

PRIVATE PILOT FLIGHT TRAINING

AIRSPEEDS AND INDICATOR MARKINGS

OBJECTIVE:

This unit has two objectives. Understanding V speeds and what they mean and be able to relate the marking on an airspeed indicator to V speeds for the particular aircraft.

MOTIVATION

Understanding V speeds allows you to fly the aircraft at its best possible performance and depending on conditions the safest airspeeds for operation. A practical example for this is knowing what V_a is and why it is used.

PRESENTATION

The aircraft industry has standardized and tested the aircraft they manufacture for operations at different indicated airspeeds. The more complex an aircraft is the more standardized airspeeds the aircraft uses will be listed. For example a Cessna 172 and a 737 will both have a V_{so} speed in the P.O.H. However the 737 will have a V_1 speed which is a takeoff decision speed. This is not needed on a 172 and so it is not listed.

For General Aviation aircraft (GA) The following speeds will be in the P.O.H. and usually on the checklist for the aircraft. You should familiarize yourself with these speeds so you don't have to look them up during busy flight operations like takeoff.

- **V_{so}** This is an aircraft's *stall speed in landing configuration*, that is usually full flaps and landing gear extended
- **V_s** This is the *stall speed in a specific configuration*. This is usually "clean" (gear up, flaps up) but could be different depending on the P.O.H.
- **V_x** This is the airplane's best *angle of climb*. At this speed the aircraft will gain the most altitude over a given ground distance. Use this speed to climb and stay over the airfield, or climb to clear an obstacle.
- **V_y** This is the aircraft's best *rate of climb*. Use this speed to gain the most altitude over time. This airspeed is the one you should use on takeoff unless you are clearing an obstacle. If you use **V_x** to clear an obstacle you would normally transition to this speed after you have passed the obstacle.
- **V_r** *Rotation speed*. The minimum airspeed that you should have on the ground before you pull back on the yoke. Some aircraft might have different **V_r** speeds depending on weight.
- **V_a** This is "*maneuvering speed*". This is the speed at which you can give the airplane a FULL control input in any ONE direction without overstressing the airframe. It is also the speed at which the aircraft will stall before overstressing the airframe if its flight path is thrown off. Use this speed if you are caught in strong turbulence. This is also the speed that you will use for Basic Flight Maneuvers. This speed changes depending on aircraft weight.
- **V_{no}** This is the *normal operating* airspeed range of the aircraft. Only exceed this speed in smooth air.
- **V_{ne}** *Never Exceed* airspeed. Damage to the airframe is very likely if you exceed this speed.
- **V_{fe}** *Maximum Flaps Extended* speed. Do not have flaps extended above this speed. Note that some aircraft will allow a small amount of flaps, such as 10 degrees, above this speed. Check the P.O.H.

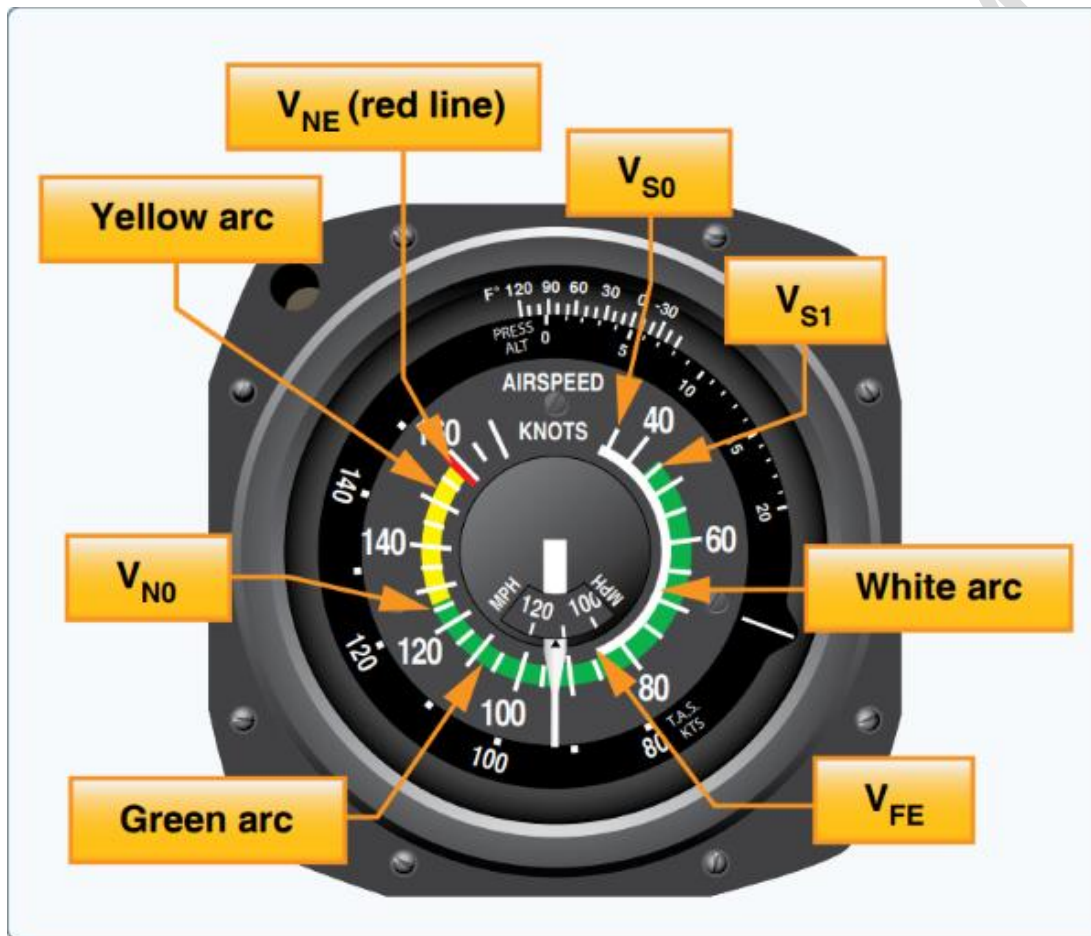
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There are many other V airspeeds depending on the aircraft. An example would be an aircraft with retractable gear. This type of aircraft would have:

- **V_{le}** The maximum speed that the landing gear may be in the extended position.
- **V_{lo}** The maximum speed that the landing gear may be retracted or extended.

TYPICAL AIRSPEED INDICATOR FOR GA AIRCRAFT THIS GAUGE INDICATES KNOTS



A very important thing to keep in mind is that some aircraft display knots for indicated airspeed. Others display Miles Per Hour (MPH), and yet others display both, with the outside of the indicator circle being MPH and the inside being knots. **THIS IS VERY IMPORTANT TO KEEP IN MIND.** You need to know **WHAT** you are reading. As a rule of thumb. MPH is 10% higher than than knots so 60 knots equals approximately 66 MPH.

On the airspeed indicator you can quickly locate important speeds such as **V_{so} & V_s** stall speeds. Note the colored arcs which indicate various speed ranges such as flap operating range, the white arc. Normal flight range, the green arc, Caution range, the yellow arc.

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Digital gauges such as the G5 may be configured to show additional reference speeds such as **V_y**. This picture shows a G5 with **V_y** indicated on the tape at 95 knots. (Note the KT in the lower left corner which indicates knots). These markers depend on the aircraft owner setting them in the unit, so they may or may not be present.



There is another airspeed that is used for landing. It is called **V_{ref}**. This is the speed that you should use for the final part of your approach to a runway. This speed is not shown on the airspeed indicator and should be listed in the P.O.H. If it is not shown you can calculate it by multiplying **V_{so}** times 1.4. In this case **V_{ref}** would be 49 knots.

A NOTE ON AIRSPEEDS

The airspeed on your gauge is the *indicated airspeed*. This is airspeed as indicated on the gauge. *Calibrated airspeed* is indicated airspeed corrected for installation and instrument errors. In straight level cruising flight calibrated and indicated airspeed will be identical. In slower flight, at large Angle of Attack or in some flap configurations calibrated airspeed might be several knots different from indicated airspeed. Keep this in mind if you are calculating something like **V_{ref}**.

KEY POINTS

- Refer to the P.O.H. to find out an aircrafts' important v speeds.
- Some speeds like **V_a**, **V_x** and **V_y** are not listed on analog gauges. You should memorize these.
- Airspeed indicators display various airspeeds by the end of colored arcs or colored arc ranges. Know what these are and what they mean.
- Know and understand if your airspeed indicator is in knots or MPH and adjust accordingly

QUESTIONS

- What is **V_x** for the aircraft you normally fly?
- What is **V_y** for the aircraft you normally fly?

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- What is the bottom of the white arc? The bottom of the green arc? Why are these important?
- What is V_a ? Why is it important for safety?
- Where is V_a on the airspeed indicator?
- What does the white arc indicate on an airspeed indicator?
- How can you compute a guestimate of V_{ref} ?

COMMON ERRORS:

- **Reading MPH as knots on some aircraft.**
- Operating flaps outside of range.
- Not climbing at V_y when departing an airport.

COMPLETION STANDARDS

Student should know by memory what V_x and V_y and V_r speeds are and what they mean.

Student should be able to demonstrate what the meaning of the various markings on a typical airspeed indicator.

Student should be able to indicate what units such as knots are displayed on the aircrafts airspeed indicator.