



Maneuvering with one engine Inoperative

Overview

WHAT

- Proper & safe control of an engine failure

WHY

- Managing an engine failure is essential to safety in a multiengine airplane

CONTENT

- One Engine Inoperative Airspeeds
- Managing an Engine Failure
- Maneuvering with One Engine Inoperative
- Hazards



OEI Airspeeds & Performance

VMC: RED Line

- Speed at which the rudder no longer has the authority to overcome the yaw caused by the critical engine being inoperative
 - Under specific FAA criteria
- Lower V_{MC} is safer
- V_{MC} is strictly concerned with directional control
 - Irrespective of performance



OEI Airspeeds & Performance

VMC: RED Line

- Published versus Actual V_{MC}
 - Published: Based on specific FAA mandated criteria
 - Actual: Varies based on conditions, configuration, & pilot technique during an engine failure
- Varies with a variety of factors



OEI Airspeeds & Performance

VMC: Red Line

FACTOR	CONTROL	VMC
Critical Engine Inoperative	Decreases	Increases
Windmilling Propeller	Decreases	Increases
Max Takeoff Power	Decreases	Increases
Sea Level Conditions	Decreases	Increases
Most Adverse Legal Weight (Light)	Decreases	Increases
Most Adverse Legal CG (Aft)	Decreases	Increases
Gear Up	Decreases	Increases
Out of Ground Effect	Decreases	Increases
Cowl Flaps set for Takeoff (Open)	Increases	Decreases
Max of 5-degrees of Bank	Increases	Decreases
Flaps Set for Takeoff	Could go either way	Could go either way
Trimmed for Takeoff	Could go either way	Could go either way



OEI Airspeeds & Performance

VYSE: Blue Line

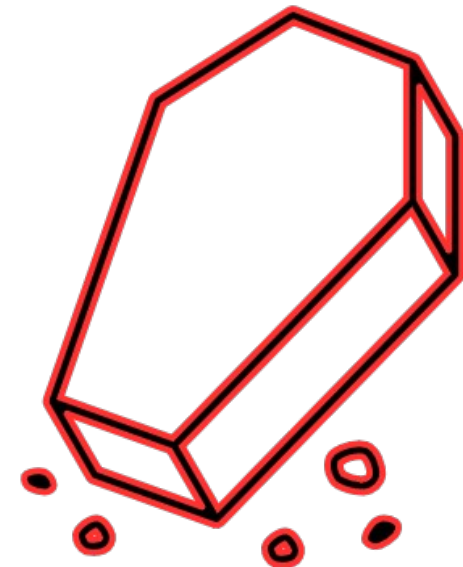
- Best rate of climb speed with OEI
- Blue line on the airspeed indicator
- Used for max performance during OEI operations
 - Or minimize descent, if above the single engine service ceiling



Managing an Engine Failure

Recognition & Control

- Recognize the Engine Failure
 - Visual: Easiest way to recognize an engine failure
 - Instrument: Use the instruments
 - Yaw toward the dead engine, nose drop, engine gauges indicate a failure
- Maintain Control
 - Use rudder & aileron to establish a zero sideslip
 - Pitch for V_{YSE}
- Zero Sideslip
 - 1-3° of bank & ½ ball deflection toward the operating engine
 - Anything other than a zero sideslip reduces performance
 - “**Raise the Dead**”



Managing an Engine Failure

Recognition & Control

- Maintain Control
 - Zero side-slip, pitch for V_{YSE}
- Max Power
 - Throttles, Prop, Mixture
- Reduce Drag
 - Gear up, flaps up
- Identify
 - Dead foot, dead engine
- Verify
 - Slowly & smoothly reduce the throttle on the dead engine
- Fix or Feather
 - Generally, feather the propeller & secure the engine in these situations



Managing an Engine Failure

Checklists

- Take a break from the checklist every step or two to verify aircraft performance
 - Flying safely is the primary concern
- There's rarely a rush to get the checklist done
 - The aircraft is under control & memory items are complete

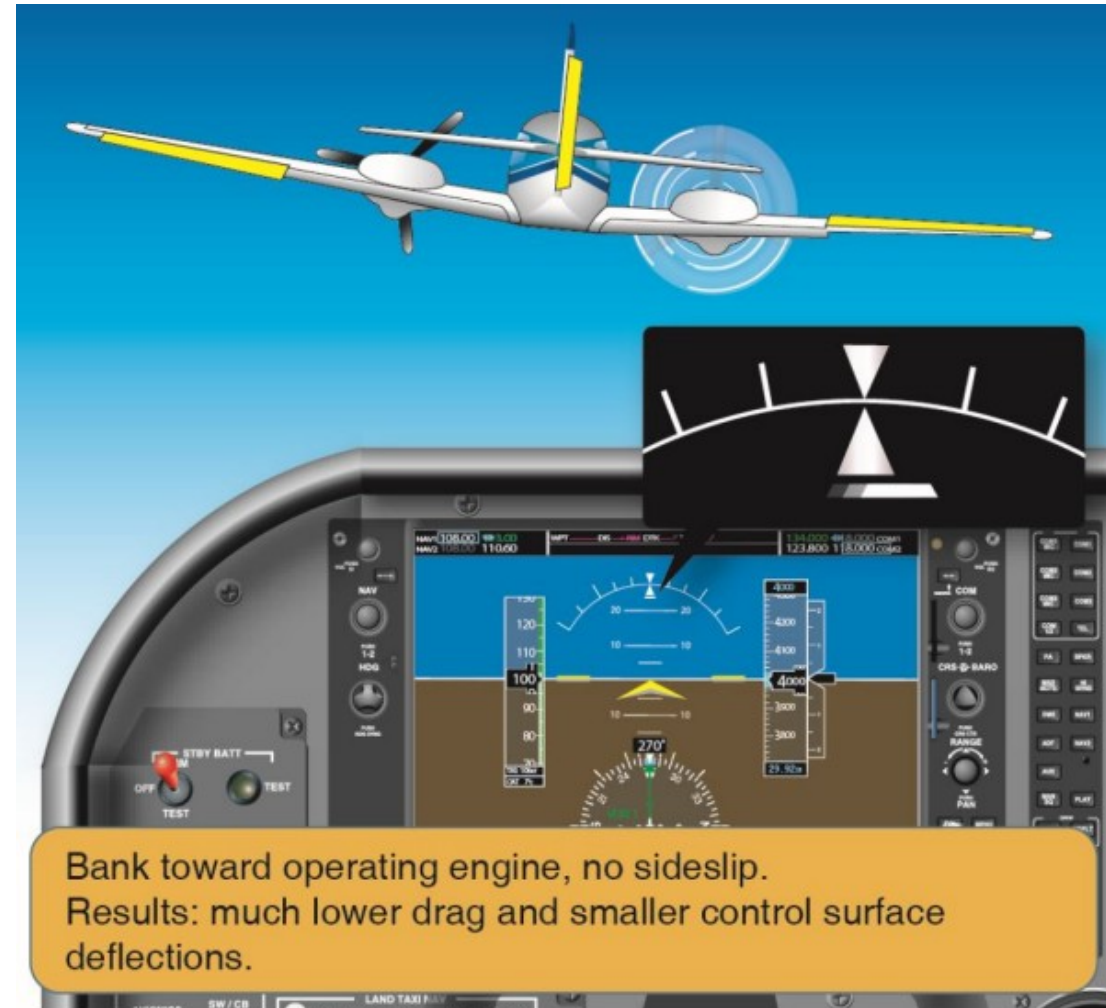
Securing Failed Engine

Mixture.....	IDLE CUT OFF
Magnetos	OFF
Alternator.....	OFF
Cowl flap.....	CLOSE
Boost pump.....	OFF
Fuel selector.....	OFF
Prop sync.....	OFF
Electrical load.....	Reduce
Crossfeed.....	Consider



Maneuvering with OEI

- Maintain a zero-sideslip
 - Straight: 1-3° bank & ½ ball deflection Turning: Maintain ½ ball deflection
- Trim
 - Elevator & rudder trim
- Maintain level flight at or above V_{YSE}
 - If impossible, maintain V_{YSE}
- Monitor fuel & crossfeed as necessary
- Decide whether to divert
- Common Error: Failure to Maintain Positive Control while Maneuvering
 - Flying comes first!



Common Errors

Maneuvering with OEI

- Failure to follow prescribed emergency checklist
- Failure to recognize an inoperative engine
- Failure to maintain best engine inoperative speed
- Failure to properly adjust engine controls and reduce drag
- Hazards of improperly identifying and verifying the inoperative engine
- Failure to maintain positive control while maneuvering
- Hazards of attempting flight contrary to the airplane's operating limitations





Hazards

Hazards

Low Altitude Maneuvering

- A small problem at high altitude can be a big problem at low altitude
- Be aware of, and avoid obstructions near the airfield
- Low Altitude & V_{MC}
 - Maintain a zero-sideslip
 - Stay at or above V_{YSE}
 - In the case of a loss of control, recover promptly
 - Reduce power
 - Lower the nose
 - Establish V_{YSE}
- Fly First!



Hazards

Low Altitude Maneuvering

- Controlled Flight Into Terrain (CFIT)
 - Avoidance starts on the ground with proper planning & decision making
- Recommendations
 - Don't attempt to fly into IMC
 - Fly above minimum safe altitudes
 - Verify ATC clearances & proper altitude
 - Maintain SA vertically and horizontally
 - Comply with appropriate regulations
 - Be extra cautious in unfamiliar areas
 - Use current charts & reference all available information
 - Use appropriate checklists
 - Know your aircraft & its equipment
 - **Verify single engine performance is compatible with the route**



Hazards

Collision Avoidance

- Scanning
 - Series of short regularly spaced eye movements
 - Continue to scan while OEI
- Communication
 - Flight Following: Inform ATC & declare an emergency
 - Not with Flight Following: Situation permitting, contact Guard and/or ATC
 - Uncontrolled Field: Clearly communicate intentions & location
- Operation Lights On
 - Turn on landing lights below 10,000' MSL
- Right-of-way rules
 - Aircraft in distress has the right-of-way
 - Be cautious



Hazards

Terrain

- Be aware of & plan for hazardous terrain along your route
- Study the Charts
 - Terminal charts & chart supplement
 - IFR/VFR chart altitudes
 - Use Maximum Elevation Figures and other data
- Performance Data
 - Ensure the single engine service ceiling clears all terrain along the route
- Minimum Safe Altitudes
 - Anywhere: Altitude allowing emergency landing without undue hazard
 - ACS: Complete all SE tasks above 3,000' AGL
 - Congested: 1,000' above the highest obstacle within 2,000'
 - Uncongested: 500' from the surface (500' from people/property)



Hazards

Obstacles & Wire Strikes

- Be familiar with any obstacles nearby airports
 - NOTAMs & Terminal Procedures
- Antenna Towers
 - Can extend over 1,000' to 2,000' AGL
 - Supporting guy wires can extend 1,500' horizontally
- Overhead Wires
 - Transmission lines often span runway departures and landmarks pilots follow
 - Lakes, highways, railroad tracks, etc.
- Minimum Safe Altitudes
 - ACS: Complete all single engine tasks > 3,000' AGL
 - Or the manufacturer's recommended altitude, whichever is higher



Hazards

Distractions

- They're dangerous
 - Remove them from view
 - If a person, explain the situation & ask them to stop
- Don't fixate on the problem at the detriment of flying
 - Airplanes have been lost due to engine failures at altitude for this reason
- Aviate, Navigate, Communicate
 - Focus on flying, especially with an inoperative engine



Hazards

SA & Disorientation

- Maintain Situational Awareness & Orientation
 - Starts with preflight planning – Know your options & have a plan
 - Know where you are, what's coming next, & stay ahead of the airplane
 - If SA or orientation is lost, admit it, and fix it
- Disoriented: Get the aircraft to a safe attitude, airspeed, and altitude
 - Zero side-slip at V_{YSE} - never below V_{MC}
 - Recover if below V_{MC}
- Ask for Help when it's Needed
 - ATC, Guard, other pilot/passengers, etc.



Hazards

Task Prioritization

- #1 Task: Safely flying the airplane
- Divide attention between the aircraft, scanning, & communicating
 - No responsibility should take full attention for more than a short period
 - Verify aircraft performance often & consistently during any checklists
- Understand what needs to be accomplished and when
 - Use standard operating procedures & checklists
- Recognize when you're behind and find a way to catch up
 - “Attack the closest alligator”





Questions?