



# PM CEMS Operation & Maintenance

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# Calibration

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- Adverse/extreme conditions affects accuracy of the equipment
- Optical, electro-dynamic and triboelectric monitors are indirect methods, as they detect an optical effect – not the dust concentration. Because of the big variety of dust characteristics, it is not possible to measure the dust concentration directly.
- To get a mass concentration output signal in  $\text{mg}/\text{m}^3$  every single dust monitors has to be calibrated by gravimetric measurement equipment.

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## Why Calibration is required ?



- Different dust characteristics in terms of:
- Colour
  - Size
  - Surface structure
  - Reflection ability
  - Density ...

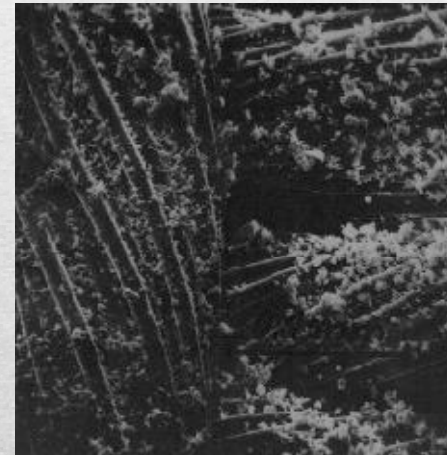
### Examples of dust structures



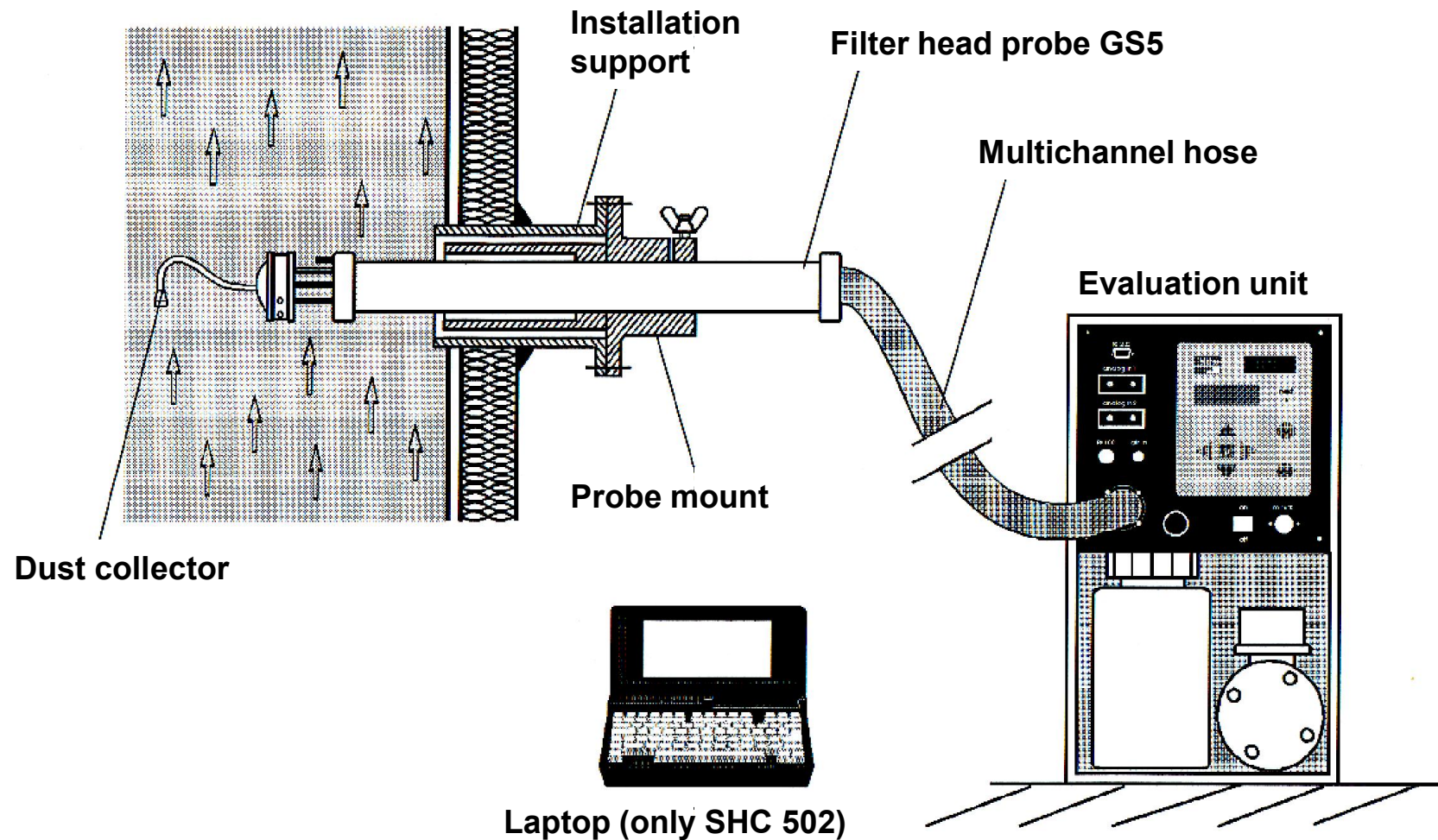
Asbest dust



Coal dust



Domestic dust



# Gravimetric Measurement – Reference Measurement

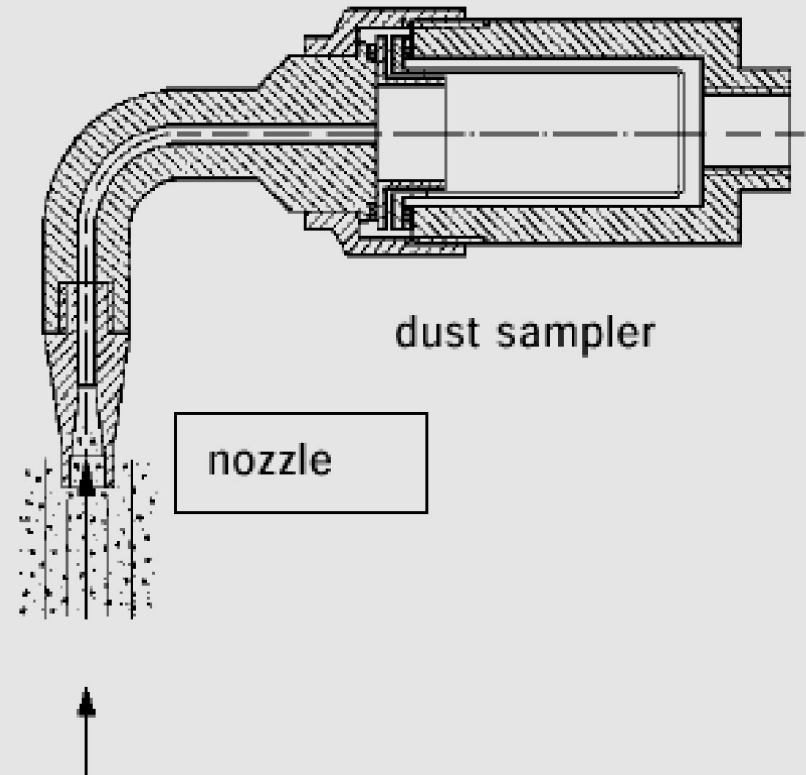


- Distance to the dust monitoring level at least 500 mm above in flow direction
- No mutual influencing of dust meter and calibrating device.



## Requirements- Gravimetric Measurement

***Homogeneous infiltration.***  
Big and little particles follow the gas stream.

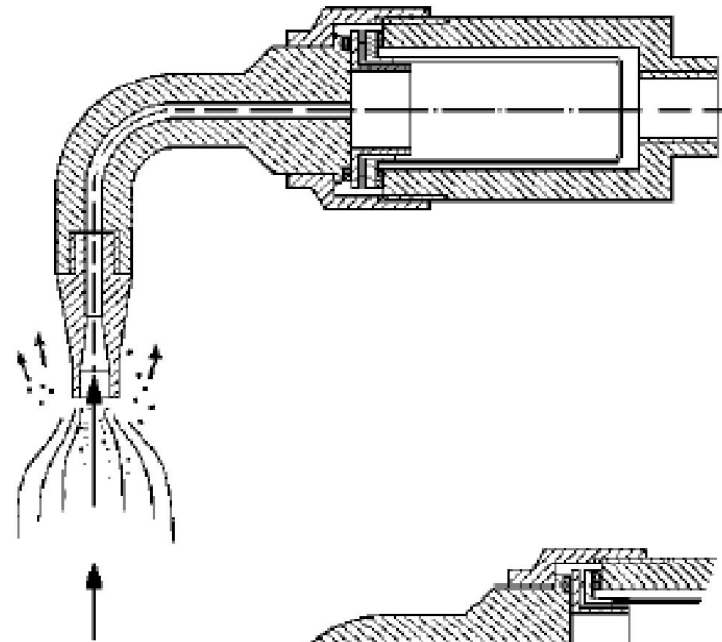


For dust gravimetric comparison (according to VDI 2066) the gas must be extracted in such way that the gas velocity in the extraction tube and the gas velocity in the stack are the same.

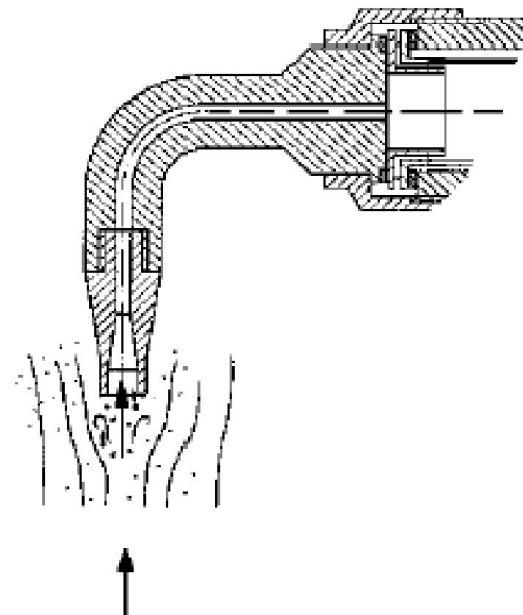
## Isokinetic Sampling



***Gas flow too high.***  
Big particles cannot follow  
the gas stream =  
Concentration too low.



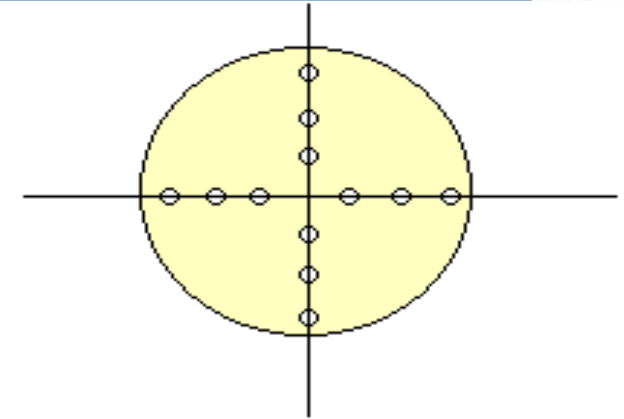
***Air flow too low***  
In relation to much big  
particles are sucked off =  
Concentration too high.



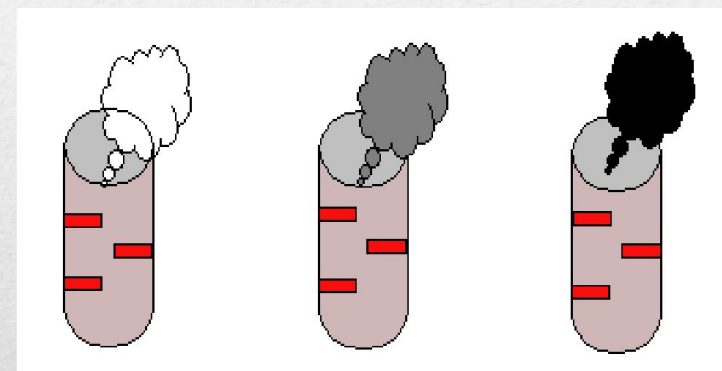
## Non- isokinetic sampling



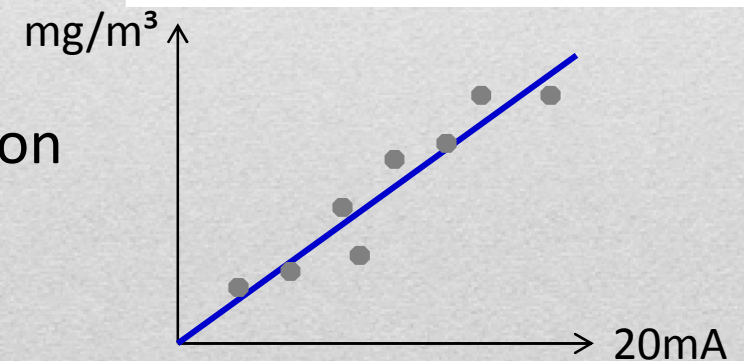
Profile measurements has to be considered.

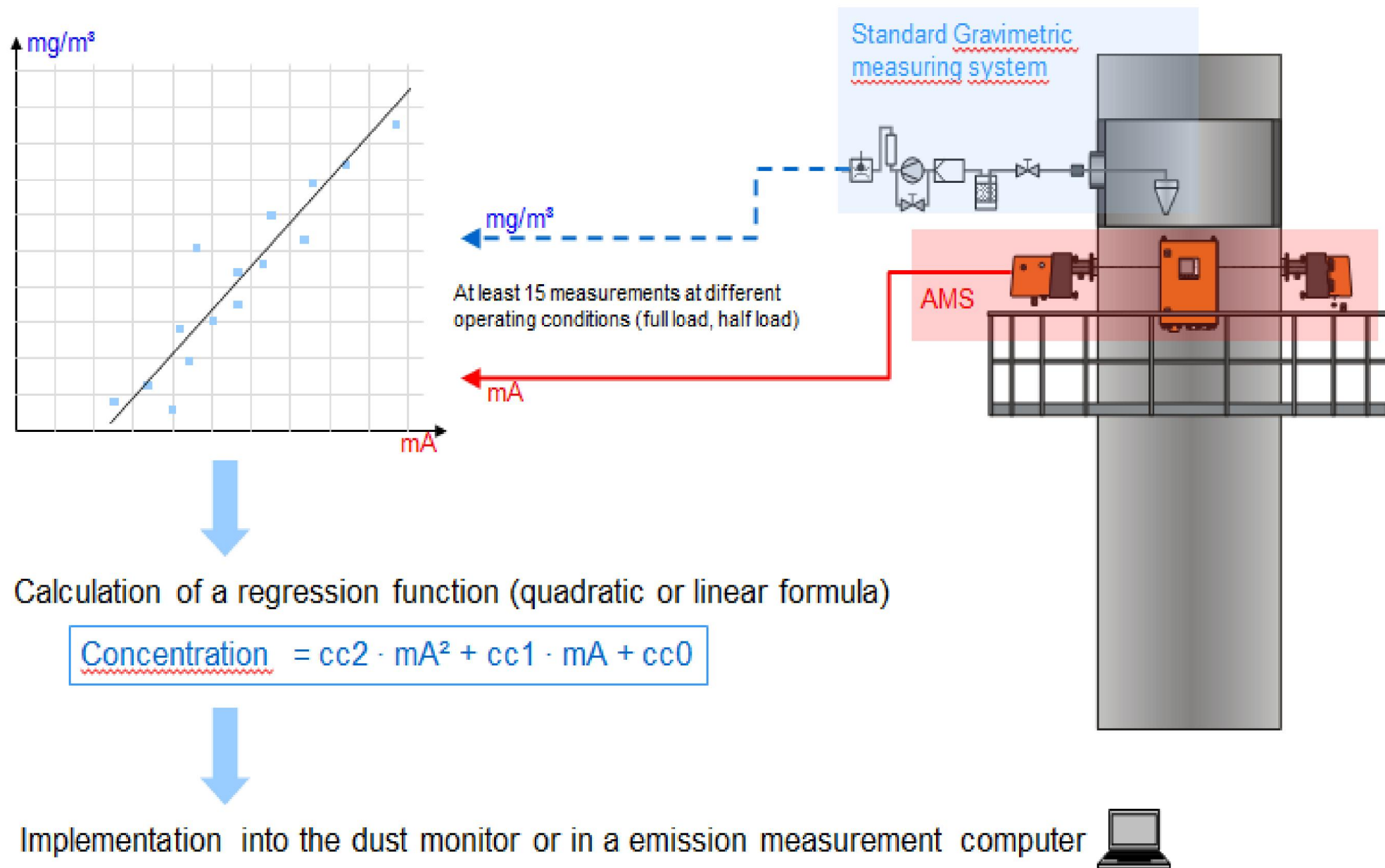


Calibration is performed under different plant operation and conditions to achieve different dust load.



Relationship between dust concentration in  $\text{mg}/\text{m}^3$  and monitor output in mA



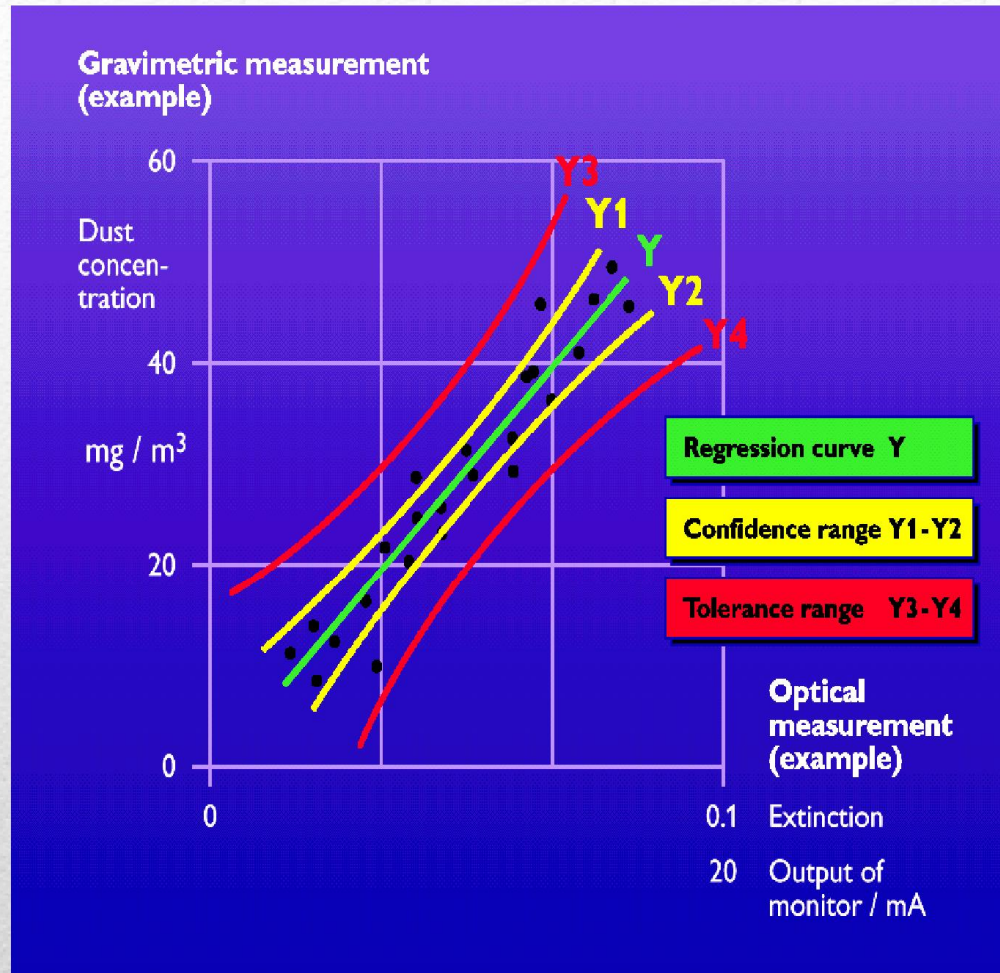


# Gravimetric Measurement



When evaluating a series of gravimetric dust measurements (accordance to VDI 2066), 95% of the measured extinction values have to be within the tolerance range Y3 and Y4 of the actual dust concentration Y.

The extinction value established over a long period of time has a 95% probability of falling inside the confidence range which is defined by Y1 and Y2.

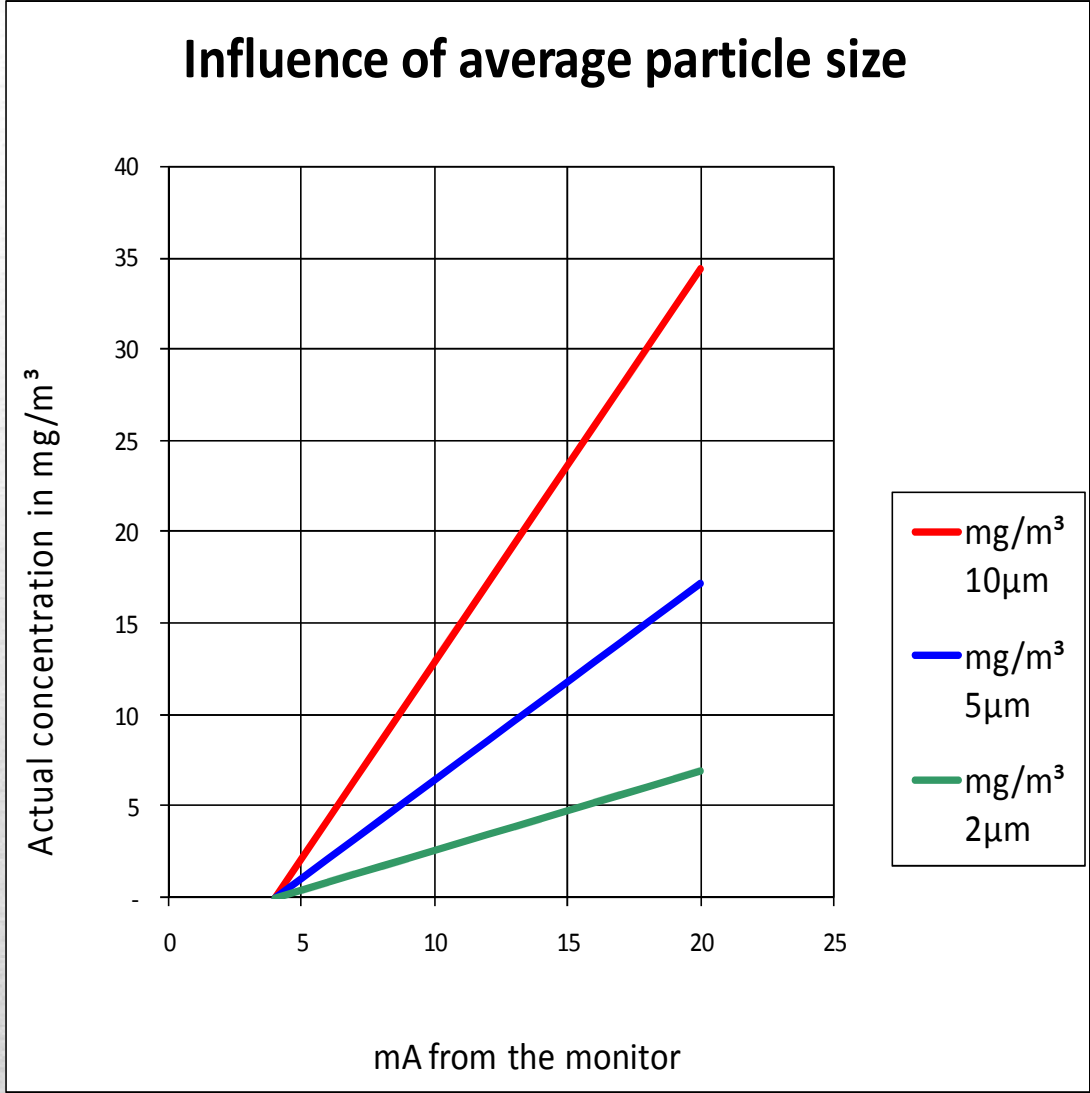


## PM CEMS calibration- Regression curve



The relation between:  
-concentration in  $\text{mg/m}^3$  and  
-monitor output in  $\text{mA}$

changes **proportional** with the  
changes in the average particle  
size.



## PM CEMS calibration- influence of particle size

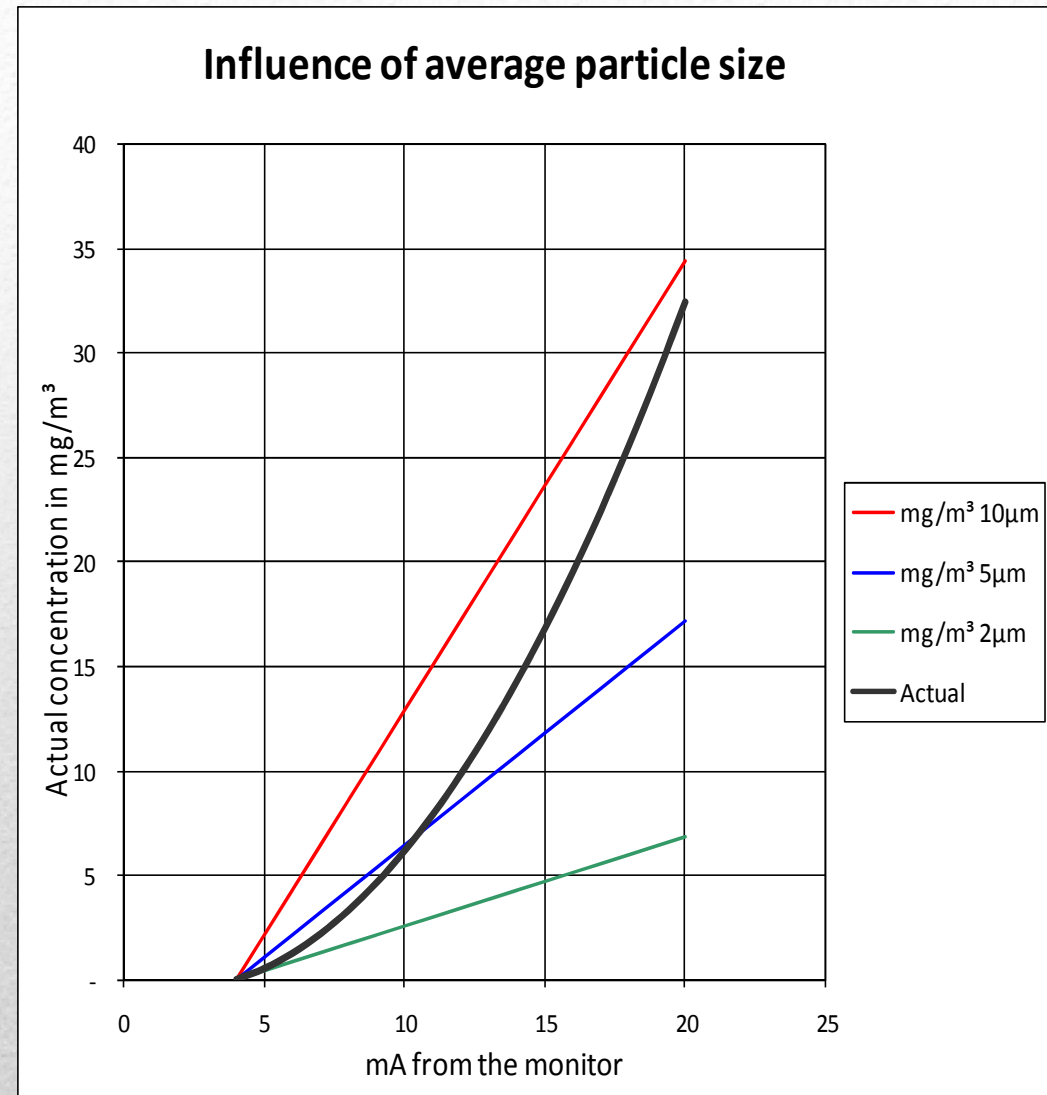




Because the average particle size often increases with the concentration (sometimes with the plant load), a non-linear upward rising calibration curve is normal (the black curve).

This has to be respected in the data processing system – means: quadratic curves have to be used.

(Requirement of [EN14181](#) )



## PM CEMS calibration- influence of particle size



Calibration at different loads against Isokinetic sampling (triplicate at each load) at the time of installation.

The results to compare fortnightly (starting 10 am, 2<sup>nd</sup> Friday) by replicate sampling with Isokinetic method. To follow at least first 6 months, afterwards the frequency may be relaxed by SPCBs.

This is only to check the performance; no adjustment of Calibrated Dust Factor is allowed unless full-scale calibration is performed.

In case, deviation of the comparison values for 2 consecutive monitoring is more than 10%, the system to be recalibrated at variable loads against Isokinetic method (replicate samples).

After any major repair that can affect accuracy, recalibration against Isokinetic sampling

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**Calibration- CPCB draft guidelines requirement**



# **Lineraity & Other maintenance checks**

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← Filterholder

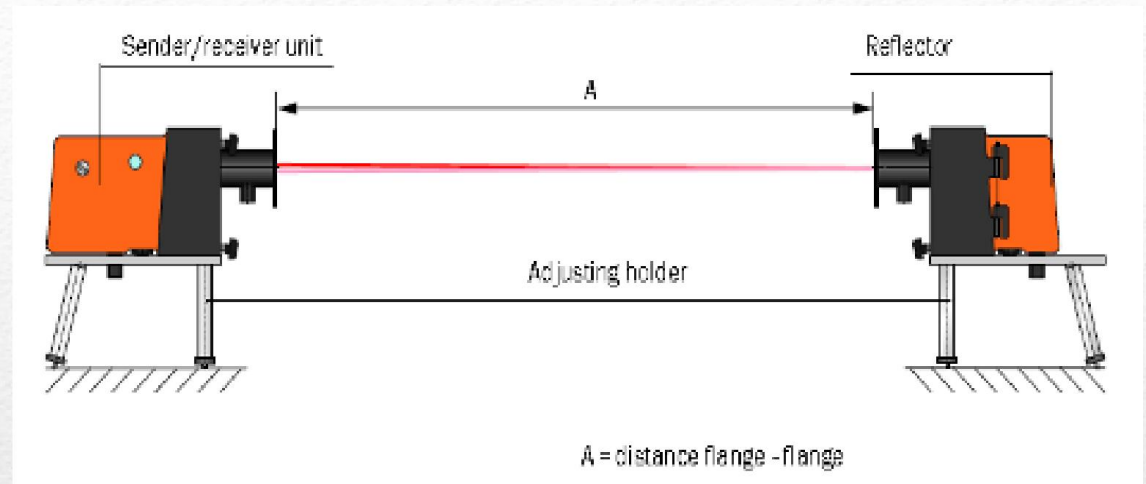
Device Filter →



## Linearity Filter Set

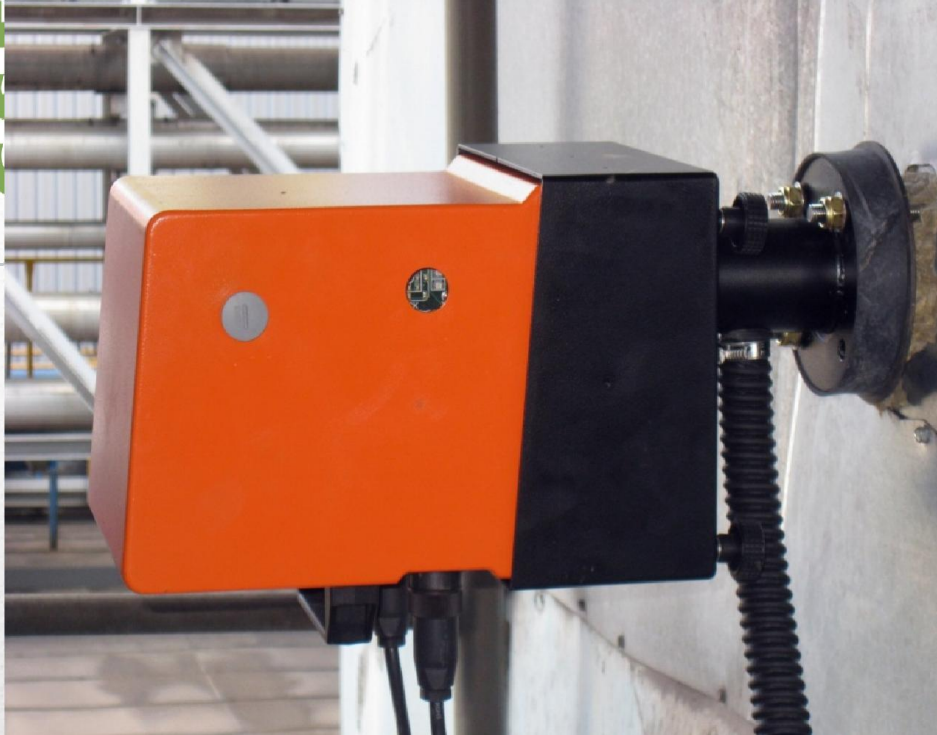


- Commissioning
- Maintenance



## Alignment





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**Cleaning the probe**



## Maintenance intervals

- The maintenance interval shall be derived from the shortest interval between the requisite maintenance work operations. This also includes **manual** zero and span point checks.
- The maintenance interval is important for QAL3 according to EN 14181
  - It defines the time span between QAL3 readings

### Maximum allowable maintenance intervals



Field test duration	Maximum allowable maintenance interval
3 months	1 month
6 months	3 months
12 months	6 months
24 months	12 months

## CEMS Maintenance (QAL3)- EN 15267

## **Ensure support resources for the CEMS**

**Target: System availability > 95%**

### **Support requirements**

- full support (engineering, installation, commissioning and start -up)
- availability of consumables on-site
- availability of critical spare parts from stock (local supplier)
- QAL3 zero and span without test gases
- training
- maintenance concept (e.g. Remote access)

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## **CEMS maintenance requirements**