Task III.D: Performance Limitation

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Lesson Overview

Objective

The student should develop knowledge of the elements related to airplane performance and limitations as required in the necessary ACS.

Reference

- FAA-H-8083-1, Weight and Balance Handbook
- FAA-H-8083-25B, Pilot's Handbook of Aeronautical Knowledge (Chapter 11)
- POH/AFM

Key Elements

- Density
- Density altitude
- Airplane performance

Elements

- Determining weight and balance
- Atmospheric conditions and performance
- Performance charts
- Exceeding airplane limitations

Equipment

- White board
- Markers
- References
- iPad

Schedule

1. Discuss objectives

2. Review material
3. Development
4. Conclusion

Instructor Actions

1. Discuss lesson objectives
2. Present lecture
3. Questions
4. Homework

Student Actions

1. Participate in discussion
2. Take notes

Completion Standards

The student is able to calculate the airplane's performance based on the current or expected conditions of a flight, and decide whether or not the performance will be sufficient.

Instructor Notes

Attention

How exciting would it be to find out first hand, that the airplane actually doesn't have the ability to takeoff from a certain runway and that it also doesn't have the ability to clear the obstacle at the departure end?

Overview

Review Objectives and Elements/Key ideas

What

The Performance and Limitations section of the POH contains the operating data for the airplane; that is, the data pertaining to takeoff, climb, range, endurance, descent, and landing.

Why

The use of the operating data for the airplane is mandatory for safe and efficient operations.

Lesson Details

Determining W&B

- CG = total moment divided by total weight
- Begin with the empty weight.
- Make a list of everything that will be loaded in the airplane (people, items, fuel, and the weight of everything).
- Be sure that the loaded weight is within the max weight limits. If the total weight is too high,

remove items/people to get within limits.

- Calculate the moment of each item—use the graph, or multiple the weight by the arm in the POH. Weight/moment of the airplane in its weight and balance documents.
- Calculate CG.
- Use the chart to determine if the airplane is within limits.

Atmospheric conditions and performance

Atmospheric pressure—air mass is affected by gravity, and therefore has a force. 14.7 lbs/in under standard conditions at sea level. Air can be compressed or expanded, changing density. Density has a significant effect on the airplane's performance. Increased air density (lower density altitude) increases airplane performance.

Air density factors

Air density varies with the following

- Directly with pressure (pressure goes up, density goes up)
- Inversely with temperature (temperature goes up, density goes down)
- Inversely with altitude (altitude goes up, density goes down)
- Inversely with humidity (humidity goes up, density goes down)

Air density and performance

As density decreases (air becomes less dense)…

- Power is reduced, as the engine takes in less air. Power produced in proportion to air density.
- Thrust is reduced, as the propeller is less effective in thin air. Thrust produced in proportion to the mass of air being accelerated.
- Lift is reduced, because the thin air exerts less force on the airfoils.

Leaning

At power settings less than 75%, or at density altitudes higher than 5,000', the engine must be leaned for maximum power on takeoff. An excessively rich mixture will deter engine performance.

High Elevation

At higher elevations, high temperatures may have a large effect on density altitude, making safe operations impossible. Even at lower temperatures, excessive humidity may make performance marginal and weight may have to be reduced.

Performance charts

Found in POH -Section 5

Used to calculate cruise performance, stall speeds, wind components, takeoff/landing distances, climb performance, true airspeed, endurance/range, based on pressure altitude.

The charts don't allow for pilot proficiency or mechanical deterioration. Changes in weather and conditions can result in changes in original calculations.

For student pilots, have 100% performance buffer.

Pressure altitude

The pressure altitude corrected for non-standard temperature; directly related to aircraft performance.

- DA = PA + [120 * (Temp — 15 °C)

Exceeding aircraft limitations

Limitations for the PA28A can be found in the POH, Chapter 2

The limitations published for an aircraft delineate the boundaries within which the aircraft can be safely operated. Exceeding any of these limits risk an adverse outcome. These include, but are not limited to the following scenarios.

Examples:

- Attempting takeoff or landing with insufficient runway (may result in collision with obstacle or runway overrun)
- Attempting to clear an obstacle that the aircraft performance will not allow at a particular weight (may result in collision with obstacle)
- Flying with insufficient fuel to reach airport of intended landing or cruising at a higher power setting (may result in emergency landing)
- Using the wrong type of fuel (may result in detonation)
- Exceeding the structural or aerodynamic limits by being overweight or outside CG limits (may result in aircraft damage or structural failure, may dampen aircraft control, will affect stall speeds)
- Exceeding maximum crosswind component (may increase landing difficulty, may make runway alignment difficult or impossible, may result in crash)

Conclusion

- Brief review of the main points.
- Before each flight, ensure the aircraft can produce required
- Performance depending on the airport and atmospheric conditions.

ACS Requirements

To determine that the applicant exhibits instructional knowledge of the elements related to performance and limitations by describing:

1. Determination of weight and balance condition.
2. Use of performance charts, tables, and other data in determining performance in various phases of flight.
3. Effects of exceeding airplane limitations.
4. Effects of atmospheric conditions on performance.
5. Factors to be considered in determining that the required performance is within the airplane’s capabilities.