

# E230 Aircraft Systems

Fly high Fly low

6th Presentation

School Of  
Engineering

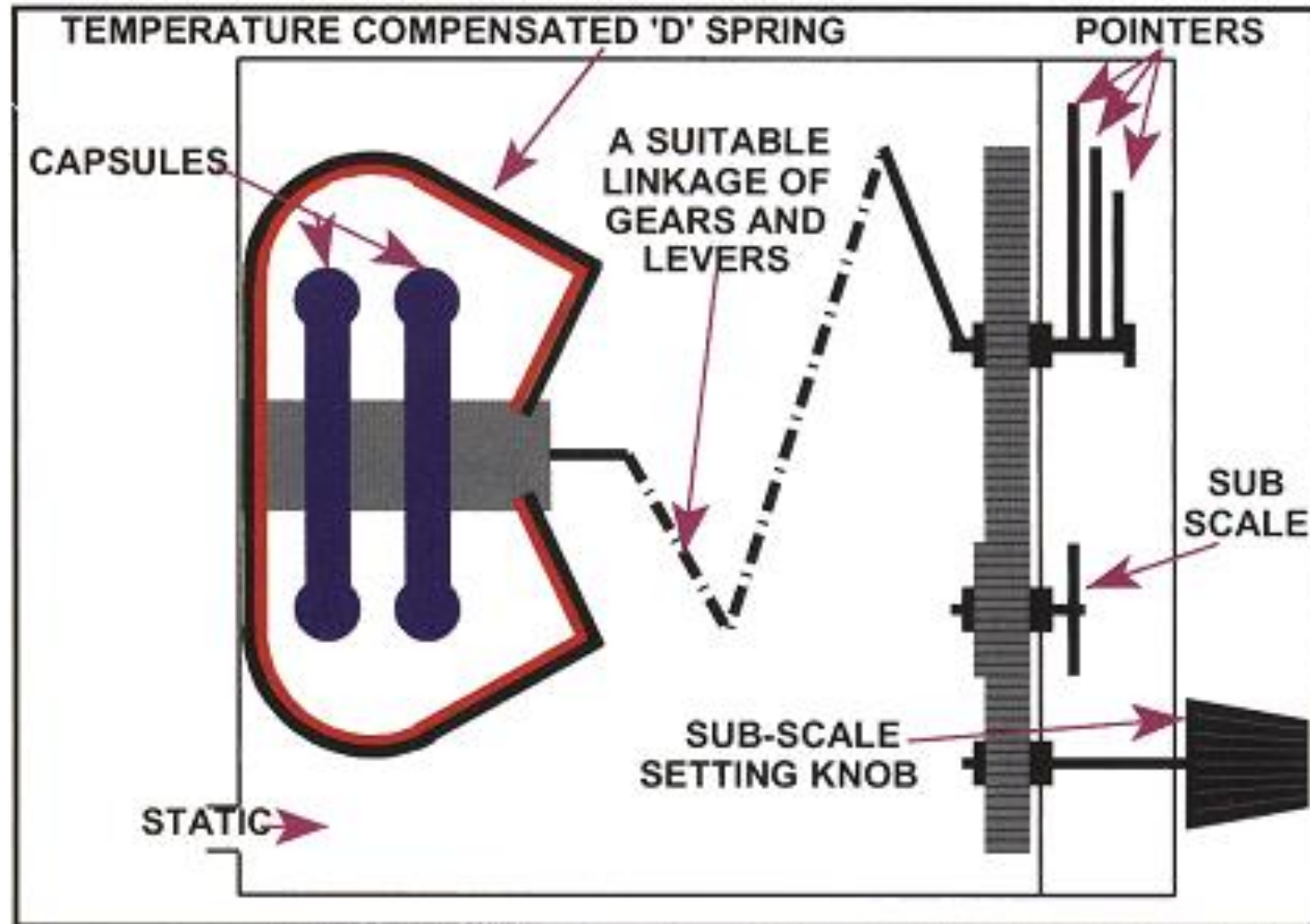


# Air Pressure Characteristics

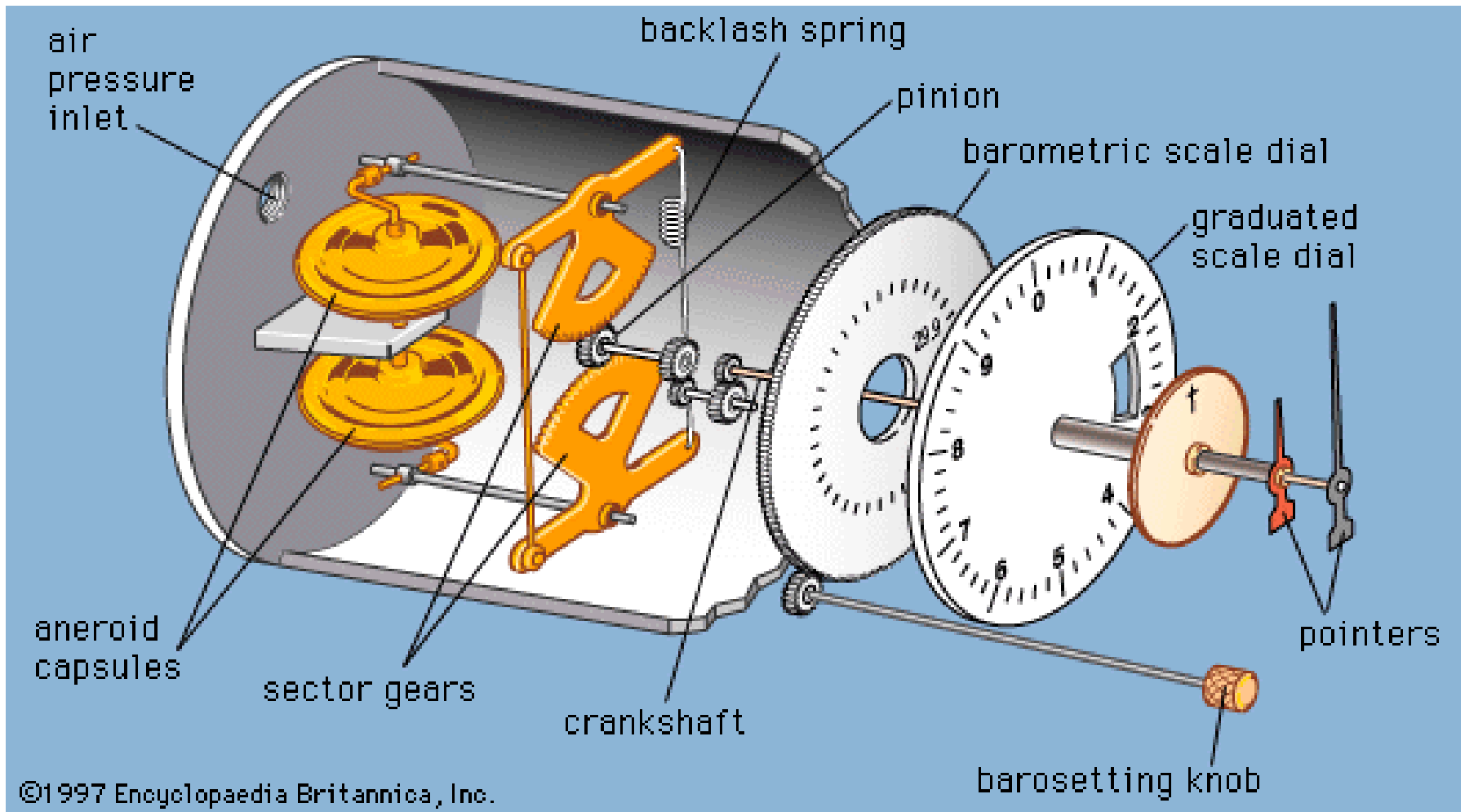
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- Altimeter is an instrument that measures the height (altitude) of the aircraft above sea level.
- The higher the altitude the lower the air pressure.
- Altimeter uses the static pressure for measurement.
- At the same altitude, air pressure may fluctuate due to temperature
- Compensation for pressure variation due to temperature is necessary

# Operation of Altimeter

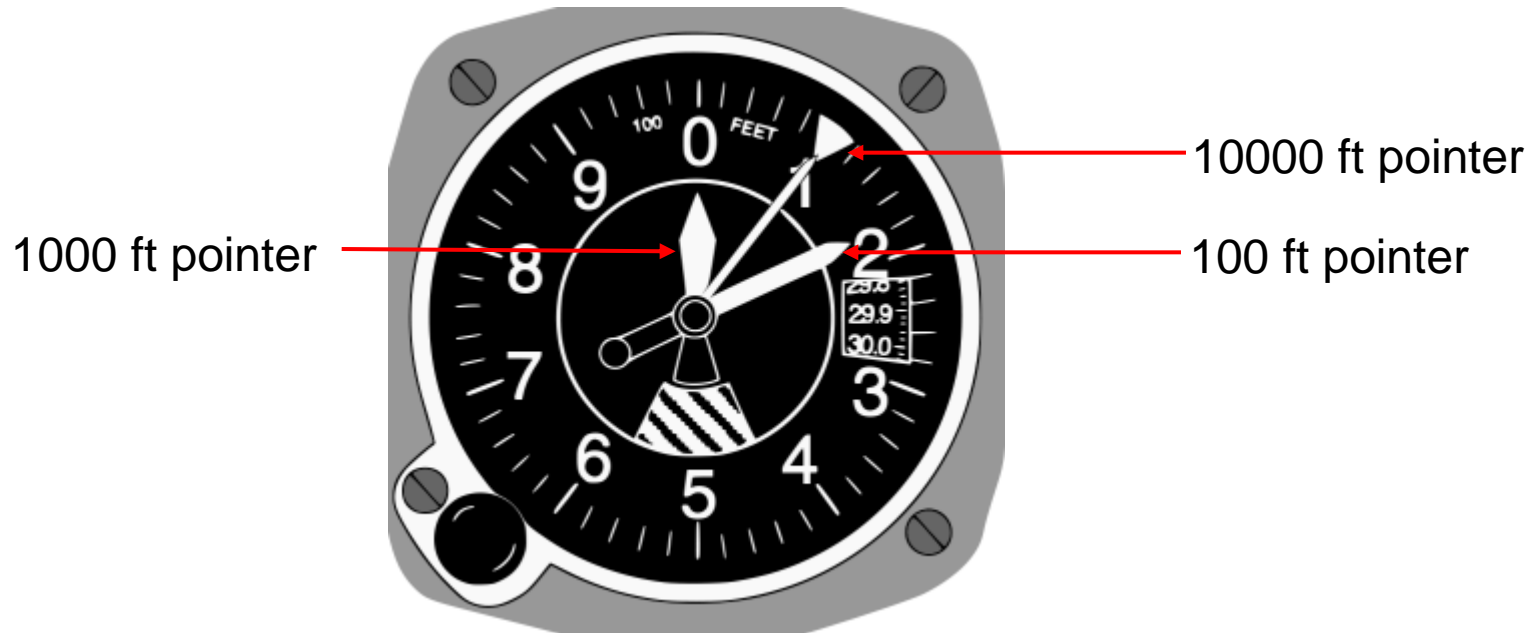


# Operation of Altimeter



# How to read a sensitive altimeter

- Altitude: 10180 feet
- Pressure setting: 29.94 inHg



# Pressure setting on an altimeter

- Turning knob to adjust pressure setting which will be displayed in the Kollsman window.



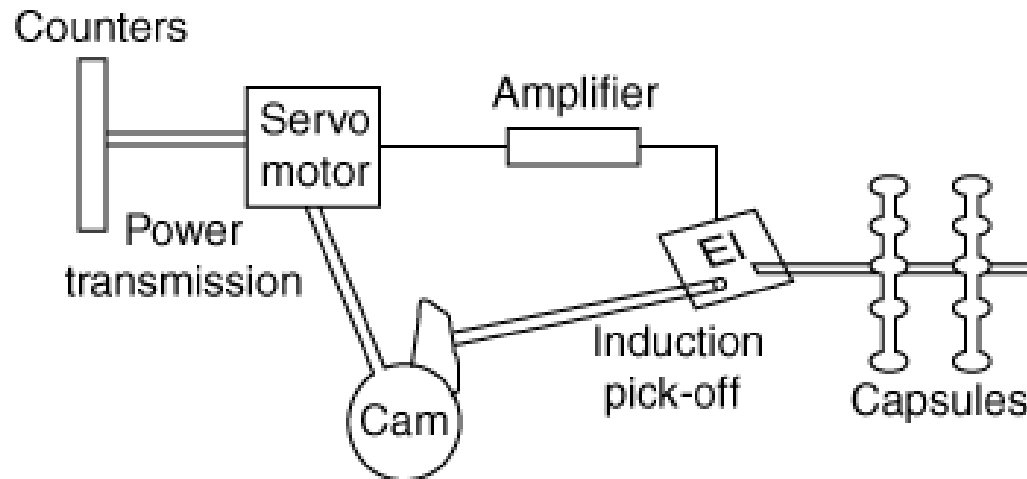
# Errors in Altimeter Reading

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- Actual temperature deviates from ISA conditions
  - Over-reads when flying in cold air
  - Under-reads when flying in hot air
- Static port is blocked
  - Altitude reading will be stuck at the point before the blockage occurred
- Time lag
  - change in altitude is faster than change in altimeter reading

# Servo-assisted altimeter

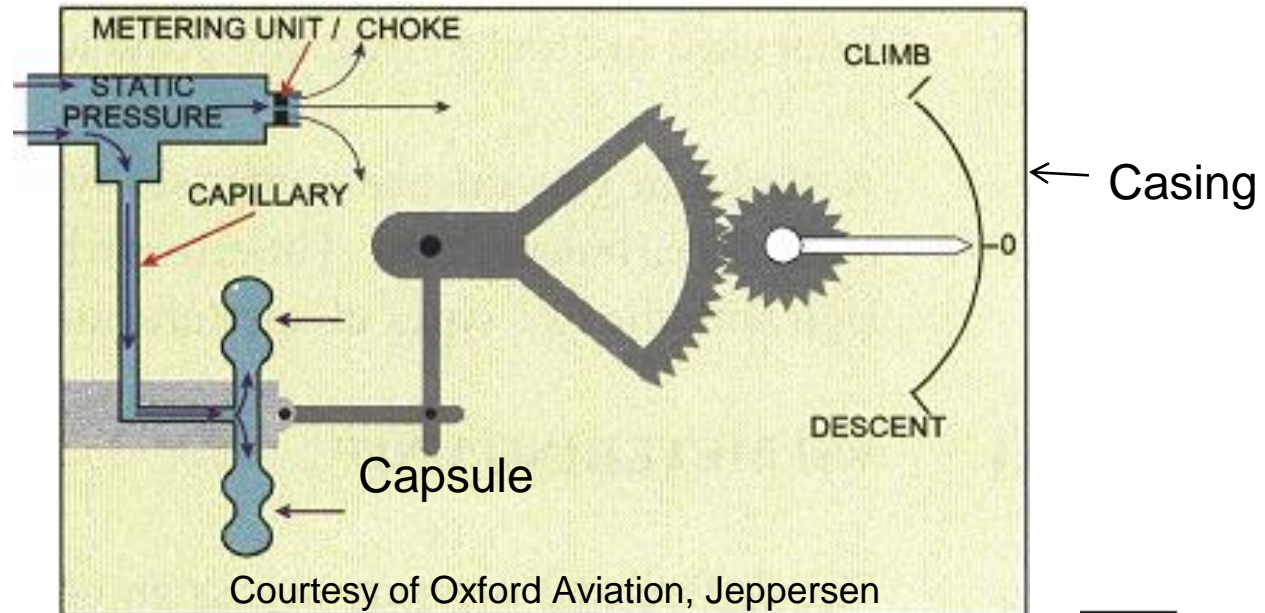
- Electrical motor is use to drive the reading on a servo-assisted altimeter.
- Less resistance on capsule movement and thus lag is reduced.



# Vertical Speed Indicator

## Level Flight

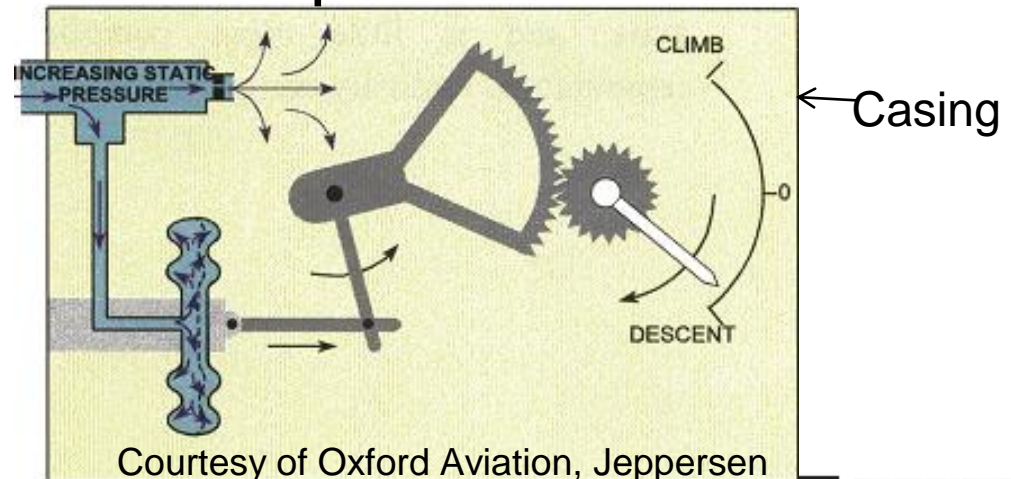
- Pressure inside capsule equals pressure inside altimeter casing
- No deflection of pointer



# Vertical Speed Indicator

## Descent

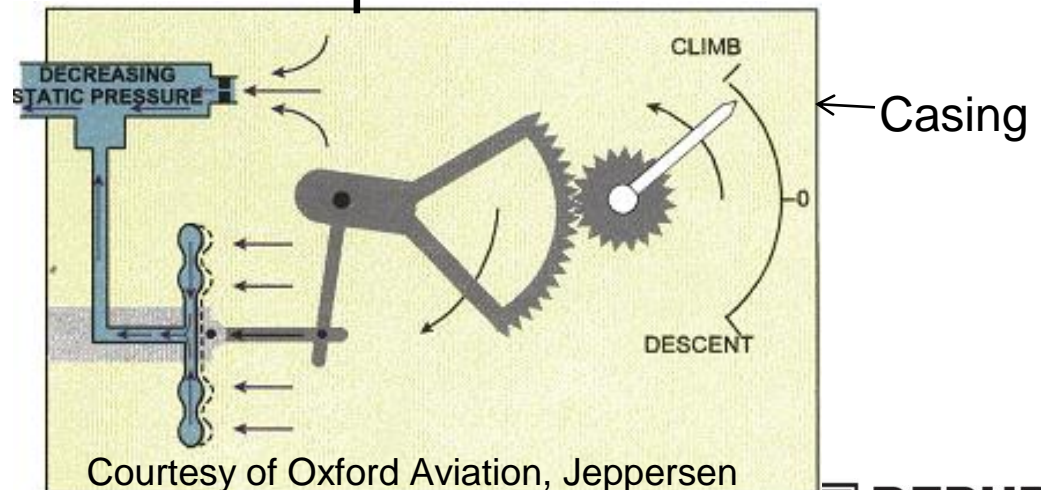
- Increasing static pressure → Higher pressure inside capsule
- Pressure inside casing is lower than pressure inside capsule
- Difference in pressure cause pointer to deflect downwards



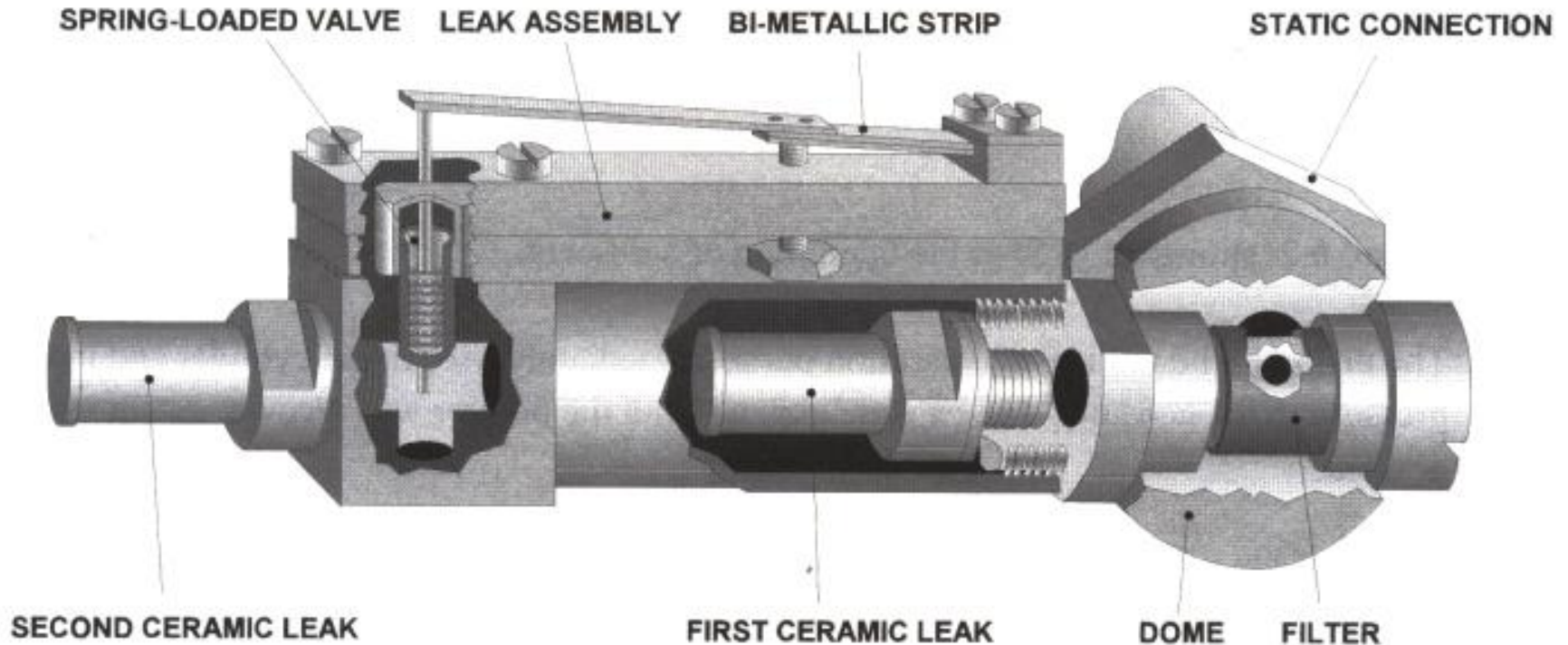
# Vertical Speed Indicator

## Climb

- Decreasing static pressure → Lower pressure inside capsule
- Pressure inside casing is higher than pressure inside capsule
- Difference in pressure cause pointer to deflect upwards



# Choke unit inside VSI



# Lag in VSI

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- Time lag in building a steady pressure difference during climb or descent
- Instantaneous VSI (IVSI) uses an accelerometer unit to speed up the response.



# Altitude Definitions

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- True Altitude
  - Height of an aircraft above sea level
- Absolute Altitude
  - Height of an aircraft above the terrain over which it is flying
- Pressure Altitude
  - reading shown on the altimeter when the altimeter setting has been set at 1013 mbar
- Density Altitude
  - Height at which at which the density of the air is equal to the density shown in the ISA table

# Altimeter pressure settings

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- **QNH: Local pressure at sea-level** (no height)
  - Provided by meteorological stations or ATC
  - Altimeter shows true altitude
  - Aircraft's height above mean sea level (AMSL)
- **QNE: ISA pressure at sea-level** (normalised elevation)
  - Also known as standard setting
  - Altimeter shows pressure altitude.
- **QFE: Local pressure at ground level** (field elevation)
  - At this setting, altimeter shows zero when aircraft is on ground.
  - Altimeter shows absolute altitude. It shows aircraft's altitude above ground level

# When to use each setting

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- QNH
  - When flying below transition altitude
- QNE
  - When flying above transition altitude
  - During flight testing of instruments
- QFE
  - When airfield is much higher than sea level  
e.g. Tibet Bangda airport 14000 feet AMSL  
(Above Mean Sea Level)

# Transition altitude (TA) & Flight level (FL)

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- TA: Height at which aircrafts change from the use of altitude to flight levels
- TA differs from country to country
  - Singapore's TA is 11000 ft
- Above the TA, altimeter pressure setting is adjusted to 1013.25 mbar or 29.92 in Hg
- Altitude is reported in terms of FL.
- E.g. FL400 = 40,000 ft AMSL

# Learning Objectives

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- Explain how altimeter and VSI make use of static source for altitude measurements.
- Discuss the effects of a blocked static port on readings
- Interpret the reading from a sensitive altimeter.
- Discuss how servo-assisted altimeter reduce lag
- Define pressure altitude, density altitude, absolute altitude and true altitude
- Assess when to report altitude in terms of flight level (FL) instead of actual height above sea level.
- Select the correct altimeter setting (QNE, QNH, QFE) for different flight conditions