**Lesson 7**

**Stalls**

Read: FTGU pages 18, 35-38

1. Laminar Flow
   1. Boundary Layer
      1. The thin layer of airflow over the wing
   2. Laminar Layer
      1. Smooth portion of the boundary layer nearest the leading edge of the wing
      2. This is the part of the airflow that produces lift
   3. Transition/Separation Point
      1. Point on the wing where the boundary layer becomes turbulent
      2. Movement of the transition point is partially responsible for the movement of the centre of pressure
   4. Turbulent Layer
      1. Turbulent portion of the boundary layer at the trailing edge of the wing
      2. This is the part of the airflow that produces drag
2. Definition of a Stall
   1. A stall occurs when the wing is no longer capable of producing sufficient lift to counteract the weight of the aircraft
      1. Flight can no longer be maintained as a result
3. Centre of Pressure
   1. The point on the wing where total aerodynamic pressure acts
   2. The centre of pressure will move forward as the angle of attack increases to the point of a stall
   3. After a stall the centre of pressure moves rapidly back
   4. The movement of the centre of pressure causes the aircraft to be unstable
4. Critical Angle of Attack
   1. Angle of attack above which air will cease to flow over the wings and a stall will occur
   2. Most aircraft have a stall angle of positive 15 to 20 degrees
5. Stalls
   1. Centre of pressure and separation point move forward to the point of a stall, and lift production is increased
   2. As the angle of attack is increased beyond the critical angle of attack, the wing stops producing lift and stalls
   3. The centre of pressure moves rapidly backwards
   4. An aircraft will stall:
      1. When the critical angle of attack is exceeded
      2. At any airspeed if the critical angle of attack is exceeded
      3. At any altitude if the critical angle of attack is exceeded
   5. Symptoms of a stall
      1. High angle of attack
      2. Airframe buffeting or shaking
      3. Warning horn or light
      4. Loss of lift
   6. Factors affecting a stall
      1. Centre of gravity
      2. Weight
      3. Turbulence
      4. Turns (and load factor)
      5. Snow, frost, and ice
6. Factors affecting stalls
   1. Centre of Gravity
      1. Too far forward
         1. Loading on the horizontal tail surfaces increase
         2. Overall weight of aircraft increases
         3. Stall speed increases
      2. Too far aft
         1. Decreased longitudinal stability
         2. Violent stall characteristics
         3. Poor stall recovery (very dangerous!)
         4. Stall speed decreases
   2. Weight
      1. The more weight on an aircraft means that it must fly at a higher angle of attack
      2. Therefore the critical angle of attack will be reached at a higher airspeed
   3. Turbulence
      1. Upward vertical currents cause the airplane to increase its angle of attack
      2. Could result in the aircraft stalling if flying near the stall speed
   4. Turns (and load factor)
      1. As angle of bank **increases** the load factor **also increases**
      2. Therefore, an **increased angle of attack** is required to maintain level flight in the turn
      3. Subsequently, the stall speed in a turn increases
      4. Just like adding more weight to an aircraft
      5. If the load factor were to increase for any other reason, the effect would be identical
   5. Snow, Frost, and Ice
      1. Accumulation of snow, frost, and ice affects a wing’s ability to produce lift
      2. Increase in stall speed
   6. Increase in stall speed is due to:
      1. Forward C of G
      2. More weight
      3. Turbulence
      4. Greater angle of bank
   7. Decrease in stall speed is due to:
      1. Aft C of G