>
<td>VSI</td>
<td>0</td>
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<tr>
<td>A/S</td>
<td>Constant Cruise AS</td>
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</table>

A. Establish - Use the AI to establish a wings level, nose on the horizon attitude adjusting power as needed
B. Trim – Trim to relieve the control pressures
C. Crosscheck
D. Adjust – Correct any performance errors as necessary and retrim the airplane, then crosscheck again

8. Constant Airspeed Climbs

<table>
<thead>
<tr>
<th>Pitch + Power = Desired Performance</th>
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<tbody>
<tr>
<td>10° Nose Up + Full Power = Constant Airspeed Climb</td>
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<table>
<thead>
<tr>
<th>Pitch</th>
<th>Bank</th>
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</thead>
<tbody>
<tr>
<td>A/I</td>
<td>10° Nose Up</td>
</tr>
<tr>
<td>Alt</td>
<td>Climbing</td>
</tr>
<tr>
<td>VSI</td>
<td>Positive Climb</td>
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<tr>
<td>A/S</td>
<td>Constant Climb AS</td>
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</tbody>
</table>

A. Establish – Raise the nose of the aircraft to the approximate pitch attitude for the desired climb speed
   i. As the AS approaches the desired climb speed, set the power to the climb setting (full)
B. Trim – Trim to relieve the control pressures
C. Crosscheck
D. Adjust – Correct any performance errors as necessary and retrim the airplane, then crosscheck again
   a. Adjust the pitch attitude to maintain the desired climb AS (1 bar or ½ bar width movements)
E. Leveling Off
   i. Lead the altitude by 10% of the vertical speed (EX: 500 fpm climb is lead 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 AI should show level flight
      c. Then Trim the airplane and maintain straight and level flight
9. Constant Airspeed Descents

<table>
<thead>
<tr>
<th>Pitch + Power = Desired Performance</th>
<th>3° Nose Down + Descent Power = Constant Airspeed Descent</th>
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</thead>
<tbody>
<tr>
<td><strong>Pitch</strong></td>
<td><strong>Bank</strong></td>
</tr>
<tr>
<td>A/I 3° Nose Down</td>
<td>A/I Wings Level</td>
</tr>
<tr>
<td>Alt Descending</td>
<td>DG Constant</td>
</tr>
<tr>
<td>VSI Negative Climb</td>
<td>Compass Constant</td>
</tr>
<tr>
<td>A/S Constant Descent AS</td>
<td>T/C Level/Coordinated</td>
</tr>
</tbody>
</table>

A. Establish – Reduce power to a predetermined setting for the descent and maintain S&L as AS decreases
   i. As the AS approaches the desired level, lower the nose with the AI to maintain a constant speed
B. Trim – Trim to relieve the control pressures
C. Crosscheck
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 AS
E. Leveling Off
   i. Lead the altitude by 10% of the vertical speed (EX: 500 fpm climb is lead 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 AI should show level flight
      c. Then Trim the airplane and maintain straight and level flight

10. Turns to Headings

<table>
<thead>
<tr>
<th>Pitch + Power = Desired Performance</th>
<th>Wings Banked/Nose Slightly High + Cruise Power = Turn to Heading</th>
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<tr>
<td><strong>Pitch</strong></td>
<td><strong>Bank</strong></td>
</tr>
<tr>
<td>A/I Nose Slightly High</td>
<td>A/I Wings Banked</td>
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<tr>
<td>Alt Constant</td>
<td>DG Turning to Heading</td>
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<tr>
<td>VSI 0</td>
<td>Compass Turning to Heading</td>
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<td>A/S Constant Cruise AS</td>
<td>T/C Banked/Coordinated</td>
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</table>

A. Prior to entering, determine which direction the turn should be made and the angle of bank required
   i. Use an angle of bank equal to the number of degrees to turn, not to exceed 30°
B. Establish – coordinated aileron and rudder pressure to establish the desired bank angle on the AI
   i. If standard rate, use the TC to check
   ii. Adjust pitch as necessary (probably increase) to maintain level flight
C. Trim – Trim the airplane
D. Crosscheck
E. Adjust – Correct any performance errors as necessary and go through the process again
F. Rolling Out
   i. Apply coordinated rudder and aileron pressure to level the wings on the AI
      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
   ii. Adjust the pitch to maintain level flight

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

Conclusion:
Brief review of the main points
In visual flight, you control aircraft attitude with relation to the natural horizon by using certain reference points on the aircraft. In instrument flight, you control aircraft attitude by reference to the flight instruments. A proper interpretation of the flight instruments will give you essentially the same information that outside references do in visual flight.

PTS Requirements:

Straight-and-Level Flight
To determine that the applicant:
1. Exhibits instructional knowledge of the elements of straight-and-level flight, solely by reference to instruments by describing:
   A. instrument cross-check, instrument interpretation, and aircraft control.
   B. instruments used for pitch, bank, and power control, and how those instruments are used to maintain altitude, heading, and airspeed.
   C. trim technique.
2. Exhibits instructional knowledge of common errors related to straight-and-level flight solely by reference to instruments by describing:
   A. “fixation,” “omission,” and “emphasis” errors during instrument cross-check.
   B. improper instrument interpretation.
   C. improper control applications.
   D. failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections.
   E. faulty trim technique.
3. Demonstrates and simultaneously explains straight-and-level flight, solely by reference to instruments, from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to straight-and-level flight, solely by reference to instruments.

Constant Airspeed Climbs
To determine that the applicant:
1. Exhibits instructional knowledge of the elements of straight and turning, constant airspeed climbs, solely by reference to instruments by describing:
   A. instrument cross-check, instrument interpretation, and aircraft control.
   B. instruments used for pitch, bank, and power control, and how those instruments are used to maintain altitude, heading, and airspeed.
   C. trim technique.
2. Exhibits instructional knowledge of common errors related to straight and turning, constant airspeed climbs solely by reference to instruments by describing:
   A. “fixation,” “omission,” and “emphasis” errors during instrument cross-check.
   B. improper instrument interpretation.
   C. improper control applications.
   D. failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections.
E. faulty trim technique.
3. Demonstrates and simultaneously explains a straight, constant airspeed climb, solely by reference to instruments, from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to straight, constant airspeed climbs, solely by reference to instruments.

**Constant Airspeed Descents**
To determine that the applicant:

1. Exhibits instructional knowledge of the elements of straight and turning, constant airspeed descents, solely by reference to instruments by describing:
   A. instrument cross-check, instrument interpretation, and aircraft control.
   B. instruments used for pitch, bank, and power control, and how those instruments are used to maintain altitude, heading, and airspeed.
   C. trim technique.
2. Exhibits instructional knowledge of common errors related to straight and turning, constant airspeed descents solely by reference to instruments by describing:
   A. “fixation,” “omission,” and “emphasis” errors during instrument cross-check.
   B. improper instrument interpretation.
   C. improper control applications.
   D. failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections.
   E. faulty trim technique.
3. Demonstrates and simultaneously explains a straight, constant airspeed descent, solely by reference to instruments.
4. Analyzes and corrects simulated common errors related to straight, constant airspeed descents, solely by reference to instruments.

**Turns to Headings**
To determine that the applicant:

1. Exhibits instructional knowledge of the elements of turns to headings, solely by reference to instruments by describing:
   A. instrument cross-check, instrument interpretation, and aircraft control.
   B. instruments used for pitch, bank, and power control, and how those instruments are used to maintain altitude, heading, and airspeed.
   C. trim technique.
2. Exhibits instructional knowledge of common errors related to turns to headings, solely by reference to instruments by describing:
   A. “fixation,” “omission,” and “emphasis” errors during instrument cross-check.
   B. improper instrument interpretation.
   C. improper control applications.
   D. failure to establish proper pitch, bank, or power adjustments during altitude, heading, or airspeed corrections.
   E. faulty trim technique.
3. Demonstrates and simultaneously explains a turn to a heading, solely by reference to instruments, from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to turns to headings, solely by reference to instruments.