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# Allowing for Contaminated Gas Standards Within the Measurement Ratification Process

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*7th July, 2007*




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- Calibrations and measurement scaling
- Problems with NO gas standards
- Ratification case studies
- The Pressure Systems Safety Regulations
- Further Safety Information






# Analyser Calibrations

- Response of analysers quantified by regular calibrations
- Fortnightly calibrations of gas analysers usually appropriate
- Calibration sources traceable to National Metrological Standards
- Each ambient measurement linked to a calibration value
- In turn traceable to a primary standard






# Scaling of $NO_x$ Measurements

- Uses $NO_x$ & NO readings from a NO span gas test
- Uses $NO_x$ & NO readings from a zero test
- Scaling Factors for $NO_x$ & NO measurement channels calculated:

  *NO Scaling Factor = NO conc cylinder /(NO span – NO zero)*

  *Scaling Factor = 400/(202-2) = 2*

- $NO_x$ & NO Scaling Factors applied to 'raw' measurements
- $NO_2$ calculated from Scaled $NO_x$ – Scaled NO





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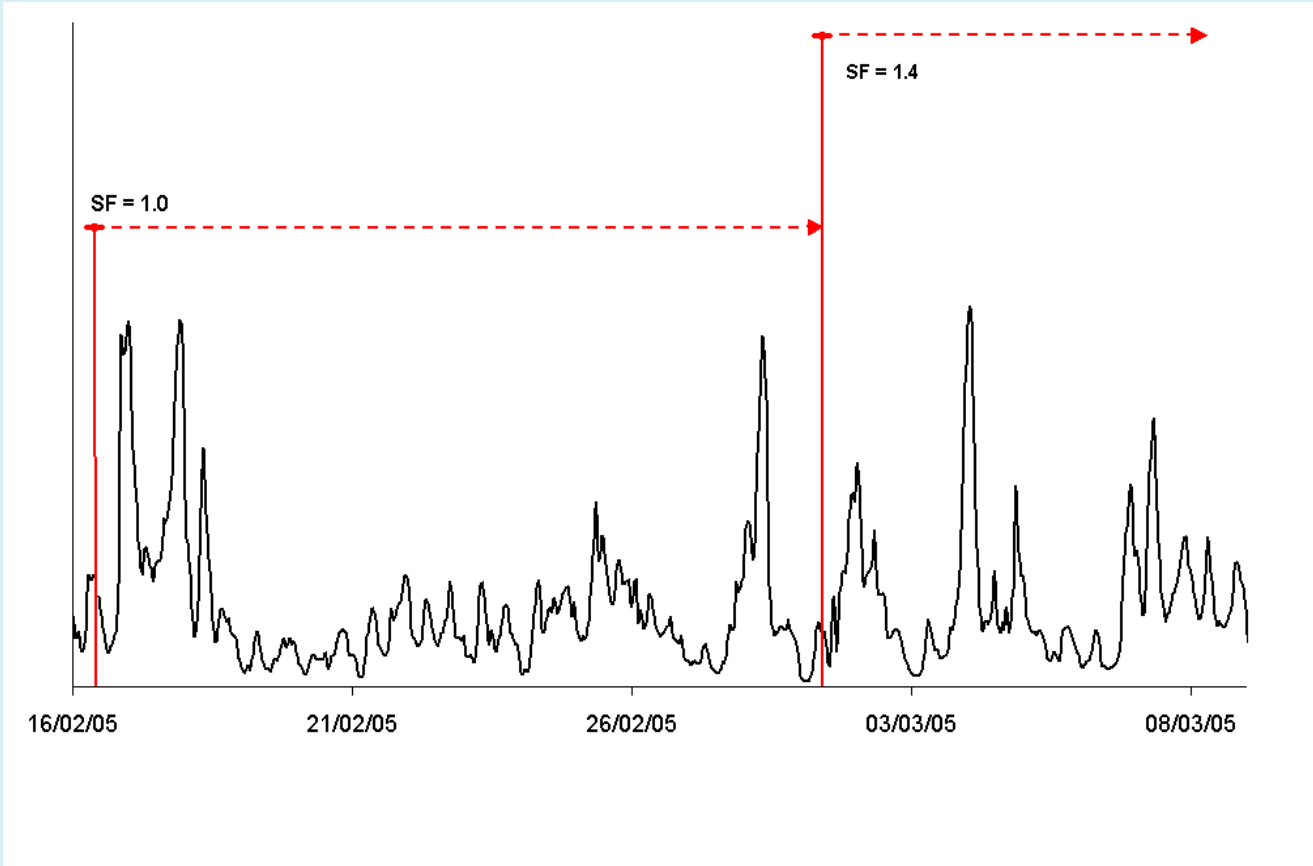
# Point Scaling of Measurements







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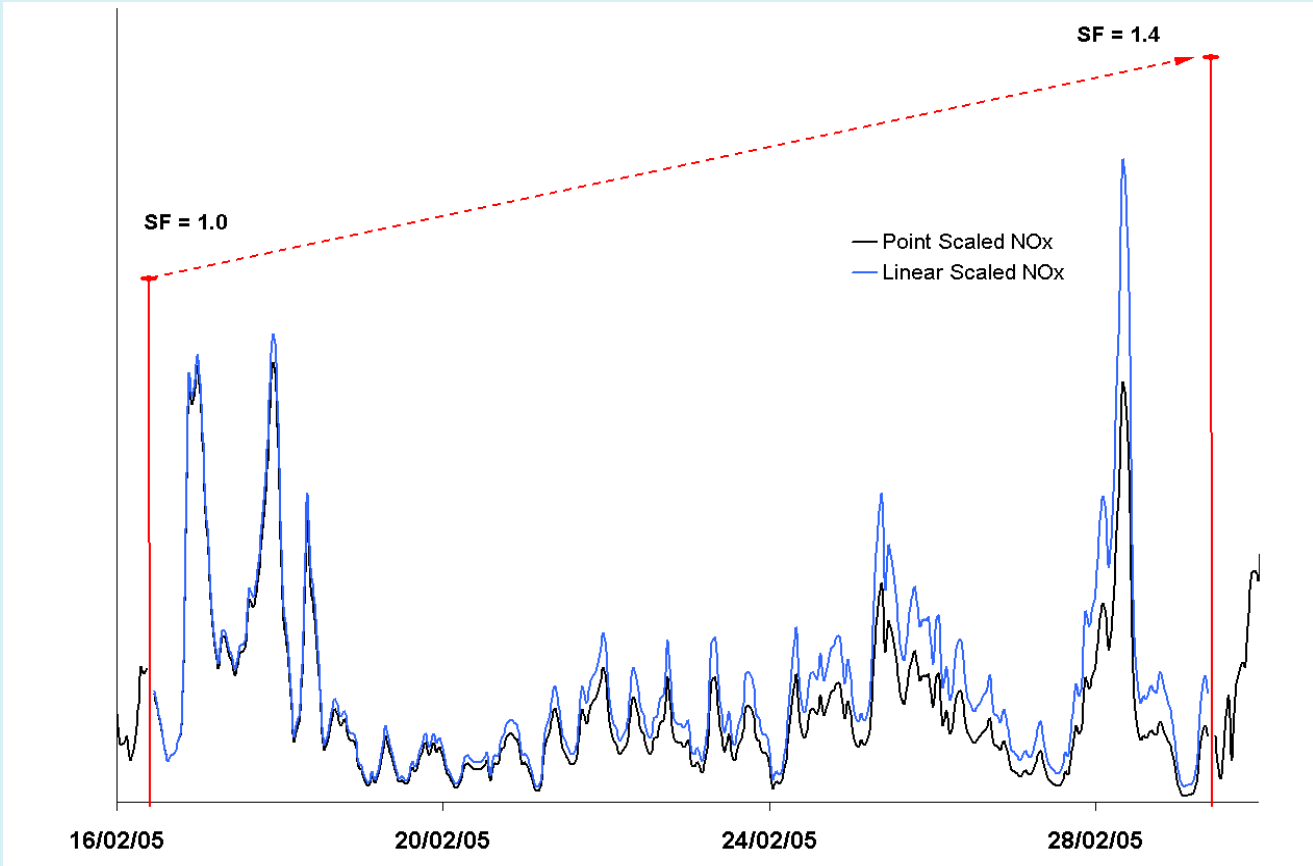
# Linear Scaling of Measurements








# Problems with NO Gas Cylinders

- Oxidation of some of the cylinder's NO to $NO_2$
- Unquantified drop in the cylinder's NO concentration
- $NO_x$ concentration usually unchanged

- Alternatively cylinder contents may degrade gradually
- Reductions in both $NO_x$ and NO concentrations

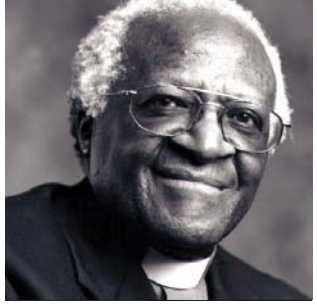
- Loss of traceability in both scenarios






# Effects on Measurement Scaling

- Reduced response on NO channel during calibration
- Corrected for by applying a falsely elevated NO Scaling Factor
- $NO_x$ Scaling Factor unaffected
- NO scaling error results in under-reporting of $NO_2$
- Effect most apparent during pollution episodes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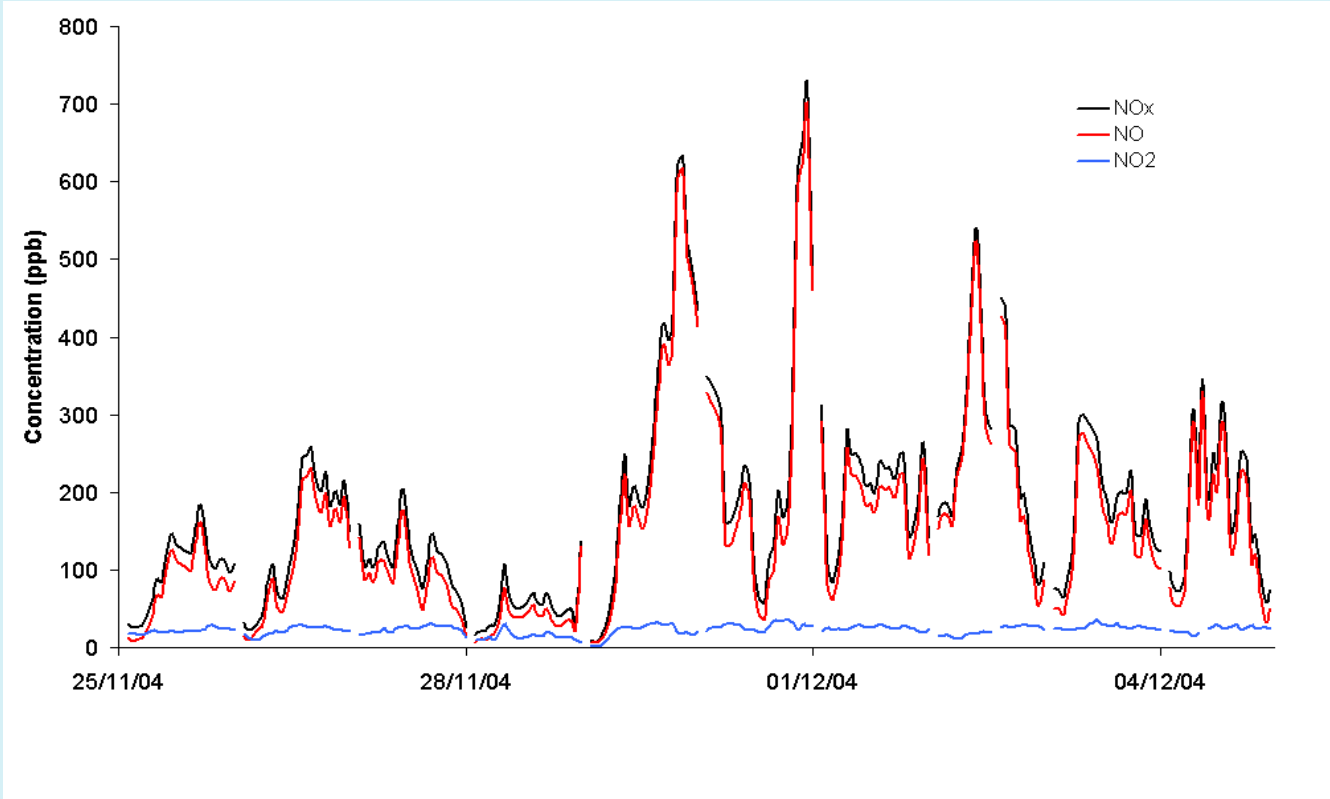
# Provisional Measurements from a west London Roadside Site







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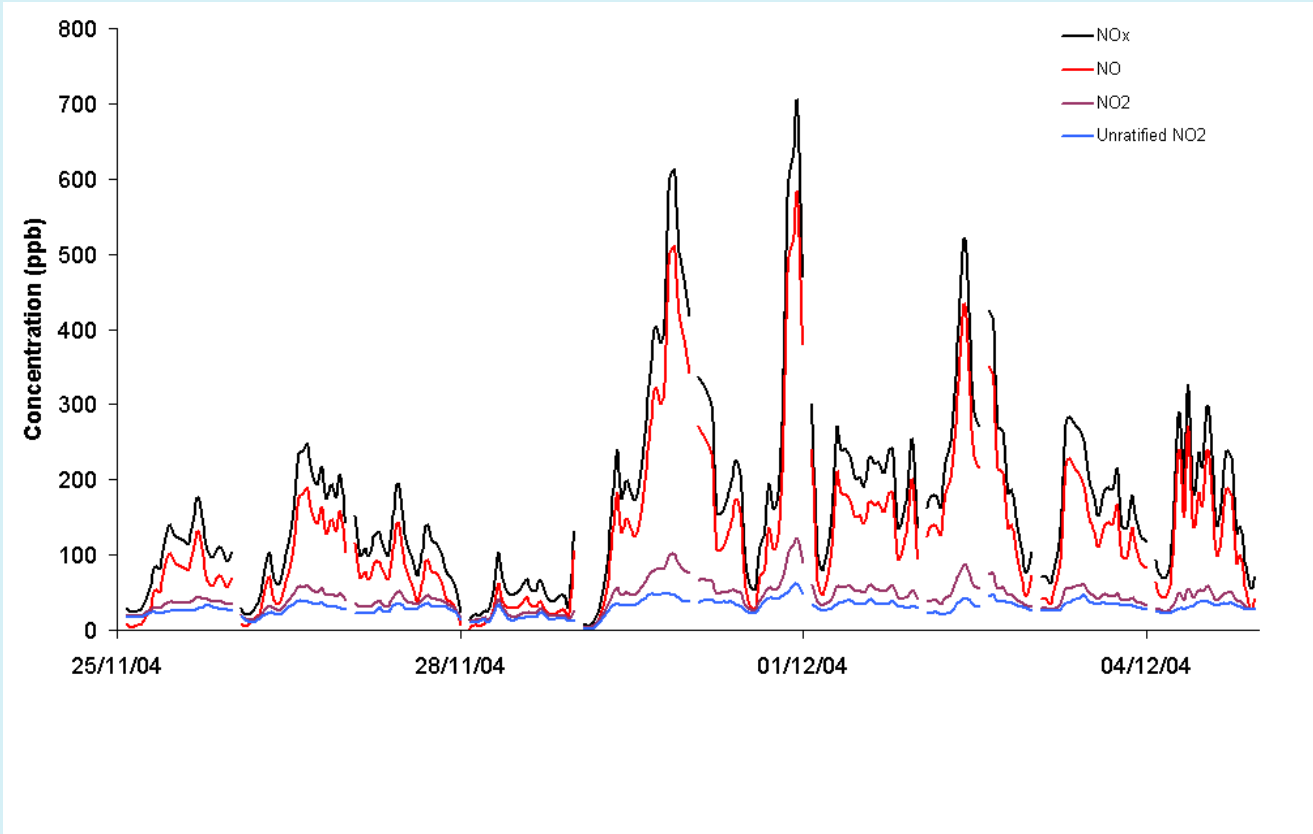
# Ratified Measurements from a west London Roadside Site



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# Ratification Case Studies




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# Case 1: Roadside Site, SW London

- Scaling Factors indicated cylinder oxidation at installation
- Problem detected and cylinder replaced after 8 weeks
- Occurred during unbroken analyser operation
- Regular calibration programme in place




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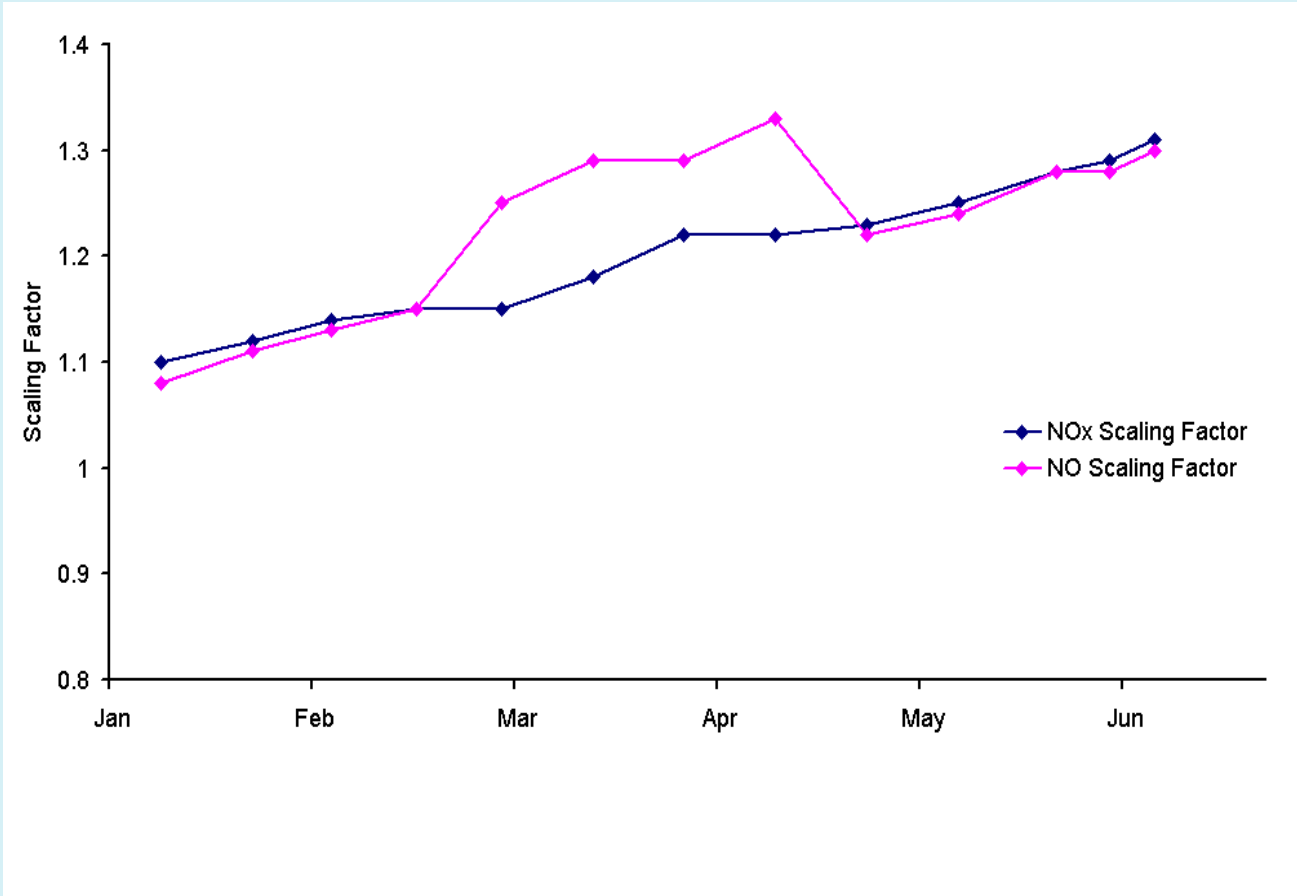
# Change in Scaling Factors with Cylinder Oxidation



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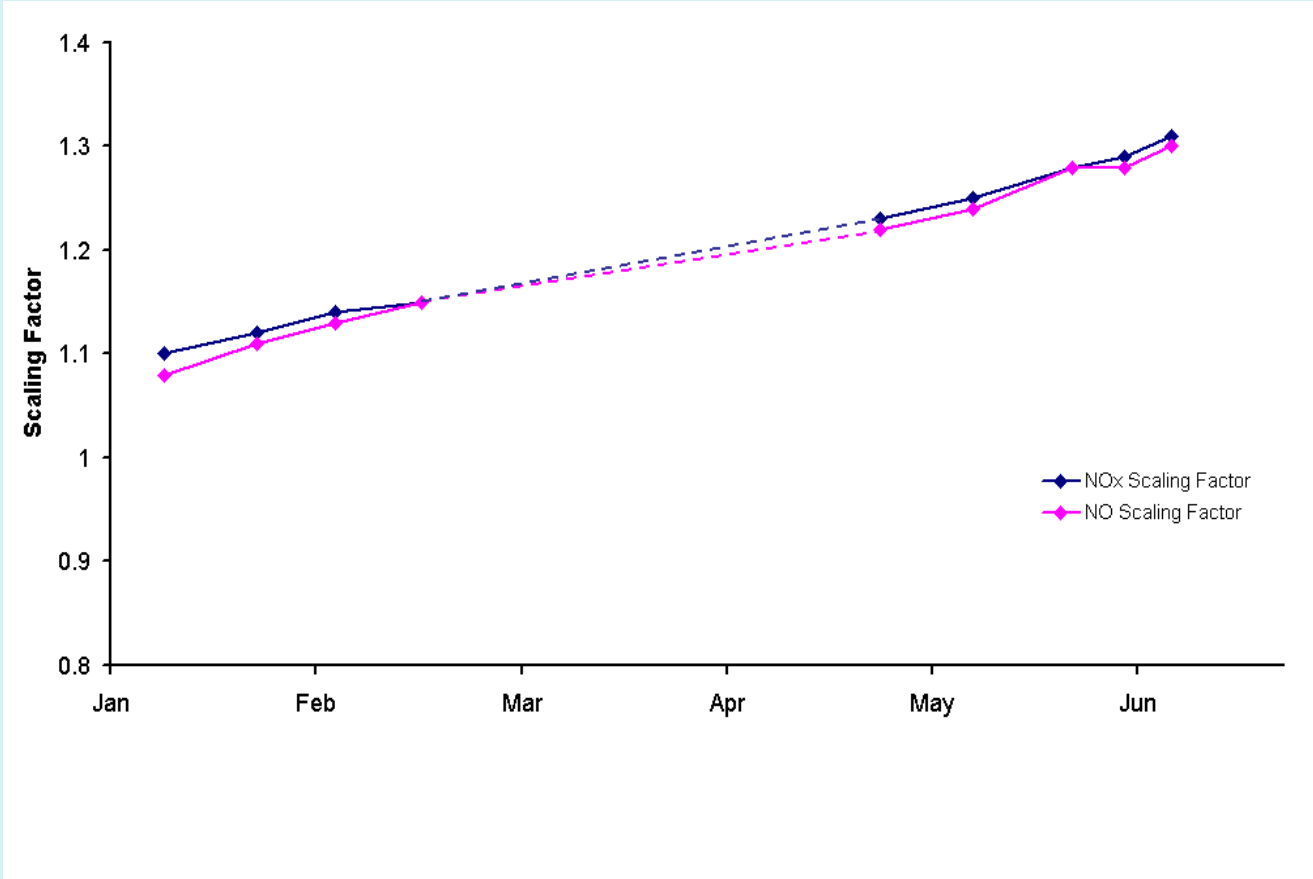
# Measurement Scaling at Ratification



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# Case 2: Background Site, SW London

- Scaling Factors indicated cylinder contamination at installation
- But not detected due to long-term communications problem at site
- Audit 5 months after cylinder installation
- Had cylinder been stable between installation & audit ?




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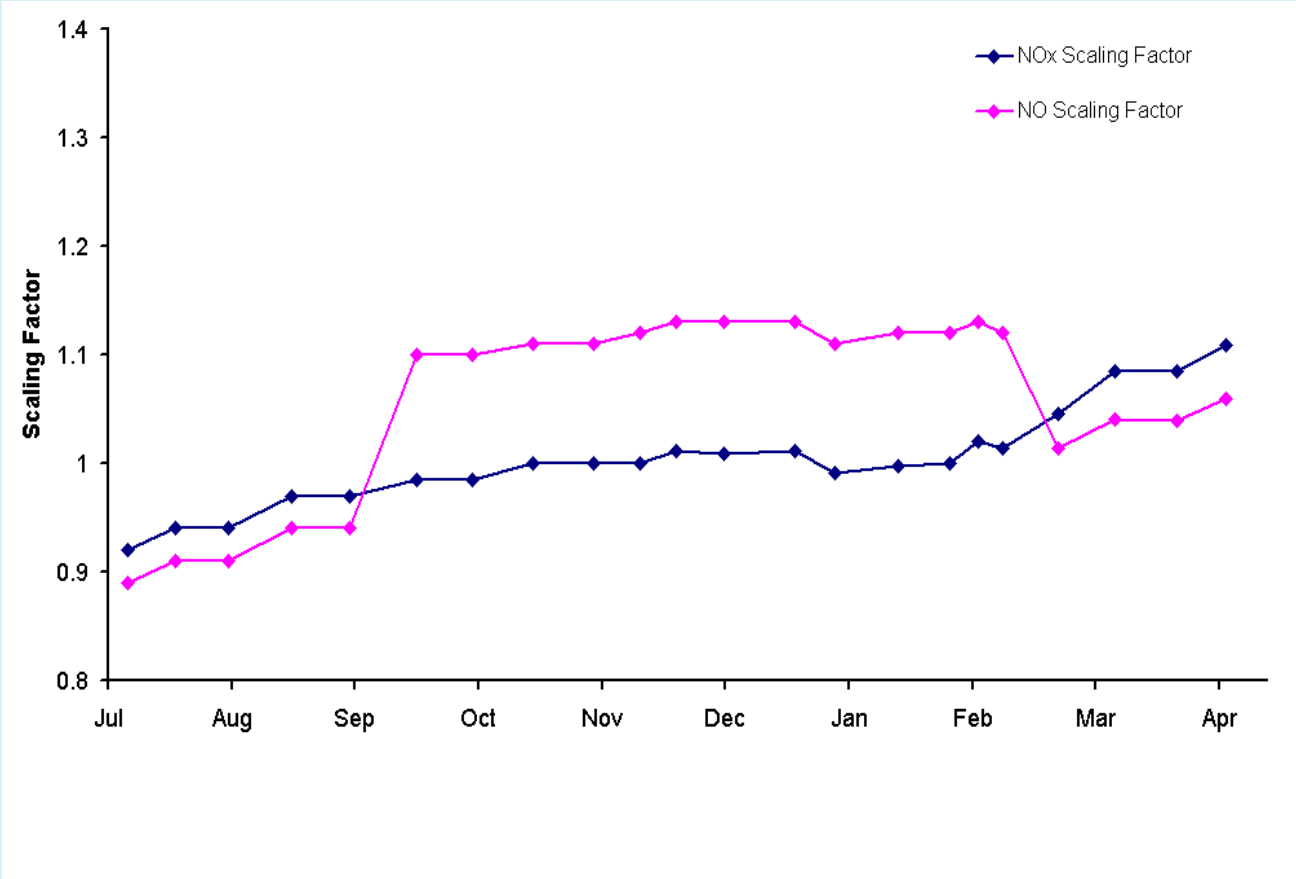
# Change in Scaling Factors with Cylinder Oxidation



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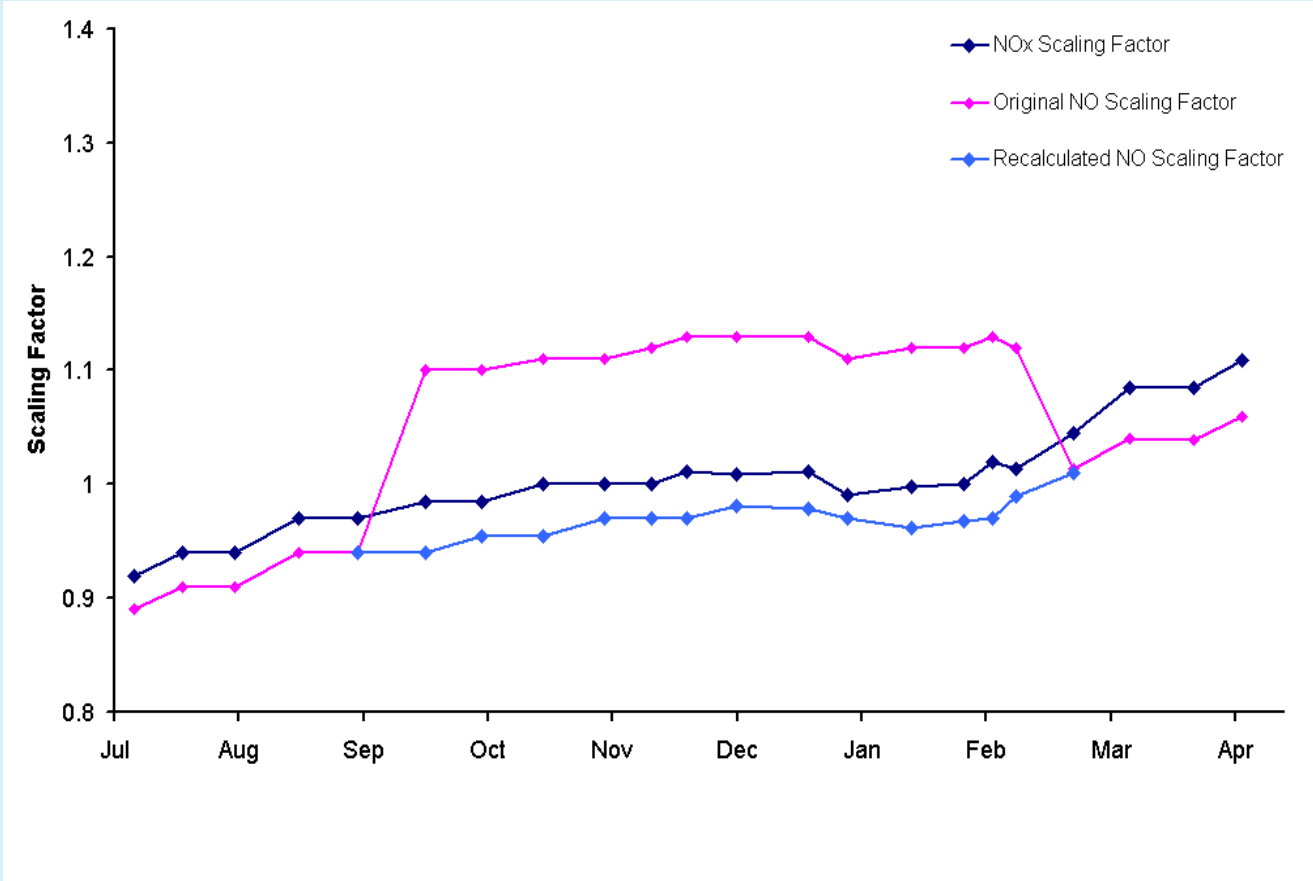
# Measurement Scaling at Ratification



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# Case 3: Roadside Site, south London

- Scaling Factors indicated contamination on installation
- 4 month interval between installation & audit
- Had cylinder been stable over this period ?




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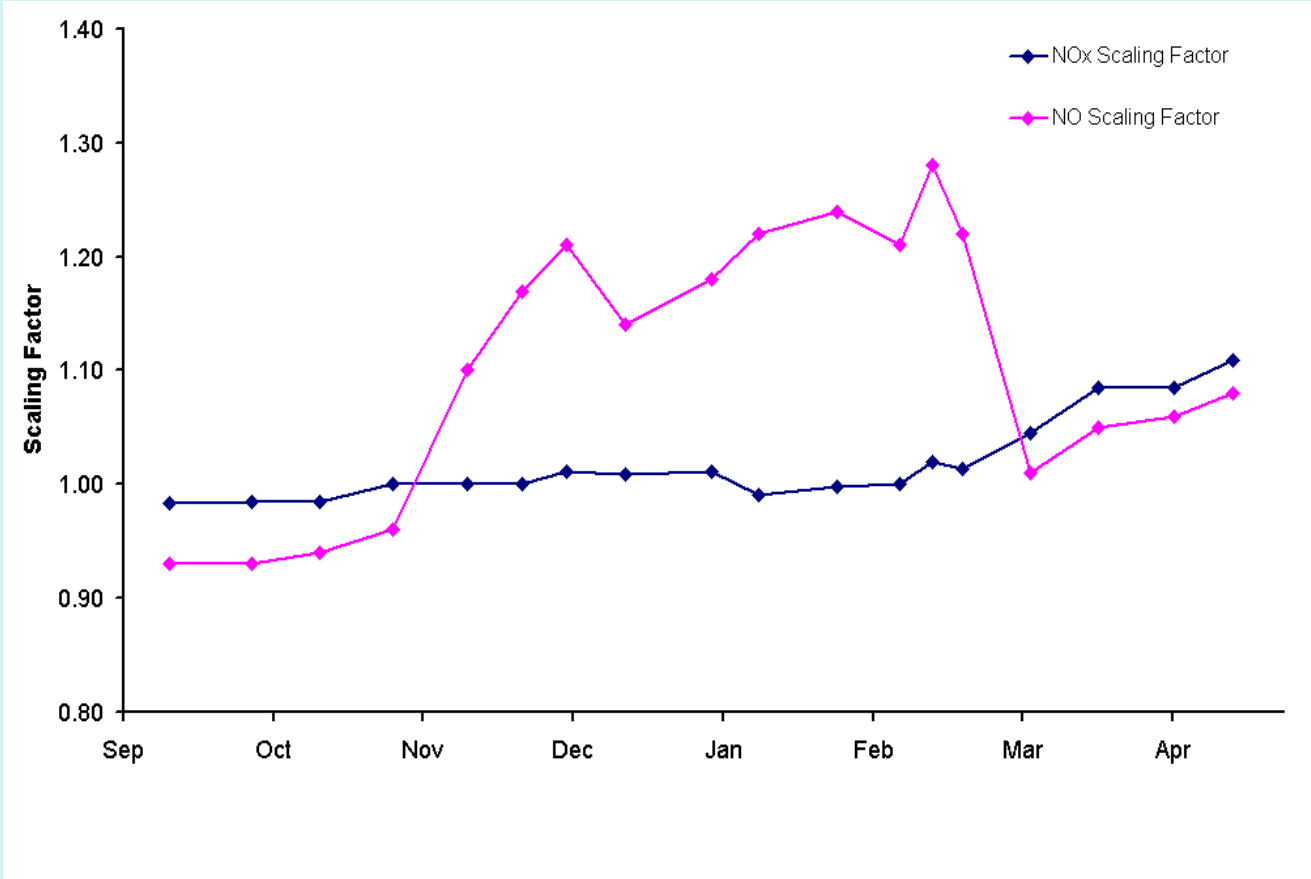
# Change in Scaling Factors with Cylinder Oxidation



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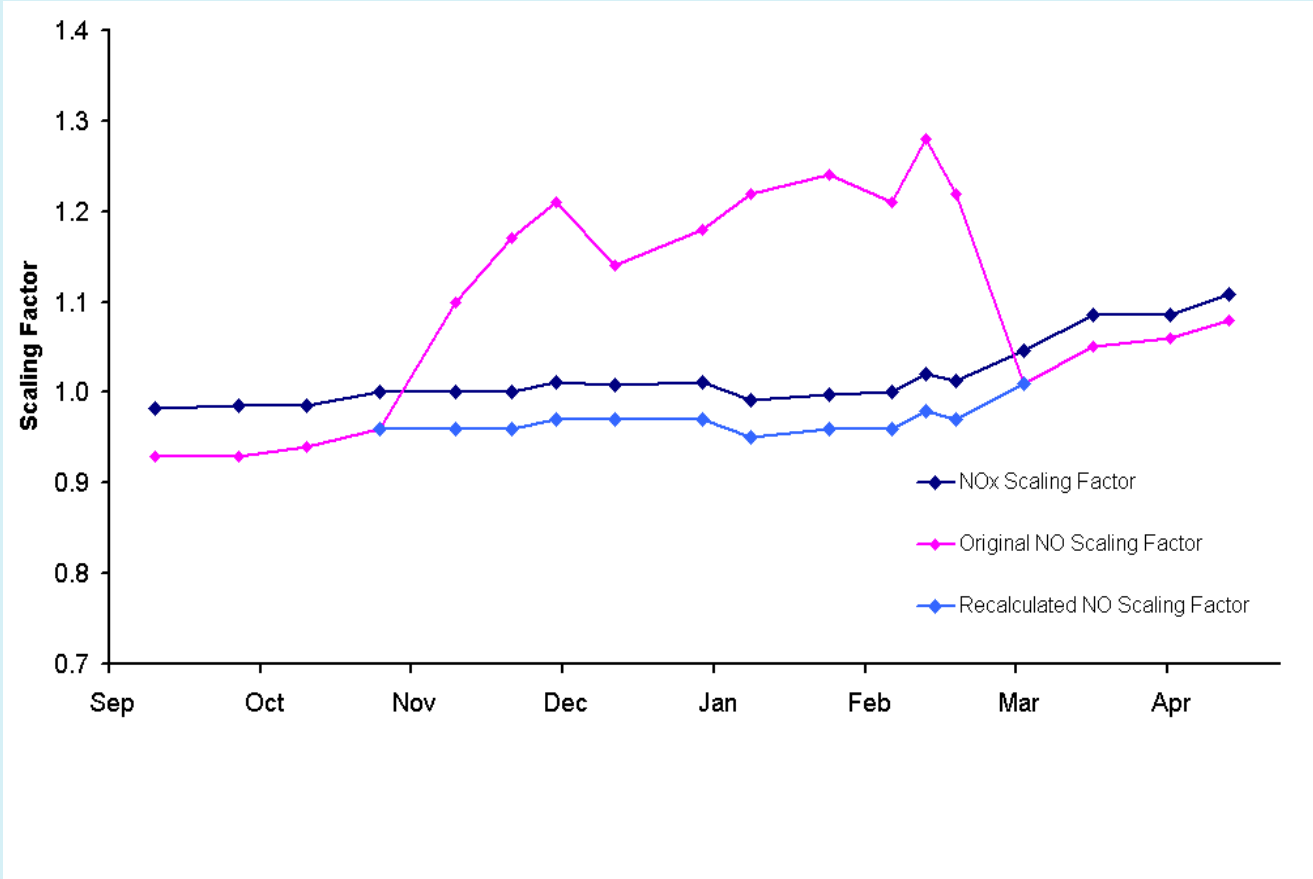
# Measurement Scaling at Ratification



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# Summary

- Problems typically occur when air within a regulator mixes with the contents of a NO cylinder
- Only a small proportion of cylinders affected
- Normally possible to rescale measurements
- But relies on long-term calibration histories and audits




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# The Pressure Systems Safety Regulations (PSSR)




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# What Is PSSR ?

- PSSR covers a wide range of devices which are pressurised above 0.5 bar
- Regulations aim to minimise the risk of uncontrolled pressure releases
- PSSR focuses upon the 'physical' hazards of uncontrolled pressure releases – such as injury from flying debris or explosion blast

- Any risk of injury from inhaling escaped gases is covered by other regulations – not PSSR




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# Pressurised Devices on the LAQN

- Gas Cylinders

  not covered by PSSR, but users have a responsibility to store and use them correctly

- Calibration Lines

  generally under very low pressure, with limited risk of injury in the event of failure

- Regulators

  operate at high pressures, principal safety device in the gas delivery system, covered by PSSR




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# Regulators

• Suppliers have a responsibility to provide safety information on their products – for example, stating maximum inlet and outlet pressures

• Owners must ensure that regulators are either:

replaced

or inspected

every 5 years

• ERG experience suggests that inspection / repair is generally more cost-effective than replacement




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# 5 Yearly Regulator Inspections

- Regulators must be inspected by a reputable organisation
- Regulator inspection typically entails:
  - disassembly & cleaning of major parts
  - pressure test to 220 bar
  - leak test
  - calibrate / replace gauges
  - determine safe inlet & outlet pressures
- Inspection and repair can normally be completed between fortnightly calibration visits




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# LSO Regulator Inspections

- Visual and basic functionality checks of regulators can be performed by LSOs
- Not a specific requirement of PSSR, but is recommended as good practice
- LSO checks should be performed either annually or with each gas cylinder exchange




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**Outlet gauge. Check:**

- Needle at 0 psi
- Lens secure & undamaged
- Back plate secure & undamaged

**Inlet stem. Check:**

- Connection free from cracks, etching & contamination
- Washer / filter in place
- Inlet nut rotates freely on stem




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# Further Information

• Further information on PSSR, regulator inspections & gas safety training provided in the seminar pack

• SOPs being written for the:

safe exchange of gas cylinders

LSO inspection of regulators

flushing of regulators to prevent NO oxidation

• The SOPs will be freely available from ERG in due course and reflect the various equipment setups on the LAQN