AIRSPEED, IT'S NOT JUST A NUMBER …

… it can creep up and bite you!

Nothing in this presentation overrides the FAA approved procedures listed in the AFM/POH of the aircraft you fly!

Some Basic Questions

At what airspeed will a wing stall?

At **any** airspeed…

…unless the wings come off first!

When will a wing stall?

- A stall occurs when the smooth airflow over the airplane's wings is disrupted, and the lift degenerates rapidly
- When the wing exceeds its critical angle of attack.
- This can occur at any airspeed, in any attitude, with any power setting.

Critical Angle of Attack

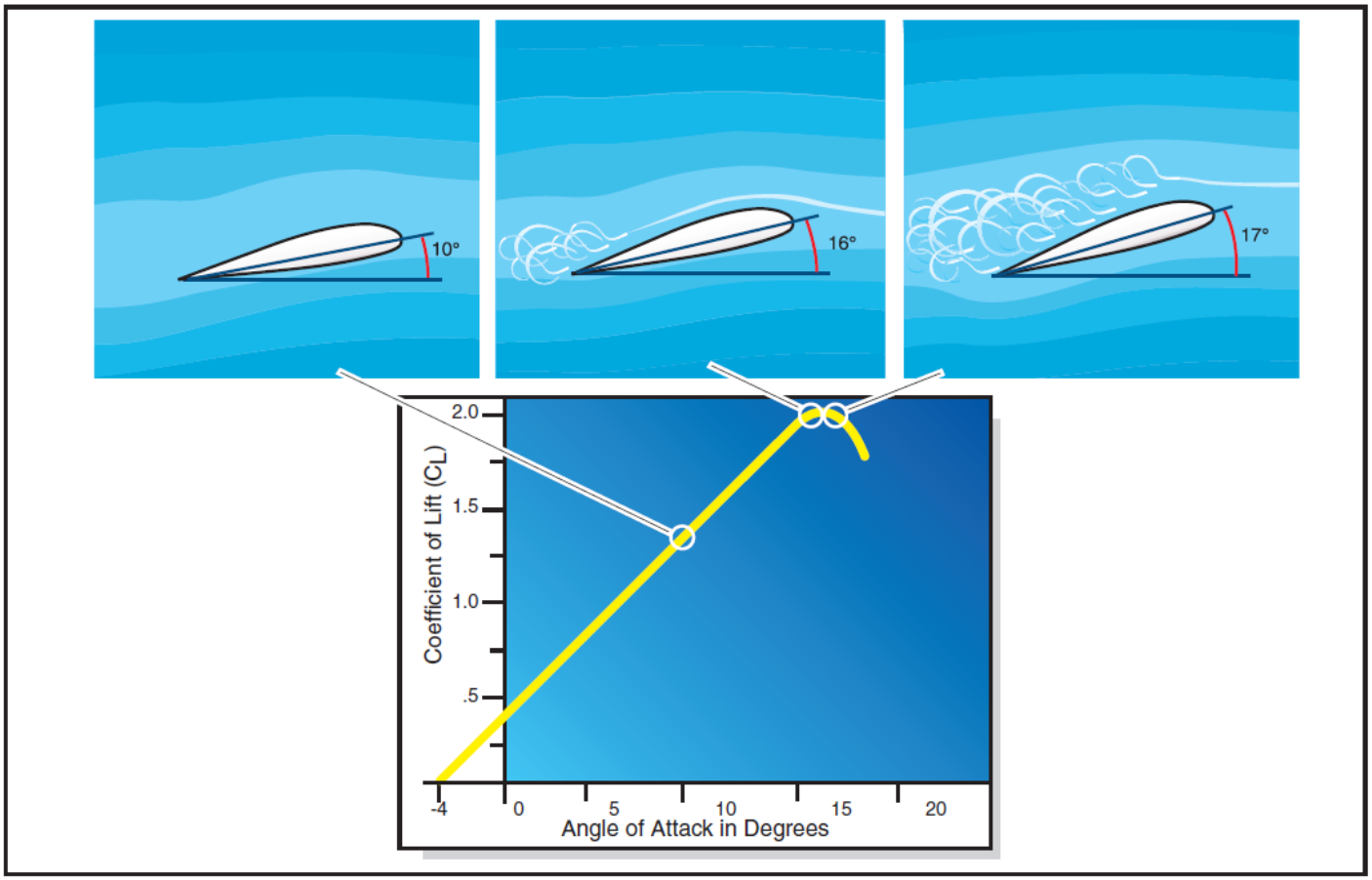
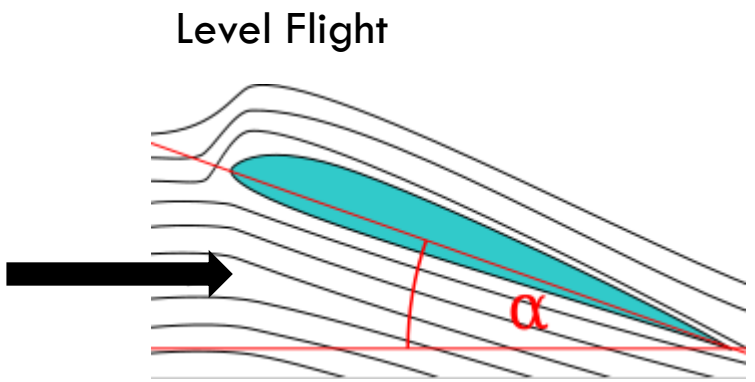
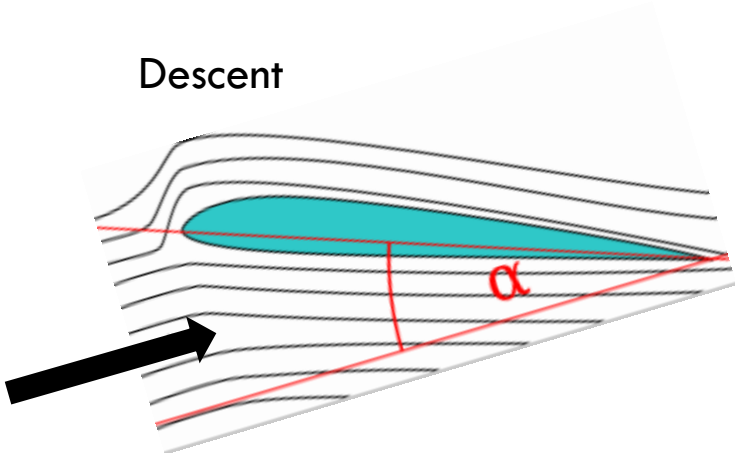


Figure 4-2. Critical angle of attack and stall.

Definition of AOA

- Angle of Attack is the angle between the cord line of an airfoil and the relative wind





Let's talk about Speeds

FAA Sources:

1.) Airplane Flying Handbook

2.) Pilot's Handbook of Aeronautical Knowledge

Pitot-Static System and Instruments

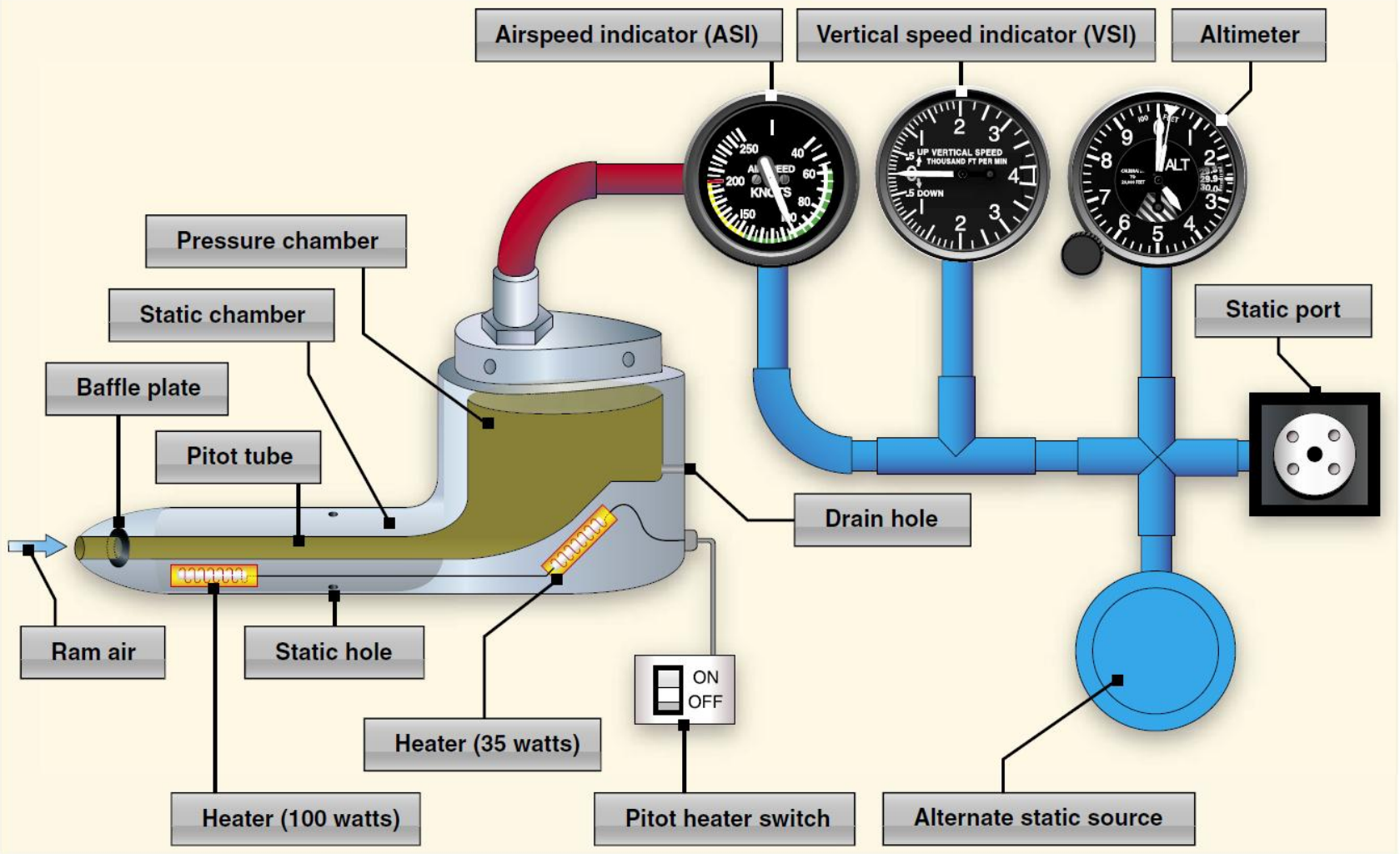
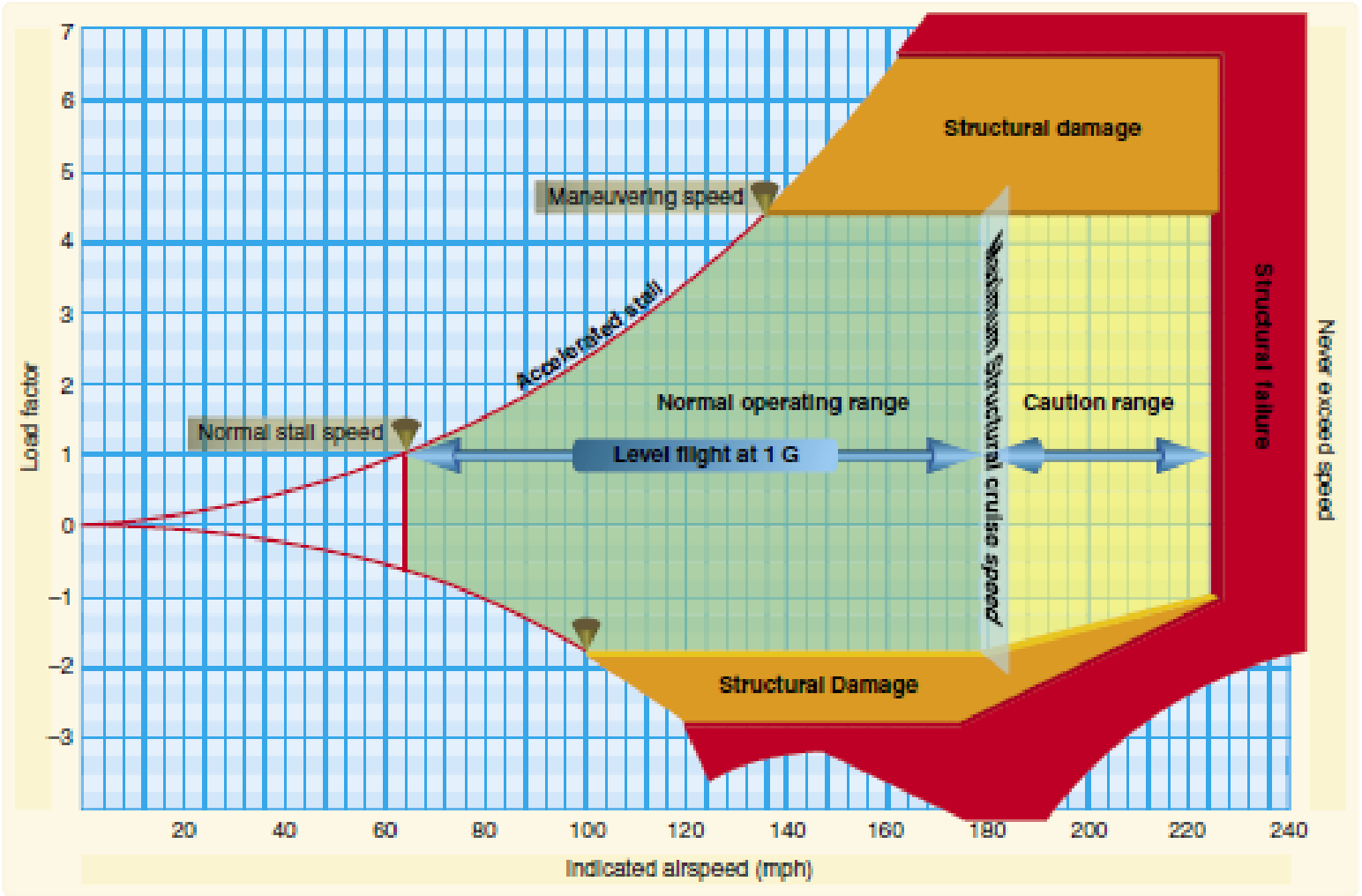


Figure 7-1. *Pitot-static system and instruments.*

Vne – Never-exceed Speed

- Operating above this speed is prohibited since it may result in damage or structural failure.

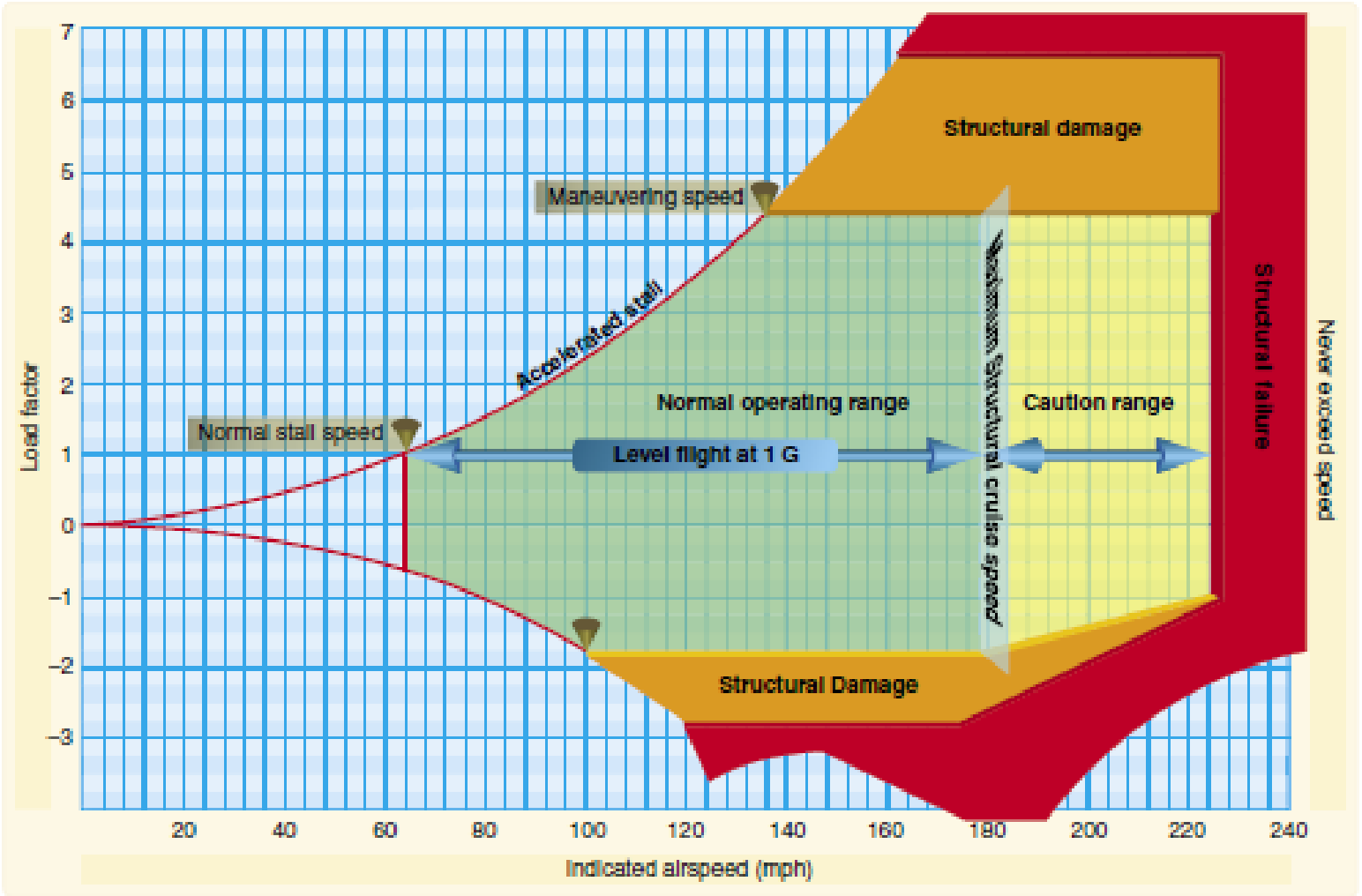
Vg Diagram (Velocity vs. G loads)



Yellow Arc – Caution Range

- Flight in this range only in smooth air, and then, only with caution.

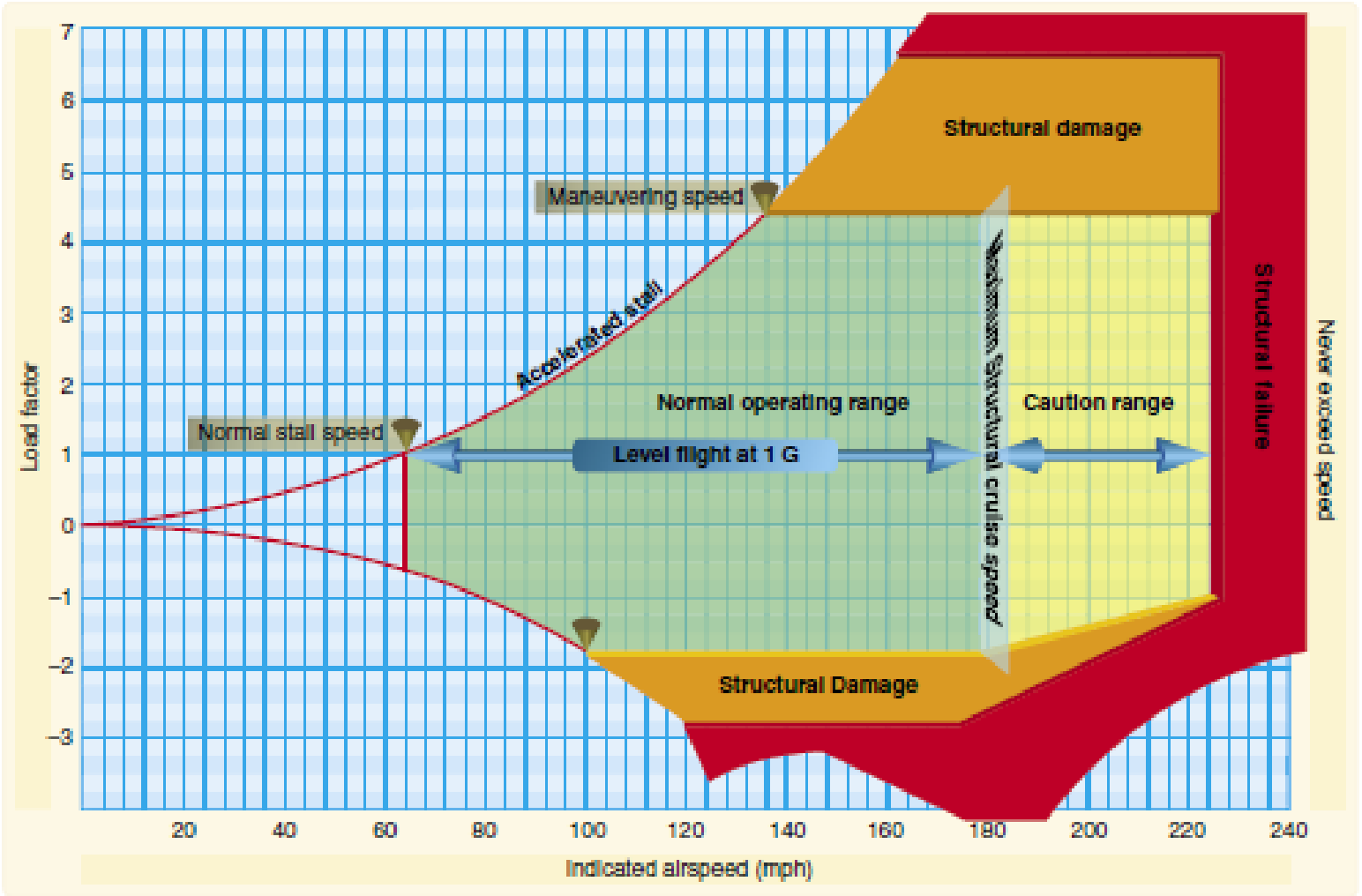
Vg Diagram (Velocity vs. G loads)



Green Arc – Normal Operating Range

- Upper limit Vno:
  - Maximum structural cruising speed.
  - Do not exceed this speed except in smooth air.

Vg Diagram (Velocity vs. G loads)



Green Arc – Normal Operating Range

- Lower limit Vs1:
  - Stalling speed or minimum steady flight speed obtained in a specific configuration.
  - Power-off stall speed at the **maximum takeoff weight** in clean configuration.

White Arc – Flap Operating Range

- Upper limit Vfe:
  - The maximum speed with the flaps extended.

White Arc – Flap Operating Range

- Lower limit Vso:
  - Stalling speed or minimum steady flight speed in the landing configuration
  - Power off stall speed at **the maximum landing weight** in the landing configuration.

What speeds are we missing?

- Vx - Best Angle of Climb
- Vy - Best Rate of Climb
- Va - Maneuvering Speed

Refer to POH/AFM

Vx – Best Angle of Climb

- Greatest amount of altitude gained in a given distance.
- To clear obstacle at the end of the runway
- Steep climb angle
- Refer to POH/AFM

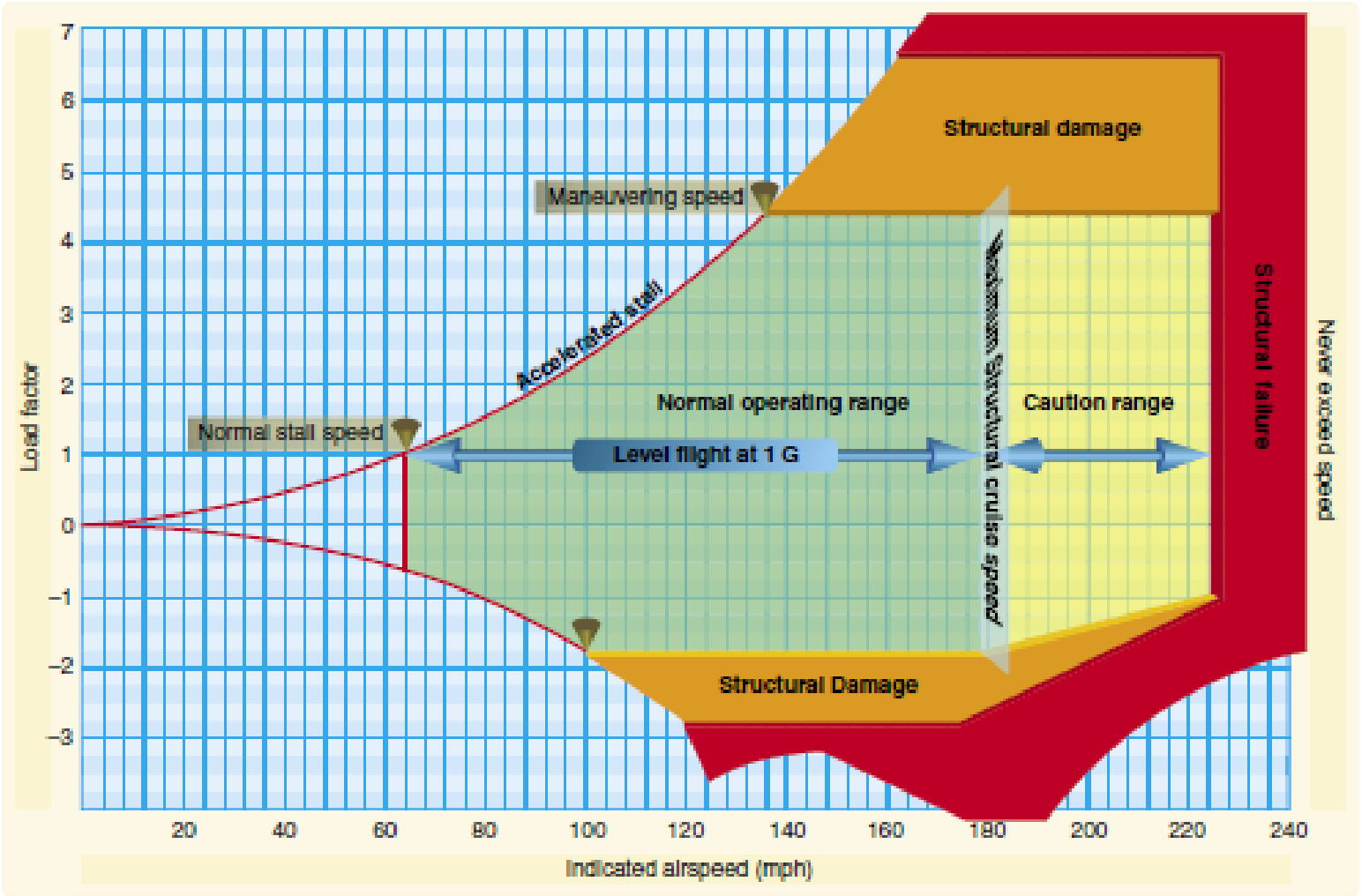
Vy – Best Rate of Climb

- Most altitude gained in a given period of time.
- High Climb Rate (VSI)
- Refer to POH/AFM

Va - Maneuvering Speed

- The maximum speed where full, abrupt control movements can be used without overstressing the airframe.
- Varies with Weight
- Specified in POH/AFM

Vg Diagram (Velocity vs. G loads)



Flying at different Gross Weights

How does changing aircraft weight affect

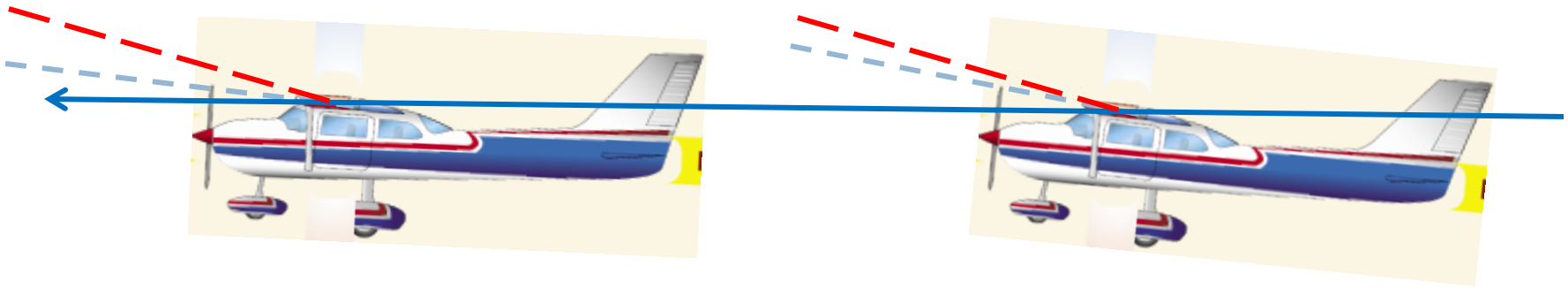
1. Maneuvering Airspeed
2. Stall Speeds
3. Approach Speeds

Level Flight, constant airspeed

GW 1400lbs

GW 2900lbs

Critical α



Lift is a product of Airspeed and Angle of Attack

Airspeed	Angle of attack
⇧	⇩
⇩	⇧

Flying at different Gross Weights

- **Stall speed** and **maneuvering speed** varies with gross weight by the following formula:

$$V_{s2} = V_{s1} \times \sqrt{W_2/W_1}$$

- Stall speed V_{s1} at 3,000 # = 73 KIAS
  Stall speed V_{s2} at 2,000 # = 60 KIAS
- Remember, the stalling AOA (critical AOA) remains the same at all weights

Va decreases with Weight

Max GW:
2,900 lbs

Va:
119-97 IAS

Actual	% of GW	% red	1/2 of red	IAS
2,900	1.00	0.00	0.00	119
2,800	0.97	0.03	0.02	117
2,700	0.93	0.07	0.03	115
2,600	0.90	0.10	0.05	113
2,500	0.86	0.14	0.07	111
2,400	0.83	0.17	0.09	109
2,300	0.79	0.21	0.10	107
2,200	0.76	0.24	0.12	105
2,100	0.72	0.28	0.14	103
2,000	0.69	0.31	0.16	101
1,900	0.66	0.34	0.17	98

Let's talk Pattern & Landing

Reference airspeeds in the pattern

How being fast affects your Landing Distance

In the Pattern – Reference Speeds?

- Base:
  - 1.4 Vso
  - 66 x 1.4 = 92.4
- Final:
  - 1.3 Vso
  - 66 x 1.3 = 85.8

Flying at different Gross Weights

- **Stall speed** and **maneuvering speed** varies with gross weight by the following formula:

$$V_{s2} = V_{s1} \times \sqrt{W_2/W_1}$$

- Vref at 3,000# = 73 KIAS
  Vref at 2,000# = 60 KIAS
- The stalling AOA (critical AOA) remains the same at all weights

Vref on Final adjusted for GW

POH / AFM:

Vref listed at GW 2,900lbs

79 IAS

Actual	% of GW	% red	1/2 of red	Vref IAS
2,900	1.00	0.00	0.00	79
2,800	0.97	0.03	0.02	78
2,700	0.93	0.07	0.03	77
2,600	0.90	0.10	0.05	75
2,500	0.86	0.14	0.07	74
2,400	0.83	0.17	0.09	72
2,300	0.79	0.21	0.10	71
2,200	0.76	0.24	0.12	70
2,100	0.72	0.28	0.14	68
2,000	0.69	0.31	0.16	67
1,900	0.66	0.34	0.17	66

Speed Matrix

Actual GW	% of GW	% of red	1/2 of red	Pattern 1.4 Vso	Final 1.3 Vso	Short 1.2 Vso	Vso IAS
2,900	1.00	0.00	0.00	85	79	73	61
2,800	0.97	0.03	0.02	84	78	72	60
2,700	0.93	0.07	0.03	82	77	71	59
2,600	0.90	0.10	0.05	81	75	69	58
2,500	0.86	0.14	0.07	80	74	68	57
2,400	0.83	0.17	0.09	78	72	67	56
2,300	0.79	0.21	0.10	77	71	66	55
2,200	0.76	0.24	0.12	75	70	64	54
2,100	0.72	0.28	0.14	74	68	63	53
2,000	0.69	0.31	0.16	72	67	62	52
1,900	0.66	0.34	0.17	71	66	61	50

Airspeed over Runway Threshold

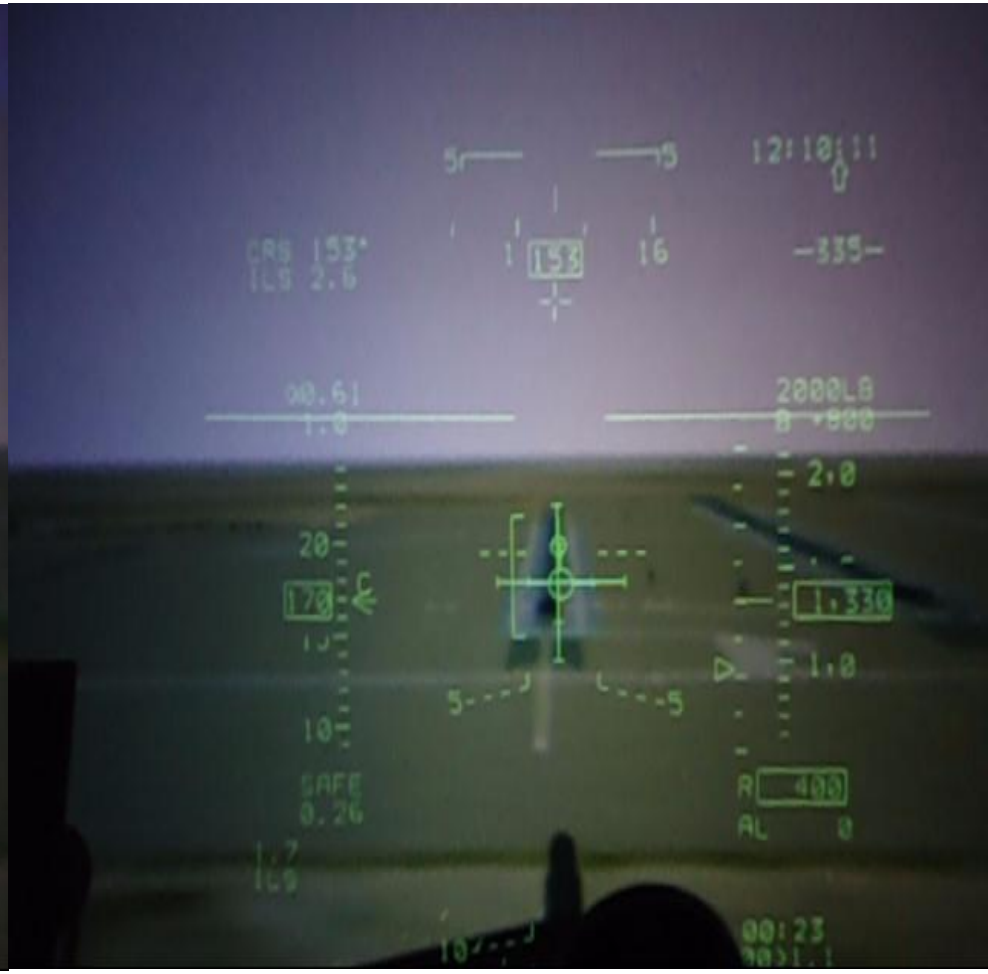
- A 10 percent increase in final approach speed results in a 20 percent increase in landing distance.
  - *This assumes a normal flare and touchdown (i.e. not allowing the aircraft to float and bleed excessive airspeed)*
  - **Vref 80 KIAS but flying 88 KIAS on final**

Flare Technique

- Extending the flare (i.e., allowing the aircraft to float and bleed excess airspeed) increases the landing distance.
- A 10 percent increase in final approach speed increases landing distance by:
  - **60** *percent, if touchdown is delayed (deceleration during an extended flare).*
  - **Vref 80 KIAS but showing 88 KIAS on final**

3,000 ft **1,800 ft**

Approach Speed: Vref	Approach Speed: 10% above Vref
Normal Flare	Extended Flare bleeding excess airspeed




Even a 10,000’ long runway
can get short in a hurry…
Sheppard AFB
© 2013 Google
Imagery Date: 12/6/2011 33°59'48.88" N 98°29'25.17" W elev 993 ft

Some Thoughts on Winds

How will wind affect me on final?

Think Winds on RWY 17

- ASOS / ATIS: … Winds 17012G24

- Would you change your Final Approach Speed?

YES

ADD ½ the Gust Factor!

Think Winds on RWY 17

Where did all my airspeed go!

Think Winds on RWY 17

- The winds have been very **strong from the South** during your flight as forecast
- You are on Final at your destination
  - ASOS / ATIS: **… Winds Calm**
  - Final Approach Speed **85 KIAS**
  - GPS Ground Speed 500 AGL **60 GS**

Summary

- Review your POH for recommended airspeeds and practice flying them – be precise!
- Feel rusty or uncomfortable doing so – recruit a CFI, practice and get some Wings credit
- Aircraft weight matters
- The wing does not know airspeeds, just AOA
- Do not carry unnecessary speed on final
- Consider and think winds
- Fly safe – Be Smart

Summary

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Questions ?