Power Hour Lessons

Vmc Aviation - A Common Internet Search Term, and Minimum Control Airspeed - Ultimate Guide

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Overview

1. Vmc refers to Minimum Control Airspeed with one engine inoperative (Vmc). Throughout this article, we use the term Vmc because that is what most people search for when they want to know more about this multi-engine speed. The actual terminology is Vmc, the speed at which a multi-engine airplane loses directional control when one engine is inoperative. The speed changes due to several factors, as we will discuss.
2. Many accidents happen when a multi-engine aircraft loses an engine, and the pilot accidentally slows it below Vmc.
3. Check out our MEI Lesson Plans for a comprehensive Outline.

Minimum Control Airspeed (Vmc): What Is It?

4. The Vmc speed is when the rudder becomes ineffective in controlling the yaw caused by an engine failure or non-operating engine. The Pilot's Operating Handbook (POH) specifies it in the limitations section. The FAA has carefully outlined the criteria under which the speed is determined.
   a. A lower Vmc usually contributes to heightened safety for the aircraft. A lower Vmc lets the plane stay in control at a slower speed if one engine fails, making it safer.
   b. Vmc is mainly about controlling the aircraft's direction, not its ability to climb.
   c. The FAA sets the criteria for the manufacturer to determine the Vmc speed you see in the POH and on the airspeed indicator. They use specific conditions and criteria. It is important to mention this. The actual Vmc value may vary under real-world conditions during an engine failure.

Determining Vmc

5. An aircraft's minimum control airspeed (Vmc) changes depending on factors like weight, setup, and surroundings. Pilots must consult their aircraft's documentation and be aware not to operate too closely to the specified Vmc speed to ensure safe flight.

Why Is Vmc Important?

6. Vmc is important for a variety of reasons:
   a. Control: Being above the Vmc speed gives the pilot better control over the aircraft. At the Minimum Control Airspeed, the plane may be unable to maintain heading.
   b. Stall Prevention: The actual Vmc speed in a non-turbocharged piston twin decreases with altitude. This is because the operating engine produces less

power at higher altitudes, so there is less yaw to be corrected for by the rudder. There can be an altitude where the Vmc speed and the stall speed are the same. Further altitude increases will put the Vmc speed below the stall speed. Whenever Vmc is at or below the stall speed, the airplane will stall first and then lose directional control, usually leading to a spin. When the Vmc speed is above the stall speed the airplane will run out of rudder to counter the yaw caused by the operating engine before it stalls.

Key points:

i. As speed reduces with one engine failed more control inputs will be required. There will be a lack of control effectiveness with one engine inoperative.
ii. Exercise extreme caution to not induce a stall - should a stall occur, immediate recovery is necessary - Close both throttles and lower the angle of attack.
iii. Always brief the maneuver for entry and safe recovery.
iv. Recognition of a stall before Vmc - No initial loss of heading - Stall warning indicator or buffeting.
v. Definition of the critical engine - The engine, if failed, would cause the highest Vmc speed. In counter-rotating engines on twins, there is no critical engine. In engines that turn the same way, the left engine is critical.
vi. NOTE: A complete discussion of multi-engine aerodynamics is outside this article's scope. For a discussion of multi-engine aerodynamics, see the FAA Airplane Flying Handbook, available for free at FAA.gov.

Factors that impact the published Vmc Speed.

7. FAR part 25 sets the criteria for how the published Vmc speed is to be determined by the manufacturer. Recent changes to this regulation, FAR 25.149, say, "In establishing the minimum control speeds required by this section, the method used to simulate critical engine failure must represent the most critical mode of powerplant failure with respect to controllability expected in service." That removes any wiggle room for gaining any advantage over another aircraft manufacturer regarding the Vmc speed that must be submitted.
    a. Here are the criteria that the manufacturer must use to determine the calibrated Vmc speed when the critical engine is suddenly made inoperative so that the airplane can maintain control of the airplane with the critical engine inoperative and straight flight with an angle of bank not more than 5 degrees into the good engine:

1. Maximum available takeoff power on the inoperative engine.
2. The most unfavorable center of gravity.
3. The airplane was trimmed for takeoff.
4. The maximum sea level takeoff weight (or any lesser weight to show Vmc.
5. The airplane in the most critical takeoff configuration existing along the flight path

after the airplane becomes airborne, except with the landing gear retracted. This is a configuration standard; however, when the landing gear is down, it acts like water rudders on a seaplane to help keep the airplane going in a constant direction.

6. The airplane airborne and the ground effect is negligible.
7. If applicable, the propeller of the inoperative engine:
   b. Windmilling.
   c. In the most probable position for the specific design of the propeller control or
   d. Feathered, if the airplane has an automatic feathering device acceptable for showing compliance with the climb requirements of FAR 25.121.
8. The rudder forces required may not exceed 150 pounds.

8. There are other criteria for determining the VMGL, Vmc, while still on the ground speed, and VmcL, the Vmc, while on approach to a landing. You can read more about those conditions in FAR 25.149.

This all means that the published Vmc speed, represented by a red radial line, that isn't the Vne speed, is not a fixed number. It changes with the factors mentioned above. While it isn't possible for the pilot to determine the exact Vmc speed based upon the conditions, it is possible to discuss how each affects the speed to see if the speed would be significantly higher or lower.

1. Maximum available takeoff power on the inoperative engine - The more power on the good engine, the greater the yaw that has to be countered with the rudder.
2. The most unfavorable center of gravity. A rearward CG is most twins will require more rudder because the force applied to counter the yaw from the rudder is less when the CG is rearward.
3. The airplane was trimmed for takeoff. This is just a configuration standard.
4. The maximum sea level takeoff weight (or any lesser weight necessary to show Vmc. The higher the weight, the lower the Vmc speed. There are two reasons. The airplane has more momentum with higher weights and tends not to change heading easily. Also, when banking into the good engine, the horizontal component of lift will be higher at higher weights, and that helps because the increased HCL reduces the yaw towards the inoperative engine. This allows for using less rudder.
5. The airplane in the most critical takeoff configuration existing along the flight path after the airplane becomes airborne, except with the landing gear retracted. This is a configuration standard; however, when the landing gear is down, it acts like water rudders on a seaplane to help keep the airplane going in a constant direction.
6. The airplane airborne and the ground effect is negligible. Ground effect will make the Vmc speed lower due to the decrease in induced drag. Ground effect is most pronounced within one wing span of the ground, so the benefit disappears when out of ground effect and climbing.
7. If applicable, the propeller of the inoperative engine:

a. Windmilling. This produces the most drag and requires more rudder to overcome.
b. In the most probable position for the specific design of the propeller control or
c. Feathered, if the airplane has an automatic feathering device acceptable for showing compliance with the climb requirements of FAR 25.121. This is a configuration standard.

9. The rudder forces required may not exceed 150 pounds. This is a configuration standard.

Vmc and a Multi-Engine Aircraft.

9. In summary, it is important to know the airplane's Vmc speed and ensure adequate speed in the event of an engine failure of the critical engine to ensure directional control can still be maintained. There is no assurance the airplane will be able to climb, however.
   a. Pilots undergo training and must demonstrate loss of control and recovery during the practical test. The surest way to eliminate loss of control is to close both throttles. There is no yaw from an operating engine and, therefore, no control issues.
10. To demonstrate loss of control in a non-turbocharged piston twin-engine airplane.
   a. Slow the airplane with both engines operating to VYSE (Blue Line.)
   b. Close the throttle on the critical engine and maintain directional control with rudder initially.
   c. Maintain VYSE.
   d. Bank up to 5 degrees into the good engine.
   e. Raise the pitch attitude to reduce the airspeed by approximately one knot per second. As the speed lowers, the rudder needed to counter the yaw increases.
   f. When there is not enough rudder to stop the yaw, begin the recovery. NOTE: If there are any stall indications, recover at that moment.

Recovery:

A. Reduce both throttles to idle.
B. Reduce the angle of attack so that the speed is back to VYSE.
C. Increase the power on the good engine at VYSE and maintain heading with the rudder and up to 5 degrees of bank into the good engine.

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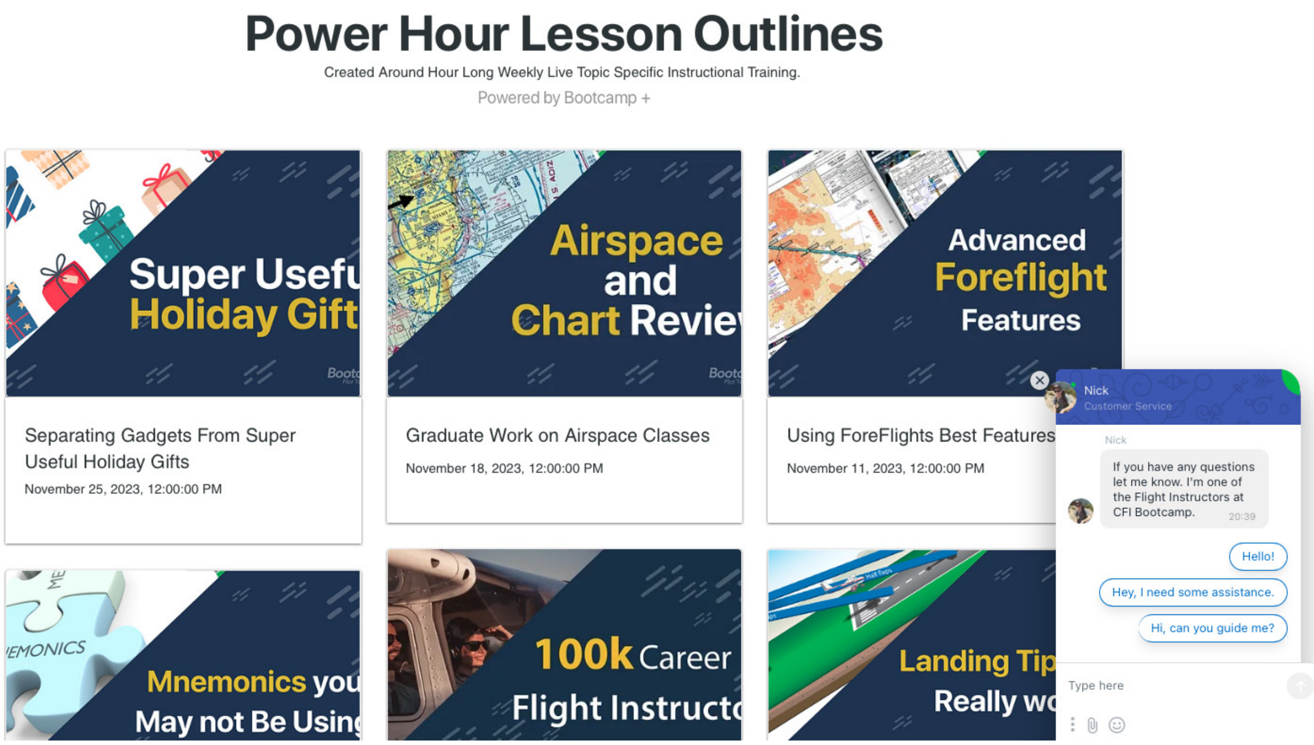

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