

Flight Instruments



Magnetic
Compass

Airspeed
indicator

Attitude
indicator

Altimeter



Turn
coordinator

Heading
indicator

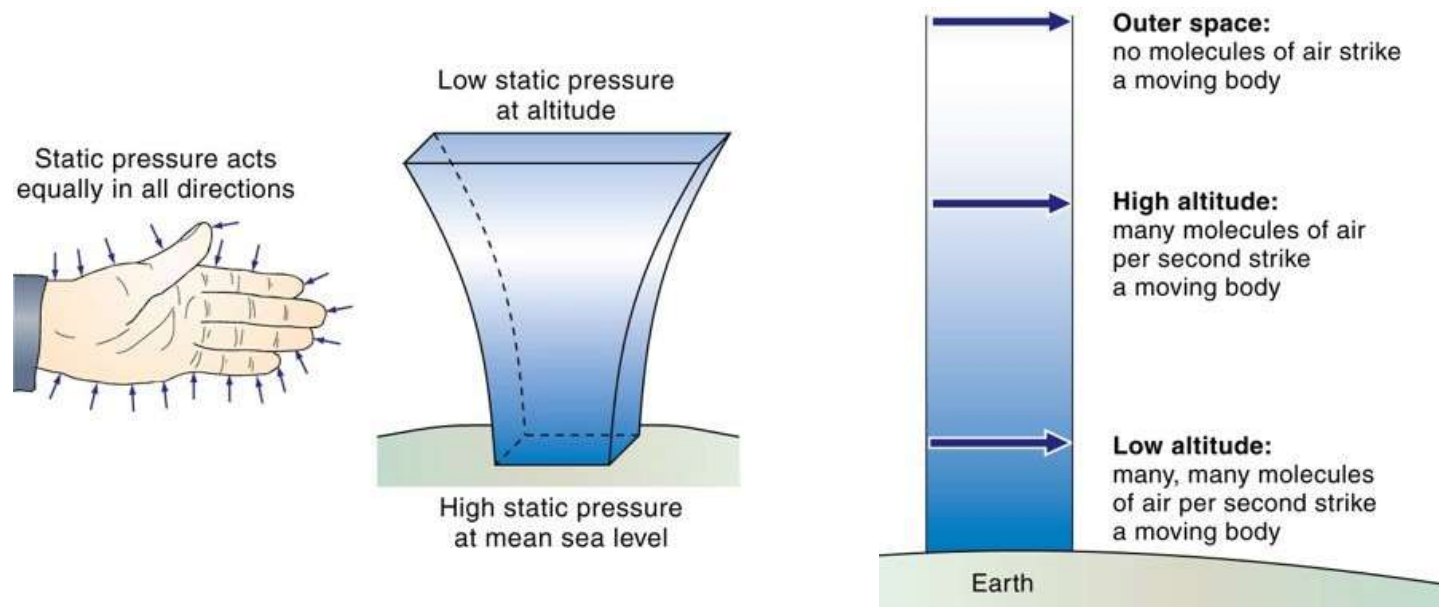
Vertical
speed
indicator

Coordination ball

Pressure Instruments

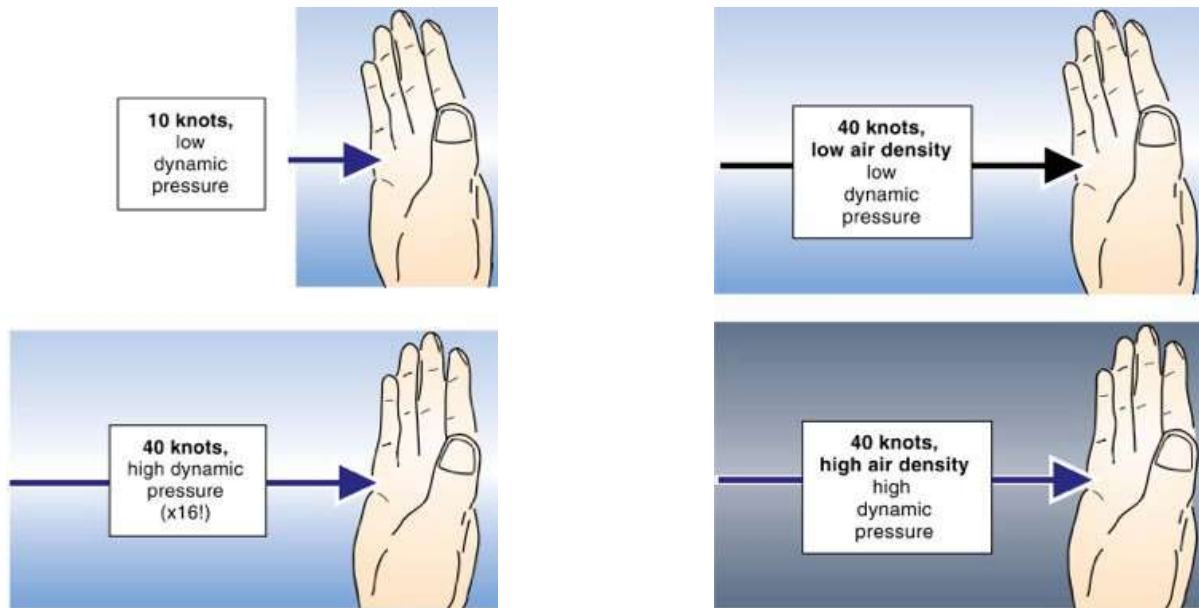
- Powered by the pitot-static system
- Altimeter
- Vertical Speed Indicator
- Airspeed Indicator

Static Pressure



at any point in the atmosphere
static pressure is exerted equally
in all directions

Dynamic Pressure



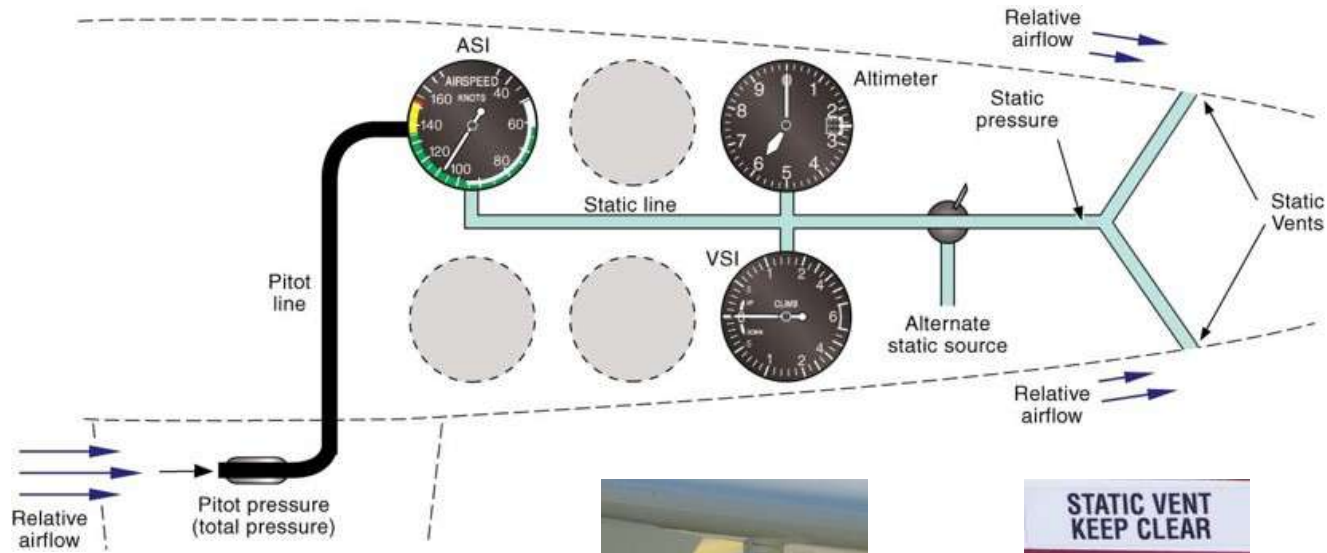
increases with speed

higher in dense air

Total Pressure

Static Pressure + Dynamic Pressure

Pitot-Static System

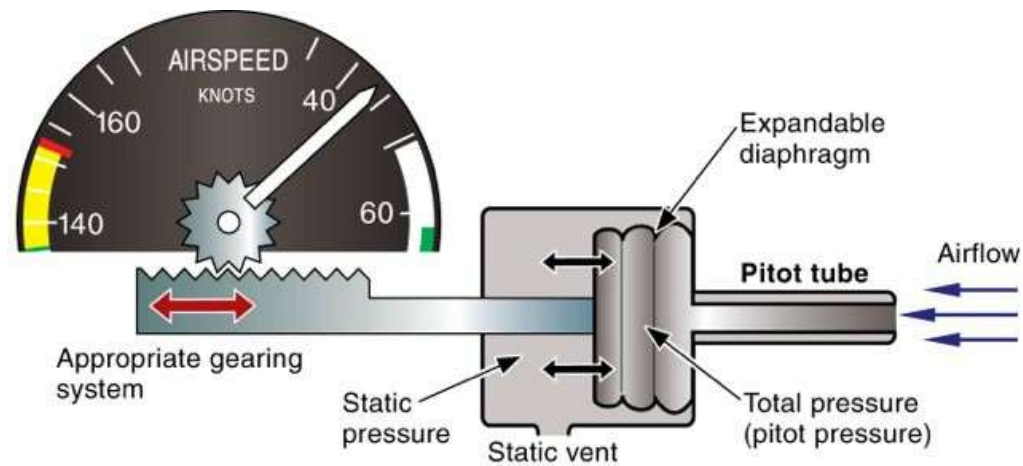


Pitot-Tube



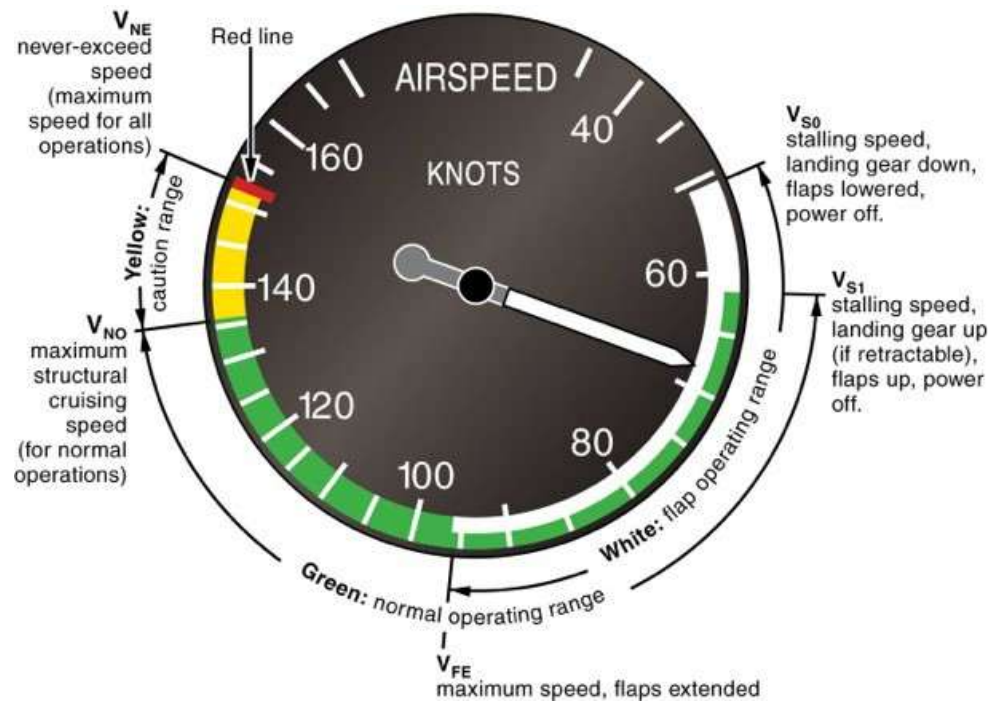
Static Vent

Airspeed Indicator



measures *dynamic* pressure

Airspeed Indicator



Airspeed

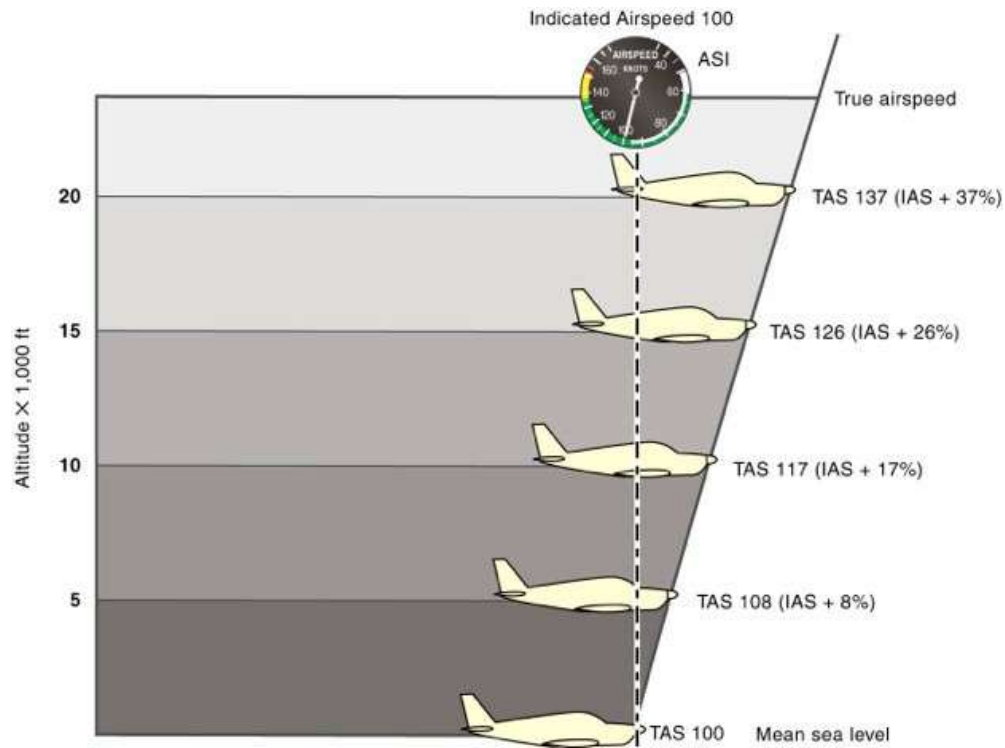
- Indicated Airspeed (KIAS)
 - indicated on airspeed indicator
- Calibrated Airspeed (KCAS)
 - KIAS adjusted for installation and instrument error
- True Airspeed (KTAS)
 - KIAS adjusted for air density

Indicated and True Airspeed

TAS usually exceeds IAS

- Indicated airspeed (IAS)
 - important for aerodynamic qualities
 - related to dynamic pressure
- True Airspeed (TAS)
 - actual speed of airplane relative to the air
 - important for navigation

Indicated and True Airspeed



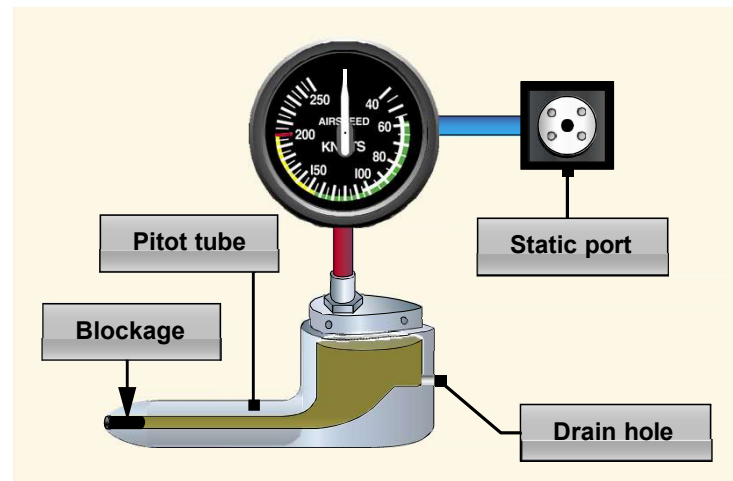
with IAS constant TAS increases with altitude

Airspeed System Malfunctions

Friday, October 5, 12

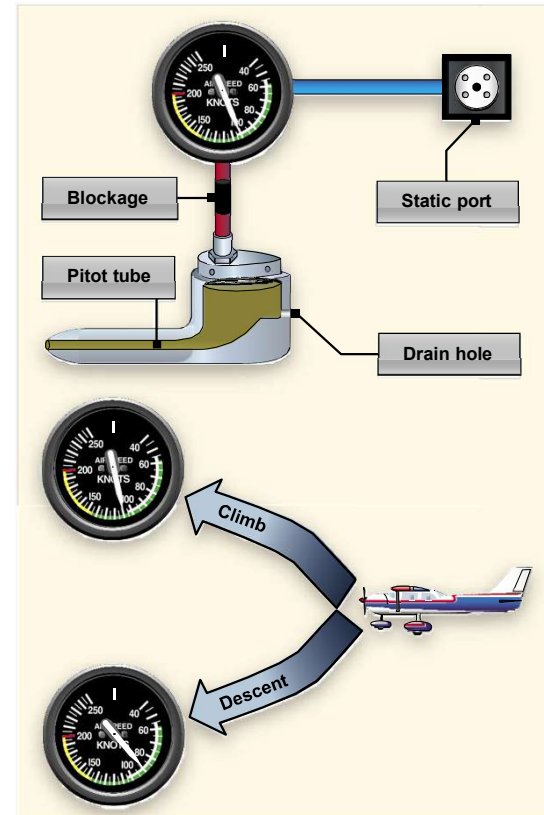
Blocked Pitot Tube

- Airspeed drops to zero when the pitot tube is blocked and the drain hole is clear



Blocked Pitot System

- With pitot tube and drain hole blocked the airspeed indicator will act like an altimeter
- Airspeed will increase in a climb
- Airspeed will decrease in a descent



Blocked Static Port

- Airspeed increases in a descent
- Airspeed decreases in a climb

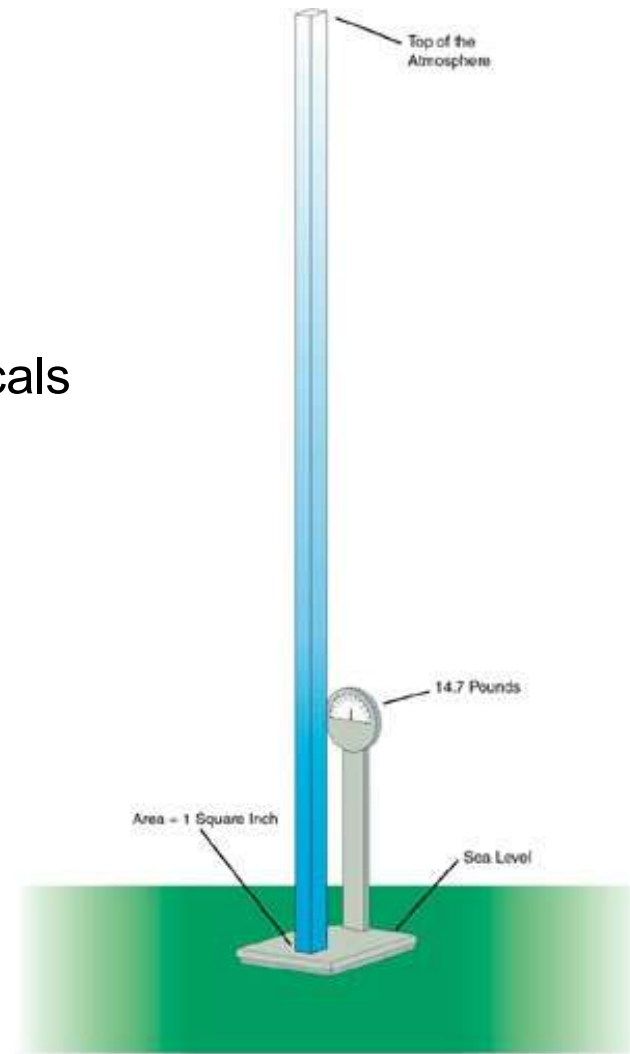
Altimeter

- Vertical navigation
- Vertical separation
 - other aircraft
 - the ground
- Mean Sea Level (MSL) is reference point for vertical navigation



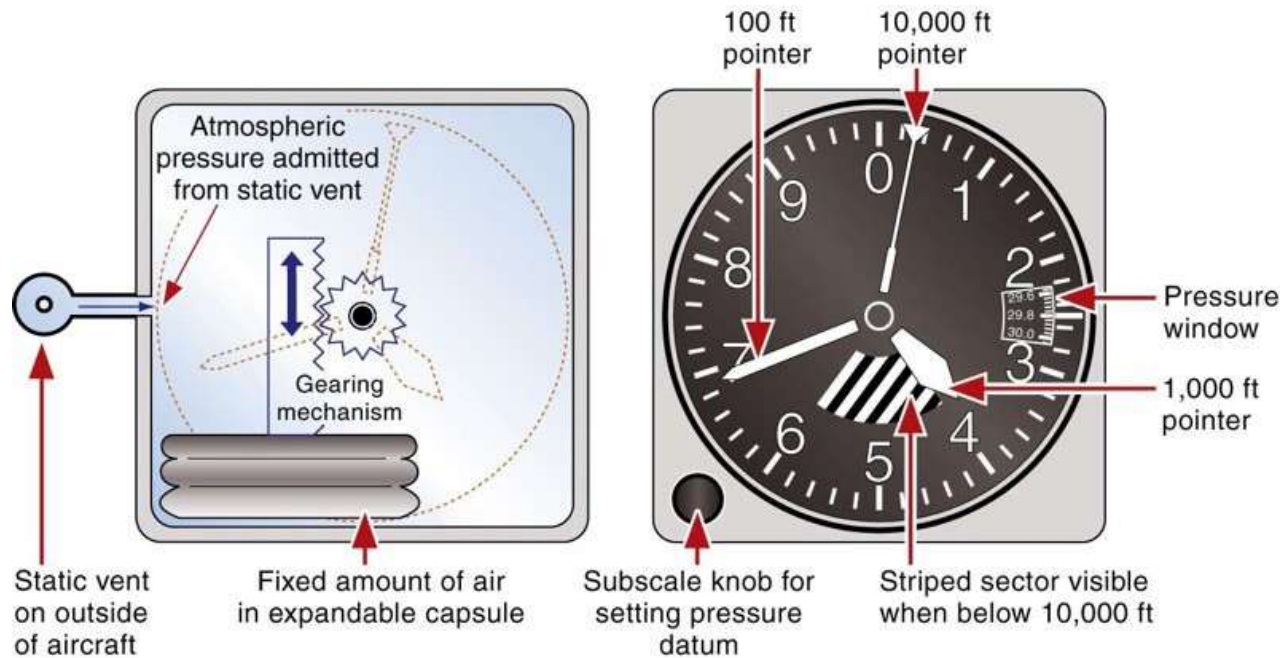
Standard Atmosphere

- 29.92 in Hg
- 1013.2 millibars or hectopascals
- 760 mm Hg
- 14.7 pounds



Friday, October 5, 12

Altimeter



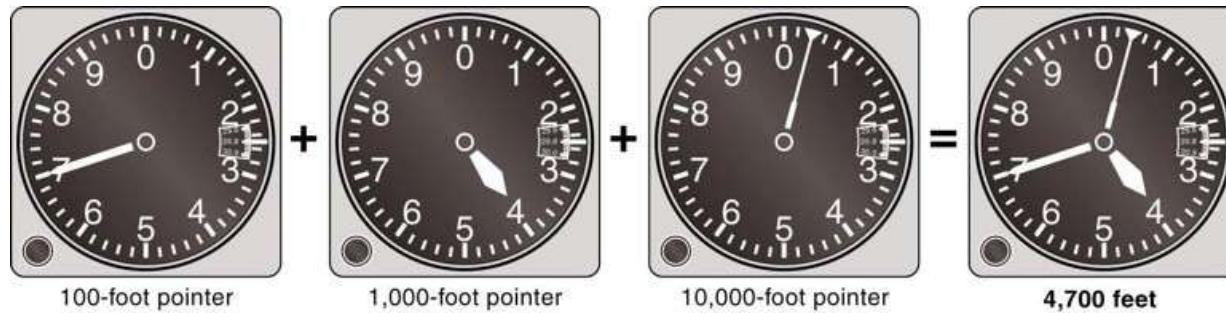
measures *static* pressure

Pressure Window

- Allows selection of pressure level from which altitude will be measured
- For pressure altitude Set 29.92”
- For true altitude set MSL pressure



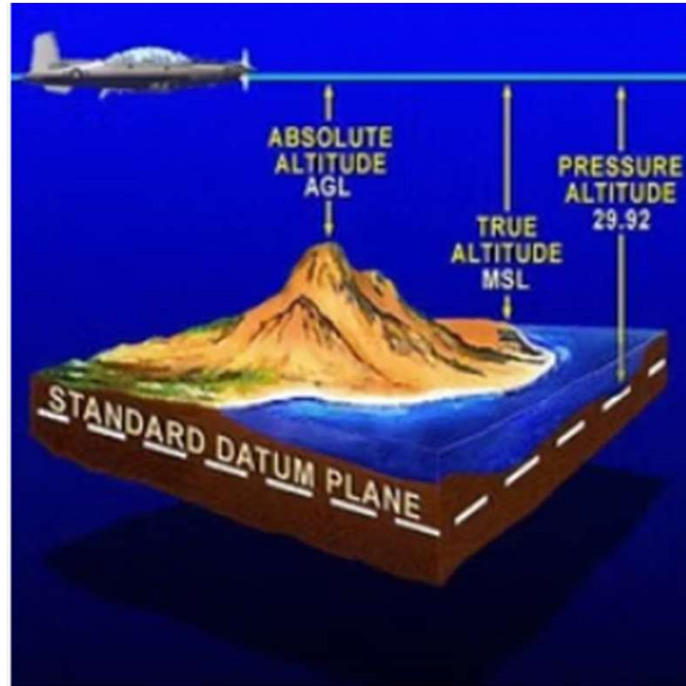
Altimeter Presentation



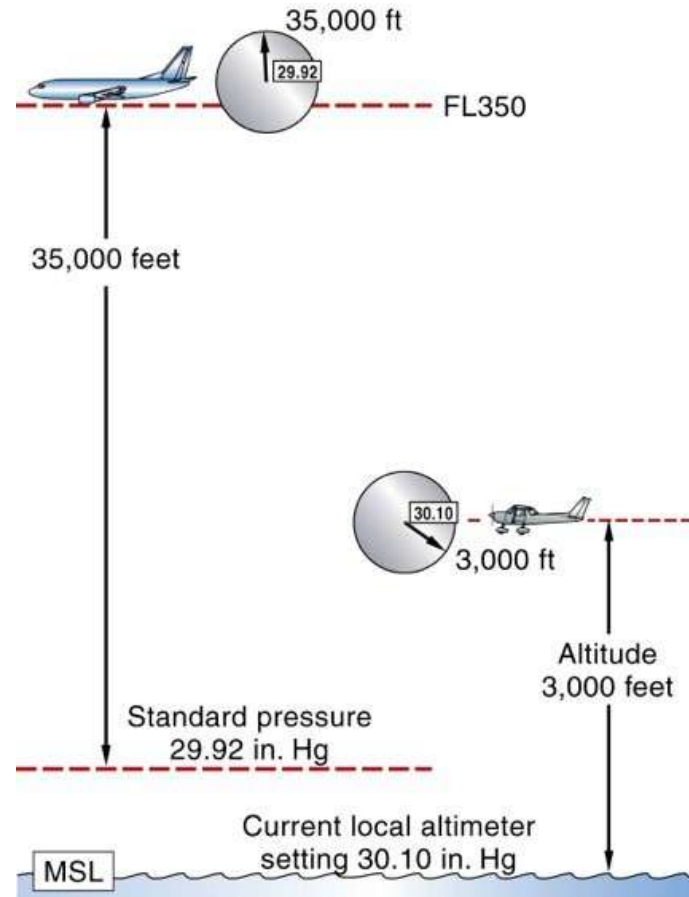
how to read the altimeter

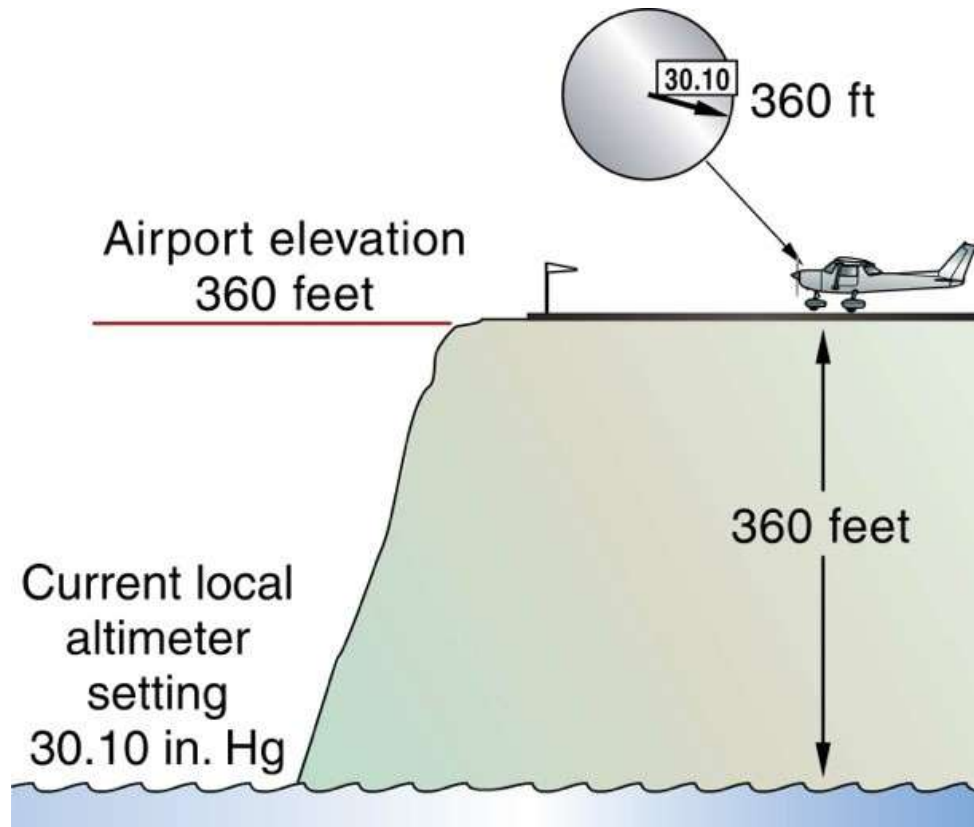
Altitude

- Indicated Altitude
- True Altitude
- Pressure Altitude
- Absolute Altitude
- Density Altitude



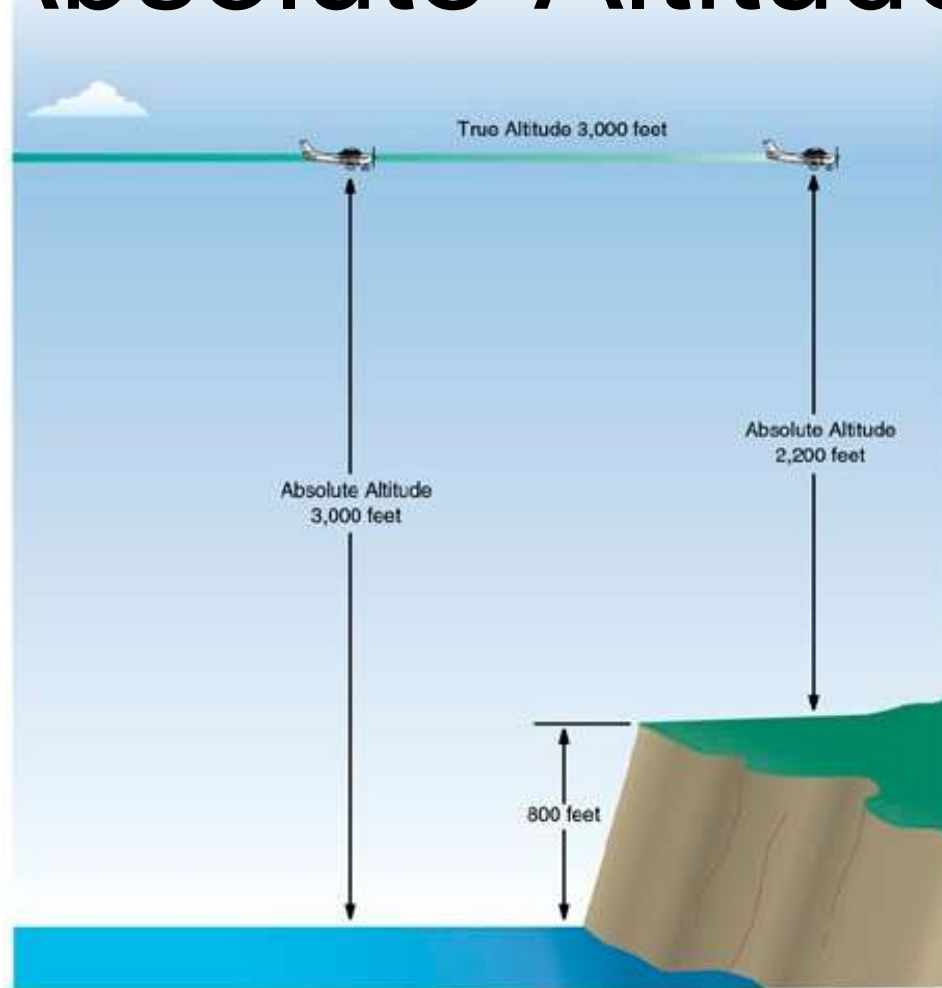
- Indicated Altitude
- True Altitude
- Pressure Altitude





on the ground the altimeter should read
airport elevation (true altitude) $\pm 75'$

Absolute Altitude

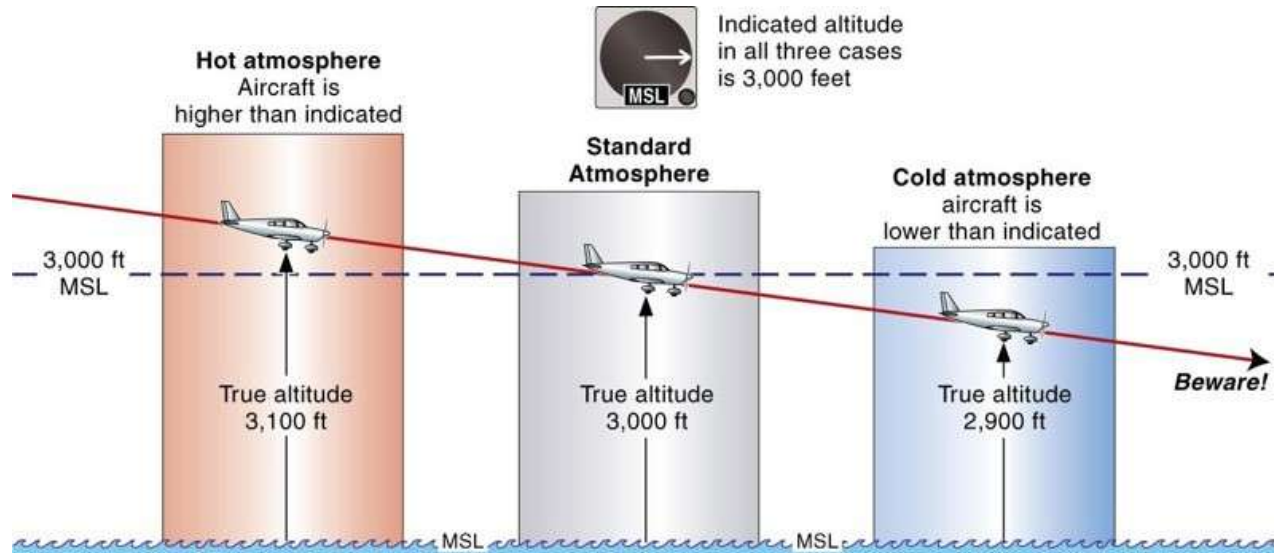


Friday, October 5, 12

Altimeter Errors

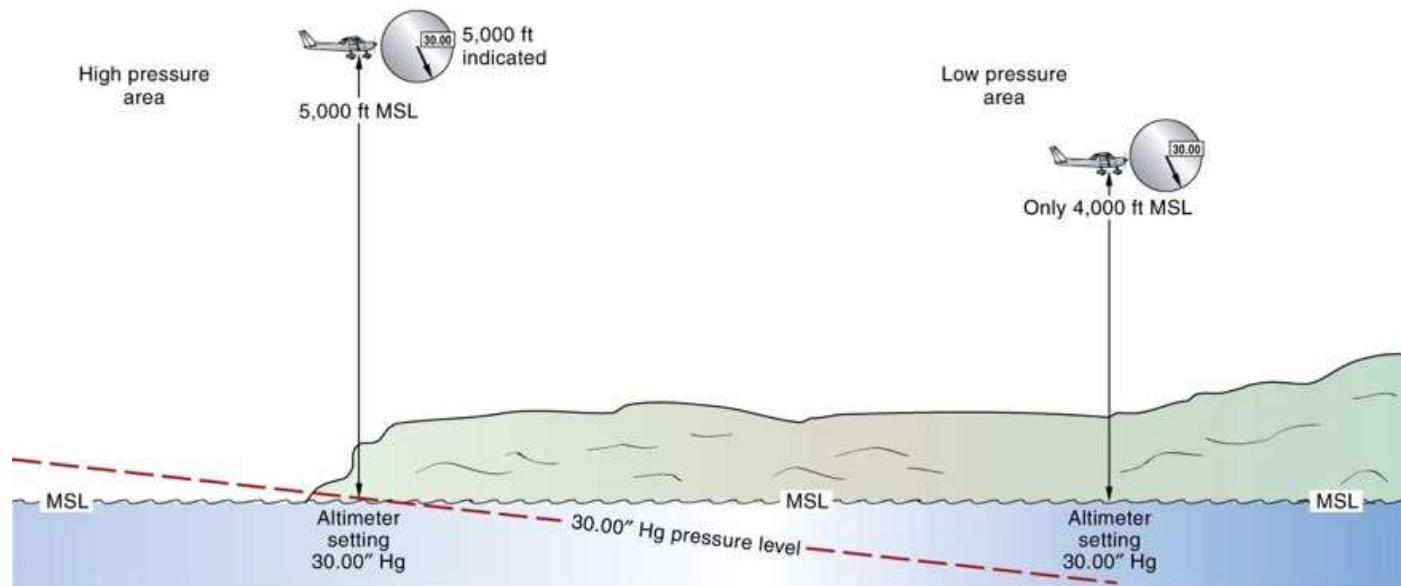
- Temperature Error: Atmosphere Induced
- Pressure Error: Pilot Induced

Temperature Error



“from high to low look out below”

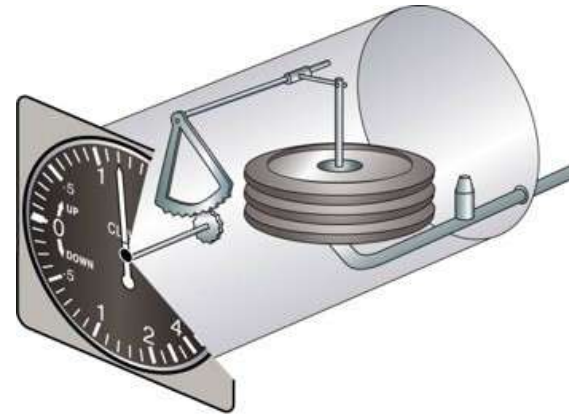
Update Altimeter



“from high to low look out below”

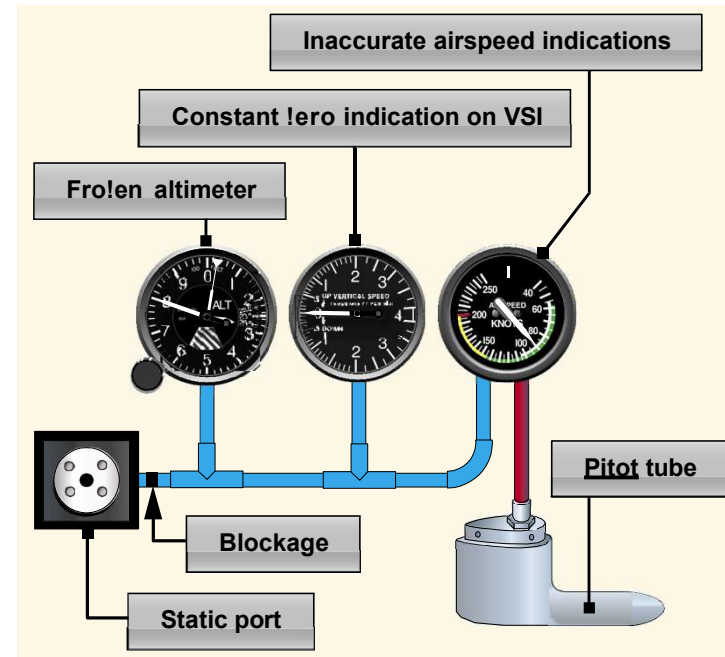
Vertical Speed Indicator

- Measures rate of change of altitude
- Measures change in static pressure



Blocked Static System

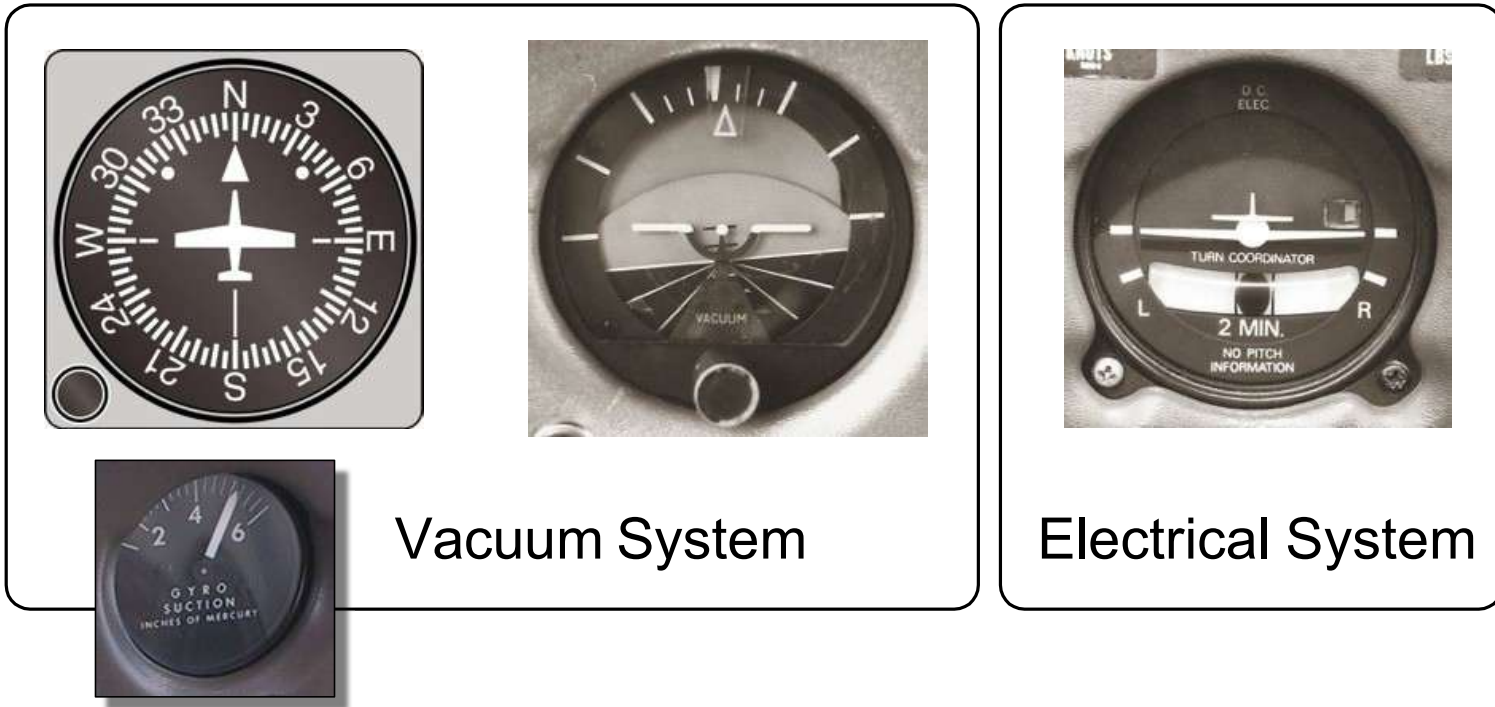
- Airspeed inaccurate
- Altimeter Frozen
- VSI constant zero



Gyroscopic Instruments

Friday, October 5, 12

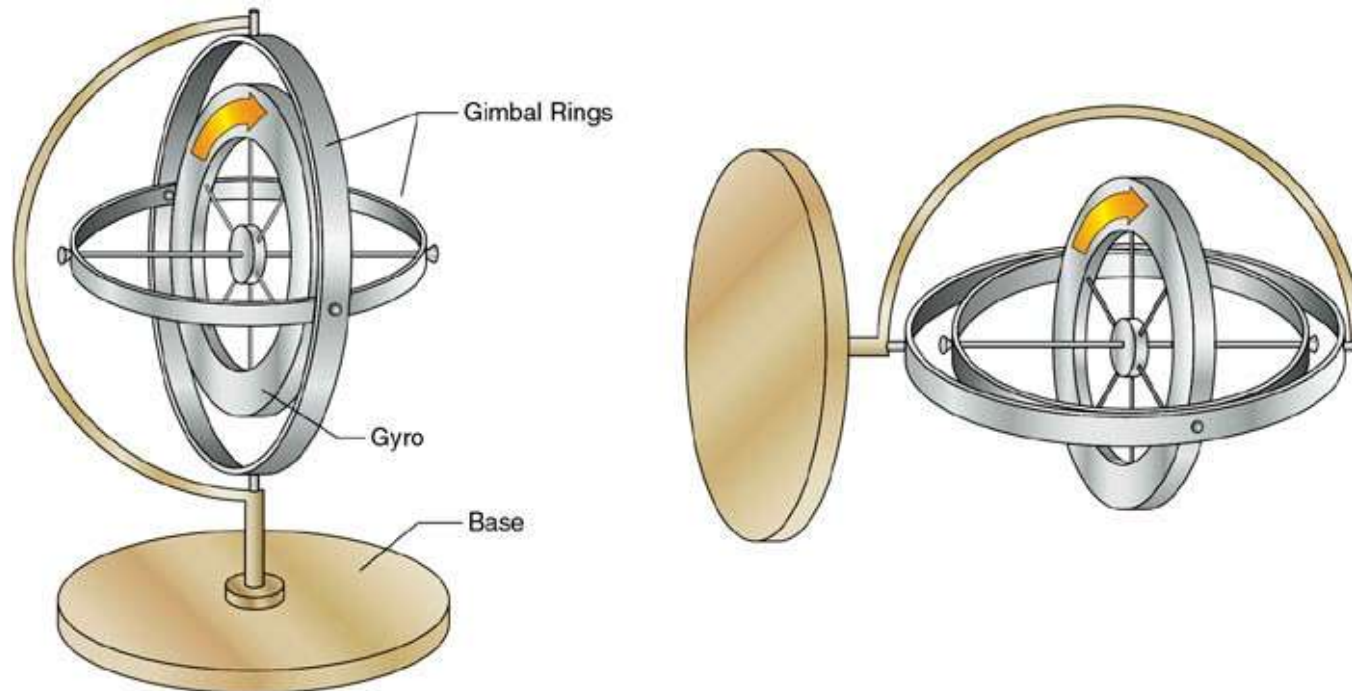
Gyroscopic Instruments



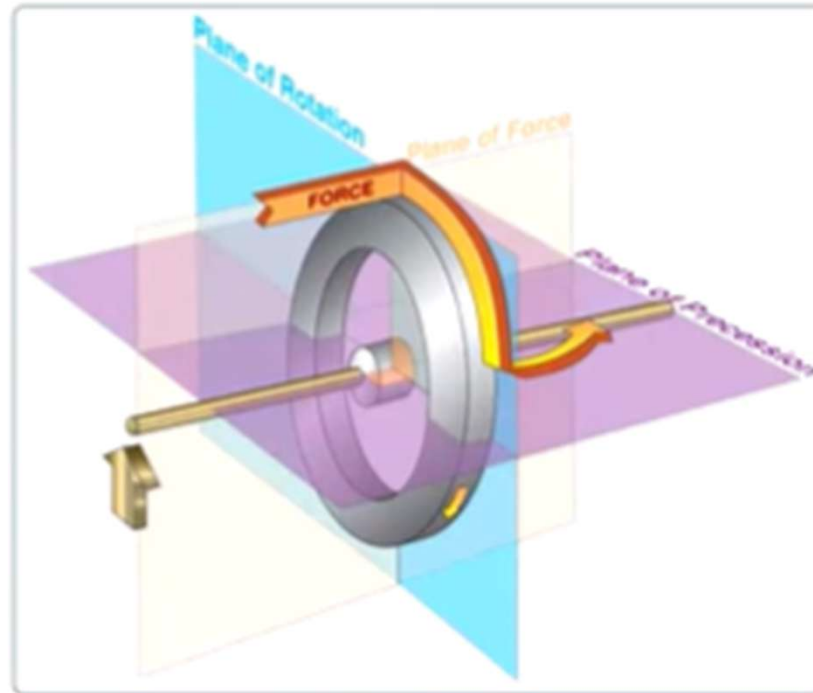
Vacuum System

Electrical System

Rigidity in Space



Precession



Gyroscopic Instruments



Vertical

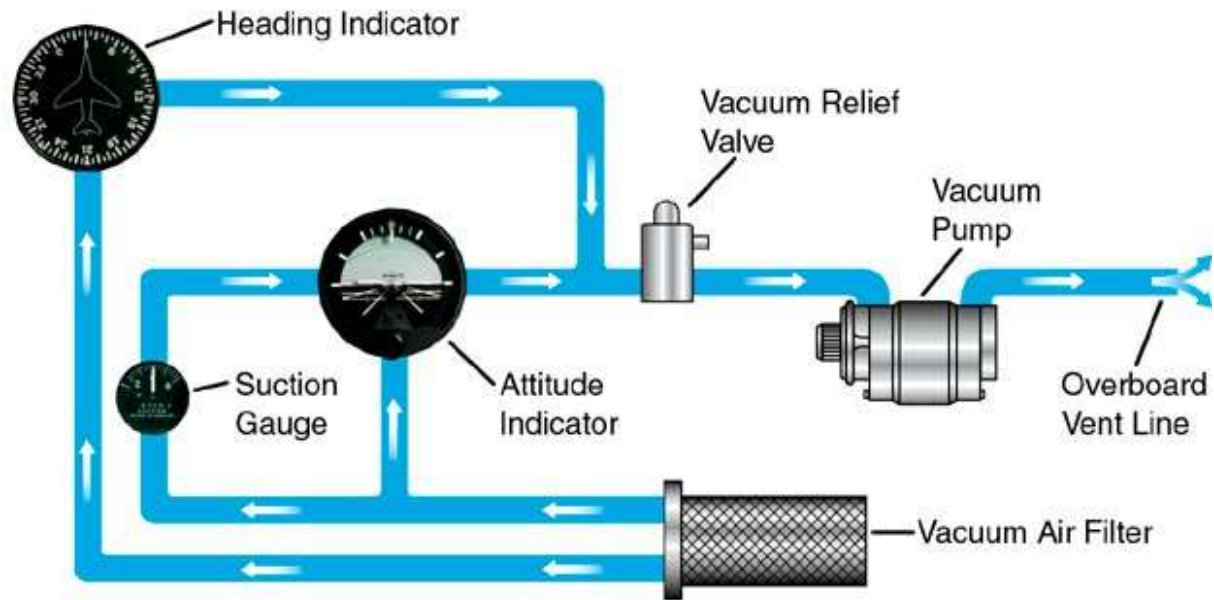


Horizontal



Canted

Vacuum System



Heading Indicator

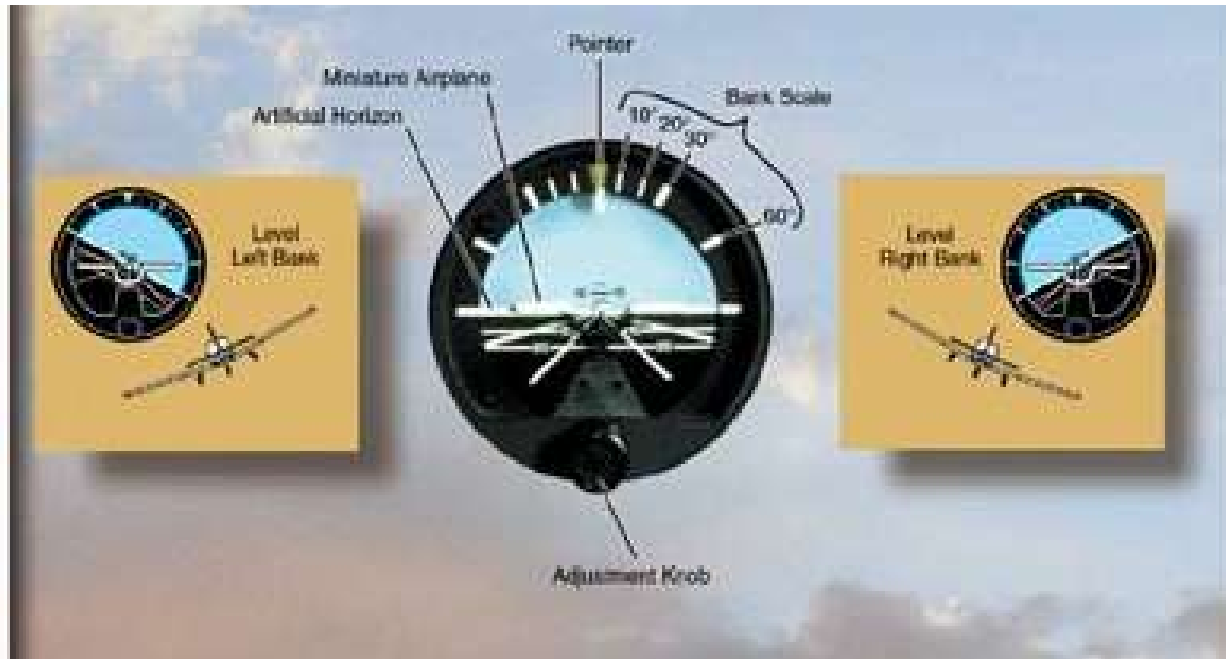
Must be **periodically aligned** with the magnetic compass as the gyro precesses



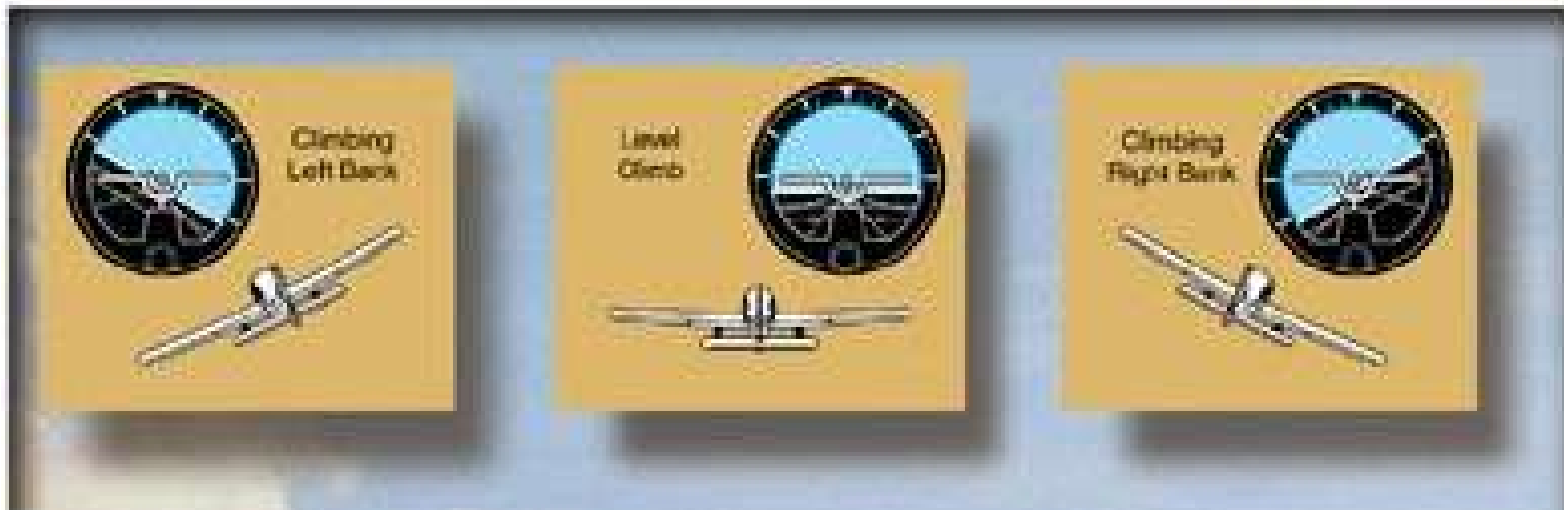
Attitude Indicator

- Align miniature aircraft to the horizon line during level flight
- Direction of bank is determined by the relationship of the miniature airplane to the deflected horizon





Friday, October 5, 12



Friday, October 5, 12



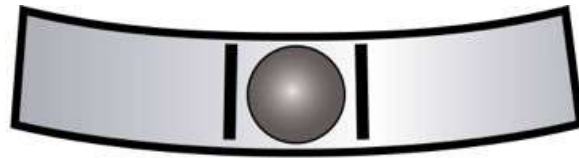
Friday, October 5, 12

Turn Coordinator

Provides an indication of the movement of the aircraft about the yaw and roll axis

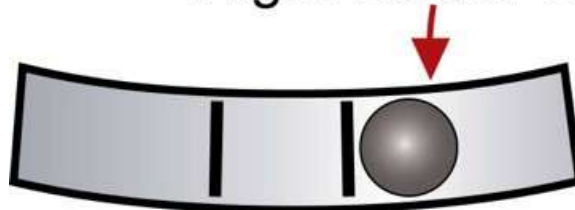


Inclinometer



Coordinated

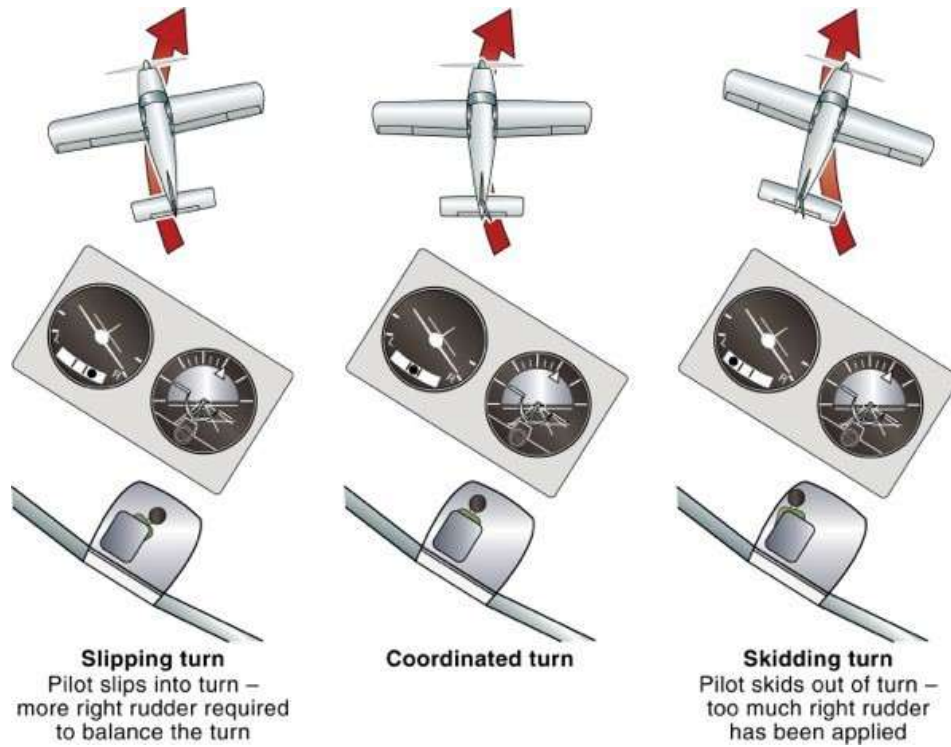
Right rudder required



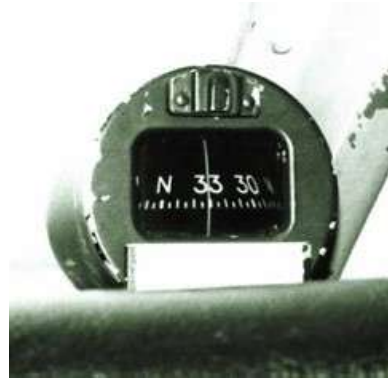
Uncoordinated

Step on the ball

Turn Coordinator

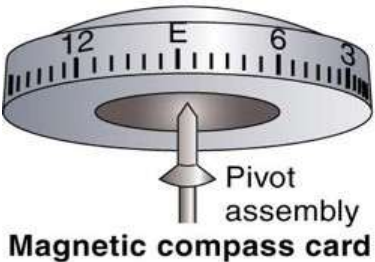


Magnetic Compass

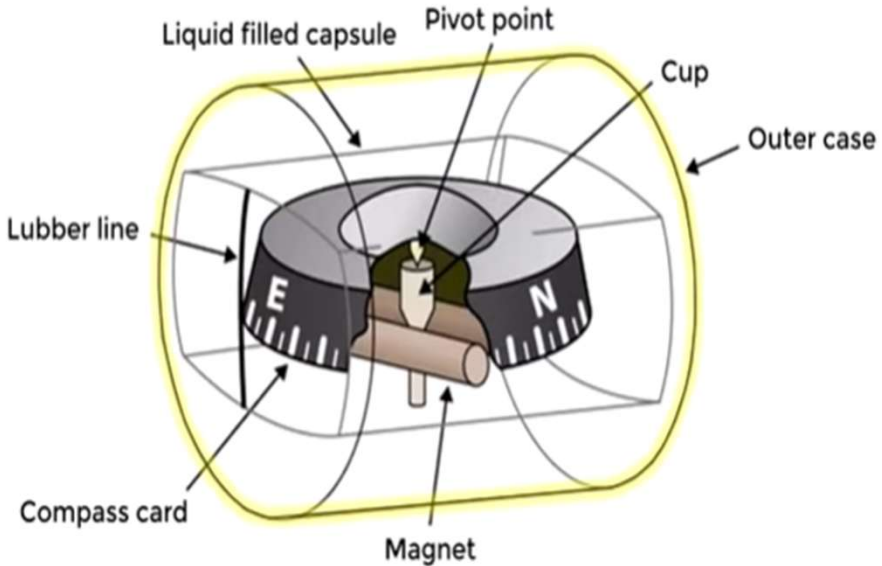


- A magnet free to rotate about a pivot point
- Used to determine the heading of the aircraft in relation to Earth's Magnetic North
- Self Contained construction- back up instrument

Magnetic Compass



Card/magnet combined with float

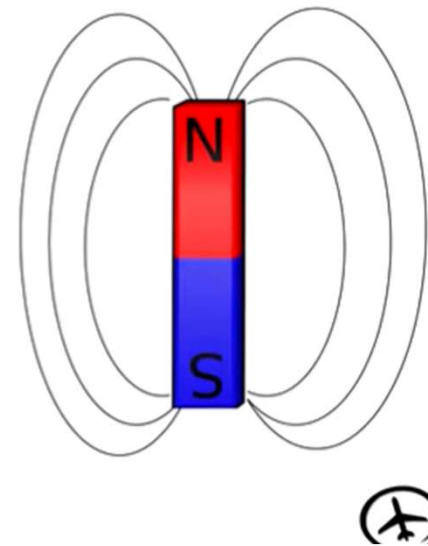
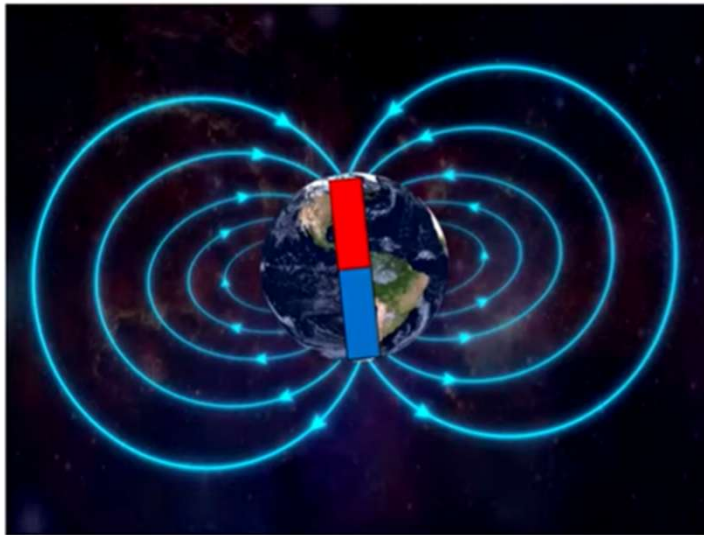


Compass Errors

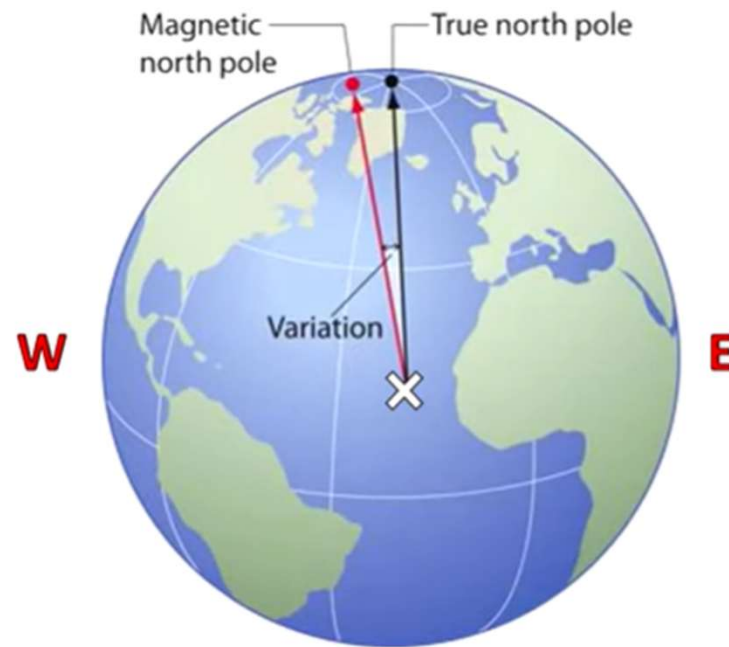
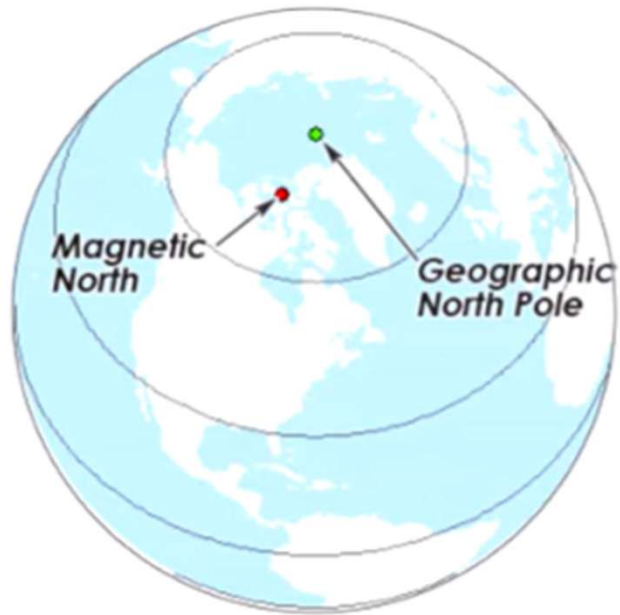
- Variation
- Deviation
- Magnetic Dip Errors
 - Turning Errors
 - Acceleration Errors

Magnetic Variation

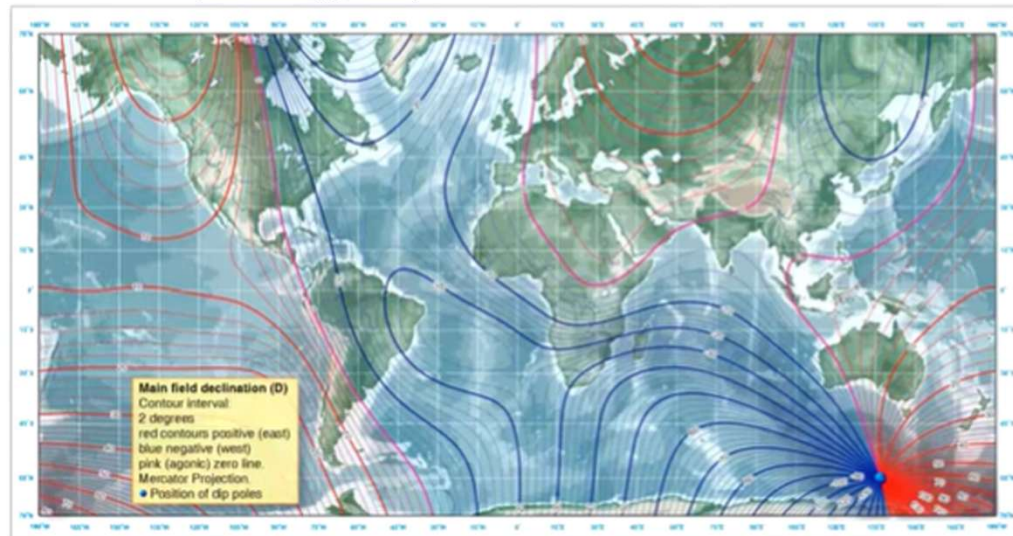
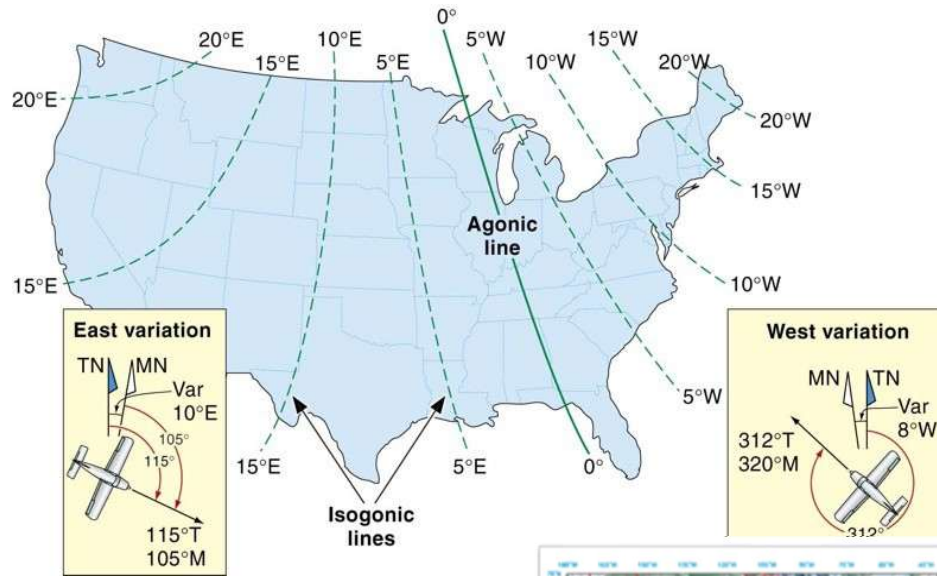
- Mag Var or Magnetic Declination
- Angle between Geographic North and Magnetic North



Variation



Variation



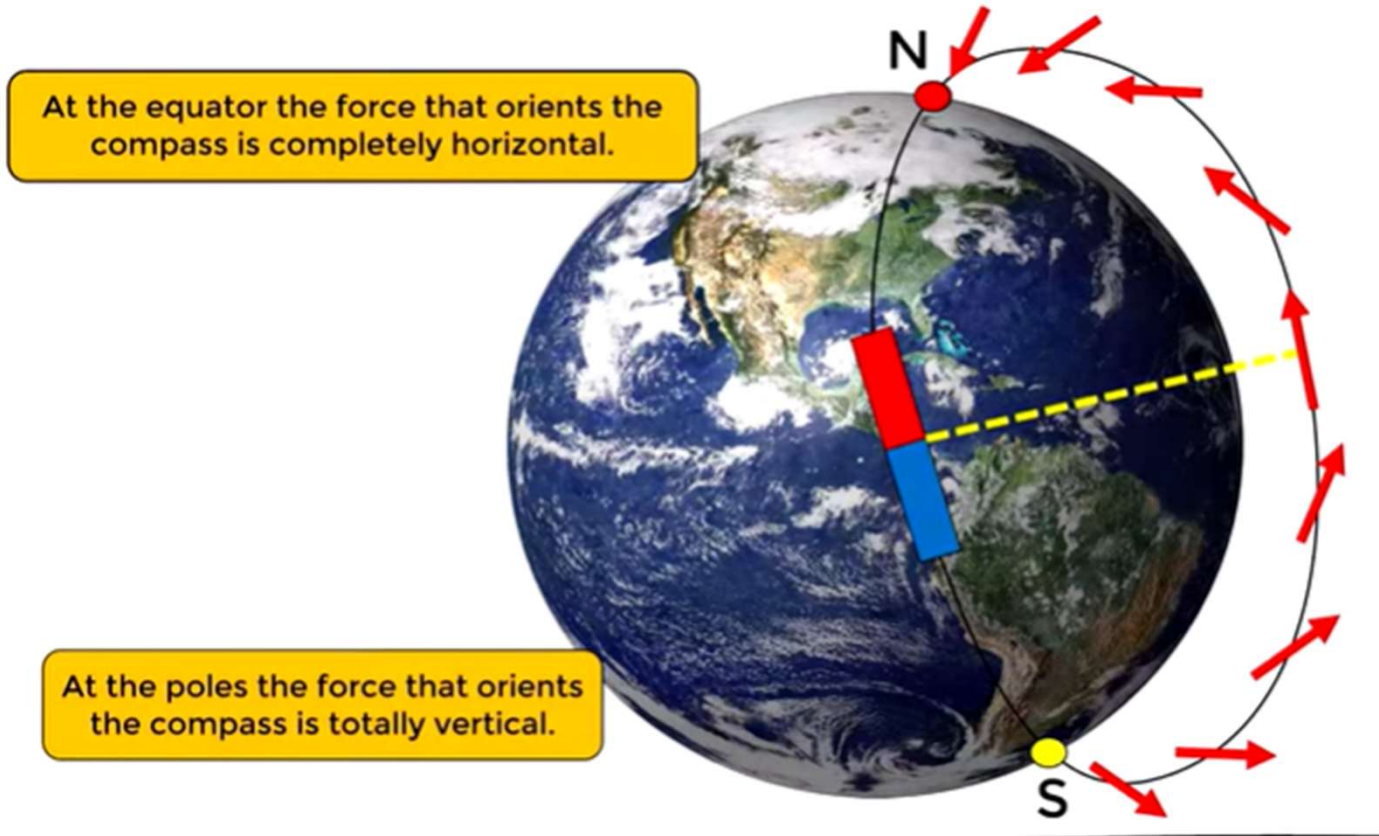
Friday, October 5, 12

Deviation

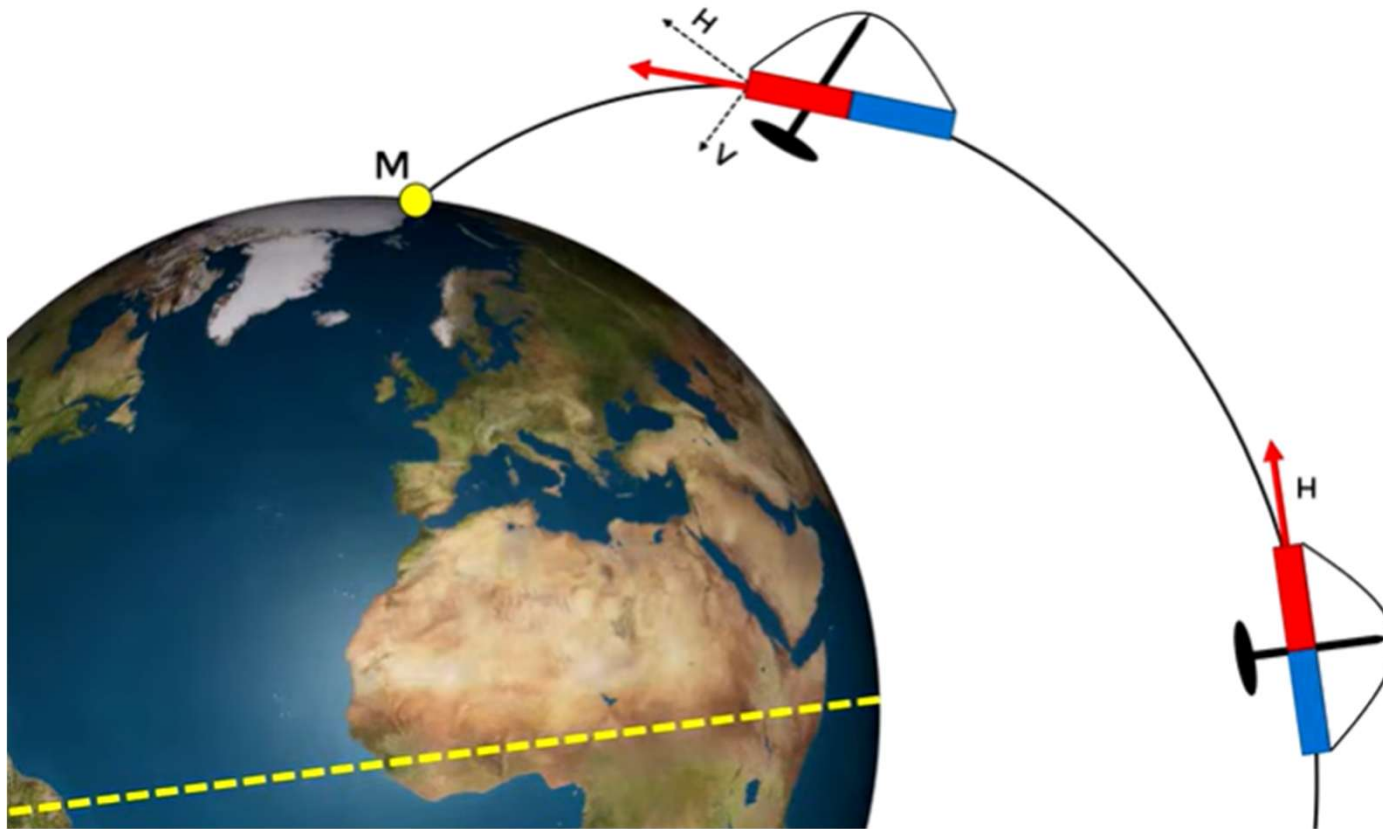
- magnetic fields generated by metals and electrical accessories disturb the compass needle

DEVIATION CARD					
FOR					
N	30	60	E	120	150
STEER					
001	031	060	089	118	149
FOR					
S	210	240	W	300	330
STEER					
181	213	242	271	301	330
ON	<input checked="" type="checkbox"/>	RADIOS	<input type="checkbox"/>	NO	

Magnetic Dip



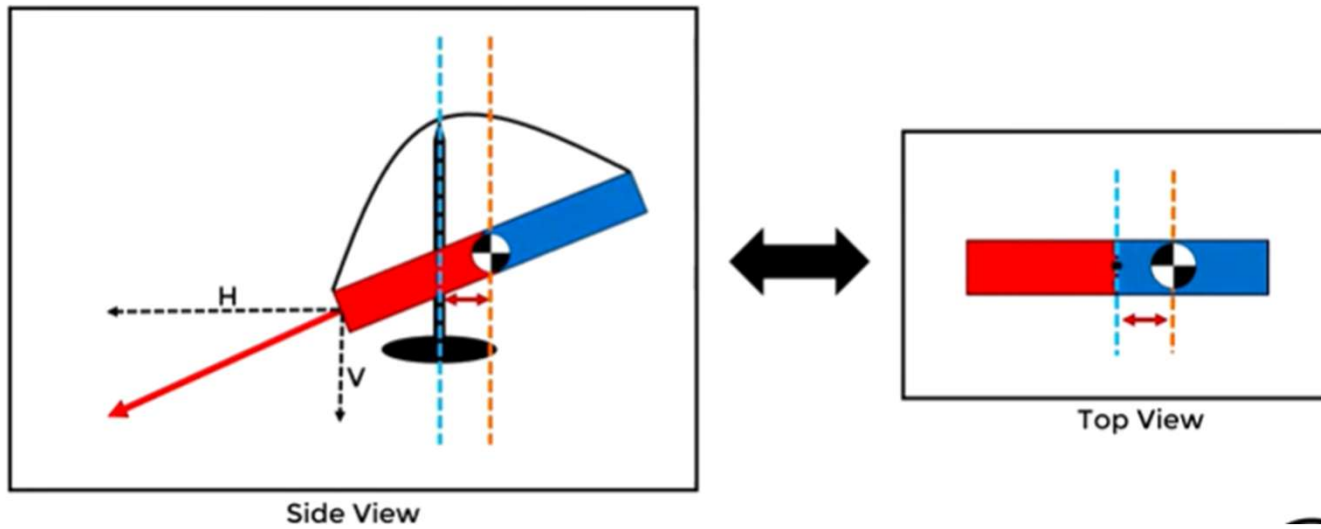
Magnetic Dip



Friday, October 5, 12

Magnetic Dip

NORTHERN HEMISPHERE



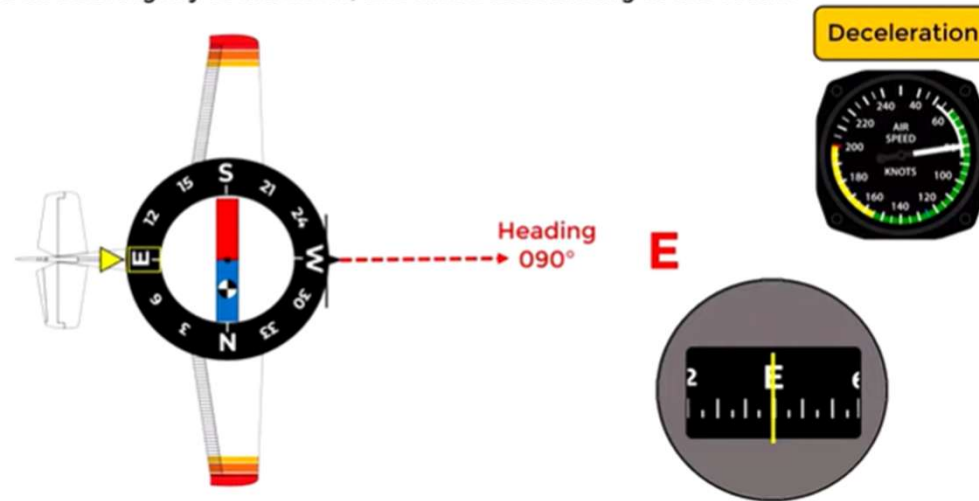
Acceleration Errors

“ANDS”

“Accelerate North, Decelerate South

NORTHERN HEMISPHERE

When flying on a **West** or **East** heading, the inertia when accelerating will cause the compass indication to deviate slightly to the north, and when decelerating to the south.



- While on an east or west heading
- No errors on a north or south heading

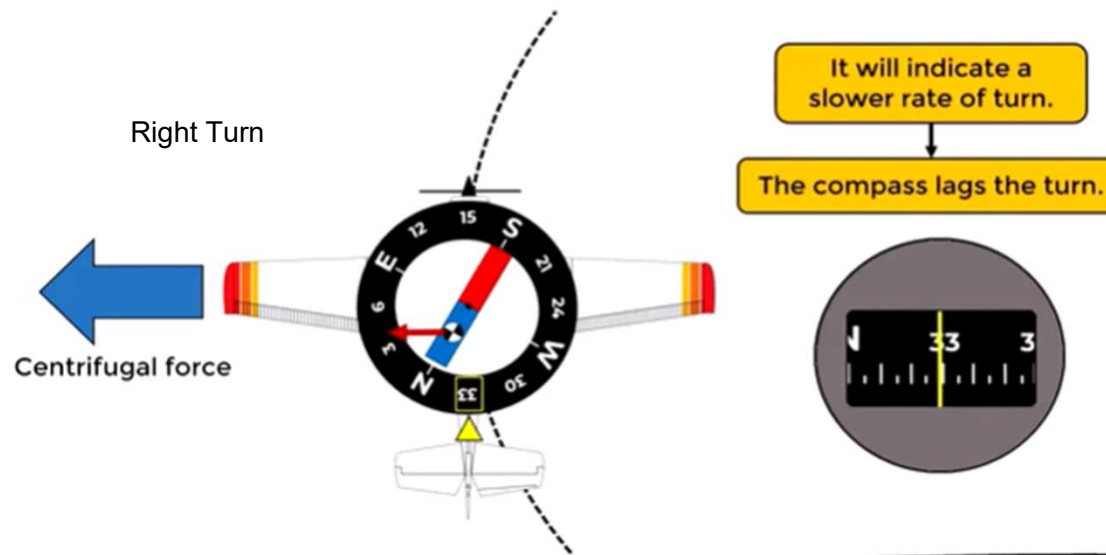
Turning Errors

“UNOS”

“Undershoot North, Overshoot South”

NORTHERN HEMISPHERE

When flying on a north heading, the centrifugal force generated when turning will cause the compass indication to initially deflect to the opposite side of the turn.



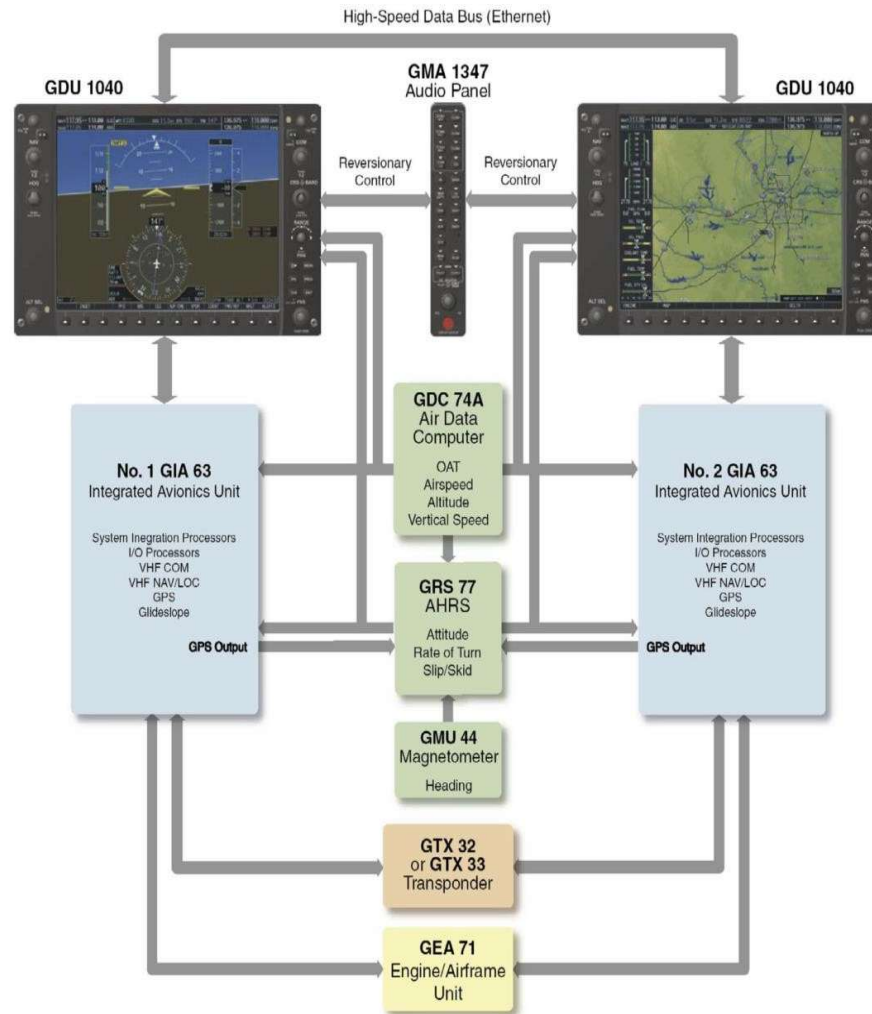
- Turns from the **north** will indicate **opposite**
- Turns from the **south** will be in the **same direction** but exaggerated
- No errors on an East or West Heading

Electronic Flight Displays

- Generally, have a primary flight display (PFD) and multifunction display (MFD)



Electronic Flight Displays Diagram



Electronic Flight Displays Failure

