

# Stack flow measurement

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# Stack emission measurements

- The Industrial Emissions Directive sets out emission limits for various species of pollutant
- Operators are required to measure their stack emissions in order to ascertain whether they are meeting these requirements
- In order to calculate the mass emissions from a stack two elements have to be measured:
  - Concentration of the pollutant
  - Flow rate out of the stack

# Flow Measurement Standards

- ISO 10780:1994 *Stationary source emissions – Measurement of velocity and volume flowrate of gas streams in ducts*
  - Specified manual methods for determining velocity and volume flowrate using Pitot tubes
- EN ISO 16911:2013 *Stationary source emissions – Manual and automatic determination of velocity and volume flow rate in ducts*
  - Part 1: Manual reference method
  - Part 2: Automated measuring systems

# Problems with ISO 10780

- Most instrumental methods for stack monitoring take continuous measurements of the concentration of the pollutants being emitted
- Flow rate measurements under ISO 10780 are discontinuous which can lead to inconsistencies when propagating uncertainty in the calculations to determine annual emissions
- The uncertainty levels in ISO 10780 were unsupported by published work
- Limits specified on measurement conditions (e.g. minimum flow rate, minimum cross sectional area, etc.) can leave some measurements outside the scope of the standard so no uncertainty can be assigned

# EN ISO 16911:2013

- Written by Working Group 23 under Technical Committee 264, with NPL representation
- Describes a wider variety of methods including continuous emission monitoring systems (CEMS)
- Provides solutions for some of the problems in ISO 10780:
  - Adjustment factors for wall effects
  - Method for flow at low differential pressures
  - Range of quoted uncertainty values dependant on flow profile and measurement methodology

# Work under IMPRESS

- Project is developing a new CFD model of stack flow.
- This will be used to better understand the flow measurement uncertainty under different stack conditions and sampling procedures.
- In addition, the impact of propagating the uncertainty associated with a periodic flow measurement to the annual mass emission uncertainty is being studied in order to provide a much needed industry guidance document