DOUG DANIEL
PrivatePilotTrainingOnline.ORG

Making Superior Piloting Simple

Module 9 of Phase 1

Basic Maneuvers:

Stalls

Here's What You'll Learn

- Stalls are mostly bad but sometimes good.
- Why you want to become really good at detecting and recovering from stalls.
- What causes a stall and what doesn't.
- How to practice stalls & do it safely.
- Common mistakes.

Causes of Stalls

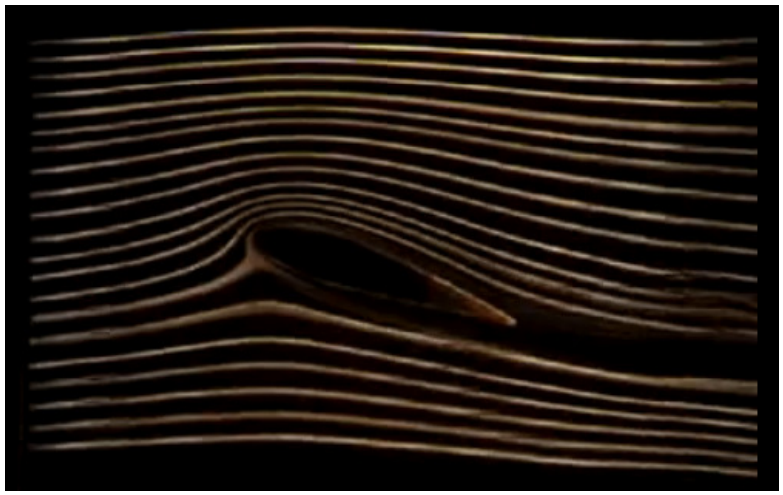
There is only one cause of a stall: boundary layer separation.

There is only one situation when a stall occurs: when the wing (or any other airfoil) exceeds its critical angle of attack.

Anything that causes the wing to exceed that critical angle (increased load, high G turn, etc.) can be thought of as causing a stall.

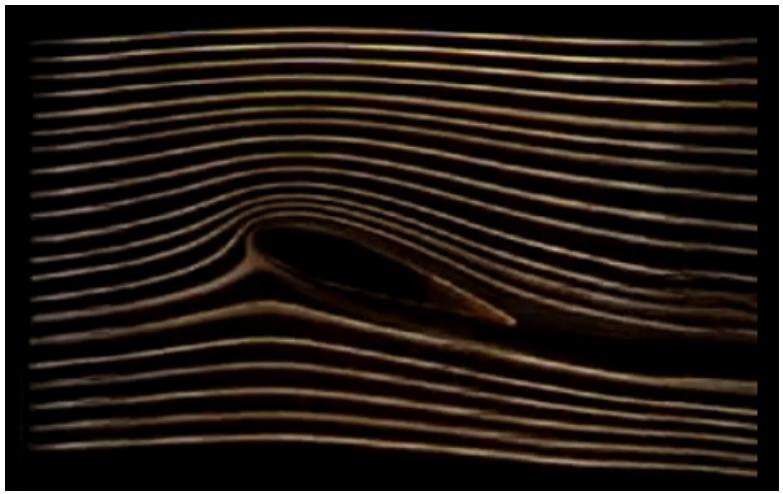
Causes of Stalls

Wing in the Cambridge wind tunnel: notice the smooth flow over the upper surface.



Causes of Stalls

I’m about to increase the angle of attack. Focus on the air above and down stream of the wing. This is the burbling that signals an imminent stall. **Watch the picture**.



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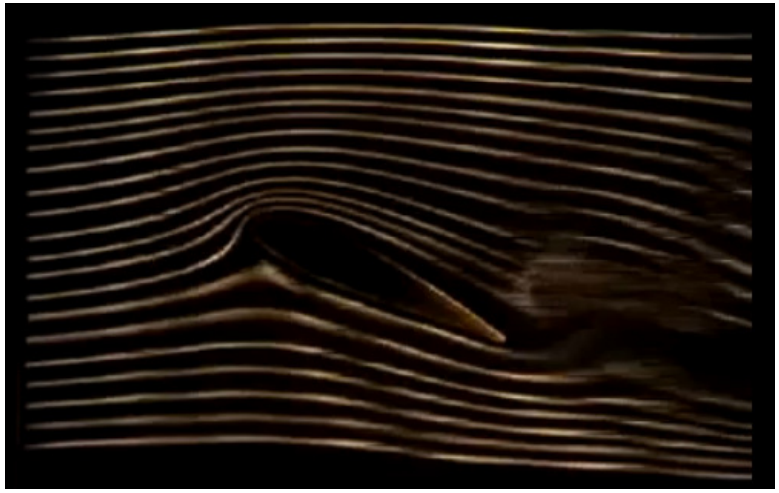
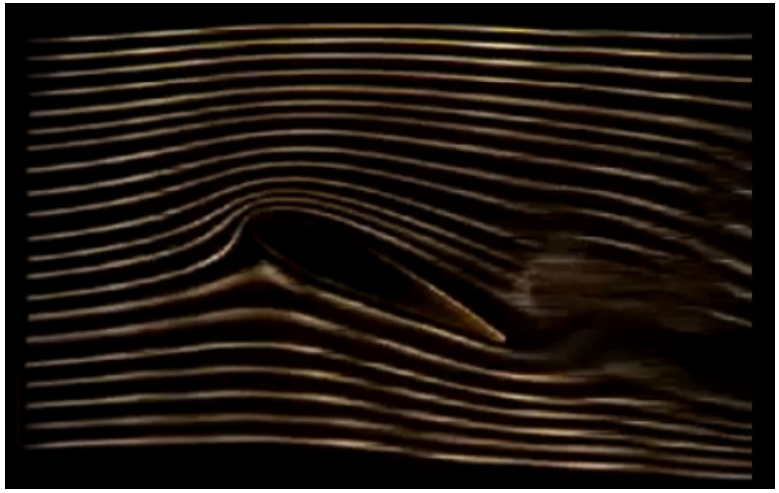


Causes of Stalls

I will increase the angle of attack enough to force flow separation. This is a stall. **Watch the picture**.



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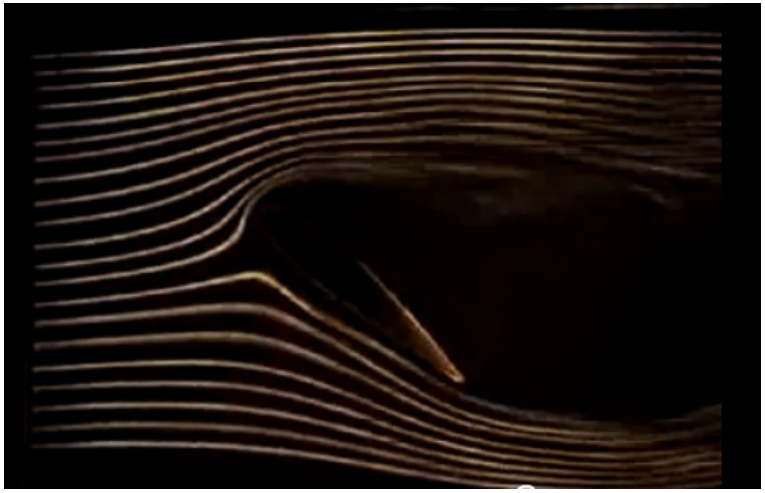
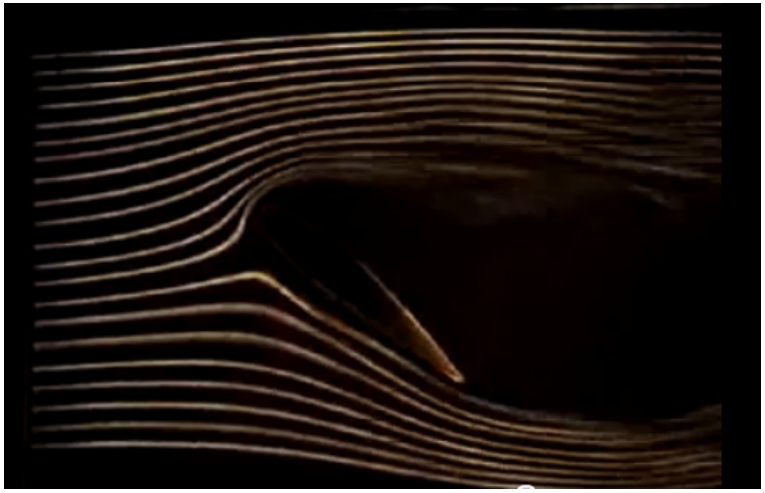


Causes of Stalls

Because the wind is no longer curving over the upper surface, creating a partial vacuum with centrifugal force, the top surface cannot produce lift – just the high pressure on the bottom produces lift.



Some stalls are good, others bad

Without me telling you, you have figured out that in straight and level flight, a stall happens when the airplane is going so slow that it cannot produce enough lift to fly. That is the ideal condition for a landing. The slower it lands, the easier it is to stop. If the wing can't lift the airplane, the brakes should be more effective.

That's the good situation. Here's the bad one. Suppose you are 200 feet up, turning to line up with the runway and you stall. Well…I've been telling you that if you want to lift your nose, pull back on the controls. Here's the really bad news and why this lesson is so important. <u>The worse thing you can do is what you've been trained to do: pull back on the controls.</u>

With that motivational bit behind us…

You need to practice stall detection and recovery until you don't think—you just react correctly.

The aviation authorities decided that it would be clever to have pilots practice stall recovery when the stall warning first sounded. I have to admit that it seemed reasonable when I first heard it. Then Air France, flying from Rio in Brazil to Charles de Gaulle in Paris, crashed a new Airbus killing all onboard. It was discovered that the stall warning never worked and the pilot flying the airplane did not detect the stall, so he pulled back on the controls and never realized in the next 30,000 feet what was happening.

Fundamentals of Stall Recovery

First you need to know that you're in a stall or about to be.

Since a stall is caused by excessive angle of attack and the elevator is the angle of attack control, you'll want to push forward on the elevator control and not backward.

Here's the tricky point. All airplanes' wings stall before their tails. This results in nose down pitching because the tail is still efficiently producing lift and the wing isn't. It's going to take some pretty good training for the pilot to stall at 200 feet, see that the nose is unexpectedly pointed well below the horizon, and calmly push the nose farther down.

Fundamentals of Stall Recovery

You can detect the impending stall when the stall warning sounds off. If that doesn't work, the airplane will start to shutter just before is stalls. If that doesn't get your attention, you're probably going to stall.

You know you've stalled because the nose suddenly pitches down without any input from you.

Now is the time to start recovery procedures. Simultaneously apply full power and pitch down some – don't over do it, but do it now.

Fundamentals of Stall Recovery

Almost no airplane wing stalls from root to tip all at once. They are designed to stall at the root so the stall will be less violent and to give you aileron control during recovery. (You really have to work hard to stall the entire wing in modern production airplane.)

If you panic and clutch the elevator control to your chest, you increase the probability that you will stall the entire wing and enter a spin. The subject of spin recovery is beyond the scope of this lesson.

After you have addressed the power and pitch parts of the stall recovery, the next thing is to level the wings. Within a fraction of second, if you reacted properly, the wing should be flying normally and you can and should start gently leveling off and climbing.

Precautions before Practicing Stalls – *Clearing Turns*

Scan the airspace near, above and below the practice. You'll want to do two turns, one in each direction, looking above and below as well as horizontally. The turns get the wings out of your field of view.

Building skill and confidence by a series of progressively more challenging stalls

- Start with the easiest, simplest, safest, and least frightening stall. This builds skill but more importantly, it builds confidence. (You should know that stalls can really scare you – not because practicing is dangerous, but because the airplane, with you in it, can suddenly fall like a stone.)
- After a few gentle stalls, they start to feel more like a carnival ride than a near death experience.
- Panic is when pilots do foolish and dangerous things.
- Familiarity with stalls and repeated success certainly reduces the chance of panic.
- In the following slides, we progress from the least to the most challenging.

Power-off, Straight ahead Stalls:

1. Pick a point on the horizon and fly directly toward it in straight and level flight.
2. Reduce power to idle.
3. Maintain constant heading and altitude as the airplane slows.
4. You will need to slowly pitch up to compensate for the loss of lift caused by the loss of airspeed.
5. Once you hear the Cessna's stall warning sound, smoothly advance the throttle remembering to compensate for the sudden increase in P-factor.
6. Drop the nose slightly to accelerate more quickly.
7. Once the stall warning silences, return to level flight until you have reached best rate of climb airspeed – then climb.
8. Throughout the exercise, keep wings level and ball centered.

Power-off, Straight ahead Stalls with Flaps:

Follow the same procedure as without flaps except:

1. In straight and level flight at idle power, once the ASI needle enters the white arc, deploy full flaps.

2. During stall recovery, after applying full power, retract flaps.

Don't forget to keep wings level and the ball centered throughout the exercise.

Approach Stall:

This stall simulates an approach to landing that results in a stall:

1. Set up a straight ahead, idle power, carb heat, full flap glide at 60 knots.
2. Slowly lift the nose until you stall.
3. Apply full power and turn off the carb heat.
4. Lower the nose to a slightly nose low attitude while retracting the flaps.
5. Once the stall warning is silenced and the flaps retracted, slowly – without entering a secondary stall – lift the nose to a best angle of climb attitude.

Don't forget to keep wings level and the ball centered throughout the exercise.

Departure Stall:

This stall simulates a runway departure where the pilot climbed too steeply:

1. With flaps fully retracted and at full power, climb at the best *angle of climb* airspeed (~60 knots).
2. Slowly lift the nose until the stall. – *This is where you should be very serious about P-factor compensation if you want to avoid spin practice.*
3. Lower the nose to a slightly nose low attitude.
4. Once the stall warning is silenced, slowly – without entering a secondary stall – lift the nose to a best angle of climb attitude.

Don't forget to keep wings level and the ball centered throughout the exercise.

Things to guard against:

1. Letting the airplane become cross-controlled (the ball not centered). – This is probably the most common flying mistake that pilots make. It is what makes stalls dangerous.
2. Pushing the nose too far down. – This results in unnecessary altitude loss.
3. Trying to pull out too fast. – This can result in a another stall, called a *secondary stall.*

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- Stalls are mostly bad but sometimes good.
- Why you want to become really good at detecting and recovering from stalls.
- What causes a stall and what doesn't.
- How to practice stalls & do it safely.
- Common mistakes.

Here's What's Next

- Ground track maneuvers
  - Turns around a point
  - S-turns
  - Rectangular patterns
- These exercises are valuable because they teach:
  - Compensating for the wind
  - Dividing your attention between outside and inside the cockpit
  - Skills needed in the airport traffic area

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