# Major factors to be considered during air sampling

- Constituent or pollutant
- Sampling rate
- Sampling time

# Types of air monitoring

- Personal sampling
  - Undertaken within breathing zone of operative
    - As close to mouth and nose as practicable (within 200 mm)
    - Inlet to the sampling head shouldn't be obstructed
- Portable monitors
  - Can be moved during sampling
- Stationary sampling
  - Fixed during sampling

# Air Quality Measurement

- Measurements of air quality generally fall into:
  - **Source sampling** - Emission from a source is measured
  - **Ambient Air Quality** - Measures the quality of air in a particular place.
  - **Industrial Hygiene sampling** - for testing the air quality inside of factories and places of work
  - **Indoor sampling** - to study the quality of air in living spaces

# Types of measurement/sampling

- Active sampling
- Passive sampling
- Electrochemical methods
- Optical analyzers

# Types of Ambient monitoring Stations

| Station type | Description |
|---|---|
| **Pedestrian exposure station** | In congested areas, surrounded by buildings with many pedestrians and average traffic flow > 10000 vehicles/day. |
| **Downtown neighbor hood exposure stations** | In central business districts but not congested areas, and less high rise buildings. The average traffic flow < 500 vehicles/day. Eg. parks, landscapes areas etc. |
| **Residential population exposure station** | In the residential or sub-urban areas but not in central business districts. Should be more than 100 m away from any street. |
| **Mesoscale stations** | At appropriate height to collect meteorological and air quality data at upper elevation; main purpose to collect the trend of data variations not human exposure. |
| **Non-urban stations** | In remote non-urban areas with no traffic and industrial activity. Mainly for background concentrations. |

***Location of all stations but mesoscale stations should be*** *0.5 m from curve and 2.5 to 3.5 m above the ground. For mesoscale stations it could be at even higher elevations.*

# Active sampling

- Pumped Sampling
- Analytes all physically pulled into the sampler using an air sampling pump
- Concentrating the analytes on some sort of media (adsorbents, or filters)

# Passive sampling

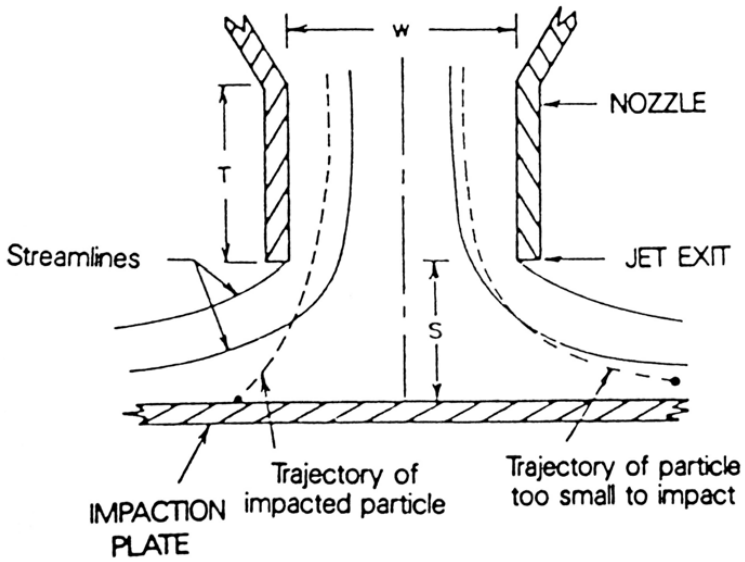
- Diffusive sampling
- Analytes enter the sampler unassisted due to molecular diffusion.
- Unlike active sampling, passive samplers don’t require electricity.
- The adsorbed analytes can be desorbed off the adsorbent by solvent or thermal desorption.

# Particulate Matter Sampling

- Gravimetric based
- Light scattering based

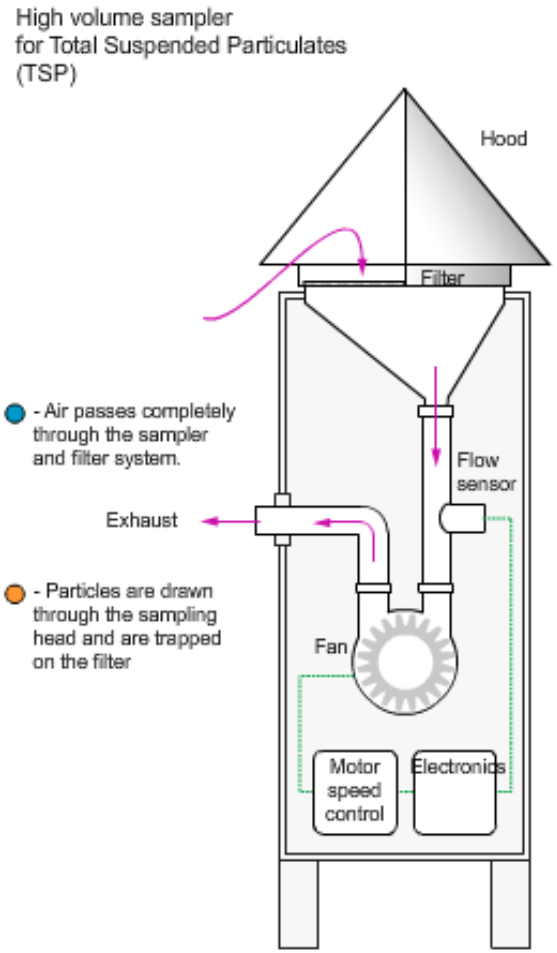
# Working principles of gravimetric PM samplers

- Samplers work on the principle of Inertia
- Sub classified into
  - Impactors



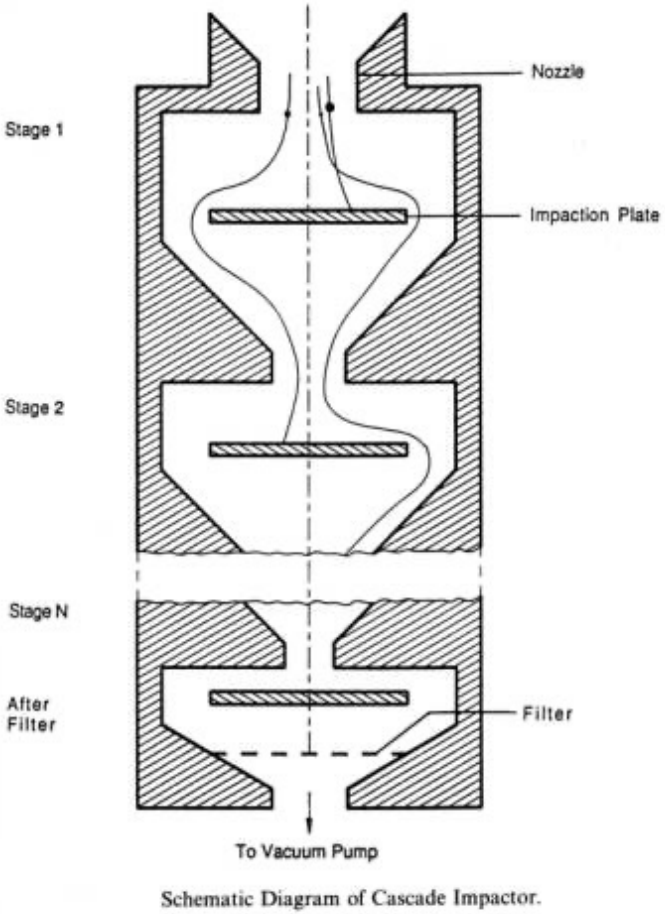

- Jet of aerosol impinge on flat plate.
- Particles larger than cut size slips across the streamline and impacts the plate
- Smaller particles follow the streamline

# High Volume Sampler

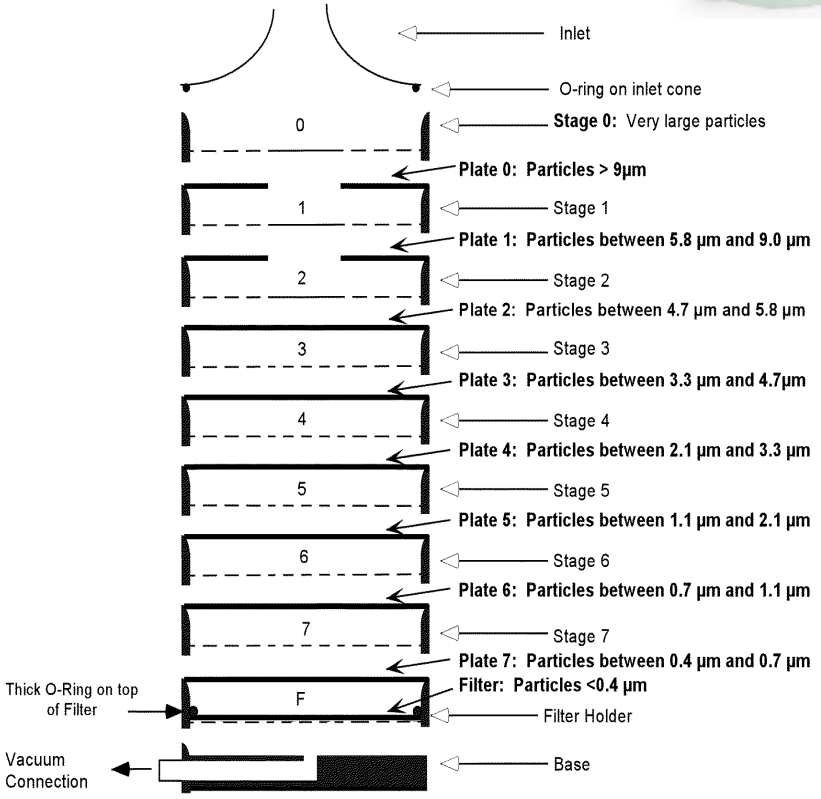



https://www.qld.gov.au/environment/pollution/monitoring/air-pollution/samplers

# Cascade Impactor




Schematic Diagram of Cascade Impactor.

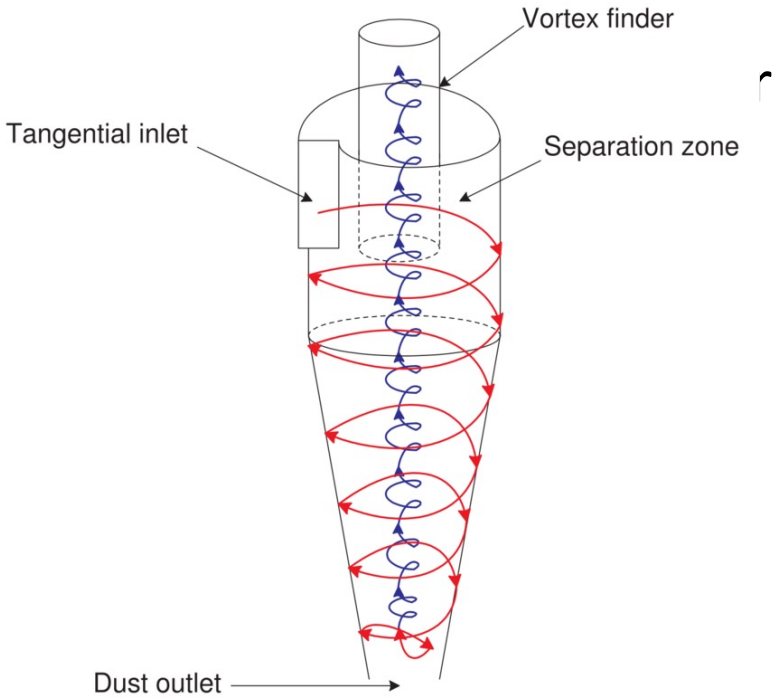


# Working principles of gravimetric PM samplers

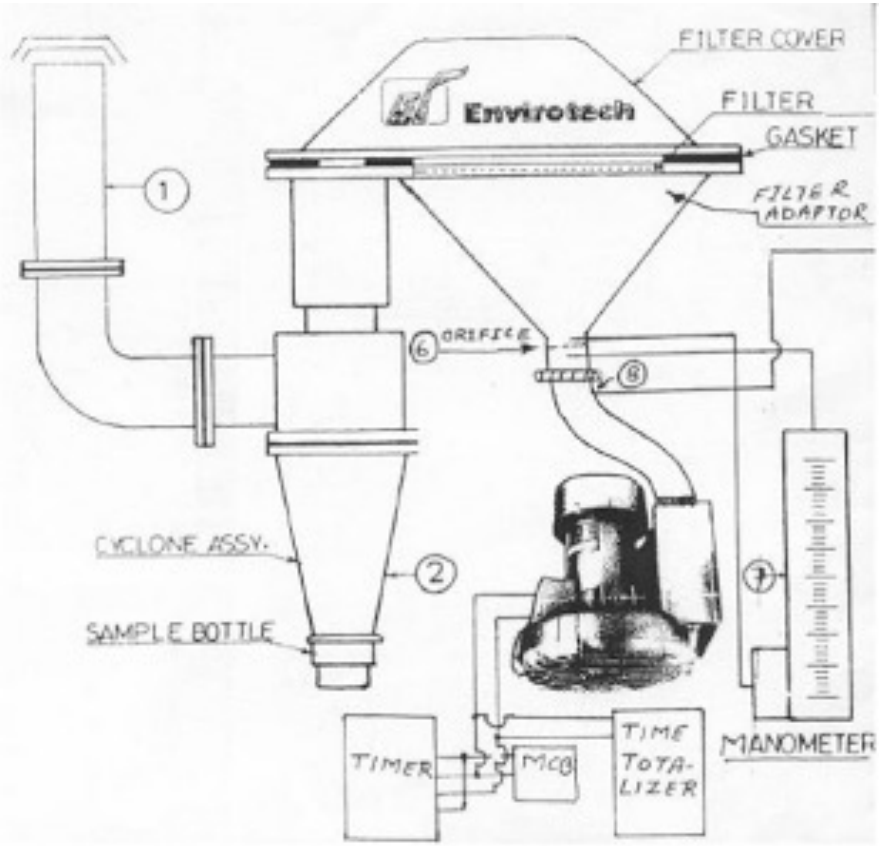
## Cyclone

- Jet of air impinges tangentially on inner surface
- Swirls downward in a cyclonic fashion and into a conical section
- Air reverses direction and spirals upward to exit at the upper end
- Particles larger than cut size and

  later collects in grit pot.

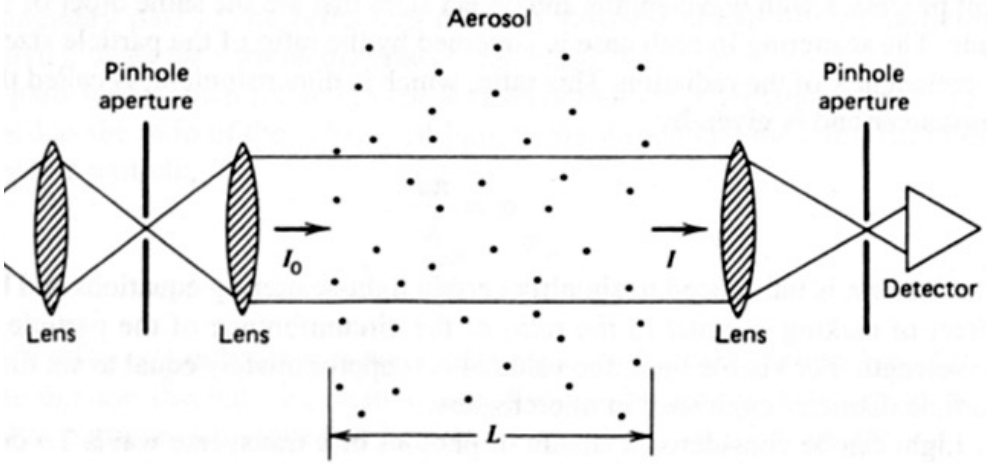


# Respirable dust sampler




SCHEMATIC DIAGRAM OF HIGH VOLUME SAMPLER.

# Light Scattering method

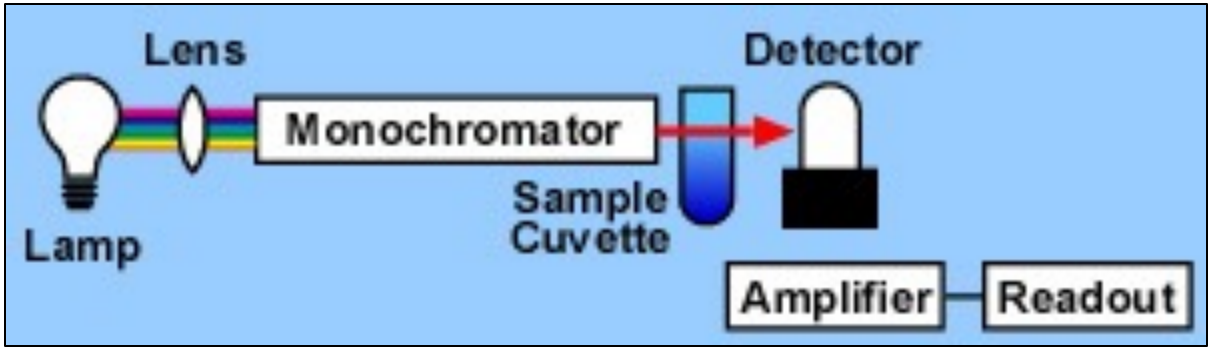



Aethalometer

# Measurement of gases

## Sulfur Dioxide

- UV Fluorescence
  - Air sample drawn into a scrubber chamber and then on into an irradiation chamber where it is exposed to UV light
- $SO_2$ absorbs in 190-230nm
- The amount of fluorescent radiation is directly proportional to the concentration of $SO_2$



# Sulfur Dioxide

$SO_2 + UV \longrightarrow SO_2^*$

$SO_2^* \longrightarrow SO_2 + light$

# Measurement of gases

## Oxides of Nitrogen

- **Chemiluminescence**
  - Passing sample over a catalyst to convert $NO_2$ to NO
- Suitable for ambient air containing NOx (NO and $NO_2$) at levels less than 1 $mL/m^3$
- Reaction of NO with ozone in a dark enclosed chamber to produce light
- Provided the ozone is present in excess the light output is directly proportional to the concentration of NO
- $\mathbf{NO + O_3 \longrightarrow NO_2^* + O_2}$
- $\mathbf{NO_2^* \longrightarrow NO_2 + h\nu\ (light)}$

# Measurement of gases

**Ozone**

- Either by chemiluminescence methods or direct reading UV detectors.
- Chemiluminescence method-Sample drawn into a mixing chamber mixed with a stream of Ethene - causes a chemiluminescent reaction and the subsequent emitted light at about 430nm
- Direct reading UV method - stream of gas in the sample is drawn through a flow cell where it is irradiated with UV light at 254nm

# Measurement of gases

## Carbon Monoxide

- Non-dispersive infra red devices
- Sample through a flow cell in the instrument where it is irradiated with infrared radiation

# Impingers

**Impingers** are glass bubble tubes designed for the collection of airborne particles into a liquid medium.

- When using an air sampler, a known volume of air bubbles is pumped through the glass tube that contains a liquid specified in the method.
- The liquid is then analyzed to determine airborne concentrations.

| Pollutant | Solution |
|---|---|
| $SO_2$ | Tetrachloromercurate |
| $NO_2$ | Arsenite |
| $NH_3$ | Sulfuric acid |
| $H_2S$ | Cadmium hydroxide |
| $Cl_2$ | Methylorange |

Glass Impinger