XIV.D. Maneuvering with One Engine Inoperative

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

Objectives
The student should develop knowledge of the elements related to single engine operation.

Key Elements
1. Fly First
2. Zero Sideslip
3. Rudder Control

Elements
1. Maneuvering with One Engine Inoperative
2. Managing the Engine Failure
3. Critical Engine

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 handle an engine failure and maneuver the aircraft as necessary.
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Instructors Notes:

Introduction:
   Attention
Interesting fact or attention grabbing story

Overview
Review Objectives and Elements/Key ideas

What
The ability to properly and safely control an engine failure will be discussed in this lesson, emphasizing the importance of flying the plane first and handling the checklists second.

Why
Being able to manage an engine failure and control the aircraft is obviously necessary for safety. An incompetent pilot during an engine failure is most likely not going to survive.

How:
1. Maneuvering with One Engine Inoperative
   A. Recognize engine failure and maintain control
      i. CE – Failure to recognize an inoperative engine
      ii. The easiest way to recognize an engine failure is visually
         a. Also allows for better control, don’t stare at the engine instruments, fly the plane
      iii. When an engine fails use rudder and aileron to maintain directional control
         a. Establish a zero sideslip configuration by adding approx 2-3\(^\circ\) of bank to counteract the roll and maintaining heading visually with rudder pressure (the aircraft will almost fall into a sideslip)
            • After a couple degrees of bank are established and rudder pressure is set to maintain heading double check the zero sideslip on the instruments and make changes needed
               a. A zero sideslip will vary based on the aircraft flown, but 1-3\(^\circ\) bank toward the operating engine and ½ ball deflection (on the TC) toward the operating engine should be close
         b. CE – Failure to establish and maintain proper bank for best performance
            • Additional bank or too little bank will create excess drag on the airframe (since it is no longer coordinated), thus reducing performance

2. Manage the Engine Failure
   A. After controlled has been established follow the following steps:
      i. Set Controls
         a. Initially this means add full power on both engines
            • Increasing power means increase the rudder
            • The more power, the yaw created, don’t increase the power and lose control of heading
            • Smoothly increase the power and rudder pressure (fast movements are hard to control)
      ii. Reduce Drag
         a. CE – Failure to properly adjust engine controls and reduce drag
            • Full power is necessary due to the loss of an engine
            • Reducing drag is necessary to prevent altitude loss
            • In an engine failure always add full power and reduce drag immediately
               a. Maintain control of the aircraft, right rudder with the increase in power
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iii. Identify
   a. Dead Foot, Dead Engine
      • Whichever foot is not being used on the rudder correlates to the engine that has failed
         a. If the Right foot is “dead” on the ground, the Right engine is the failed engine
   iv. Verify
      a. To verify reduce the throttle for the dead engine to idle
         • There should be no change
            a. You’ll know if you got it wrong when the aircraft yaws rapidly in the wrong direction
            b. Reduce the throttle gently, if you accidentally got the wrong engine it will be easier to
               maintain control (again, fast movements are hard to control)
      b. CE – Hazards of improperly identifying and verifying the inoperative engine
         • Choosing the wrong engine can be very dangerous
         • One engine is already failed, if you feather the incorrect engine (because you skipped or
           didn’t properly identify/verify the failed engine) you will suddenly be in a situation with zero
           engines operating
   v. Fix or Feather
      a. If there is time and altitude attempt to fix the failed engine
         • Follow manufacturer procedures
            a. CE – Failure to follow prescribed emergency checklist
            b. Take a break from the checklist every couple steps to check airspeed, altitude, heading, zero
               sideslip and engine instruments (there’s no rush to getting the checklist done, flying is most
               important)
      b. If it cannot be fixed (or if time does not allow it) then feather the engine
         • Follow manufacturer procedures
         • Take a break from the checklist every couple steps to check airspeed, altitude, heading, zero
           sideslip and engine instruments (there’s no rush to getting the checklist done, flying is most
           important)
      c. Before feathering the engine ALWAYS verify you have the correct engine
      d. When feathered rudder can be reduced
         • Yaw toward the dead engine is reduced since the drag on the inoperative prop is reduced
         • Adjust the controls to maintain the zero sideslip
   vi. Restart the Inoperative Engine
      a. Follow manufacturer Procedures
      b. Maintain control during the process
         • When the engine restarts rudder will have to be increased as yaw/drag will increases
      c. As you increase the power, adjust rudder
         • Maintain directional control with the rudder/aileron visually

3. Flying on One Engine
   A. Approx 80% power will maintain a comfortable airspeed in level flight
      i. Will need to be adjusted based on weight/atmospheric conditions
   B. Trim the aircraft for straight and level flight and use rudder trim (if available) to assist in maintaining a
      zero sideslip
      i. Remove rudder trim prior to landing
         a. As you reduce power during the landing the aircraft will yaw toward the rudder trim if it is left in
            during landing
            • This could result in a sideloaded landing, and can be potentially dangerous
         ii. CE – Improper trim procedure
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C. Maintain level flight at speeds above Vyse, if possible
   i. If impossible, maintain Vyse
      a. The aircraft will descend until the an altitude is reached that can be maintained
         • Approx the single engine service ceiling
   ii. CE – Failure to establish and maintain the best engine inoperative speed
      a. Speeds other than Vyse will result in worse performance
         • If you need to climb maintain Vyse
         • In straight and level maintain Vyse or faster

D. Monitor the fuel and crossfeed as necessary to maintain balance

E. Decide whether to continue to the destination or divert to an alternate
   i. In the case of a diversion, find the approximate heading and turn toward the field
      a. Then, use diversion procedures to determine time/distance/fuel requirements

F. CE – Failure to maintain positive control while maneuvering
   i. Consistently monitor the performance of the aircraft
      a. During all checklists, take your time, take breaks between each step or two to ensure heading,
         altitude, airspeed and zero sideslip are properly maintained

Conclusion:
Brief review of the main points
Fly first; maintain control of the aircraft during the entire process. There is no rush to complete the checklist

PTS Requirements:
To determine that the applicant:
1. Exhibits instructional knowledge of the elements related to maneuvering with one engine inoperative by describing:
   a. flight characteristics and controllability associated with maneuvering with one engine inoperative.
   b. use of prescribed emergency checklist to verify accomplishment of procedures for securing inoperative engine.
   c. proper adjustment of engine controls, reduction of drag, and identification and verification of the inoperative engine.
   d. how to establish and maintain the best engine inoperative airspeed.
   e. proper trim procedure.
   f. how to establish and maintain a bank, as required, for best performance.
   g. appropriate methods to be used for determining the reason for the malfunction.
   h. importance of establishing a heading toward the nearest suitable airport or seaplane base.
   i. importance of monitoring and adjusting the operating engine.
   j. performance of straight-and-level flight, turns, descents, and climbs, if the airplane is capable of those maneuvers under existing conditions.
2. Exhibits instructional knowledge of common errors related to maneuvering with one engine inoperative by describing:
   a. failure to follow prescribed emergency checklist.
   b. failure to recognize an inoperative engine.
   c. hazards of improperly identifying and verifying the inoperative engine.
   d. failure to properly adjust engine controls and reducedrag.
   e. failure to establish and maintain the best engine inoperative airspeed.
   f. improper trim procedure.
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- g. failure to establish and maintain proper bank for best performance.
- h. failure to maintain positive control while maneuvering.
- i. hazards of attempting flight contrary to the airplane’s operating limitations.

3. Demonstrates and simultaneously explains maneuvering with one engine inoperative from an instructional standpoint.

4. Analyzes and corrects simulated common errors related to maneuvering with one engine inoperative.

**NOTE:** The feathering of one propeller can be demonstrated in any multiengine airplane equipped with propellers that can be safely feathered unless the manufacturer prohibits the intentional feathering of the propellers during flight. Feathering for pilot flight test purposes should be performed only under such conditions and at such altitudes (no lower than 3,000 feet above the surface) and positions where safe landings on established airports can be readily accomplished, in the event difficulty is encountered during unfeathering.

At altitudes lower than 3,000 feet above the surface, simulated engine failure will be performed by throttling the engine and then establishing zero thrust.

In the event a propeller cannot be unfeathered during the practical test, it should be treated as an emergency.