# Abatement HEPA Filter Efficiency Measurement Auditing

## NACC 2022

**G Hall, AWE, Reading, Berkshire. United Kingdom**

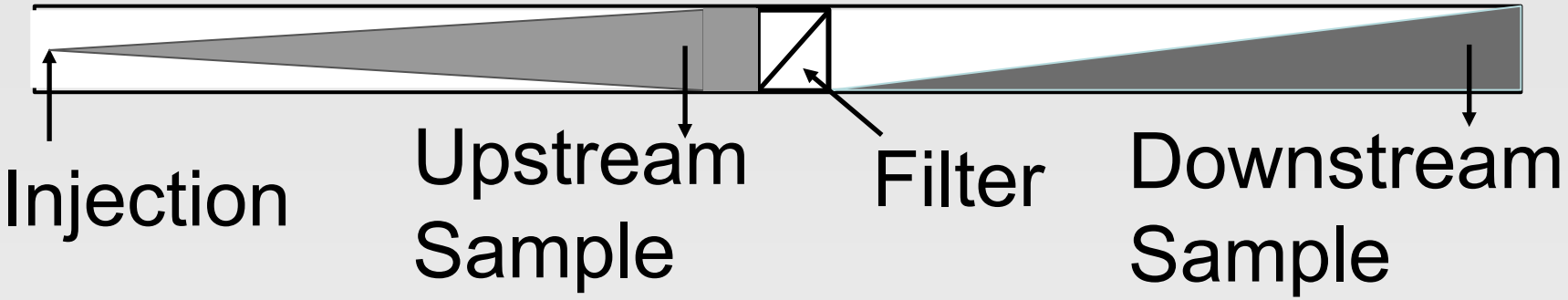
# Aim Of The Talk

- Show Driver For The Need To Review Filter Efficiency Measurement Systems
- Explain Some Of The Issues Found During Reviews To Help Other Identify Them And Prevent Them Being Repeated
- To Explain The General Measurement Errors To Aid The Determination If A Concession Is Possible.

# Drivers For Review

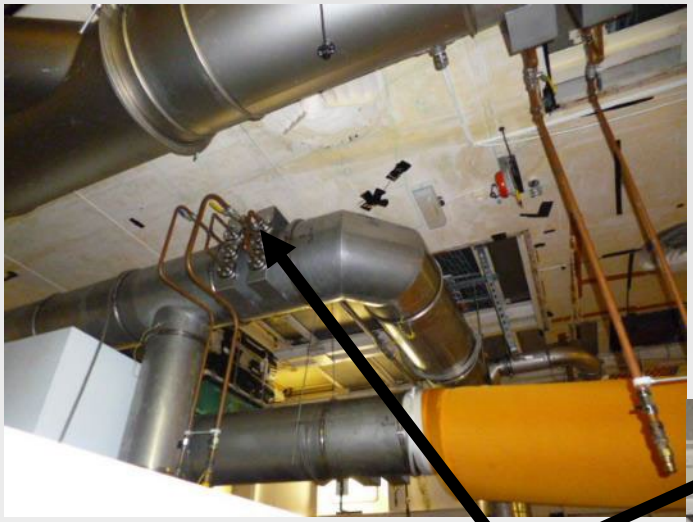
- UK Regulator Licence Condition 15 - Periodic Review Of Safety
- Where safety claims are made these should be substantiated every 10 years.
- Normally an efficiency claim is made on the last stage or two stages of HEPA filters.

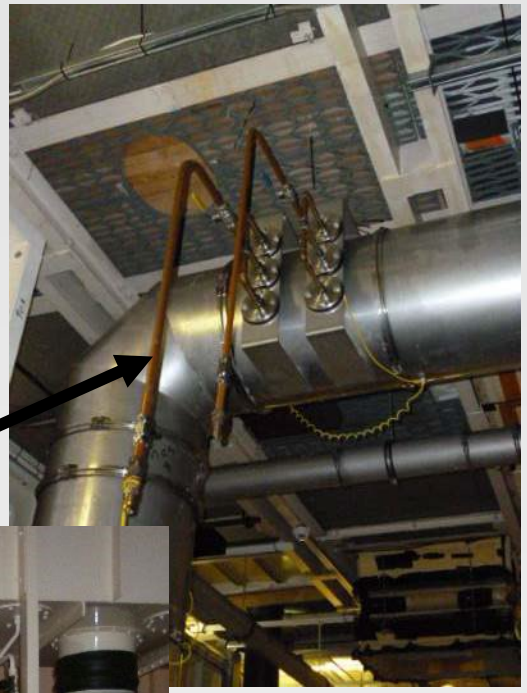
# Basic Theory Of Mixing Length Efficiency Testing




- Note: This introduction covers the “mixing” length method using Dispersed Oil Particulate
- Inlet Particulate Challenge, Measure Upstream Particulate Concentration, Measure Downstream Concentration, Calculate % Penetration (or decontamination factor)

# Basic Theory Of Mixing Length Efficiency Testing






Typical Filter Test Sample Points

# 1, Insufficient Mixing Lengths

Mostly on older facilities (pre-1970's)

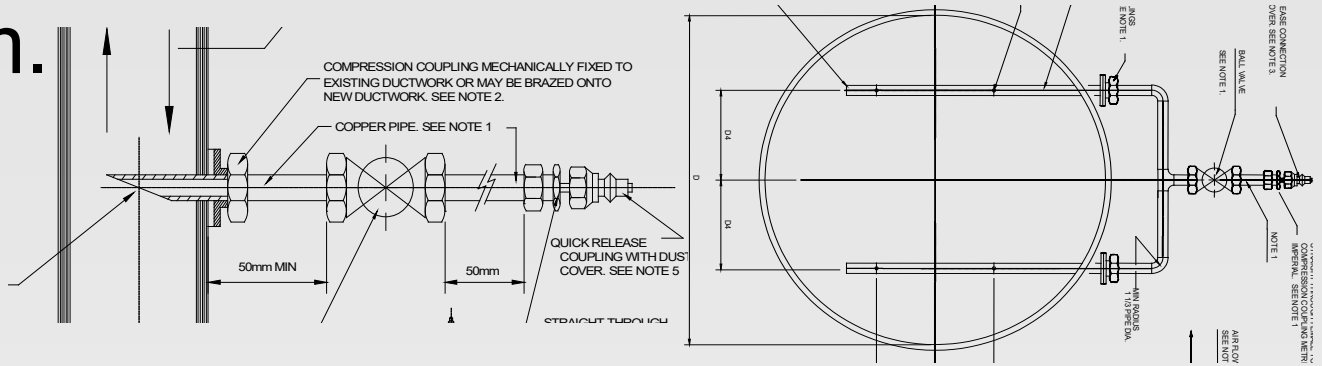
whole filter canisters designed to be efficiency tested

in a laboratory

Photo showing removable non safe change filters.

# 1, Insufficient Mixing Lengths

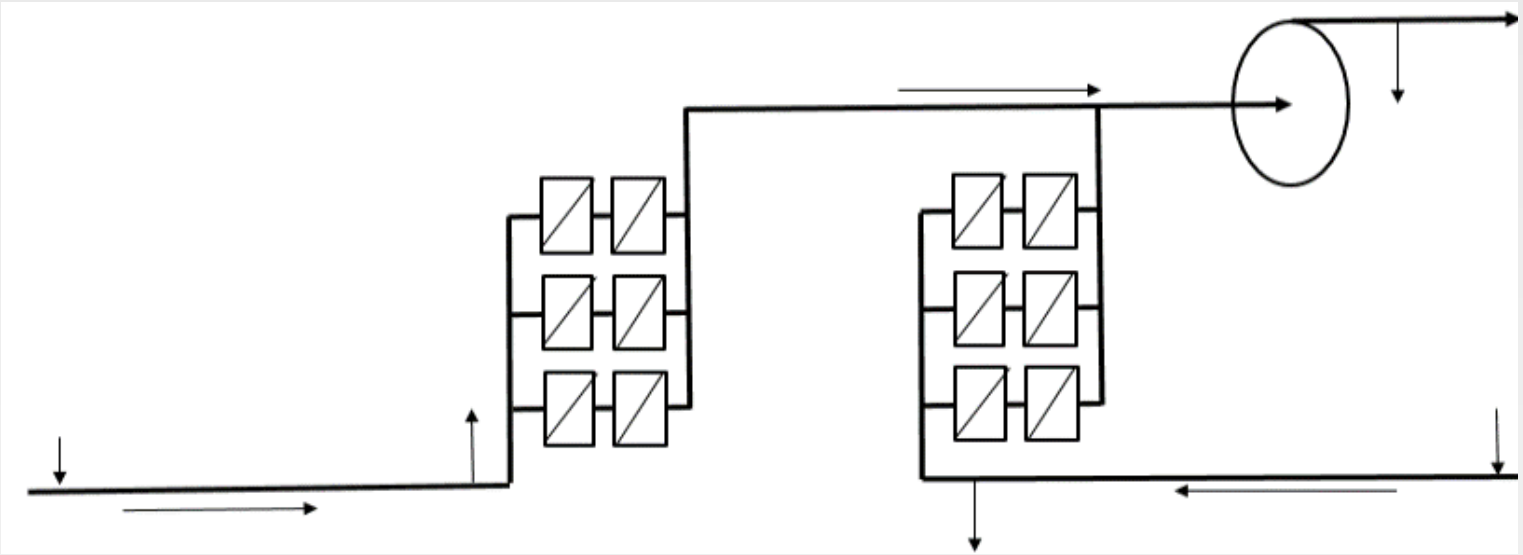
- Solution. Install multi-point injection system.




- Solution. Move the injection/sampling points.
- Solution. Inlet the particulate challenge into an extract grill.
- Solution. Conclude that the test won't be as accurate as first thought.

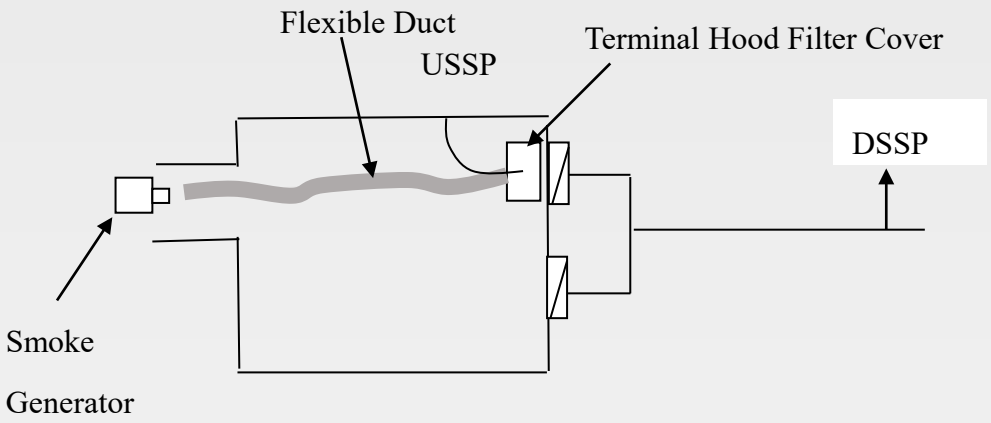
# 2, Dilution Of Challenge

- Dilution up or downstream positions.
- Example 1 – Downstream Sample Point Common For Two Systems - Account for dilution



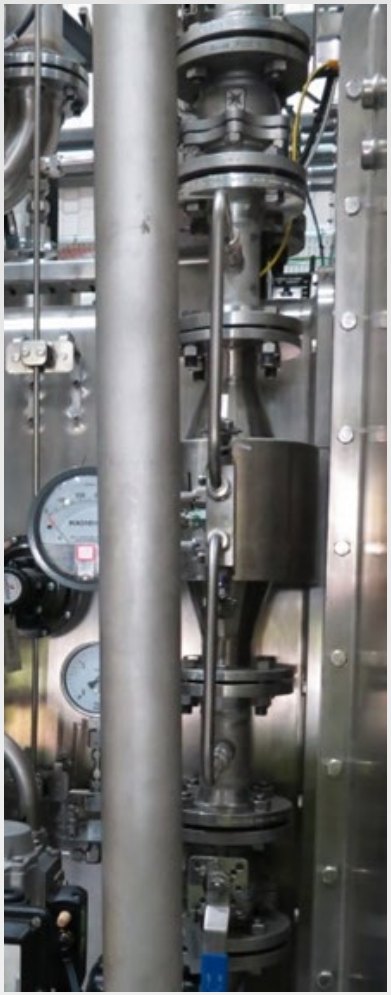
# 2, Dilution Of Challenge

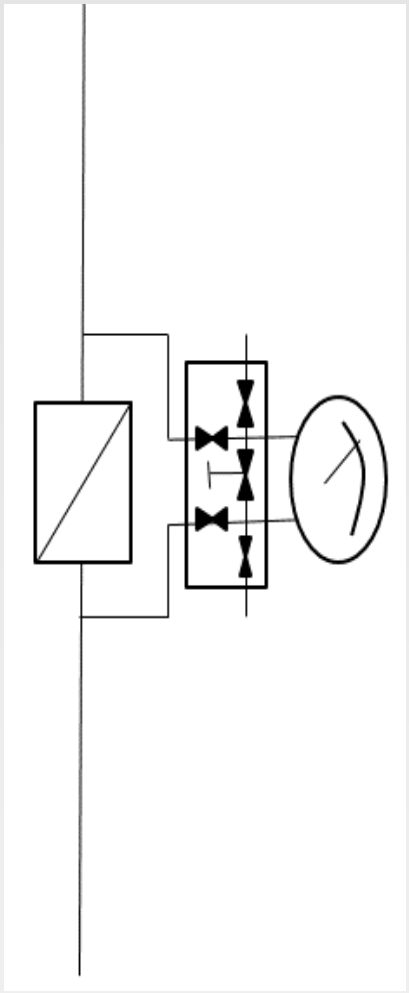
- Example 2 – Non-Challenged Inlet In Decommissioning Cells
- Example 3 – Inlet Branch At Sample Point - Move sampling points



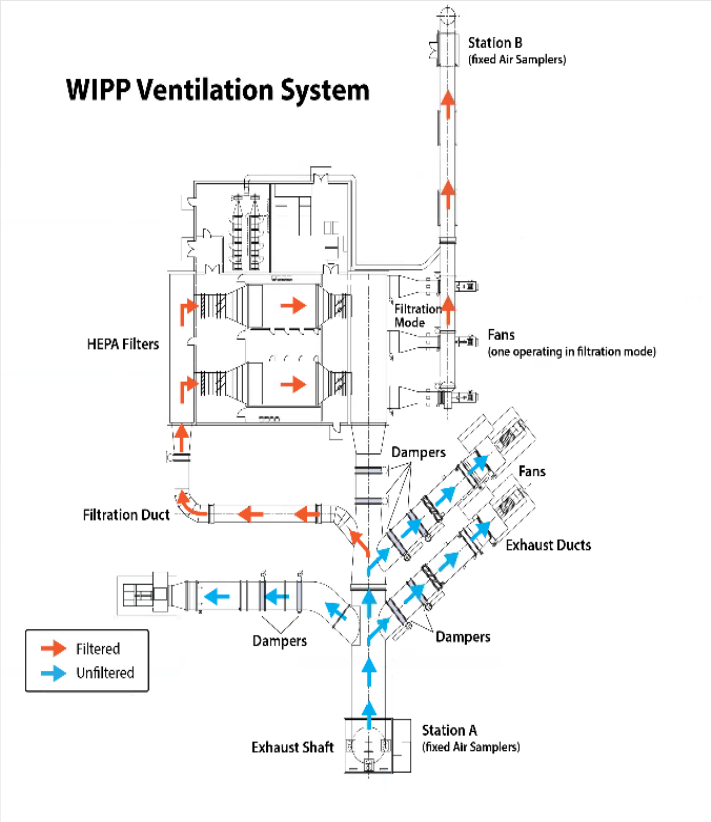

# 3, By-Passing

- By-passing – leading to un-filtered route
- Example 1. Five port calibration valve over process filter

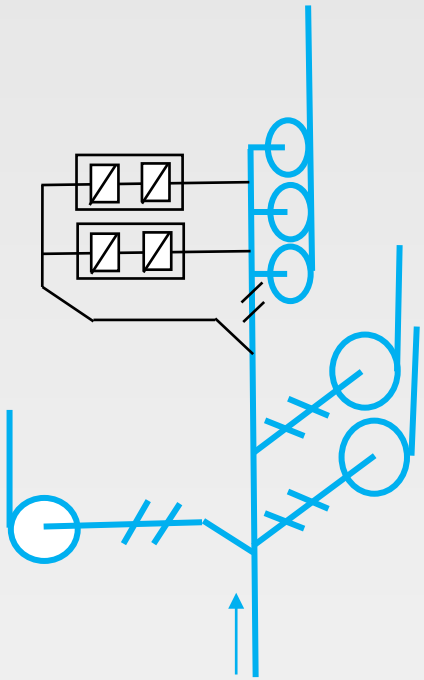




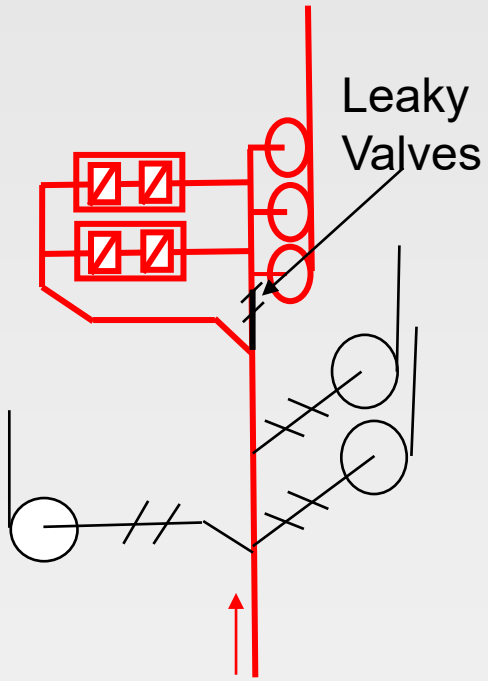
# 3, By-Passing - WIPP




Non-Filtered Mode

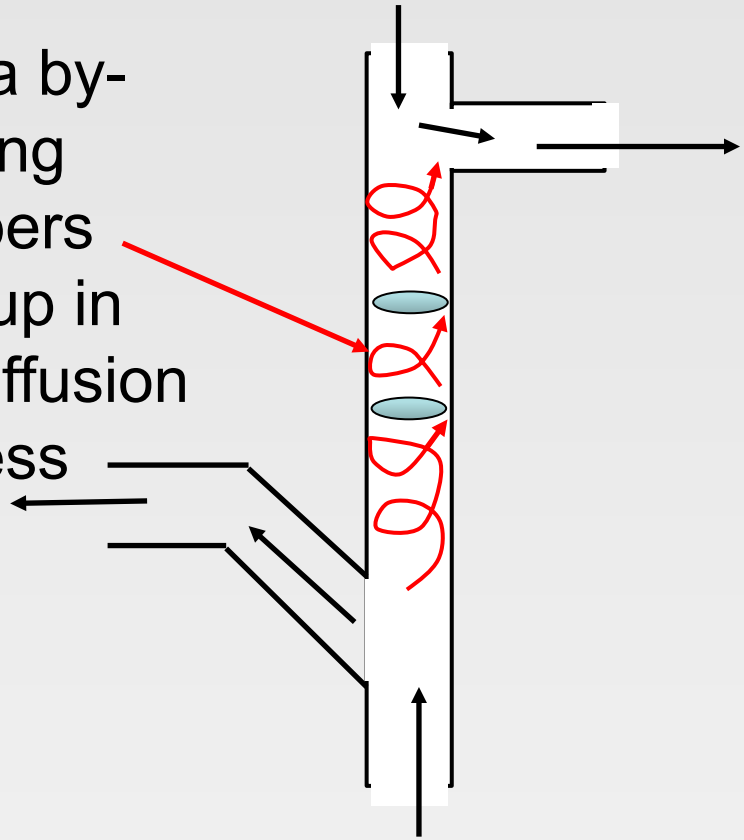


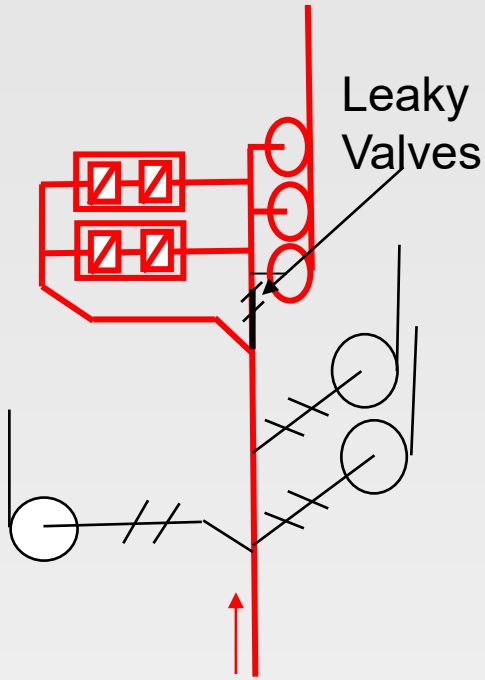
Filtered Mode



# 3, By-Passing - WIPP

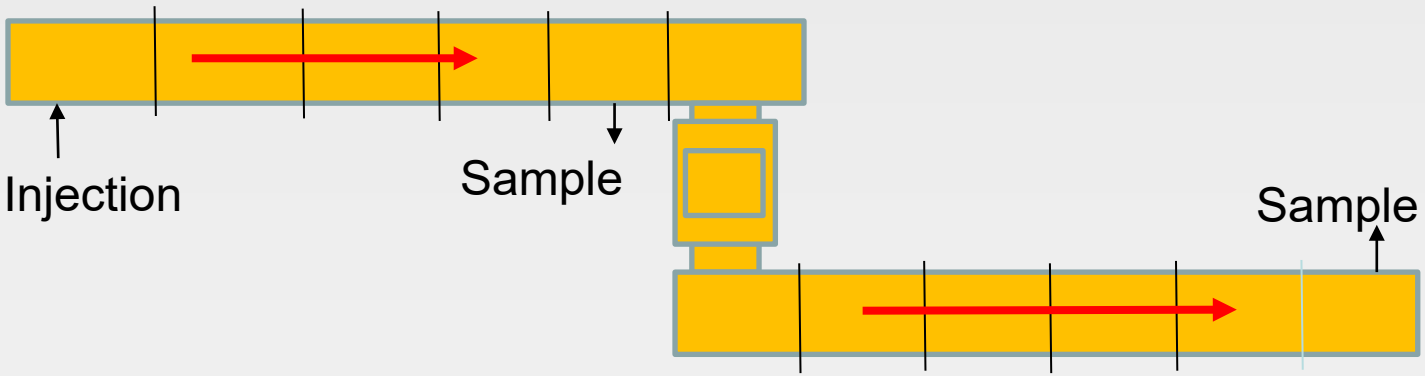
Media by-passing dampers held up in the diffusion process





# 4, Low Flows

- Example 1 – Low Flows On Leaky Ductwork System
- Example 2- Low Flows Below Generator Minimum Inlet Level (63 l/sec)



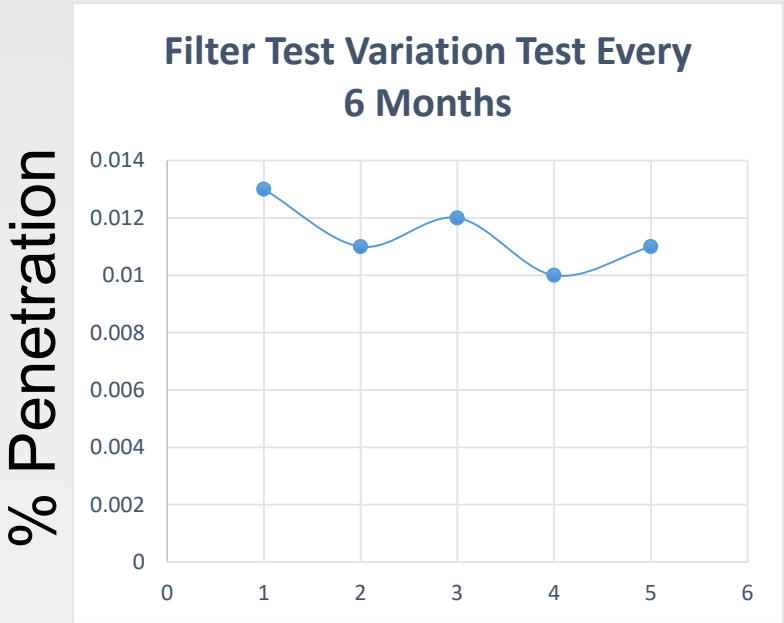
# Test Accuracy

- So How Accurate Is A Normal In-Situ Test – 95%, 80%, 40%?

- The repeatability of result does not mean the result is accurate, it means the errors are very consistent.

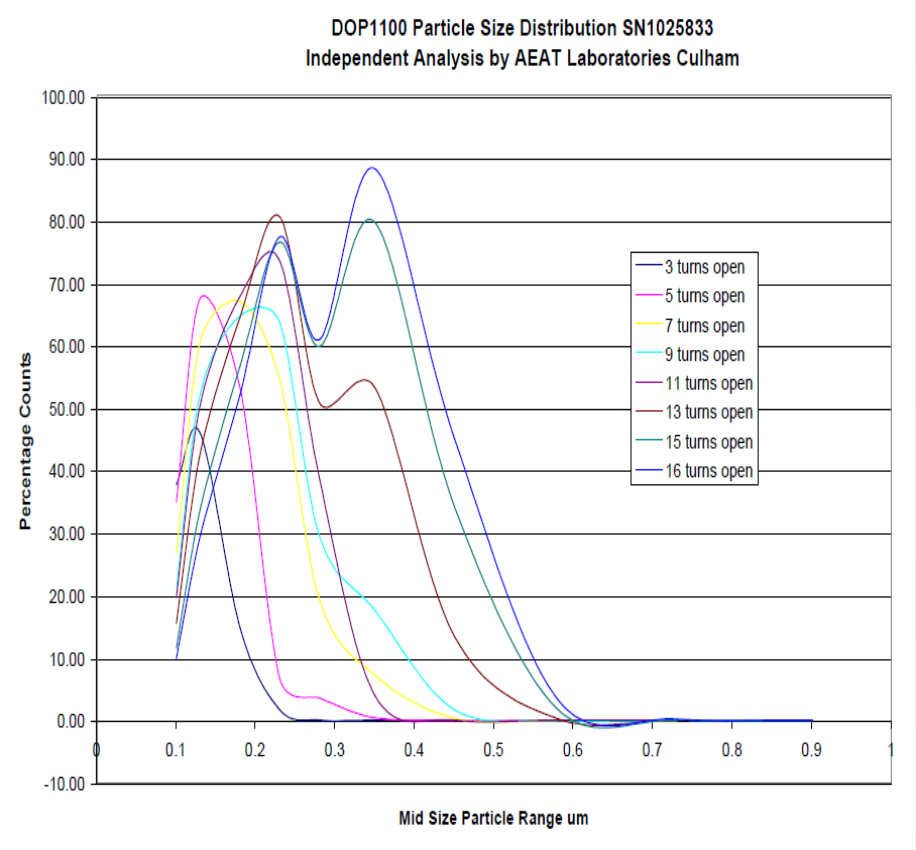
# Changes In Temperature And Humidity

- Measuring efficiency at 6 monthly intervals we can see cyclic variations.
- Normally you would expect a 5% change in efficiency where humidity's and temperatures change with the seasons.



# Particle Size Generation.

The larger the system the more particles challenge needs to be generated. However, the more particles are generated means the larger the average particle size is, therefore for the same filter the filter will be measured as less efficient on a small system. Moving from 0.15µm to 0.35µm may increase the efficiency by about 30%



# Test Instrument Accuracy

- Using the same photometer will cancel out some of the errors.
- Accuracy could be within 5%
- There will be losses of particulate in the connecting hoses is excessively long or the wrong material.

# Test Accuracy Summary

5%

20%

10%

30%

- Good system +/-40% Error
- Less Good +/-60% Error

From AECP 1054 : 1987 Annex B

# Summary

- Understanding of mixing length, dilution and by-passing issues with a toolbox of ideas to identify and resolve.

- Understanding of measurement errors to enable a decision to modify plant or raise a concession.

Any Questions?