

VIII.A. Straight and Level Flight

References: FAA-H-8083-3; FAA-H-8083-25

Objectives	The student should develop the ability to maintain straight-and-level flight primarily through the use of outside visual references. The student should be able to reference the instruments inside the airplane to ensure straight-and-level flight is continued. The ability to effectively trim the airplane for straight-and-level flight should also be developed.
Key Elements	<ol style="list-style-type: none">1. Control <i>Pressure</i>2. Outside 90%, Inside 10%3. Trim the airplane
Elements	<ol style="list-style-type: none">1. Flight Controls2. Control Pressures and Over-Controlling3. Integrated Flight Instruction4. Straight and Level Flight5. Level Flight6. Straight Flight7. Power8. Trim Procedure
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 understands how to make adjustments to keep the aircraft in straight-and-level flight. He or she can also relieve the control pressures by trimming the aircraft and provides light, positive, proactive control pressures when aircraft attitude needs to be corrected.

Instructors Notes:

Introduction:

Attention

Interesting fact or attention grabbing story

Straight and level flight is the basis of *everything* dealing with flying. Every maneuver is based off a competent ability to maintain straight and level flight. It is the ground work for your flying abilities, and as simple and boring as it sounds, it is extremely important.

Overview

Review Objectives and Elements/Key ideas

What

Straight and level flight is flight in which a constant heading and altitude are maintained. It is accomplished by making immediate and measured corrections for deviations in direction and altitude from unintentional slight turns, descents, and climbs

Why

It is impossible to emphasize too strongly the necessity for forming correct habits in flying straight and level. All other flight maneuvers are in essence a deviation from this fundamental flight maneuver. It is not uncommon to find a pilot whose basic flying ability consistently falls just short of minimum expected standards, and upon analyzing the reasons for the shortcomings we discover that the cause is the inability to fly straight and level properly.

How:

1. Flight Controls

- A. Axis of Rotation
 - i. Pitch - Lateral Axis
 - ii. Roll - Longitudinal Axis
 - iii. Yaw - Vertical Axis
- B. Pitch
 - i. Controlled by the elevators
 - a. Back pressure
 - Deflects the trailing edge of the elevator surface up
 - a Decreases the camber of the elevator and creates a downward aerodynamic force
 - Overall Effect
 - a Causes the tail of the airplane to move down and the nose to pitch up
 - b The pitching moment occurs about the CG
 - 1. Strength of the pitching moment depends on the distance between the CG and the horizontal tail surface
 - b. Forward pressure
 - Deflects the trailing edge of the elevator surface down
 - a Increases the camber, creating more lift (less tail down force)
 - Overall Effect
 - a Causes the tail to move upward and pitches the moment down
 - b The pitching moment occurs around the CG
- C. Roll

VIII.A. Straight-and-Level Flight

- i. Controlled by the ailerons
 - a. Controls to the right
 - Right aileron deflects up decreasing the camber resulting in decreased lift on the right wing
 - Left aileron deflects down increasing the camber resulting in increased lift on the left wing
 - a. The increased lift on the left wing and the decreased lift on the right wing causes the airplane to roll to the right
 - b. Controls to the left
 - Opposite of above

D. Yaw

- i. Controlled by the rudders
 - a. When the rudder is deflected into the airflow, a horizontal force is exerted in the opposite direction
 - Pushing the left pedal moves the rudder left
 - a. This alters the airflow around the vertical stabilizer and rudder creating a sideward lift that moves the tail to the right and yaws the nose of the plane to the left
 - Right does the opposite

2. Control Pressures and Over-Controlling

- A. It is important to maintain a light grip on the flight controls
 - i. Only grip with the fingertips
- B. The control forces desired should be exerted lightly and just enough to produce the desired result
 - i. **CE** - Application of control movements rather than pressures
 - a. Smooth, light pressure, not jerky movements
 - ii. Student performs the maneuver with the instructor to feel the control pressures being used to maintain straight and level flight
 - a. Shows little control movements are necessary
 - b. Student becomes more confident through the procedures
- C. Overcoming Tenseness/Over-controlling
 - i. Signs of over-controlling
 - a. Control movements rather than control pressures
 - Jolty, large movements of the flight controls
 - White knuckles (look for the death grip)
 - Overall nervousness
 - ii. Prevention
 - a. Point out the over-controlling and demonstrate the correct light/fingertip grip and pressures desired
 - b. If over-controlling is consistent, place a wooden pencil on top of the middle and ring finger and under the index and pointer finger of the hand the student uses to fly
 - If the student starts the death grip, the force of the pencil on his middle/ring finger will remind him to relax, if the student continues to tighten their grip the pencil will break

3. Integrated Flight Instruction

- A. Each flight maneuver is learned first by outside visual references and then by instrument references only
 - i. Instruction in the control of the airplane by outside visual references is integrated with instruction in the use of flight instrument indications
 - ii. This will also help the student develop a habit of monitoring the flight and engine instruments
- B. **CE** - Failure to crosscheck and correctly interpret outside and instrument references
 - i. Ensure the student understands how to use visual and instrument references together to interpret the aircraft's attitude

4. Straight and Level Flight

- A. The objective of straight and level flight is to detect small deviations from laterally level flight as soon as they occur, necessitating only small corrections

5. Level Flight

- A. A matter of consciously fixing the relationship of the position of some portion of the airplane, used as a reference point, with the horizon
 - i. Want to learn to associate the movement of references with the forces which produce it
 - a. Develops the ability to regulate the change desired in the airplane's attitude
- B. Pitch (Constant Altitude)
 - i. Outside
 - a. Select a portion of the airplane's nose or instrument glare shield as a reference point and keeping that point in a fixed position relative to the horizon
 - ii. Inside
 - a. To determine whether or not the pitch attitude is correct, the outside reference should be cross checked occasionally against:
 - The altimeter
 - a To check actual altitude
 - The attitude indicator
 - a To show the position of the nose in relation to the horizon
 - VSI
 - a To show any trends forming
 - Airspeed Indicator
 - a Faster airspeed = Descending
 - b Slower airspeed = Climbing
 - iii. Corrections (Control Procedure)
 - a. If altitude is being lost or gained, the pitch attitude should be readjusted in relation to the horizon, then the altimeter should be checked to determine altitude is being maintained
 - b. Elevators are the control
 - Forward or back elevator pressure is used to control the pitch attitude
 - a Increasing pitch attitude (back pressure) raises the nose in relation to the horizon
 - b Decreasing pitch attitude (forward pressure) lowers the nose in relation to the horizon
 - c. Note the relationship between control pressure and the airplane's change in attitude

6. Straight Flight

- A. Bank
 - i. Outside
 - a. Both wingtips should be equidistant above or below the horizon
 - b. Also, select two or more outside visual reference points directly ahead of the airplane (e.g. roads, towns, lakes, buildings, anything really)
 - Form an imaginary line between them and keep the airplane headed along that line
 - a If the points move out of alignment make the necessary corrections to realign the airplane
 - Similar to the site on a gun
 - a Line up the 'V' with the point at the end of the barrel
 - 1. Line up the two points like a gun
 - ii. Inside
 - a. To determine whether or not the bank attitude is correct, the outside reference should be cross checked occasionally against:

VIII.A. Straight-and-Level Flight

- The heading indicator
 - a To determine that the desired heading is maintained
 - The attitude indicator
 - a To ensure the wings are level
 - Turn Coordinator
 - a To ensure coordination and that the aircraft is not unintentionally in a turn
 - b **CE** - Uncoordinated use of flight controls
 - Magnetic Compass
 - a Again, to ensure the desired heading is maintained and the heading indicator is correct
- iii. Corrections (Control Procedure)
- a. If the airplane is banking in one direction or the other, the bank should be readjusted to put both wings an equal distance from the horizon
 - b. Ailerons are the control
 - Right aileron pressure (turns right) results in the left wing raising and right wing lowering
 - Left aileron pressure (turns left) results in the right wing raising and the left wing lowering
 - c. Note the relationship between control pressure and the airplane's change in attitude
 - d. **CE** - Uncoordinated use of flight controls
 - It's important not to correct heading errors solely by yawing the airplane
 - a Maintain a coordinated flight condition throughout straight and level flight
 - 1. And during any corrections back to straight and level flight
 - b Uncoordinated flight slows the aircraft since the fuselage is put into the relative wind

7. Power

- A. Airspeed will remain constant in straight and level flight with a constant power setting
- B. Outside
 - i. Changes in power settings (airspeed) will require changes in pitch attitude to maintain altitude
- C. Inside
 - i. Cross check changes in airspeed with the Engine RPM and/or manifold pressure gauges
 - a. Increased power will result in a climb if no changes are made to the pitch attitude
 - b. Decreased power will result in a descent if no pitch changes are made to the pitch attitude
- D. Corrections (Control Procedure)
 - i. As power is increased or decreased pitch attitude must be adjust
 - a. As power is increased, progressively decrease pitch in order to maintain altitude
 - Once acceleration ceases and the aircraft is level note the new visual reference in relation to the horizon and use it to maintain level flight
 - b. If power is decreased, progressively increase pitch in order to maintain altitude
 - Once deceleration ceases and the aircraft is level note the new visual reference in relation to the horizon and use it to maintain level flight

8. Trim Procedure

- A. The airplane is designed so that the primary flight controls (rudder, aileron, elevator) are streamlined with the non-movable airplane surfaces when the airplane is cruising straight and level at normal weight and loading
 - i. If the airplane is out of that balanced condition, one or more of the control surfaces is going to have to be held out of its streamlined position by continuous control input
 - a. Trim tabs relieve the pilot of this requirement
 - If the airplane is trimmed properly and the air is smooth, straight and level flight requires almost no application of control pressure
- B. Trimming the Airplane

VIII.A. Straight-and-Level Flight

- i. Set the power
- ii. Set the pitch
- iii. Let the airspeed stabilize
- iv. Trim the airplane for the current airspeed
 - a. Method
 - Establish and hold the airplane in the desired attitude using the primary flight controls
 - a Proper attitude should be established with reference to the horizon and then verified by reference to the flight instruments
 - Then apply trim to relieve whatever pressure was required
 - a The airplane attitude must be established and held first, then control pressures trimmed out so that the airplane will maintain the desired flight attitude in “hands off” flight
 - As previously discussed, if power changes, the pitch attitude to maintain level flight will change, and the aircraft will have to be re-trimmed
 - v. **CE** - Faulty trim procedure
 - a. Use trim frequently and in small amounts
 - b. Trying to fly the airplane with trim is a common fault in basic flying technique
 - Establish the desired attitude, then trim the aircraft (establish first, trim second)
 - Do not trim to establish the desired attitude (trim first, establish second)
- C. Any control pressure the pilot feels should be a result of deliberate pilot control input during a planned change in airplane attitude
 - i. It should not be a result of pressure being applied by the airplane because the pilot is allowing it to assume control

Common Errors:

- Failure to crosscheck and correctly interpret outside and instrument references
- Application of control movements rather than pressures
- Uncoordinated use of flight controls
- Faulty trim procedure

Conclusion:

Brief review of the main points

Level flight is maintained through pitch. We monitor pitch by keeping the reference point off the nose of the plane in the same place on the horizon and referencing the altimeter and attitude indicator. Level flight is controlled with elevator pressure. Straight flight is maintained through roll. We monitor bank by keeping an equal distance above each wing and the horizon as well as lining up two points in front of the airplane and keeping them in line. These visual references are cross checked with the heading indicator as well as the attitude indicator. Trim is essential in relieving the pilot of the control pressures necessary to maintain level flight. We should trim frequently and in small amounts in order to obtain and maintain straight and level flight.

PTS Requirements:

To determine that the applicant:

1. Exhibits instructional knowledge of the elements of straight-and-level flight by describing:
 - a. Effect and use of flight controls.
 - b. The integrated flight instruction method.
 - c. Outside and instrument references used for pitch, bank, yaw, and power control; the crosscheck and interpretation of those references; and the control procedure used.

VIII.A. Straight-and-Level Flight

- d. Trim procedure.
- e. Methods that can be used to overcome tenseness and over controlling.
2. Exhibits instructional knowledge of common errors related to straight-and-level flight by describing:
 - a. Failure to cross-check and correctly interpret outside and instrument references.
 - b. Application of control movements rather than pressures.
 - c. Uncoordinated use of flight controls.
 - d. Faulty trim procedure.
3. Demonstrates and simultaneously explains straight-and-level flight from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to straight-and-level flight.