

VII.B. Short-Field Takeoff and Maximum Performance Climb

References: FAA-H-8083-3; POH/AFM

Objectives	The student should develop knowledge of the elements related to short field takeoffs and maximum performance climbs. The student will have the ability to demonstrate a short field takeoff and climb as prescribed in the necessary PTS.
Key Elements	<ol style="list-style-type: none">1. Use the Entire Runway2. Maximum Performance Climb at V_x3. Focus Outside the Airplane
Elements	<ol style="list-style-type: none">1. V_x (Best Angle of Climb Airspeed)2. Runway Incursion Avoidance3. Pre-Takeoff4. Takeoff Roll5. Lift-Off6. Maximum Performance Climb
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 shows the ability to execute a proper short-field takeoff and climb by using the entire runway, after rotation pitching immediately for V_x until clear of obstacles, then pitching for V_y .

Instructors Notes:

Introduction:

Attention

Interesting fact or attention grabbing story

Maximum Performance Takeoff and Climb... this is the mother of all takeoffs, where we put the airplane at its limits to obtain the most performance out of the airplane.

Overview

Review Objectives and Elements/Key ideas

What

Takeoffs and climbs from fields where the takeoff area is short or the available takeoff area is restricted by obstructions requiring the pilot to operate the airplane at the limit of its takeoff performance capabilities.

Why

Short Field Takeoffs develop the pilot's ability to operate the airplane at its maximum takeoff performance capabilities. This develops a better feel for the plane and results in improved takeoffs and airplane control.

How:

1. V_x (Best Angle-of-Climb Speed)

- A. To accomplish this takeoff safely a pilot must have knowledge of V_x , the best angle-of-climb speed
- B. V_x is 58 knots (DA20)
- C. V_x is the speed which will provide the greatest gain in altitude for a given distance over the ground
 - i. It is usually slightly less than V_y , which provides the greatest gain in altitude per unit of time
- D. Small deviations (5 knots) in some airplanes will result in a significant reduction in climb performance
 - i. Precise control of airspeed has an important bearing on the execution/safety of the maneuver

2. Runway Incursion Avoidance

- A. Controlled Airport
 - i. Request and receive the appropriate clearance to taxi
 - ii. Request and receive the appropriate clearance before crossing any hold short bars onto a runway
- B. Uncontrolled Airport
 - i. Announce intentions on the CTAF
- C. **CE** - Improper runway incursion avoidance
 - i. Check Final Approach
 - a. Before taxiing onto the runway, ensure you have time to takeoff before any aircraft turn onto final
 - b. A 360° turn on the ground in the direction of the traffic pattern is recommended to check for traffic at uncontrolled fields
 - ii. Check the Runway
 - a. Before taxiing out, ensure the runway is clear of other aircraft, vehicles, persons, or other hazards

3. Pre-Takeoff

- A. In the case of the DA20, the airplane should be configured for a normal takeoff

4. Takeoff Roll

- A. Start at the very beginning of the runway; the field is short, don't waste any runway
 - i. Align the airplane with the runway centerline/intended takeoff path and come to a complete stop
 - ii. Apply and adjust any necessary crosswind correction as would be done in a normal takeoff

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- B. Hold the brakes while smoothly advancing the throttle to maximum power
 - i. Check engine gauges GREEN
 - C. Release the brakes
 - i. Maintain directional control with the rudders
 - a. Anticipate torque pulling the aircraft to the left by applying right rudder
 - ii. Announce "Airspeed Alive," and "Engine Gauges are Green"
 - a. Do not hesitate to abort the takeoff if there is a problem with either the airspeed or engine gauges
 - iii. The airplane should be allowed to roll with full weight on the mains and accelerate to liftoff speed
 - a. Short Field V_R – 52 knots
 - D. **CE** - Improper use of controls during a short-field takeoff
 - i. Maintain crosswind controls as in a normal takeoff
- 5. Lift-Off**
- A. Smoothly and firmly rotate the airplane at V_R (52 knots) immediately to an attitude that will result in V_X
 - i. Use outside references and pitch on the attitude indicator to maintain the correct attitude
 - Approximately 12° nose up (slightly steeper than a normal takeoff)
 - ii. In the case the airplane lifts off prior to 52 knots, allow the airplane to accelerate in ground effect
 - a. Do not intentionally raise the nose prior to V_R , this will increase drag and prolong the roll
 - A premature lift-off/too steep a climb may result in settling onto the runway or obstacle
 - a. Even if the airplane remains airborne, the initial climb will remain flat and climb performance and obstacle clearance are severely degraded until reaching V_X
 - iii. Since the airplane accelerates more rapidly after liftoff, more back pressure is required to hold airspeed
 - a. Airspeed is increasing rapidly, therefore pitch will have to be increased to maintain 58 knots
 - B. Once airborne, a wings level climb should be maintained at V_X until obstacles have been cleared
 - C. **CE** - Improper liftoff procedures
 - i. Excessive back pressure will result in an excessively high pitch attitude and delay takeoff or result in settling back to the runway
 - ii. Not enough back pressure may result in insufficient lift and the airplane settling onto runway
 - iii. Improper trim settings will make it more difficult to maintain the proper takeoff attitude
- 6. Maximum Performance Climb**
- A. Climb out at V_X until clear of obstacles
 - i. Maintain visual references, but occasionally glance at the attitude and airspeed indicators to check pitch and V_X
 - B. Configuration is not changed until clear of obstacles
 - i. The pilot should not be in the cockpit reaching for gear/flap controls until clear of the obstacle
 - C. Once clear of obstacles pitch for V_Y (65 knots)
 - i. Visually – Normal takeoff climb picture
 - ii. Once stabilized at V_Y , the climb checklist can be completed as normal
 - D. **CE** - Improper initial climb attitude, power setting, and airspeed (V_X) to clear obstacle
 - i. Use the POH to determine the proper configuration and airspeed
 - ii. Do not retract flaps until clear of obstacles
 - iii. Maintain V_X until clear of obstacles then accelerate and maintain V_Y
 - iv. Maintain pitch attitude by outside references; cross check with the airspeed and attitude indicator
 - E. **CE** - Improper use of checklists
 - i. Fly first, only begin checklists when safely climbing and clear of obstacles

Common Errors:

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- Improper runway incursion avoidance
- Improper use of controls during a short-field takeoff
- Improper lift-off procedures
- Improper initial climb attitude, power setting, and airspeed (V_x) to clear obstacle
- Improper use of checklist

Conclusion:

Brief review of the main points

The short-field takeoff and maximum performance climb is based on rotating near and pitching directly for V_x . This allows for the greatest climb in the shortest distance, providing obstacle clearance.

PTS Requirements:

To determine that the applicant:

1. Exhibits instructional knowledge of the elements of a short-field takeoff and climb by describing:
 - a. Procedures before taxiing onto the runway or takeoff area to ensure runway incursion avoidance. Verify ATC clearance/no aircraft on final at non-towered airports before entering the runway, and ensure that correct takeoff runway positioning of the airplane with consideration for other aircraft, surface conditions, and wind.
 - b. Short-field takeoff and lift-off procedures.
 - c. Initial climb attitude and airspeed (V_x) until obstacle is cleared (50 feet AGL).
 - d. Proper use of checklist.
2. Exhibits instructional knowledge of common errors related to a short-field takeoff and climb by describing:
 - a. Improper runway incursion avoidance procedures.
 - b. Improper use of controls during a short-field takeoff.
 - c. Improper lift-off procedures.
 - d. Improper initial climb attitude, power setting, and airspeed (V_x) to clear obstacle.
 - e. Improper use of checklist.
3. Demonstrates and simultaneously explains a short-field takeoff and climb from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to a short-field takeoff and climb.

