Flight Instruments

There are six instruments that are common to most general aviation aircraft. They help a pilot determine things like altitude, attitude, and airspeed. Pilots initially learn to fly by looking outside the cockpit and using the horizon as a reference. More advanced pilots learn to use the instruments so they can control the airplane if the actual horizon is not visible, when flying in the clouds for example.

Airspeed Indicator:

The airspeed indicator shows a plane's speed through the air. Depending on the wind, it may be different from the plane's speed over the ground. Typically, IAS (Indicated Airspeed) is shown in *knots* or nautical miles per hour. The instrument shows the difference between the ambient air pressure and ram air pressure. Ambient air pressure is simply the pressure of the surrounding air, which is taken from a static port usually on the side of the fuselage. Ram air pressure is the pressure of the air that is forced into a device called a pitot tube. Air is forced into the pitot tube by the forward motion of the airplane. The colored arcs indicate various ranges. The white arc shows the airspeed at which it is safe to deploy flaps and landing gear. The green arc is the normal operating range. The yellow arc is the caution range. It is only safe to operate at this speed in very stable conditions. If it is turbulent and the airplane is operating in the yellow arc, the pilot is risking structural damage to the airframe. The thin red line is the *Never Exceed* speed. The airframe will suffer structural damage at this speed.

Attitude Indicator:

The attitude indicator shows an artificial horizon so a pilot knows that attitude of his aircraft. Both pitch and bank information is shown with the AI. Here the orange bars show the position of the airplanes wings relative to the ground. This intrument is operated from the vacuum pump. If the vacuum pump fails, this instrument will no longer work.

Altimeter:

The altimeter shows the altitude of the aircraft in feet above sea level. It uses ambient air pressure to show how high the airplane is. A pilot needs to know both the what the barometric pressure is, so he can set his altimeter to read correctly (the small numbers in the window; this altimeter is set to a barometric pressure of 29.90 in Hg). A pilot also needs to know the elevation of the ground. This altimeter shows an altitude of 1,400 feet above sea

level. If the airport is at 400 feet above sea level, then the plane is only 1,000 feet above ground level. This instrument shows the ambient air pressure that is taken from the static port.

Turn Coordinator:

The turn coordinator shows the bank of the wings. The position of the black ball shows if the aircraft is in a coordinated turn. Both the ailerons and the rudder work together to turn the airplane. If a pilot banks to the right, he must also use the rudder pedals to move the rudder to the right. If he is not using enough rudder the ball will be to the right of center. The pilot will "step on the ball," which means he will push on the right rudder pedal to coordinate his turn. When he uses enough right rudder, the ball will be in the center. If he uses too much, the ball will be on the left and he has to use less pressure on the right rudder pedal. The white marks show the rate of turn. This image shows the airplane is turning to the right at a standard rate. Standard rate is 3º per second. At this rate it will take the airplane two minutes to turn 360º, which is why it say "2 MIN." at the bottom. This intrument is electrical. If the electrical system fails, the turn coordinator will no longer work. However, if the vacuum system fails, the turn coordinator will continue to work, since it is a part of different system.

Directional Gyro:

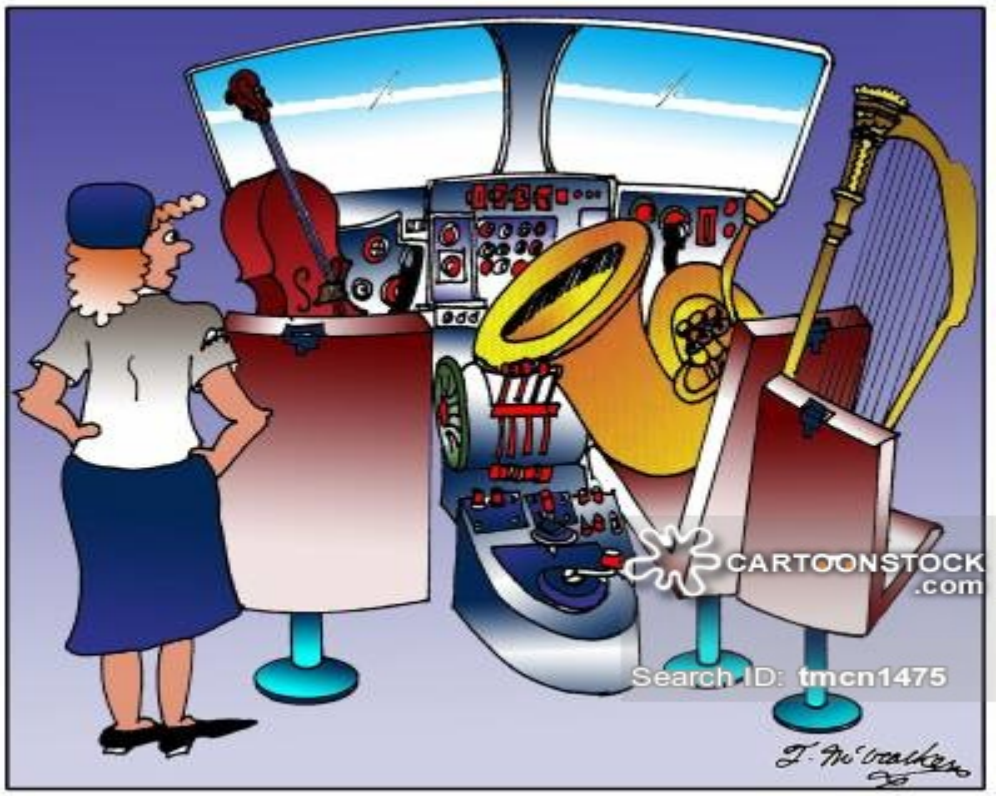
The Directional Gyro (DG) is also called a heading indicator. A pilot sets it to a compass in the cockpit. As the airplane's heading changes, the DG will show the change. North, South, East and West are shown with N, S, E, and W. Other headings are shown with numbers. A pilot needs to know that a heading of 90 degrees means he or she is going east. A heading of 210 degrees is southwest. This DG is indicating a heading of 83 degrees. This instrument is also powered by the vacuum system. If the vacuum system fails, a pilot can use the compass instead of the DG. The only problem with that is the compass isn't always accurate *while* the airplane is turning. When the airplane returns to straight and level flight, the compass will read accurately again.

Vertical Speed Indicator:

The Vertical Speed Indicator (VSI) shows an aircraft's change in altitude. If the aircraft is climbing, the needle will be deflected upward. If the aircraft is descending the needle will deflect downward. The numbers will indicate the rate of climb or descent in hundreds of feet per minute. This VSI is showing a climb of 320 feet per minute. This instrument is also taking its reading from the static port. There is a lag with this instrument. When a pilot initiates a climb, it may take 5 to 7 seconds for the VSI to show that the plane is climbing. When the pilot levels off, he will get more immediate information from the altimeter. It will take a few seconds for the VSI to stabilize and show that the aircraft is level.

Six Pack

These six primary flight instruments are located together so a pilot can look at them easily. In all modern aircraft, they are in the same positions on an instrument panel, so a pilot will be used to having them in the same position in any aircraft.



"I guess we're flying by instruments."

Flight Instruments Worksheet