GRUMMAN COUGAR TRAINING MANUAL

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Introduction

Power Settings

This document is intended to introduce to you the standard method of performing maneuvers in the Grumman American GA-7 Cougar aircraft. Each maneuver has been written to reduce the amount of steps and aid in memorization.

The GA-7 Cougar has five simple initial power settings each pilot should remember. They serve as a reference point to initiate a maneuver. Fine-tuning will be necessary. They are:

	MP	**RPM**
Climb	25”	2500 or MAX (Not to Exceed Red Line)
Normal Cruise	23”	2300
All-Engine Pattern/Landing	15-17”	2300
Single-Engine Pattern/Landing	18-21”	2500
Sustained Single-Engine	25”	2500

The sustained single-engine power setting is meant to reduce engine wear if practicing single-engine maneuvers and enable you to maintain altitude. If you are unable to maintain altitude at V_{YSE}, use full power and full operating RPM.

While practicing single-engine operations all pilots should monitor engine gauges with increased attention. Consider closing the cowl flap on the inoperative engine and opening the operating engine’s cowl flap.

As always, if the approved Airplane Flight Manual and this Maneuvers Checklist disagree, the procedure in the AFM should be followed in the interest of safety.

Landing Speed Considerations

Note that there are slight differences in the speeds in our procedures and those specified in the Pilot’s Operating Handbook. Our speeds are slightly higher in order to add a margin of safety should an engine fail while in the landing phase. Accordingly, when calculating landing distances, you should account for the extra speed needed to come to a complete stop.

Single engine landings are to be conducted with no more than 20° of flaps due to drag considerations. Runways less than 4,000’ should not be considered for a single engine landing.

Recurrent Training

In addition to basic landing currency requirements, it is highly recommended that multiengine pilots receive regular recurrent training from a qualified multiengine instructor or training firm, at a minimum of twelve month intervals. This training should include instrument procedures, operations with an engine failure under VMC and IMC, and a review of systems and procedures.

Clearing Turns

Objective:	To visually clear the area surrounding the aircraft so as to not pose a collision hazard to any other traffic.	
ACS	**Private Multi Add-On:**	None
	Commercial Multi Add-On:	None
	ME Instructor:	None

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed			

PROCEDURE

1) Establish power setting for appropriate speed for maneuver to be followed by clearing turns.
2) Visually clear the areas to the right, front, left, and behind the aircraft. Also look for traffic above and below your altitude.
3) Turn 90° to the left.
4) Visually scan the area again.
5) Turn 90° to the right.
6) Scan the area one last time.
7) Announce intentions on Practice Area Advisory Frequency (if applicable).

PRE-MANEUVER CHECKLIST AND PATTERN CHECKLIST (DOWNWIND, BASE AND FINAL)

G= GAS
U= UNDERCARRIAGE
M= MIXTURES
P= PROPELLERS
S= SEAT BELTS, LIGHTS AND COWL FLAPS (PILOT'S DISCRETION).

Normal/Crosswind Takeoff

Objective:	To depart an airport during normal or crosswind conditions with more than adequate clearance of obstacles on departure.	
ACS	**Private Multi Add-On:**	V_Y +10/-5 knots
	Commercial Multi Add-On:	V_Y ±5 knots
	ME Instructor:	V_Y ±5 knots

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed		Liftoff: 71 KIAS Climb: 95 KIAS VY	
CLIMB	V_Y = 95 KIAS	V_X = 81 KIAS	V_{YSE} = 85 KIAS

PROCEDURE

1) Visually scan for traffic on final and down the departure end of runway.
2) Taxi into position for takeoff. Position aileron controls for crosswind.
3) Smoothly increase throttles to takeoff power while maintaining directional control. If a crosswind exists, it is acceptable to lead slightly with the upwind throttle.
4) Scan engine instruments, manifold pressure and tachometers.
5) Verify indicated airspeed is functioning.
6) Announce “Engine instruments checked, Airspeed alive.”
7) Maintain enough aileron pressure to keep wings level if a crosswind exists.
8) At 71 KIAS, smoothly pitch up to rotate (Approximately 3°/second).
9) Establish climb attitude (Approximately 10° up) while accelerating to 95 KIAS (VY).
10) When established in a climb above 35’ (NO MORE USABLE RWY), announce “Positive rate (on the altimeter), Gear UP,” and retract the landing gear.
11) Crab into the wind if necessary.
12) At 1000’ AGL, Set Climb Power. 25 MP 2500 RPM. If staying in the pattern: Check for traffic and turn crosswind at 300’ from TPA. Follow noise abatement procedures if applicable.
13) If exiting the pattern: At 1000’ AGL turn fuel pumps off one at a time, and complete “Climb” checklist. Accelerate to Cruse Climb (100 KTS).

Short Field Takeoff

Objective:	To depart an airport during with obstacles on departure demanding a maximum performance takeoff and climb out.	
ACS	**Private Multi Add-On:**	V_X +10/-5 knots until clear, then V_Y +10/-5 knots
	Commercial Multi Add-On:	V_X +5/-0 knots until clear, then V_Y ±5 knots
	ME Instructor:	V_X +5/-0 knots until clear, then V_Y ±5 knots

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed		Liftoff: 71 KIAS 50-Ft: 81 KIAS (VX)	

PROCEDURE

1) Visually scan for traffic on final and down the departure end of runway.
2) Taxi into position for takeoff utilizing maximum available runway. Position aileron controls for crosswind.
3) Stand on the brakes and increase the power to FULL POWER
4) Check engine instruments, Manifold Pressure, and Tachometers.
5) Release brakes.

Caution:

Expect full right rudder pressure to be necessary during beginning of takeoff roll due to Torque Effect

6) Scan engine instruments and verify indicated airspeed is functioning.
7) Maintain enough aileron pressure to keep wings level if a crosswind exists.
8) At 71 KIAS, rotate, looking for V_X (**81 KIAS**).
9) Establish climb attitude (Approx 12° up).
10) When established in a climb above 35’, announce “Positive rate, Gear UP,” and retract the landing gear.
11) Maintain 81 KIAS until clear of obstacles or 50’, and then lower the nose slightly to accelerate to 95 KIAS.
12) Crab into the wind if necessary.
13) At 1000’ AGL, set Climb Power 25 MP 2500 RPM.
14) If staying the pattern: Check for traffic and turn crosswind at 300’ from TPA. Follow noise abatement procedures if applicable.
15) If exiting the pattern: At 1000’ AGL turn fuel pumps off one at a time, set climb power 2500 RPM/25 in and complete “Climb checklist.” Accelerate to Cruise Climb (100 KTS).

Normal/Crosswind Landing

Objective:	To arrive and land at an airport during normal or crosswind conditions with more than adequate clearance of obstacles on approach.	
ACS	**Private Multi Add-On:**	V_{REF} +10/-5 knots (plus wind factor)
	Commercial Multi Add-On:	V_{REF} ±5 knots (plus wind factor)
	ME Instructor:	V_{REF} ±5 knots (plus wind factor)

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	85 KIAS	Downwind: 100 KIAS Base: 90 KIAS Final: 85 KIAS	Pattern: 120 KIAS

PROCEDURE

1) Complete the Approach checklist 5 NM prior to entering pattern (GUMPS).
2) Slow to desired pattern entry speed 2 NM prior to entering pattern.
3) Enter the pattern on a 45° downwind entry at least 2 NM from the runway, at pattern altitude. Set power to approximately 17-20”/2300 RPM.
4) Maintain ½ to ¾ mile separation from the runway and turn downwind. (Runway should appear about ¾ up wing)
5) Abeam the selected point of landing, extend the landing gear and leave hand on handle until 3 Green/No Yellow has been confirmed. Announce “Gear Down and Locked.”
6) Extend flaps to 10°. Descend at 100 KIAS.
7) 45° from the point of landing turn base extend flaps to 20° and GUMPS check.
8) Visually clear opposite base and final.
9) Turn final, GUMPS check. Props Forward Set flaps to 30° (Full Down) when runway is made.
10) Slow to 85 KIAS, adjusting power if necessary.
11) At 500’ AGL, verify cleared to land, Gear Down and brake check.
12) During flare, reduce throttles to idle (at pilots discretion, some power may be left on upwind engine in a crosswind until touchdown), and touch down smoothly.
13) Initiate braking after nose wheel has touched down.

Short Field Landing

Objective:	To arrive at an airport and land safely where there is a limited length of runway and/or obstacles on approach.	
ACS	**Private Multi Add-On:**	V_{REF} +10/-5 knots (plus wind factor), within 200 feet of touchdown point, on centerline, no side drift
	Commercial Multi Add-On:	V_{REF} ±5 knots (plus wind factor), within 100 feet of touchdown point, on centerline, no side drift
	ME Instructor:	V_{REF} ±5 knots (plus wind factor), within 100 feet of touchdown point, on centerline, no side drift

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	81 KIAS (WHEN RWY MADE)	Downwind: 100 KIAS Base: 90 KIAS Final: 85 KIAS	Pattern: 120 KIAS

PROCEDURE

1) Complete the Approach checklist 5 NM prior to entering pattern.
2) Slow to desired pattern entry speed 2 NM prior to entering pattern.
3) Enter the pattern on a 45° downwind entry at least 2 NM from the runway, at pattern altitude. Set power to 15”/2300 RPM.
4) Maintain ½ to ¾ mile separation from the runway and turn downwind. (Runway should appear about ¾ up wing)
5) Abeam your selected point of landing, extend landing gear and leave hand on handle until 3 Green/No Yellow has been confirmed. Announce “Gear Down and Locked.”
6) Extend flaps to 10°. Descend at 100 KIAS.
7) 45° from the point of landing turn base and extend flaps to 20°. GUMPS check.
8) Visually clear opposite base and final.
9) Turn final (85 KTS), GUMPS check. Props Forward. Set flaps to 30° (Full Down) when runway is made.
10) Slow to 80 KIAS by setting Manifold Pressure to 14” or as necessary. It is likely that additional power may be required to maintain Vref after aircraft is stabilized on speed and descent profile.
11) At 500’ AGL, verify cleared to land, Gear Down and brake check.
12) During flare, reduce throttles to idle and touch down smoothly.
13) Initiate maximum braking after nose wheel has touched down.

Go-Around/Rejected Landing

Objective:	To safely abort a landing and establish climb configuration as quickly as possible.	
ACS	**Private Multi Add-On:**	V_Y +10/-5 knots
	Commercial Multi Add-On:	V_Y ±5 knots
	ME Instructor:	V_Y ±5 knots

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	85 KIAS		

PROCEDURE

1) Apply full power.
2) Pitch up for V_{YSE} (85 KIAS).
3) Verify props and mixtures full forward, and retract flaps to 20˚.
4) When Established in a positive rate of climb, retract the landing gear.
5) Clear of obstacles, Verify airspeed is at or above 85 KIAS, and retract flaps.
6) Sidestep to the left or right (as appropriate) and announce intentions to CTAF/ATC.
7) Accomplish “Climb” checklist.

Note

The recall checklist for a go-around is as follows:

- **“MAX POWER, FLAPS 20”**
- **“POSITIVE RATE, GEAR UP”**
- *Clear obstacles:* **“FLAPS UP, CLIMB CHECKLIST”**

Emergency Descent

Objective:	To quickly gain airspeed and lose altitude. Simulation of putting out an engine fire is appropriate for this maneuver and should be practiced.	
ACS	**Private:**	Bank 30 to 45° A/S +0/-10, Recovery Alt +/-100’
	Commercial:	Bank 30 to 45° A/S +0/-10, Recovery Alt +/-100’
	ME Instructor:	Bank 30 to 45° A/S +0/-10, Recovery Alt +/-100’

Restrictions	Minimum	Optimum	Maximum
Altitude	Recovery: 2000’ AGL	4000’ AGL	
Speed	130 KIAS		140KIAS

PROCEDURE

1) Brief entry and level off altitudes.
2) Perform clearing turns, with increased emphasis on traffic below your position.
3) Throttles IDLE. Carb Heat On.
4) Set props full forward.
5) Mixtures Rich.
6) Flaps up.
7) Gear down below 145 kts.
8) Initiate bank (30 º - 45º), Airspeed not to exceed VLE (145 KIAS).

Note

The recall checklist for an emergency descent is as follows:

- **THROTTLES IDLE, CARB HEAT ON, MIXTURES RICH**
- **PROPELLERS MAX RPM**
- **GEAR DOWN< 145**
- **LEVEL OFF ALTITUDE-CHECK**
- **ATC – ADVISE**

1) Approaching level-off altitude, begin pitching up to arrest descent rate.
2) At target altitude, maintain altitude while slowing to landing gear retraction speed (V_{LO}).
3) Carb. heat off.
4) Retract landing gear.
5) Return aircraft to cruise configuration. Complete “Cruise” checklist.

DISCUSSION:

This maneuver can be used:

- To extinguish and engine fire
- Rapidly loose altitude in preparation for a precautionary landing
- In the event of a medical emergency
- Escaping altitude hypoxia

PERFORMANCE MANEUVER

Steep Turns

Objective:	To maintain two opposite-direction, level turns while rolling out on entry heading for both turns.	
ACS	**Private:**	45° Bank ±5°, Altitude ±100 feet, Heading ±10°, Airspeed ±10 knots
	Commercial:	50° Bank ±5°, Altitude ±100 feet, Heading ±10°, Airspeed ±10 knots

	ME Instructor:	50° Bank ±5°, Altitude ±100 feet, Heading ±10°, Airspeed ±10 knots

Restrictions	Minimum	Optimum	Maximum
Altitude	3000' AGL		
Speed		120 KIAS	

PROCEDURE

1) Perform pre-maneuver check, and clearing turns.
2) Set power to 22"/2300 RPM and maintain approximately 120 KIAS (V_A).
3) Stabilize aircraft on entry heading and set heading indicator bug.
4) Roll left into the turn. Add power (MP 23").
5) Maintain altitude by pitching up; maintain coordination with rudder pressure, and monitor VSI, altimeter, heading indicator, and airspeed to coordinate rollout.
6) Using your heading reference bug, lead rollout by approximately twenty degrees, reduce power again to 20" MP past 30° of bank and maintain altitude by reducing pressure on yoke.
7) Roll out on reference heading.
8) Repeat procedure in opposite direction.
9) After rolling out again, return airplane to cruise configuration.

Maneuvering During Slow Flight

Objective:	To maneuver the aircraft safely at minimum possible airspeed.	
ACS	**Private:**	Bank ±10°, Altitude ±100 feet, Heading ±10°, Airspeed +10/-0 knots. Stall recovery at first indication.
	Commercial:	Bank ±5°, Altitude ±50 feet, Heading ±10°, Airspeed +5/-0 knots. Stall recovery at first indication.
	ME Instructor:	Bank ±5°, Altitude ±50 feet, Heading ±10°, Airspeed +5/-0 knots. Stall recovery at first indication.

Restrictions	Minimum	Optimum	Maximum
Altitude	Completed no lower than 3000’	3500’	
Speed	80 KIAS	80 KIAS	

PROCEDURE

1) Set power to 15”/2300 RPM.
2) Perform pre-maneuver check, and clearing turns.
3) Below 145 KTS Gear Down, Prop Levers Full Forward, flaps to 30°.
4) Establish and maintain an airspeed at which any further increase in angle of attack, increase in load factor, or reduction in power, would result in a stall warning (e.g., aircraft buffet, stall horn, etc.). Add power to maintain level flight at altitude and pitch to maintain air speed.
5) Maintain coordinated flight, add power during turns to prevent a stall.
6) Recovery:
    a) Set MAX power and flaps to 20˚
    b) At 85 KIAS retract the landing gear.
    c) Retract remaining flaps.
    d) At cruise airspeed, set cruise power and Complete “Cruise” checklist.

Power On Stall

Objective:	To demonstrate recovery from a stall in the takeoff configuration.	
ACS	**Private:**	Heading ±10°, Bank not to exceed 20°±10°, V_Y before Flaps 0°. Stall Recovery at first indication.
	Commercial:	Heading ±10°, Bank not to exceed 20°±10°, V_Y before Flaps 0°. Stall Recovery at first indication.
	ME Instructor:	Heading ±10°, Bank not to exceed 20°±10°, V_Y before Flaps 0°. Stall Recovery at first indication.

Restrictions	Minimum	Optimum	Maximum
Altitude	3500’ AGL no lower than 3000’ AGL		
Speed			

PROCEDURE

1) Set power to 15”/2300 RPM.
2) Perform pre-maneuver check, and clearing turns.
3) Prop Levers Full Forward.
4) At 80 KIAS, set power to 20” Manifold Pressure (no lower than 65% power).
5) Pitch up to stalling airspeed (Maximum pitch attitude 20°).

Recovery:

6) At first sign of stall (buffet or horn), add full Power and reduce pitch attitude. Maintain coordinated flight and level the wings.
7) Pitch for V_{YSE}.
8) At completion of maneuver:
    a) Pitch for level flight.
    b) Establish cruise configuration.
    c) Complete “Cruise” checklist.

Power Off Stall

Objective:	To demonstrate recovery from a stall in the landing configuration.	
ACS	**Private:**	Heading ±10°, Bank not to exceed 20°±10°, V_Y before Flaps 0°. Stall Recovery at first indication.
	Commercial:	Heading ±10°, Bank not to exceed 20°±5°, V_Y before Flaps 0°. Stall Recovery at first indication.
	ME Instructor:	Heading ±10°, Bank not to exceed 20°±10°, V_Y before Flaps 0°. Stall Recovery at first indication.

Restrictions	Minimum	Optimum	Maximum
Altitude	3500' AGL no lower than 3000'AGL		
Speed			

PROCEDURE

1) Set power to 15"/2300 RPM.
2) Perform clearing turns.
3) Below 145 KIAS: Landing Gear Down.
4) Props Forward, flaps to 30°, begin gradual descent.
9) Reduce power to idle and pitch up smoothly; do not climb.

Recovery:

5) At first sign of impending stall (buffet or horn), add Full Power and reduce pitch attitude. Maintain coordinated flight and level the wings.
6) Above VS0, Retract flaps to 20° and pitch for VX (if obstructions) or VY .
7) Positive rate, Gear UP.
8) Retract flaps to 0° above.
9) At completion of maneuver:
    a) Pitch for level flight.
    b) Establish cruise configuration.
    c) Complete "Cruise" checklist.

Accelerated Stalls

Objective:	To demonstrate recovery from a n accelerated stall.	
ACS	**Private:**	
	Commercial:	Bank 45°. Stall Recovery at first indication. Accelerate to VX/VY
	ME Instructor:	Bank 45° 0°. Stall Recovery at first indication. Acceleratr to VX/VY

Restrictions	Minimum	Optimum	Maximum
Altitude	3000'AGL	3500	
Speed		120	VA

PROCEDURE

1) Perform clearing turns
2) Set; Power 15-17 MP, Props FWD
3) Establish a 45° Bank
4) Slowly increase the backpressure until first stall indication

Recovery:

1) Level the wings and apply full power
2) Accelerate to VX/VY

Complete "Cruise" checklist.

Engine Failure During Takeoff Before V_{MC}

Objective:	To demonstrate a successful aborted takeoff in the event of an engine failure before liftoff.	
ACS	**Private:**	Throttles to idle, maintain directional control.
	Commercial:	Throttles to idle, maintain directional control.
	ME Instructor:	Throttles to idle, maintain directional control.

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	30 KIAS	35 KIAS	40 KIAS

PROCEDURE

1) Reduce throttles to idle.
2) Maintain directional control.
3) Apply sufficient braking to stop on the runway.
4) Notify ATC/CTAF.

Note:
The recall checklist for an engine failure prior to Vmc is as follows:

- **THROTTLES** **IDLE**
- **BRAKING** **MAXIMUM AS REQUIRED**

Advise ATC and accomplish "Ground Evacuation" checklist if required

Engine Failure After Liftoff (Simulated)

Objective:	To demonstrate a successful engine failure procedure after liftoff.	
ACS	**Private:**	Heading ±10°, Airspeed ±5 knots (VYSE 85)
	Commercial:	Heading ±10°, Airspeed ±5 knots (VYSE 85)
	ME Instructor:	Heading ±10°, Airspeed ±5 knots (VYSE 85)

Restrictions	Minimum	Optimum	Maximum
Altitude	500' AGL		
Speed	85 KIAS	85 KIAS	

PROCEDURE

1) Maintain Directional Control of the aircraft.
2) Maintain V_{YSE} as appropriate (at or above).
3) Verify Maximum Thrust:
   a) Mixtures **FULL RICH**.
   b) Prop Levers **FULL FORWARD**.
   c) Throttles **FULL FORWARD**.
   d) Speed VYSE 85 KTS (at or above)
4) Verify flaps and landing gear are **UP.**
5) **IDENTIFY** inoperative engine ("dead foot, dead engine").
6) **VERIFY** inoperative engine by reducing throttle on suspected engine.
7) **Point to the Propeller** to be feathered. Instructor will set Zero Thrust (12" MP) to simulate feathering the inoperative engine (props remain forward).
8) **ESTABLISH** Zero-Sideslip (Sufficient rudder pressure into operating engine, 2°-3° of bank and half a ball into operating engine). Only in straight and level flight.
9) Maintain @ or above V_{YSE}.
10) Accomplish "Engine Failure, Fire, or Severe Damage" recall items and "securing inoperative engine" checklist.
11) Simulate declaring emergency, return for landing.

Note:
The recall checklist for an engine failure in flight is as follows:

- MIXTURES-FWD
- PROPS-FWD
- THROTTLE -FWD
- VYSE 85 KTS
- FLAPS AND GEAR UP
- IDENTIFY (dead foot dead engine) VERIFY (throttle back) FIX OR FEATHER.

Accomplish "Securing Inoperative Engine" checklist

Discussion:

An engine failure in a critical phase of flight requires an immediate and precise response in order to maintain aircraft control. The response should be memorized as follows:

“mixtures forward, propellers forward, throttles forward, , flaps up and gear up, identify (“dead foot, dead engine”), verify (with affected engine throttle), fix or feather (inoperative engine), CHECKLIST.

Approach & Landing with Inoperative Engine

Objective:	To approach an airport and land safely with one engine inoperative. This maneuver should only be attempted with a simulated failure.	
ACS	**Private:**	Stabilized Approach, Airspeed V_{YSE} +10/-5 knots
	Commercial:	Stabilized Approach, Airspeed V_{YSE} ±5 knots
	ME Instructor:	Stabilized Approach, Airspeed V_{YSE} ±5 knots

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	90 KIAS		

PROCEDURE

1) Complete “Engine Failure, Fire, or Severe Damage” checklist and “Securing Inoperative Engine” checklist.
2) Complete the Approach checklist 5 NM prior to entering pattern.
3) Enter the pattern on a 45° downwind entry, at pattern altitude*. Set power to 22”/2500 RPM. If more power is required to maintain V_{YSE}/altitude, more may be used. Maintain 100 KIAS.
4) Abeam the selected point of landing or 3 nm final, Gear Down .
5) 45° from the point of landing, turn base, 10° may be selected.
6) Visually clear opposite base and final.
7) Turn final. Slow to 90-100 KIAS, adjusting power if necessary. Complete final GUMPS check.
8) Props Forward. Maximum flap setting is 20° on one engine.
9) Clearing the airport boundary, begin slowing to touchdown speed.
10) During flare, reduce throttles to idle, maintain directional control, and touch down smoothly.
11) Initiate braking after nose-wheel has touched down.

Note:

Rudder trim should be set to neutral prior to commencing approach to alleviate directional control issues in flare. Be prepared to center rudder and/or use appropriate crosswind technique during flare to maintain aircraft position and heading over runway centerline

**If an engine failure after takeoff during initial climb*, *pattern altitude shall be the minimum safe altitude for obstacle clearance, typically 1,000’ AGL. For an engine failure at cruise or in descent, standard pattern altitude should be used.*

Maneuvering with One Inoperative Engine

Objective:	To demonstrate the aircraft's behavior and performance during operations with one engine inoperative.	
ACS	**Private:**	Altitude ±100 feet or minimum sink, Heading ±10°
	Commercial:	Altitude ±100 feet or minimum sink, Heading ±10°
	ME Instructor:	Altitude ±100 feet or minimum sink, Heading ±10°

Restrictions	Minimum	Optimum	Maximum
Altitude	4500' AGL		
Speed	85 KIAS	100 KIAS	

PROCEDURE

1) Situate aircraft above a suitable airfield in the event a restart is unsuccessful.
2) Set power to 15"/2300 RPM.
3) Perform pre-maneuver check, and clearing turns.
4) At 100 KIAS, set prop levers full forward.
5) Stabilize the aircraft at or above 85 KIAS and maintain altitude.
6) Move power to idle on inoperative engine.
7) Move mixture to idle-cutoff.
8) Use rudder pressure to counteract yawing tendency, establish zero sideslip.
9) Feather inoperative engine.
10) Perform "Securing Inoperative Engine" checklist.
11) Maintain altitude and at least V_{YSE}+10. Set 25" MP and 2500 RPM.
12) Perform climbs, descents, and turns as directed.
13) Perform "In-flight Engine Start" checklist.
14) Return to cruise configuration. Complete "Cruise" checklist.

Note

If unable to restart the inoperative engine, it is to be considered an emergency and the aircraft should be landed at the nearest suitable airport. Demonstration of actual shut-down of an engine should only be accomplished above 4,500 AGL and within GLIDING DISTANCE of a suitable airfield.

V_{MC} Demonstration

Objective:	To demonstrate the aircraft's behavior during simulated V_{MC} conditions. The instructor will block the rudder in order to induce V_{MC} conditions before stalling speed. See notes at end of procedure.	
ACS	**Private:**	Heading ±20°, Recover to V_{YSE} +10/-5 knots
	Commercial:	Heading ±20°, Recover to V_{YSE} ±5 knots
	ME Instructor:	Heading ±20°, Recover to V_{YSE} ±5 knots

Restrictions	Minimum	Optimum	Maximum
Altitude	3000' AGL		
Speed	80 KIAS (simulated VMC)		

PROCEDURE

1) Set power to 15-17"/2300 RPM.
2) Mixtures Rich Flaps and Landing Gear Up.
3) Perform pre-maneuver check, and clearing turns.
4) At 100 KIAS, set prop levers full forward.
5) Reduce power on simulated inoperative engine (Left Engine). Engine should remain wind-milling.
6) Set full power on operating engine (Right Engine).
7) Establish zero sideslip.
8) Being pitching up and slowing at 1 knot per second.
9) Use rudder pressure to counteract yawing tendency.
10) At 85 KIAS, instructor will block the rudder to maintain safe margin from stall speed. Refrain from using ailerons to maintain directional control.
11) Initiate recovery at the first sign of uncontrolled heading drift, stall horn, stall buffet, or stall airspeed:
    a) Reduce power on operating engine smoothly to regain control.
    b) Maintain maximum available rudder pressure.
    c) Lower nose to regain airspeed.
    d) As airspeed increases above V_{MC} increase power on available engine.
    e) With sufficient airspeed, maintain V_{YSE} and full power on operating engine.
12) Increase power on inoperative engine and return to cruise configuration.
13) Complete "Cruise" checklist.

Note:

In addition to blocking rudder, use of aileron for directional control beyond initial zero sideslip configuration should be avoided so as to permit realistic V_{MC} demonstration without the aircraft stalling first.

Drag Demonstration

Objective:	To demonstrate the associated drag penalties with different configurations during single-engine operations.	
	Private:	Not Applicable
	Commercial:	Not Applicable
	ME Instructor:	Exhibits instructional knowledge; demonstrates and explains.

Restrictions	Minimum	Optimum	Maximum
Altitude	3000' AGL		
Speed	75 KIAS	85 KIAS	95 KIAS

PROCEDURE

1) Set power to 15-17"/2300 RPM.
2) Perform pre-maneuver check, and clearing turns.
3) Gear and Flaps up. Mixtures Rich.
4) Set propeller levers full forward at or below 100 KIAS.
5) Slow to 85 KIAS (V_{YSE}).
6) Reduce power on simulated inoperative engine. Set zero thrust (12"MP).
7) Advance operating engine to full power, Cowl Flaps **OPEN**.
8) Establish **zero sideslip**.
9) Maintain 85 KIAS (V_{YSE}). Note VSI indication.
10) Slow to 75 KIAS. Note VSI indication.
11) Increase to 95 KIAS. Note VSI indication.
12) Extend landing gear and maintain 85 KIAS. Note VSI indication.
13) Extend flaps to 10°, 20°, and full down. For each, note VSI indication.
14) Retract flaps and landing gear on schedule.
15) Reduce power on inoperative engine to idle to windmill propeller. Note VSI
16) Recover and return to cruise configuration.
17) Complete "Cruise" checklist.

Precision Approach, Single-Engine

Objective:	To safely execute a precision instrument approach procedure with one engine inoperative.	
Practical Test Standards	**Private:**	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale
	Commercial:	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale
	ME Instructor:	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	85 KIAS	90 KIAS	100 KIAS

PROCEDURE

1) Outside FAF (approximately 1 to 2 miles) FAF, 10° of flaps and accomplish “Before Landing” checklist (GUMPS). Gear Down @ FAF.
2) Set 18” MP and propeller on operating engine to maximum RPM.
3) Maintain 90-100 KIAS.
4) Maximum flap setting shall be 20° when landing assured.

Caution:

Use maximum flap setting of 20° for landing once the RWY is made. Recovery from a missed approach or low altitude go-around with more than 20° of flaps is doubtful. Adjust landing speed and distance to account for partial flap configuration.

Non-Precision Approach, Single-Engine

Objective:	To safely execute a non-precision instrument approach procedure with one engine inoperative.	
ACS	**Private:**	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale
	Commercial:	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale
	ME Instructor:	Altitude ±100’, Airspeed ±10 knots, Heading ±10°, CDI ¾ scale

Restrictions	Minimum	Optimum	Maximum
Altitude			
Speed	85 KIAS	90 KIAS	100 KIAS

PROCEDURE

1) Outside FAF (approximately 1 to 2 miles) , 10° of flaps. Initial power setting is 18” MP and MAX RPM. Perform GUMPS check. Gear down @ FAF.
2) Maintain 90-100 KIAS.
3) Maximum flap setting shall be 20° when landing assured.
4) Upon reaching MDA/VDP, verify runway in sight. If not in sight, execute missed approach using SE Missed Approach Procedure
5) On Circling Approach, extend the gear after circling and when the runway is assured.

Caution:

Use maximum flap setting of 20° for landing. Recovery from a missed approach or low altitude go-around with more than 20° of flaps is doubtful. Adjust landing distance and speed to account for partial flap configuration.

WARNING:

*Use **extreme caution** when executing a non-precision single engine approach as level off at MDA is impracticable and/or the success of a missed approach is doubtful. Plan the descent so that MDA is reached at an appropriate Visual Descent Point (VDP) so a continuous, stabilized descent to landing can be achieved without leveling off at the MDA.*

WARNING:

*In the event of an actual engine failure in instrument meteorological conditions, it is **strongly recommended** that a precision approach be utilized. Consider diversion to an airport with suitable facilities and VFR WX conditions.*

Grumman Cougar GA7

VMC	61 kts	
VYSE	85 kts	
VX	81 kts	
VY	95 kts	100 kts recommended for cruise climb
VS1	71 kts	
VSO	63 kts	
VNE	188 kts	
VNO	160 kts	
VA 3800 lbs	120 kts	VA=sqrt of GW/MTOGW x VA@ mtogw
VA 2800 lbs	105 kts	
VFE 10 deg	145 kts	
VFE 30 deg	110 kts	
VLE	145 kts	
VLO G/retract	115 kts	
VLO G/extend	145 kts	
VG 3800 lbs	98 kts	
VG 2800 lbs	85 kts	
Max X wind demo	15 kts	

Approach 30 deg flap 85 kts
0 deg flap 95-100 kts

Fuel Capacity 118 gal (114gal usable)
Fuel Required 100 LL . Two (2) independent 59 Gal tanks (57 Gal usable) with X feed capability.

Engines AVCO Lycoming O-320-D1D 160 hp
Max Engine Speed 2700 RPM

Propellers Hartzell Hc-F2yl-2UF/FC7663D-3 min 72"mx 73"
Constant Speed

Max T/O Gross Weight 3800 lbs Empty Weight 2569 lbs

Electrical Power 14 Volt DC system, 12 Volt 23 amp/hr Battery. Two (2) Engine Driven Alternators (60 amps each).

WHAT MAKES A CRITICAL ENGINE CRITICAL

Part 1 of 14 CFR (the FAR's) defines the term "critical engine" in these terms: "*Critical* engine means the engine whose failure would most adversely affect the performance and handling qualities of an aircraft." Naturally, the aircraft mentioned in this definition is understood to be a *multiengine* airplane. Although no further explanation is provided in Part 1, applicants for Airplane Multiengine ratings are required to provide details of critical engine dynamics in the oral portion of the practical test, as indicated in the following excerpt from the Private Pilot and Commercial Pilot Practical Test Standard:

I. AREA OF OPERATION: PREFLIGHT PREPARATION

H. TASK: PRINCIPLES OF FLIGHT—ENGINE INOPERATIVE
(AMEL and AMES)
REFERENCES: FAA-H-8083-3, AC 61-23/FAA-H-8083-25; POH/AFM.
Objective. To determine that the applicant exhibits knowledge of the elements related to engine inoperative principles of flight by explaining the:

1. **meaning of the term "critical engine."**
2. effects of density altitude on the V_{MC} demonstration.
3. effects of airplane weight and center of gravity on control.
4. effects of angle of bank on V_{MC}.
5. relationship of V_{MC} to stall speed.
6. **reasons for loss of directional control.**
7. indications of loss of directional control.
8. importance of maintaining the proper pitch and bank attitude, and the proper coordination of controls.
9. loss of directional control recovery procedure.
10. engine failure during takeoff including planning, decisions, and single-engine operations.

Effective discussion of elements 1 and 6 (author's bold print) above requires a complete working knowledge of the dynamics involved.

Commercially-available texts offer coverage of this subject that is disorganized, incomplete, or (in some cases) erroneous. The goal of this article is to provide multiengine students with a properly-organized, accurate, and easily-understood discussion of critical engine dynamics that will enable them to quickly and correctly deal with this subject on the practical test.

Offered here is the *conventional* explanation of critical engine dynamics. While it contains some disturbing inconsistencies, discussion in these terms will satisfy the elements in the practical test standard.

Additionally, the explanation presented here is valid to a "conventional" multiengine airplane, where both propellers rotate in a clockwise direction (as viewed from the rear).

The elements involved a discussion of critical engine mechanics are commonly committed to memory using the mnemonic acronym **PAST**: **P**-factor, **A**ccelerated slipstream, **S**piraling slipstream, and **T**orque.

P-FACTOR, more properly called asymmetrical disc loading, is a phenomenon that occurs when an airplane is flown a high angle of attack, as would be the case of a multiengine attempting to maintain altitude or climb when being flown single-engine. As every student pilot knows (or SHOULD know), the descending blade of the propeller is operating at a much higher angle of attack than the ascending blade. This shifts the **center of thrust** to the right of the propeller hub, as illustrated in **Figure 1**.

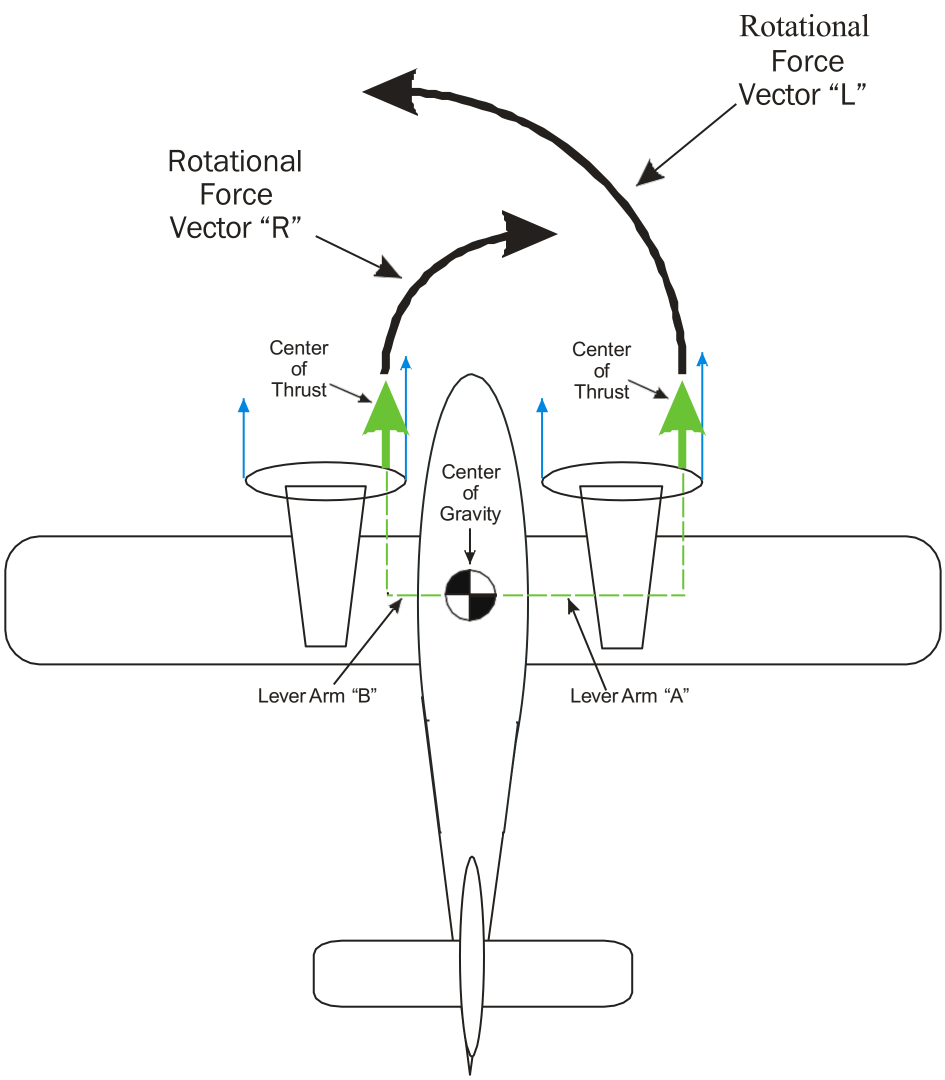

Figure 1

In this figure, the relative amounts of thrust generated by the propellers operating at a high angle of attack are represented by the blue vector arrows. When these force vectors are averaged, the result is the centers of thrust, depicted by the green vector arrows. The dashed green lines demonstrate the lever arms from the center of gravity to the centers of thrust. The same amount of thrust is generated by each engine, but, since Lever Arm "A" is longer that Lever Arm "B", then the yawing force to the left provided by the right propeller (Rotational Force Vector "L") is greater than the yawing force to the right (Rotational Force Vector "R". The conclusion is: the pilot's ability to generate enough rudder effectiveness to control yaw is diminished with the loss of the thrust from the left engine compared to the opposite condition.

Flight characteristics of the airplane that are associated with P-factor directly impact **YAW control** in single-engine operations.

ACCELERATED SLIPSTREAM is an adverse *rolling* phenomenon that is the result of P-factor. As shown in **Figure 2**, when the center of thrust shifts right as angle of attack is increased, the accelerated air behind the propeller shifts in a similar fashion.

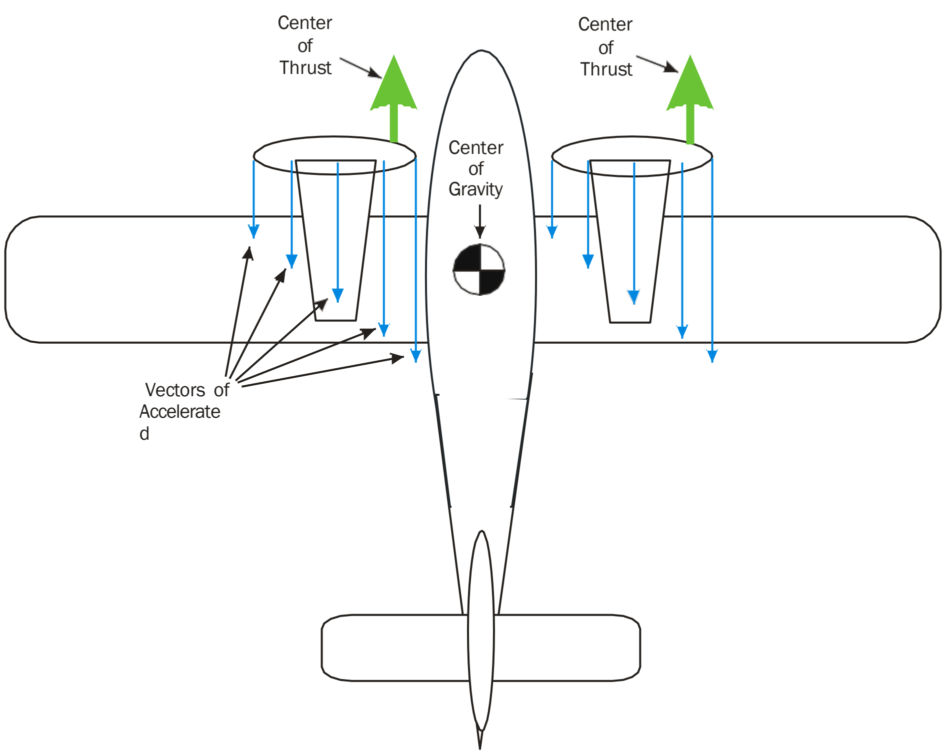

Figure 2

Since Bernoullian lift is airspeed-dependent, the center of lift shifts in the direction of the greater accelerated slipstream, as illustrated in **Figure 3**, as viewed from the rear of the airplane.

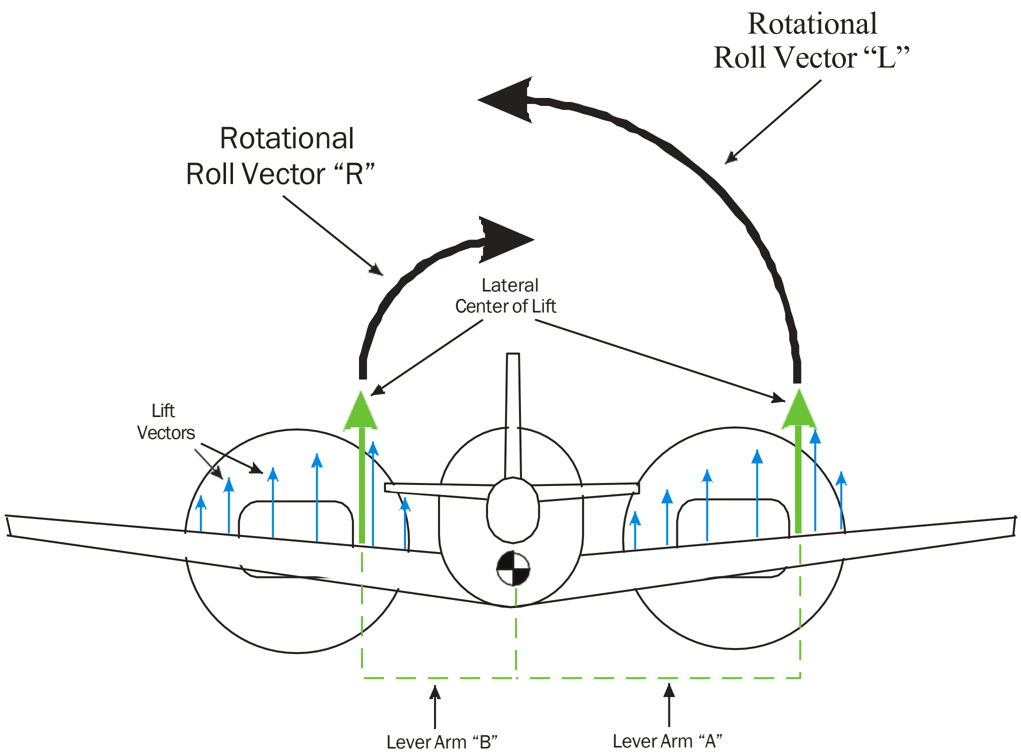

Figure 3

The lateral centers of lift produce rolling moments around the center of gravity. Since the right center of lift acts at a longer lever arm, "A", its rotational force vector, "L", is greater than rotational force vector "R" generated by the left engine/propeller. Therefore, the left engine meets the definition of *critical* because its loss would result in an airplane whose control around its roll axis would be limited to the greatest degree.

Flight characteristics of the airplane that are associated with accelerated slipstream directly impact **ROLL control** in single-engine operations.

The traditional view of the subject of **SPIRALLING SLIPSTREAM** maintains that, as a spinning propeller creates thrust, it imparts a spin to the airflow behind it. The coriolis effect causes this spiralling slipstream to be displaced laterally. In conventional multiengine airplanes with engines rotating clockwise (when viewed from the rear), that displacement is to the left, as illustrated in **Figure 4** below:

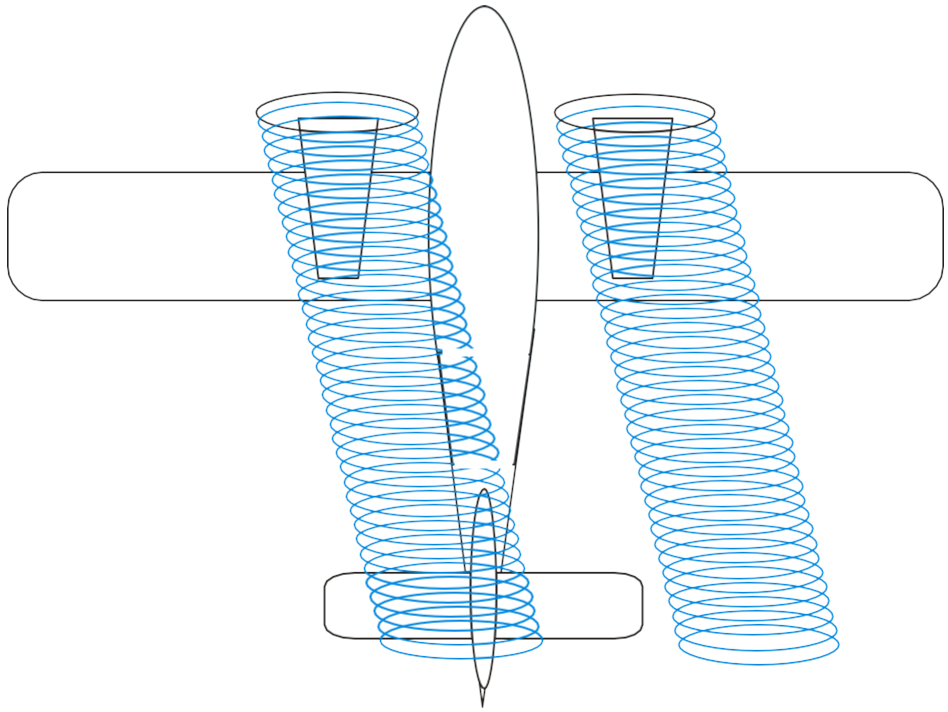

Figure 4

The slipstream from the left propeller is displaced inboard. The resulting increased airflow over the vertical fin enhances longitudinal stability. Increased airflow across the rudder provides greater control around the yaw axis. The slipstream from the right propeller angles away from the aircraft centerline, providing no advantage in terms of stability and rudder control. Therefore, loss of thrust from the left engine/propeller renders control more problematic, meeting the definition of *critical*.

Flight characteristics of the airplane that are associated with spiralling slipstream directly impact **YAW control** in single-engine operations.

TORQUE in an aircraft engine is a physical demonstration of Newton's third law of motion, which states (simply) that each action produces an equal and opposite reaction. In a conventional airplane having a propeller that rotates clockwise when viewed from behind, the torque generated by the engine will impart a left-rolling moment to the airframe. In a conventional twin-engine airplane, the torque from each engine is produced around axes defined by the engine crankshaft, and are equidistant from the aircraft centerline, as shown in **Figure 5**.

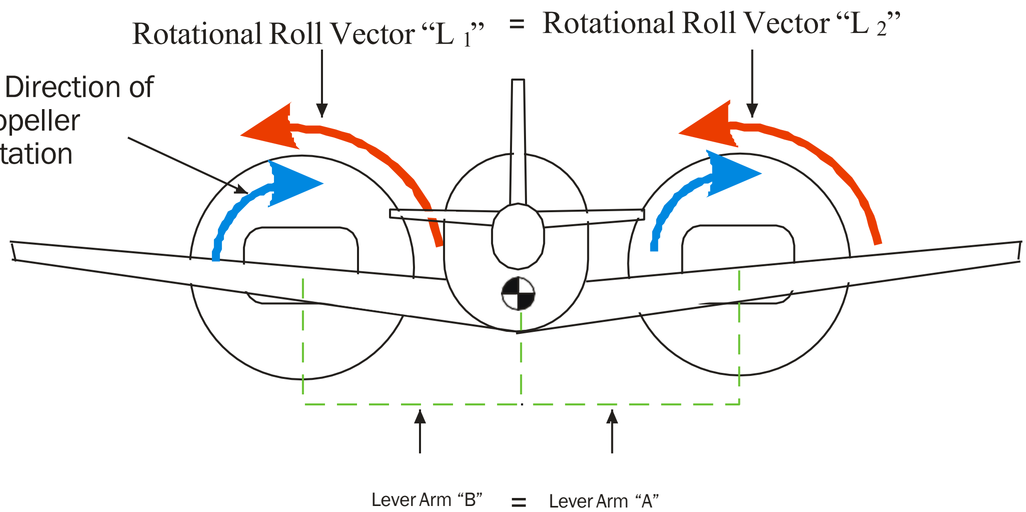

Figure 5

When torque alone is considered, neither engine meets the definition of *critical*, since each engine creates the same amount of torque in the same direction. But when torque is considered in combination with asymmetrical thrust resulting from power loss on one engine, the concept becomes clear. **Figure 6** illustrates these forces when the right engine is inoperative.

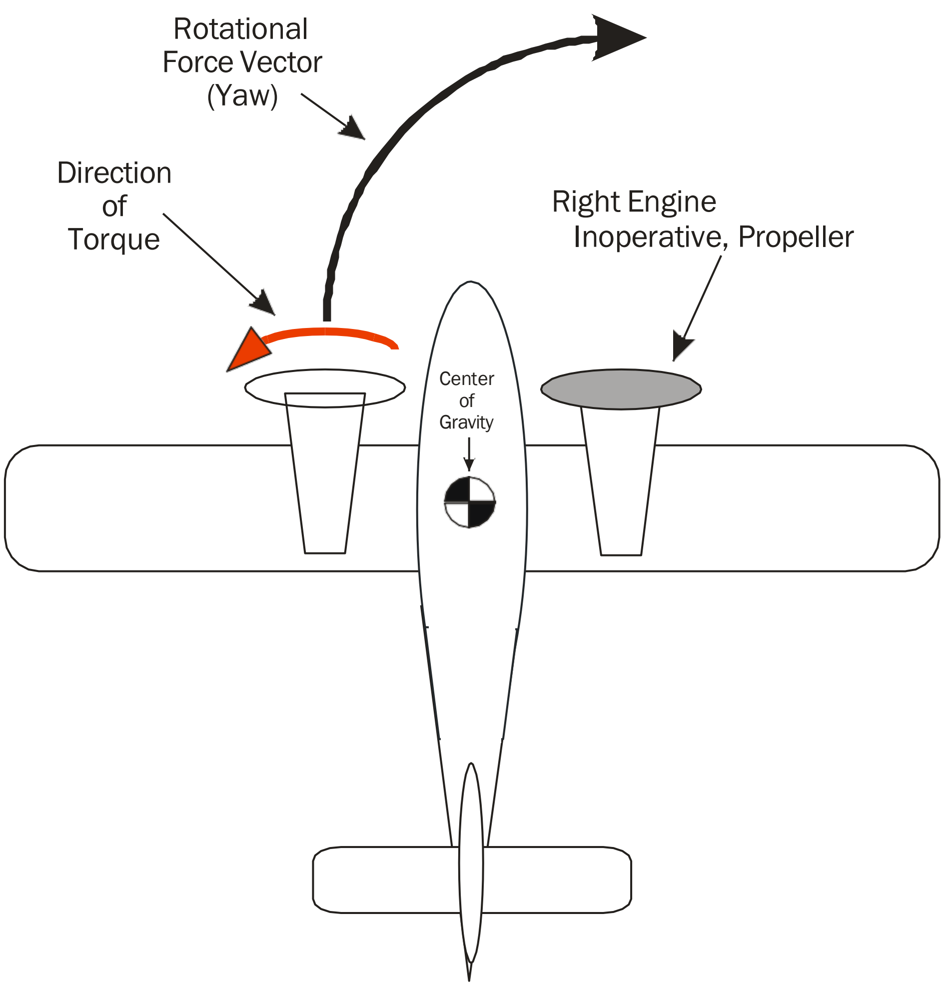

Figure 6

In this condition, the right engine is inoperative with the propeller windmilling, The asymmetrical thrust of the left engine yaws the aircraft to the right. The torque of the left engine generates a rolling moment to the left, partially offsetting the effect of the yaw. This condition preserves some degree of control authority, enhancing the pilot's ability to maintain directional control.

Figure 7 illustrates the opposite engine-out possibility, with the left engine inoperative and the left propeller windmilling:

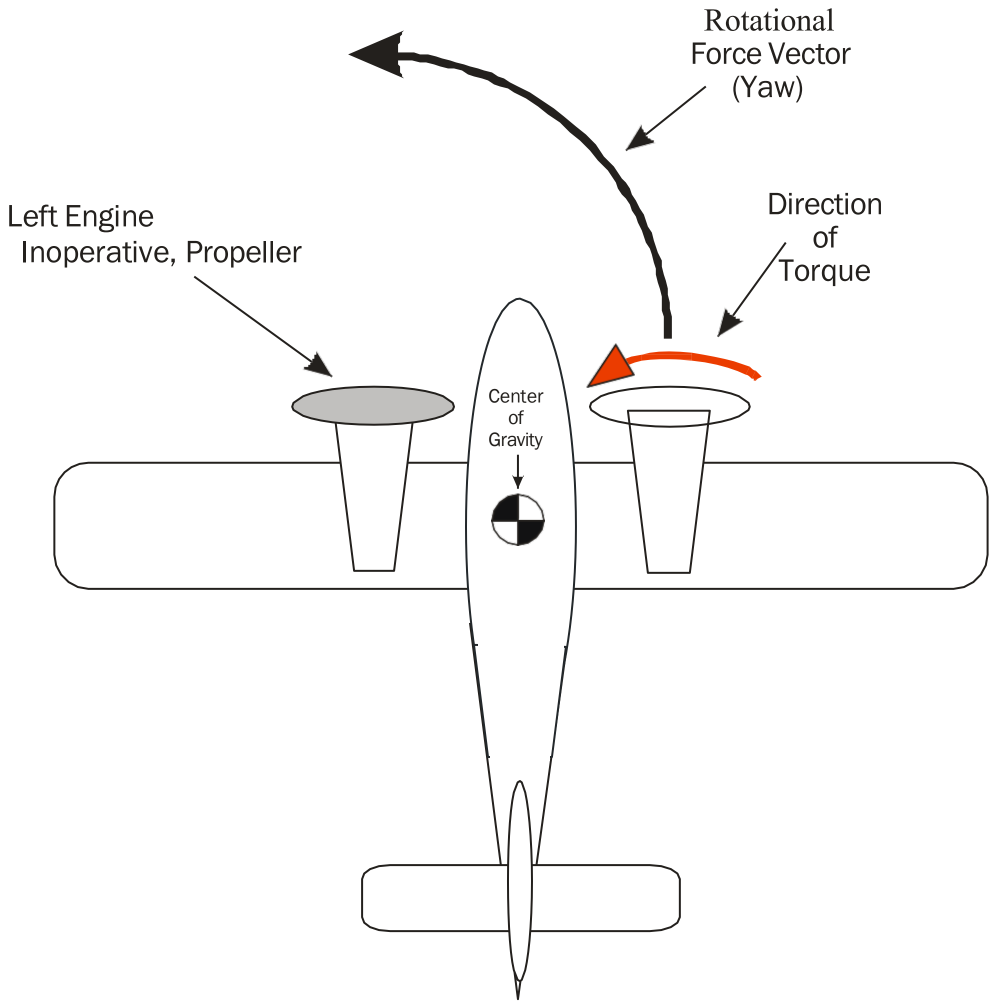

Figure 7

In this condition, the effects of yaw and roll are *additive*, maximizing directional displacement toward the inoperative engine and presenting the pilot with a substantial challenge in the quest for directional control. The additive nature this combination of effects causes the left engine to meet the definition of *critical* with regard to roll.

Flight characteristics of the airplane that are associated with torque directly impact **ROLL control** in single-engine operations.

The preceding information is valid only conventional multiengine airplanes. Twin engine airplanes with counter-rotating propellers, such as the Beechcraft Duchess, the Piper Seminole, and some of the Piper Seneca series, are considered to have no critical engine. Airplanes such as the Piper PA-31P Navajo have propellers that rotate counterclockwise, and all the physical processes mentioned here reversed, making the *right* engine critical.

The **PAST** explanation of the nature critical engines has some troubling inconsistencies. Nonetheless, demonstration of this aeronautical knowledge will satisfy the requirements of Area of Operation I on the airman practical test.