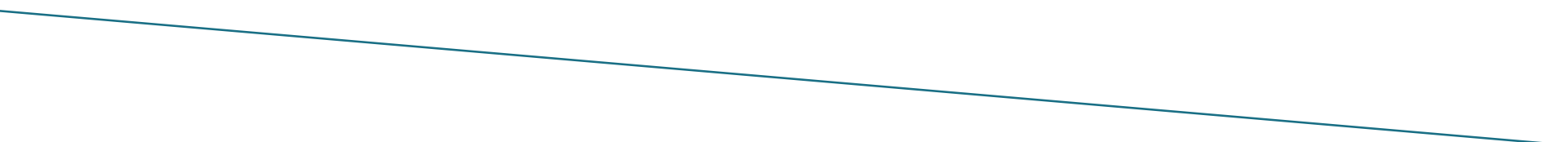


Stalls and Spins

Tom Johnson
CFIG

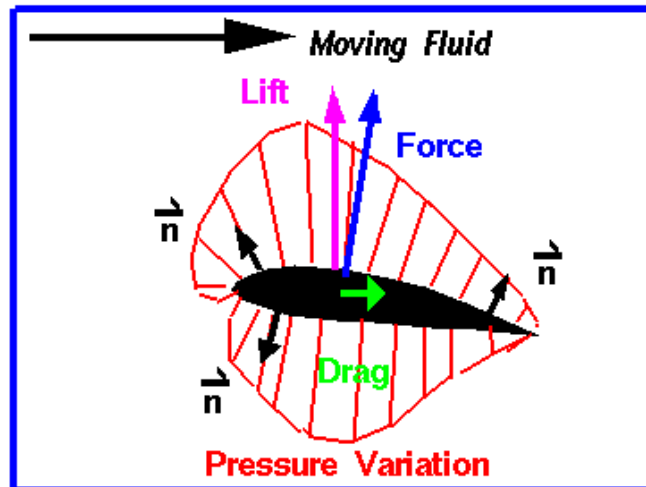


Do we need all of this?



Aerodynamic Forces

Glenn
Research
Center



Pressure forces act normal (perpendicular) to surface.
Force on the body is the vector sum of the pressure x area
around the entire solid body.

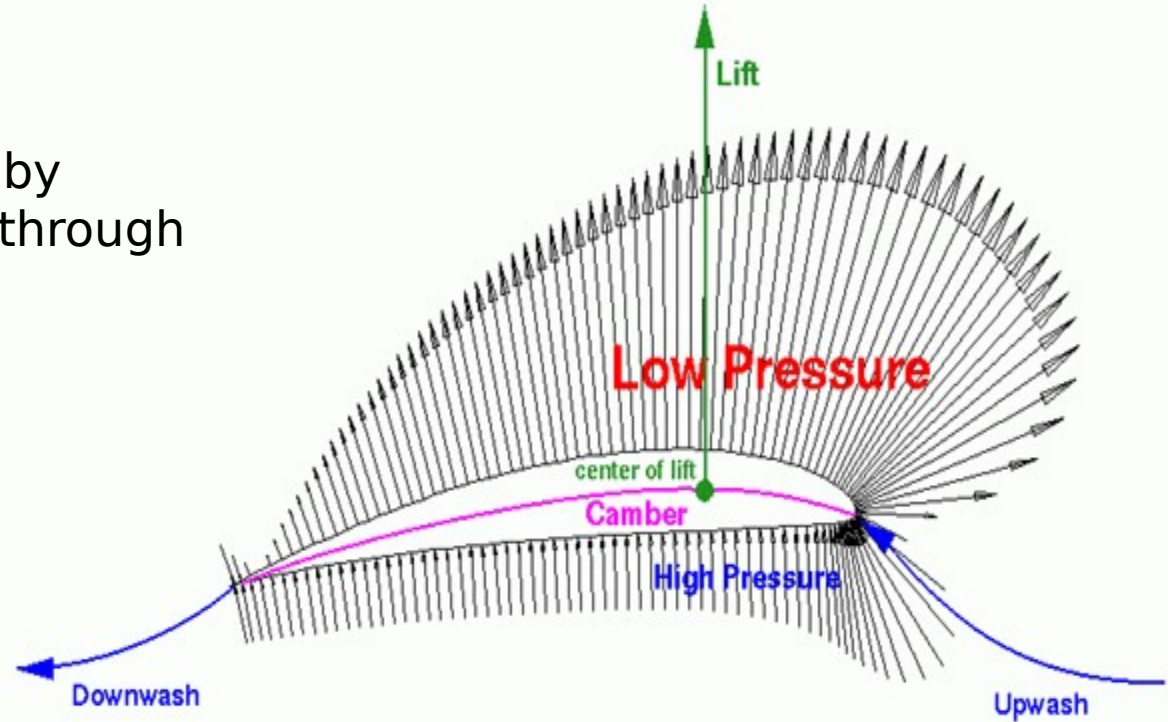
$$\vec{F} = \sum_{\text{surface}} p \vec{n} A = \oint p \vec{n} dA$$

Lift = F_{normal}

Drag = F_{stream}

Lift

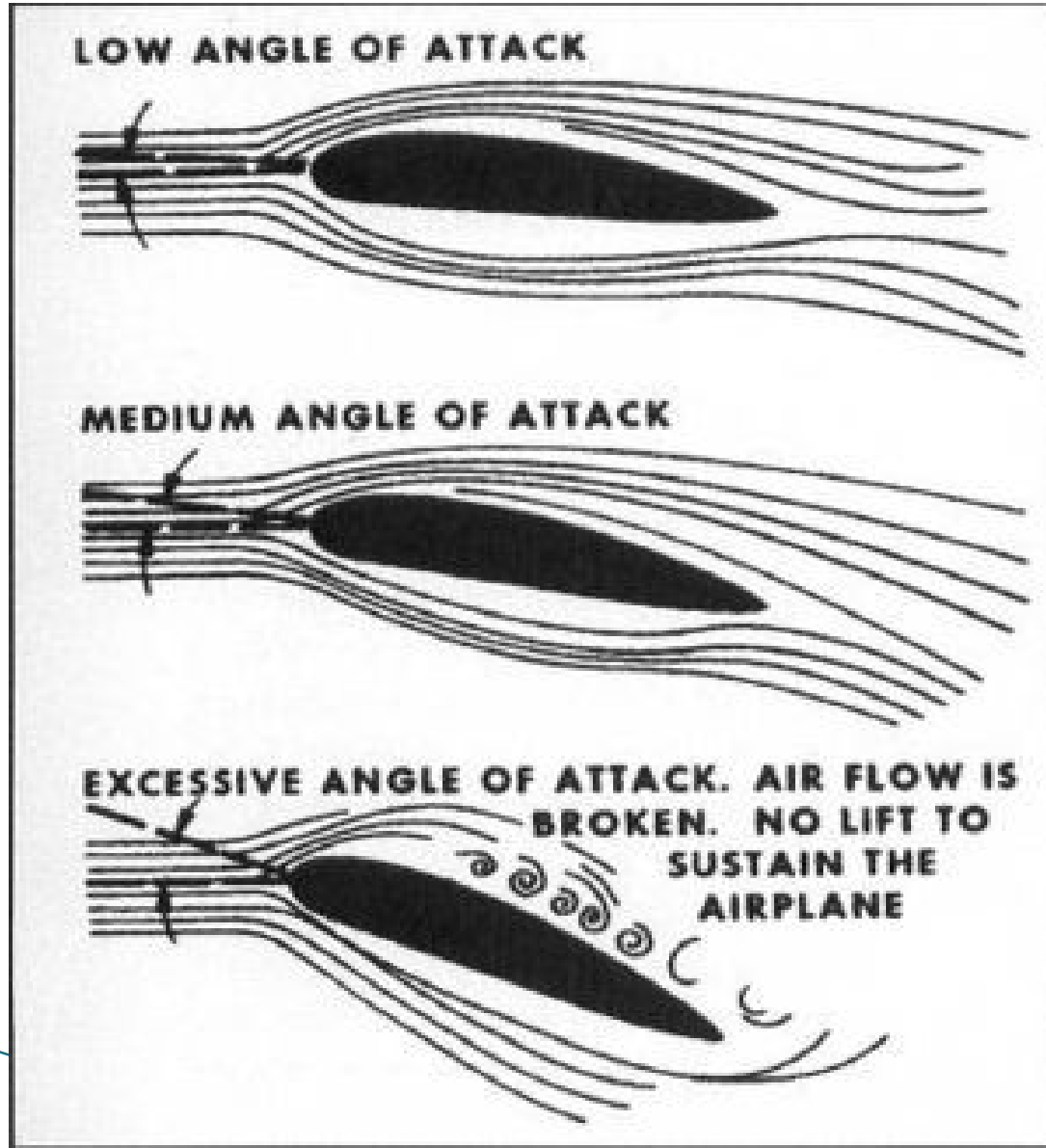
The force created by moving the wing through the air.



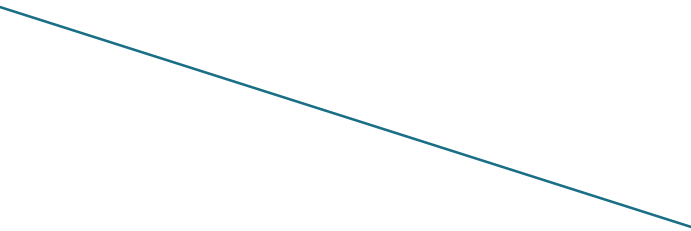
Angle of Attack: The angle between the relative wind and the wing chord line.

Pressure vectors and flow over a cambered section.

Stalls...a stall is a loss of lift when the wing exceeds the critical Angle of Attack



Impending Stall Warnings

- ▶ 1. Excessive back stick pressure
 - ▶ 2. Nose high attitude
 - ▶ 3. Low airspeed
 - ▶ 4. Quietness
 - ▶ 5. Mushy controls
 - ▶ 6. Shudder or buffeting
-
- ▶ Do all or any of these have to be present for a stall to occur?
- 

Factors affecting Stall Recovery

- ▶ Weight
- ▶ Density Altitude
- ▶ Bank Angle
- ▶ Load Factor at Stall

- ▶ Higher of any of these means more altitude to recover

- ▶ What is your recovery technique?

- ▶ Pilot Situation Awareness-Tired? Dehydrated?
 - How does this affect recovery?

Factors affecting Turn to Final

- ▶ Airspeed
- ▶ Skidding Turn..Using the Rudder to Turn
- ▶ Overshooting Crosswind
- ▶ Altitude
- ▶ Too Close Abeam
- ▶ Configuration...Spoilers/Flaps
 - **How do these factors affect the inadvertent stall recovery?**



<http://www.youtube.com/watch?v=zfFGN-3Yglo&feature=related>

Wind Gradient

- ▶ How does the Wind Gradient affect the sailplane on the turn to final and final?
- ▶ Assumptions:
 - 10 kt headwind at 200 ft
 - 5 kt headwind at 100 ft
 - IAS at 300ft is 55kts and spoilers as required to maintain desired glidepath
 - Glider descends through Wind Gradient with no change in configuration or attitude
 - What happens and why?

Wind Gradient....What Do I Do?

- ▶ 1. Assume the Wind Gradient will **ALWAYS** be there.
- ▶ 2. **MAINTAIN** Minimum IAS of $V_{L/D} + 5$ kts
 - Blanik, ASK-21, Grob 103 55kts
 - If you do lose IAS, you slow toward best L/D and decrease drag. Once you get below best L/D you increase drag as you slow.
- ▶ 3. Close spoilers to maintain glidepath as performance decreases. Do not “pull back on the stick” to maintain glidepath.

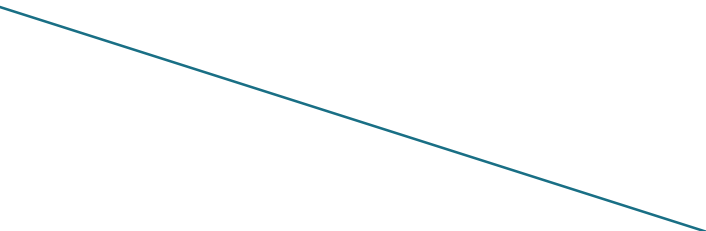
Spins



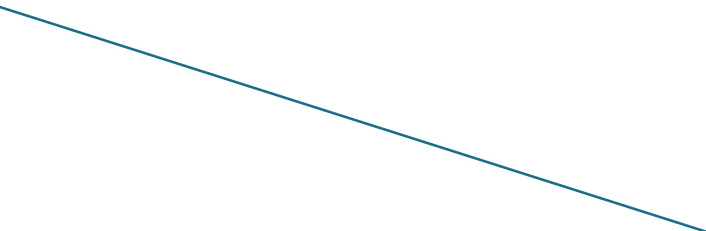
**Perception
vs reality**



Why Is Spin Training Important?

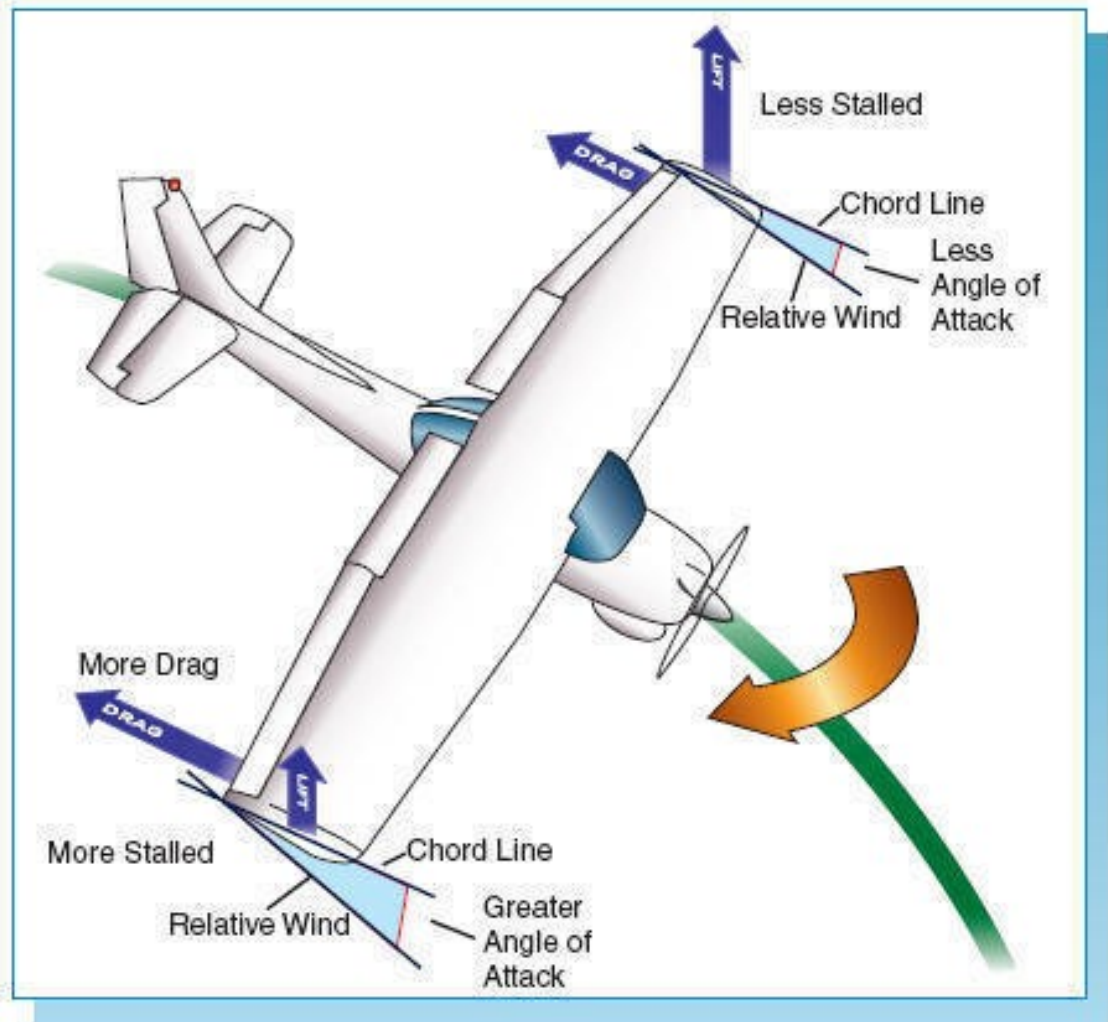
- ▶ Spins have been with us since the Wright Brothers, and probably always will be
 - ▶ Spin accidents are usually fatal
 - ▶ Ignorance of spins contributes to spin accidents
 - ▶ Fear of spins causes many pilots to avoid spin training
- 

FAA Guidance

- ▶ **Subject: STALL AND SPIN AWARENESS TRAINING**
 - ▶ **Date: 9/25/00**
 - ▶ **AC No: 61-67C**
- 

What is a spin?

Stall + Yaw
=
Autorotation



Spins

- ▶ 1. During a spin the aircraft is rolling, yawing, and pitching...therefore it very disorienting.
- ▶ 2. To spin, you must have a stall condition and yaw. Eliminate either and you will not spin.
- ▶ 3. Spin Recovery=Yaw against rotation, release back pressure to break AOA, ailerons neutral.

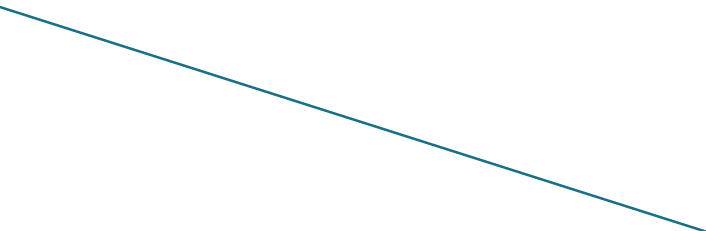
Gust Induced Stalls

- ▶ Assumptions
 - 30 degree AOB turn
 - Constant airspeed and AOB
 - You hit a 3 kt updraft
- ▶ What happens?
 - AOA
 - High wing vs low wing
- ▶ What happens if this is close to the ground?
- ▶ How about on a mountain ridge? The Whites at 13000ft on a 95F day?
 - Density Altitude of 18000+ft



<http://www.youtube.com/watch?v=PpJA53LjarM&feature=endscreen&NR=1>

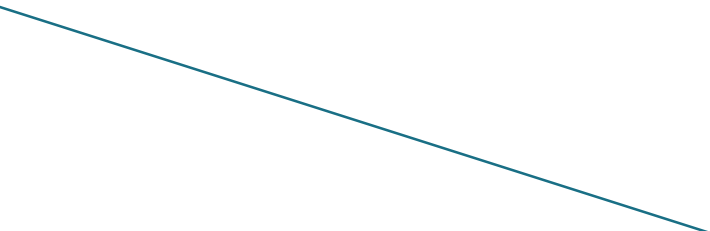
Gust Induced Stalls

- ▶ Start video at 1:50
 - ▶ Watch variometer at 2:30 and the result
 - ▶ Watch airspeed at 4:15
 - ▶ What do you think of his comments?
- 

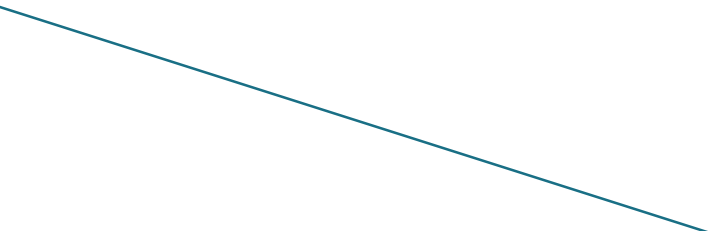
The Overshoot

- ▶ Bob entered a left downwind for Runway 36 at Hometown Gliderport. The wind on the ground is 320 at 8 knots and a little bit stronger and more westerly in the air. Bob did not correct for the crosswind on the downwind leg. He realized on the turn to final he was going to overshoot the turn.

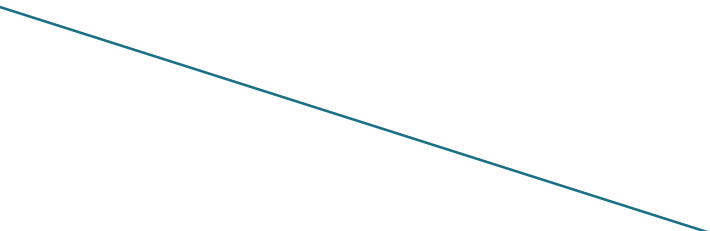


- ▶ Pilot
 - ▶ Aircraft
 - ▶ enVironment
 - ▶ ExternalS
- 

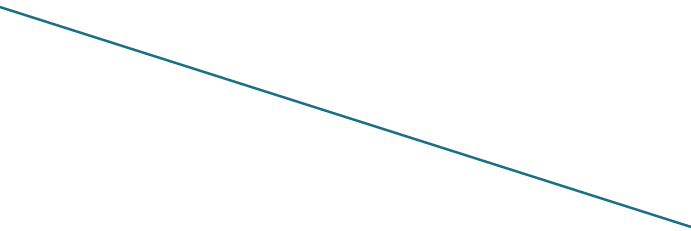
The Wind Gradient

- ▶ Bob was out on a cross country flight. The wind was stronger than when he had left the airport. As Bob turned final, he was a bit low and encountered heavy sink. The JS-1 touched down short of the runway and was substantially damaged when the gear struck the lip of the runway.
- 

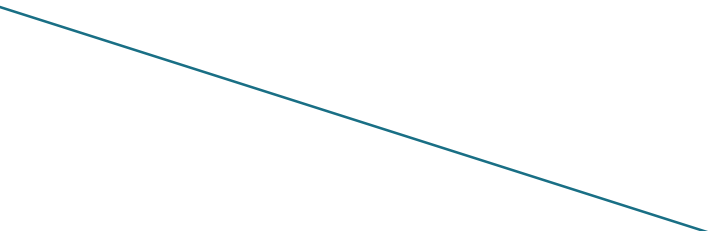


- ▶ Pilot
 - ▶ Aircraft
 - ▶ enVironment
 - ▶ Externals
- 

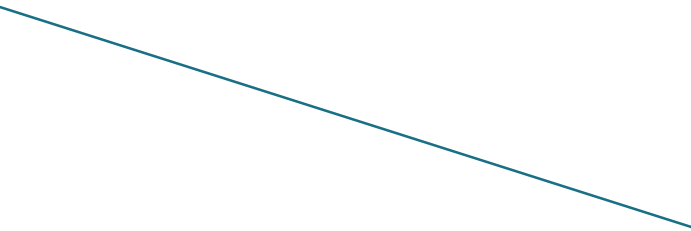
Mountain View

- ▶ Bob was at 12000 ft in his sailplane. It was a hot day with gusty conditions and difficult lift. Bob got low over the mountain and knew he had to get close to the terrain to get the best lift. He was hot, tired, and thirsty when he hit the strong gust. His immediate reaction was to pull back and left on the stick as the nose and right wing of the ASW-20 both started to drop.
- 



- ▶ Pilot
 - ▶ Aircraft
 - ▶ enVironment
 - ▶ ExternalS
- 

The gaggle

- ▶ Bob never practiced stalls. At the Seniors after a long winter with no flying, he found himself in a gaggle. The glider in front of him turned toward him a bit. Bob quickly tightened his turn to get away from the glider and subconsciously pulled back on the stick to keep from overrunning this other glider.
- 



- ▶ Pilot
 - ▶ Aircraft
 - ▶ enVironment
 - ▶ ExternalS
- 