

V.C. Engine Starting

Objectives	The student should develop knowledge of the elements related to engine starting as required in the ACS.
Key Elements	<ul style="list-style-type: none">✈ Checklist✈ Safety✈ Hand on the throttle
Elements	<ul style="list-style-type: none">✈ Safety precautions✈ Atmospheric conditions✈ Checklists✈ Engine controls during start✈ Keeping the airplane from moving✈ Starting with external power✈ Hand propping safety
Schedule	<ol style="list-style-type: none">1. Discuss objectives2. Review material3. Development4. Conclusion
Equipment	<ul style="list-style-type: none">✈ White board✈ Markers✈ References
Instructor's Actions	<ol style="list-style-type: none">1. Discuss lesson objectives2. Present lecture3. Questions4. Homework
Student's Actions	Participate in discussion Take notes
Completion Standards	The student can start the engine using the appropriate checklist and understands different conditions and their effect on starting.
References	FAA-H-8083-3B, <i>Airplane Flying Handbook</i> (Chapter 2) AC 91-55 <i>Reduction of Electrical System Failures following Aircraft Engine Starting</i> https://www.faa.gov/documentLibrary/media/Advisory_Circular/ac91-55.pdf POH/AFM

Instructor Notes

Introduction

Overview—review objectives and key ideas.

Why—starting the engine of the airplane is not as simple as starting the engine of a car, and we need to take the proper precautions. Proper engine starting is necessary for the safety of people and property on the ground and to prevent engine damage.

Safety precautions

- ✦ **Aircraft positioning**—don't point the tail toward open hangars, cars, bystanders, or anything that may be injured or damaged. **Propeller blast** can turn debris into projectiles.
- ✦ Set the **parking brake**.
- ✦ Look in all directions, make sure nothing is (or will be) in the vicinity of the propeller and propeller blast.
- ✦ Turn **strobe lights/anti-collision lights** on prior to start. At night, turn the position lights on, too.
- ✦ Call "**CLEAR**" out of the side window; wait for a response from anyone who may be nearby.
- ✦ Keep **one hand on the throttle** to allow prompt response in the case of excessively high RPM.

CE—failure to use safety precautions related to starting.

CE—failure to ensure proper clearance of the propeller.

Atmospheric conditions

In cold weather...

- ✦ Oil can congeal
Pull the propeller through several times to loosen the oil and save battery energy. Make sure the ignition is OFF, throttle IDLE, and mixture CUTOFF first.
- ✦ Engine preheating
Icing can form over the sparkplug electrodes—the engine will need to be preheated.
If the engine fires and quits, there is enough combustion to cause water in the cylinders, which condenses, freezes, and shorts them out.
- ✦ Starting
Prime the engine with fuel first. Overpriming can result in fires.
After start, idle the engine at low RPM to allow the oil to warm and circulate. The engine may quit during long idling periods since sufficient heat isn't produced to keep them from fouling.

In hot weather...

- ✦ Cylinders become flooded
Use the Flooded Start checklist to clear them.
- ✦ Fuel injected engines may have difficulty starting

Checklists

This is due to vaporization—when shut down, the air temperature in the cowling increases, vaporizing the fuel and creating vapor lock. Use the electric fuel pump to move fuel into the lines, cooling them and removing vapors.

In very hot temperatures, vapor problems may continue after start due to insufficient slipstream cooling—monitor the fuel flow gauge for fluctuations and use the electric fuel pump to purge the system.

There are different situations requiring different types of engine start. Use the appropriate checklist to ensure that every item is completed and checked.

CE—failure to use the appropriate checklist.

Engine controls during start

Always keep one hand on the throttle to help you advance the throttle if the engine falters or retard the throttle to prevent excessive RPM.

After engine start, check the engine instruments. As soon as the engine starts, check the oil pressure gauge—if it doesn't rise to the specified value there may not be enough lubrication and you should shut it down. Check all other instruments to ensure they are operating within limits. Avoid excessive engine RPM and temperatures—monitor the instruments and use checklists if the engine temperature begins to rise. Constantly monitor the engine instruments while the engine is running.

CE—improper adjustments of engine controls during start.

Keeping the airplane from moving

Set the parking brake and hold the brakes with your toes during and after engine start.

Look outside to ensure the aircraft is not moving.

Starting with external power

Supplement 1 in POH.

Check that the EPU connector is inserted and secure. Check the voltmeter and start as normal. After engine start, signal the ground crew to pull the cord and turn the master switch ON.

Hand propping safety

Do not hand prop unless two people, both familiar with hand propping techniques, are available. Do not allow anyone unfamiliar with the controls to occupy the pilot's seat while hand propping.

✈ The person pulling the propeller blades directs all activity and is in charge. Both people should discuss the procedure and agree on voice commands/expected actions.

✈ Additional precaution: tie down the tail or chock the wheels. Be careful while removing them.

✈ Make sure the ground surface near the prop is stable and free of debris (no loose gravel, wet grass, mud...) or relocate. The person pulling the prop may slip into the blades.

Engine starting setup

CE—failure to ensure proper clearance of the propeller.

- ✦ Set fuel system/engine controls for normal start (fuel pump, primer, throttle, mixture).
- ✦ Magneto switch/ignition OFF.
- ✦ Rotate descending prop blade to a position slightly above horizontal.
- ✦ Face blade squarely and stand less than one arm's length from it—if you are too far away, it may be necessary to lean forward in an unbalanced condition.

Commands

- ✦ Person out—"gas ON, switch OFF, throttle CLOSED, brakes SET."
- ✦ Person in—check fuel ON, mixture RICH, ignition OFF, throttle CLOSED, brakes SET, repeat command.
- ✦ Person out—check brakes by pushing on propeller.
- ✦ Person out—pull propeller through to prime the engine, say "brakes and contact."
- ✦ Person in—check brakes SET, turn ignition switch ON, repeat command.
- ✦ Person out—swing propeller by forcing blade downward as hard as possible. Push with the palms—fingers may result in being drawn into the blades if the engine misfires.
- ✦ If the engine does not start, don't move the propeller until you are certain that the ignition is OFF.

Common errors

- ✦ Failure to use the appropriate checklist.
- ✦ Failure to use safety precautions related to starting.
- ✦ Improper adjustment of engine controls during start.
- ✦ Failure to ensure proper clearance of the propeller.

Conclusion

Brief review of main points.
Always put safety first when starting the engine in any situation and use the appropriate checklists.

CFI PTS

Objective: To determine that the applicant:

1. Exhibits instructional knowledge of the elements of engine starting, as appropriate to the airplane used for the practical test, by describing:
 - a. Safety precautions related to starting.
 - b. Use of external power.
 - c. Effect of atmospheric conditions on starting.
 - d. Importance of following the appropriate checklist.
 - e. Adjustment of engine controls during start.
 - f. Prevention of airplane movement during and after start.
 - g. Safety procedures for hand-propping an airplane.
2. Exhibits instructional knowledge of common errors related to engine starting by describing:
 - a. Failure to properly use the appropriate checklist.
 - b. Failure to use safety precautions related to starting.
 - c. Improper adjustment of engine controls during start.
 - d. Failure to assure proper clearance of the propeller.
3. Demonstrates and simultaneously explains engine starting from an instructional standpoint.

PPL ACS

Task	C. Engine Starting
References	FAA-H-8083-2, FAA-H-8083-3, FAA-H-8083-25; POH/AFM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with recommended engine starting procedures.
Knowledge	The applicant demonstrates understanding of:
PA.II.C.K1	Starting under various conditions.
PA.II.C.K2	Starting the engine(s) by use of external power.
PA.II.C.K3	Engine limitations as they relate to starting.
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.II.C.R1	Propeller safety.
Skills	The applicant demonstrates the ability to:
PA.II.C.S1	Position the airplane properly considering structures, other aircraft, wind, and the safety of nearby persons and property.
PA.II.C.S2	Complete the appropriate checklist.

CPL ACS

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CA.II.C.S1	Position the airplane properly considering structures, other aircraft, wind, and the safety of nearby persons and property.
CA.II.C.S2	Complete the appropriate checklist.