Analysis of stack gas reference material using existing methods at NMISA

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Your measure of excellence

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- Gas laboratory contribution
- Objective of the analysis
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NMISA Intercomparisons

Act no: 18 2006

- To provide for the use of measurement units of the International System of Units and certain other measurement units;…

- SI units are, meter, kilogram, second, ampere, Kelvin, mole, candela

- NMISA Gas Metrology laboratory participates in intercomparisons to prove its measurement capabilities

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Gas laboratory focus

Partially stable/reactive

SO_2, NO, NO_2, H_2S

Stable

CO, CO_2, O_2,
propane (C_3H_8)

Natural gas (CH_4)

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Objective

- To prepare multi-component standards and analyse a comparison sample with matrix matched standards as well as with binary mixtures of interest

- Stack gas mixture comprises of the following components:

  - CO_2 100-160 mmol/mol
  - SO_2 20-200 µmol/mol
  - CO 10-100 µmol/mol
  - NO 10-100 µmol/mol
  - C_3H_8 1-10 µmol/mol
  - Balance N_2

- Identification of possible interference species and eliminating those in the measurement

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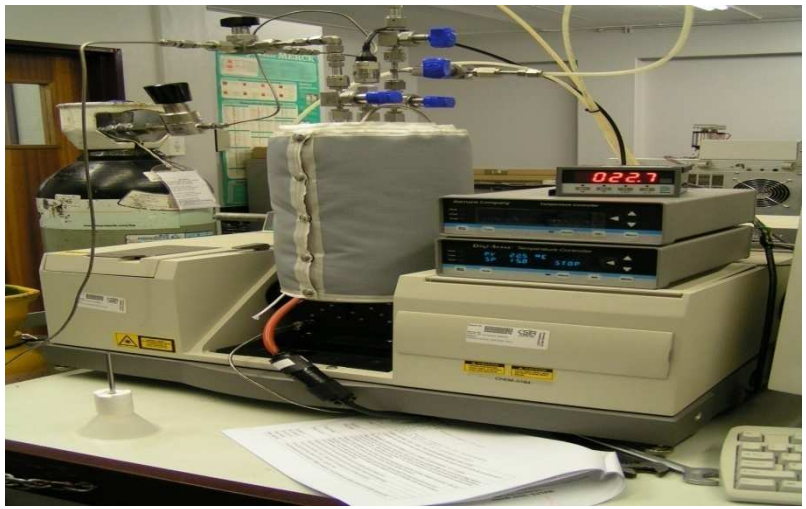
Techniques

Gas chromatography

Non- Dispersive Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy

Not used due to CO_2 interference



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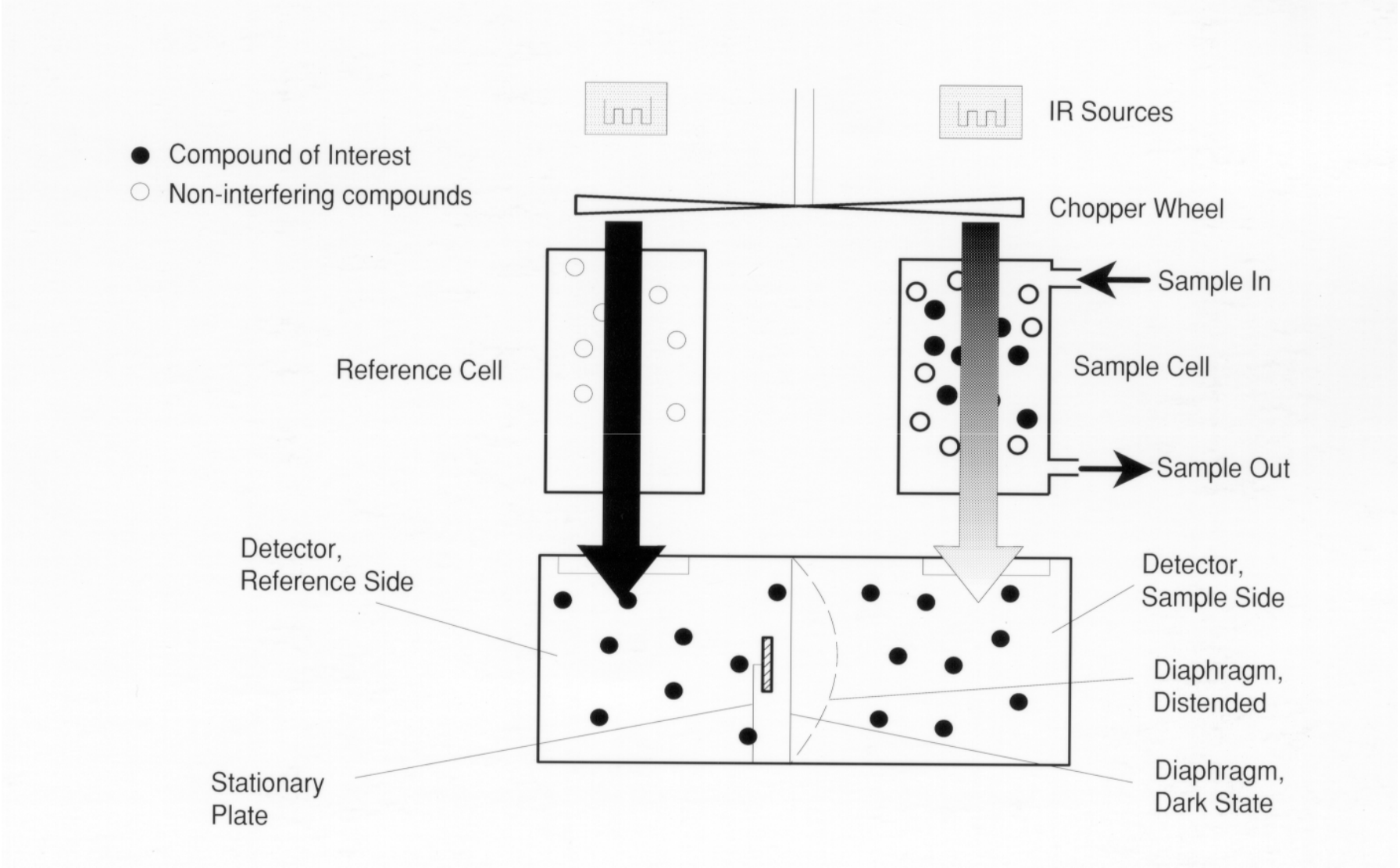
NDIR principle



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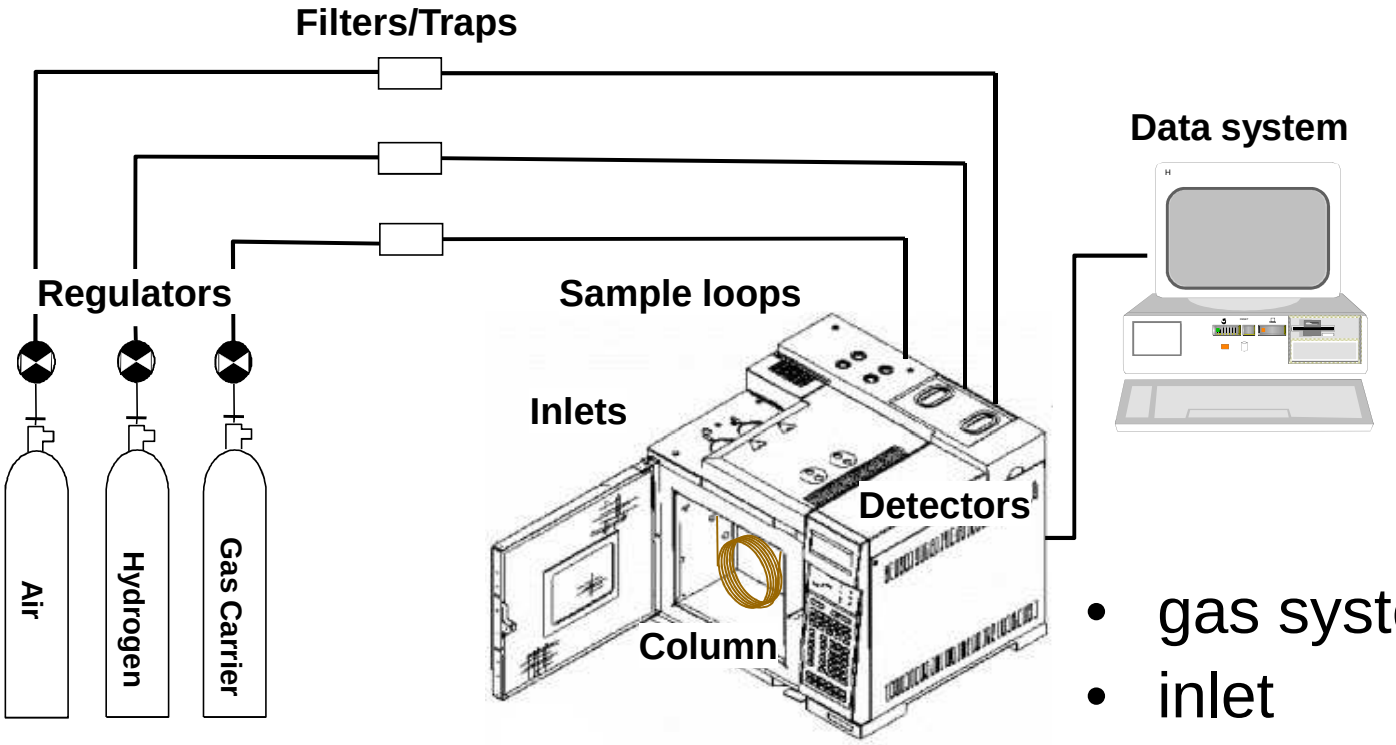
Gas Chromatography



- gas system
- inlet
- column
- detector
- data system

Gases analysed with GC detectors

Flame Ionization Detector with methaniser

- CO_2, CO, CH_4, C_2H_6, C_3H_8

Thermal Conductivity Detector

- CO_2, CO, N_2, O_2

Pulsed Discharged Helium Ionization Detector

- H_2, CO_2, CO, N_2, O_2,CH_4, Ar, C_2H_6, C_3H_8,

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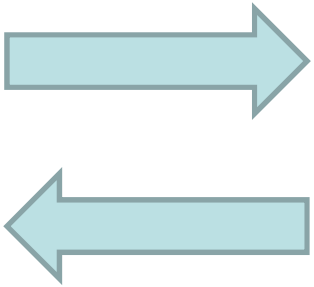
Preparation

Two sets of six multi-component mixture were gravimetrically prepared using ISO 6142 (Preparation of calibration gas mixtures — Gravimetric method)



Seven weighing cycles

Six filling turns

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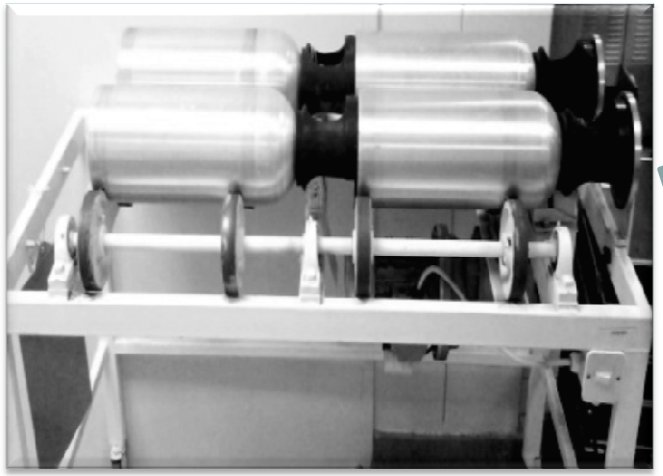
Preparation continued



GC

NDIR

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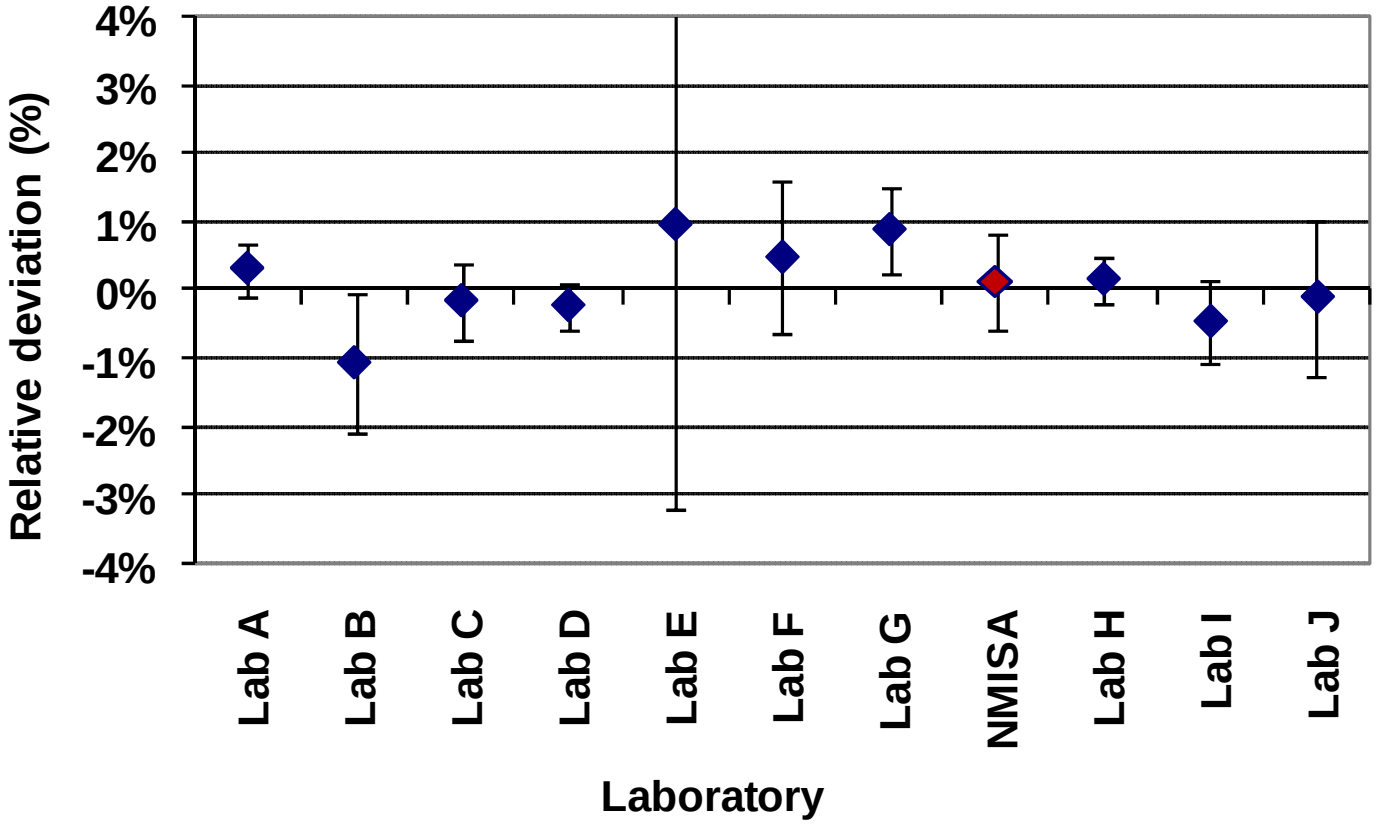
Results SO_2

NDIR- UV fluorescence SO_2: 80.13ppm, Reference: 80.026ppm
Deviation: 0.13%



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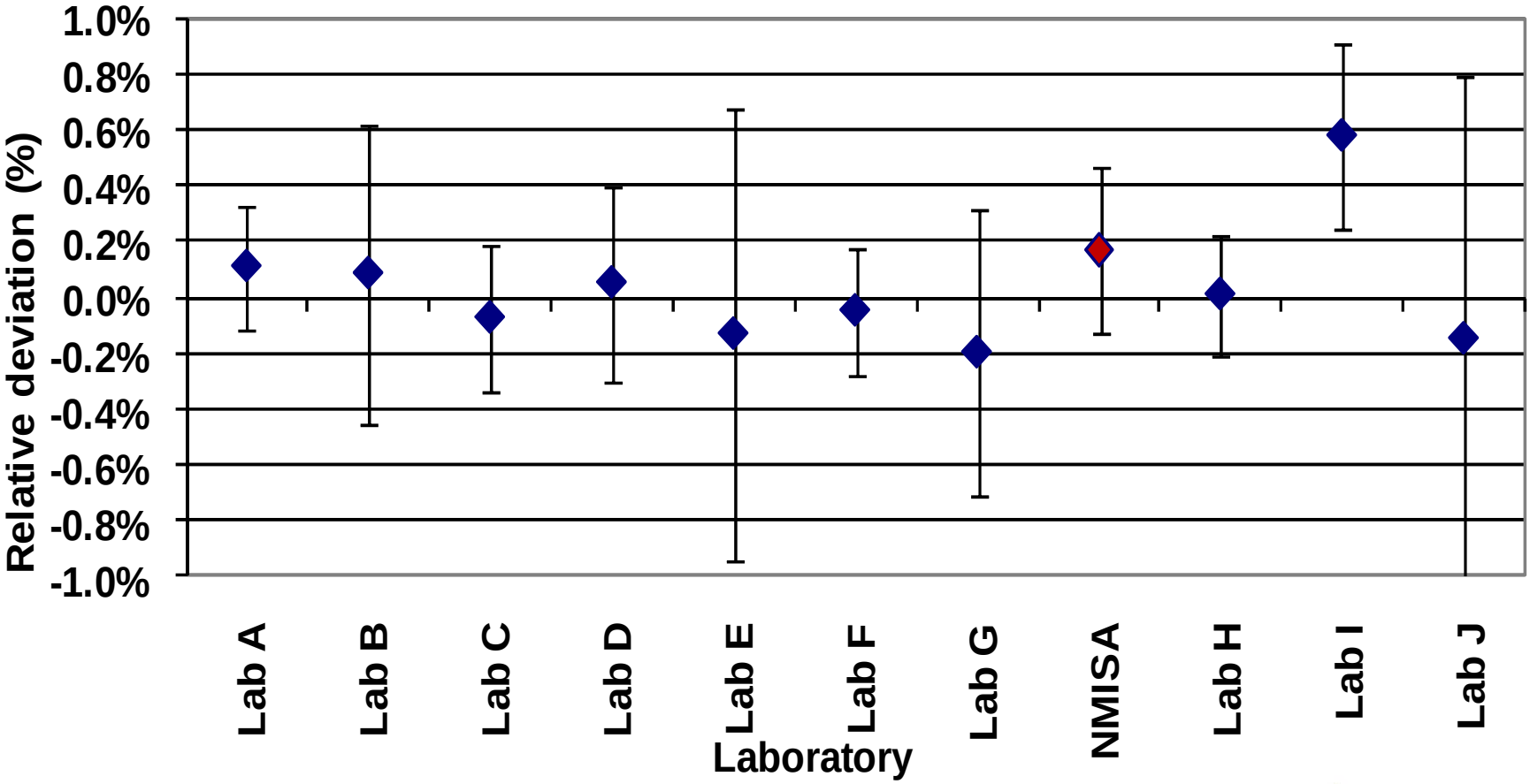
Results CO_2

NDIR: CO_2: 12.017 %, Reference: 11.997 %
Deviation: 0.17%



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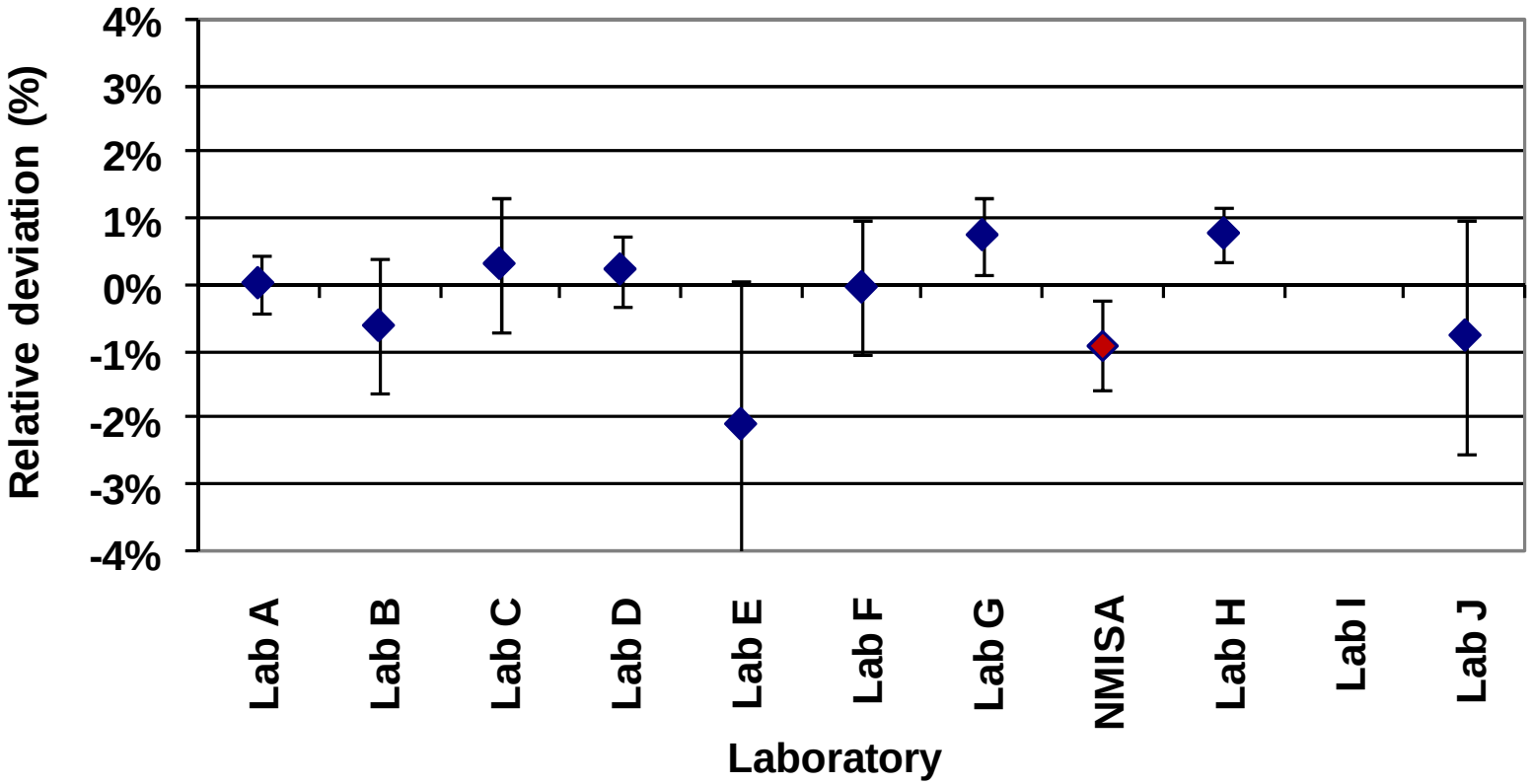
Results NO

NDIR- chemiluminescence NO: 79.420ppm, Reference: 80.142ppm
Deviation: -0.90%



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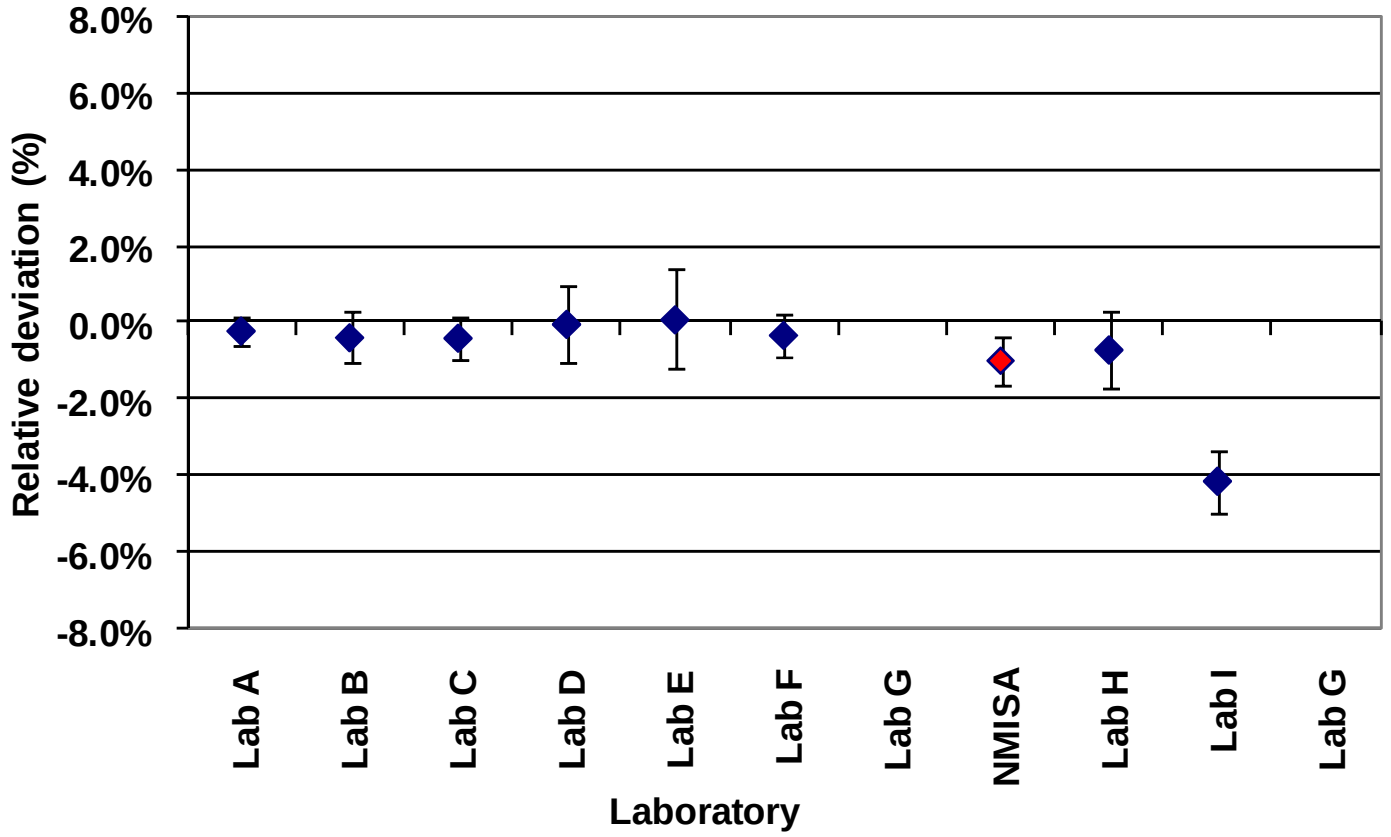
Results CO

NDIR: **CO: 39.800ppm, Reference: 40.208ppm**
Deviation: -1.01%



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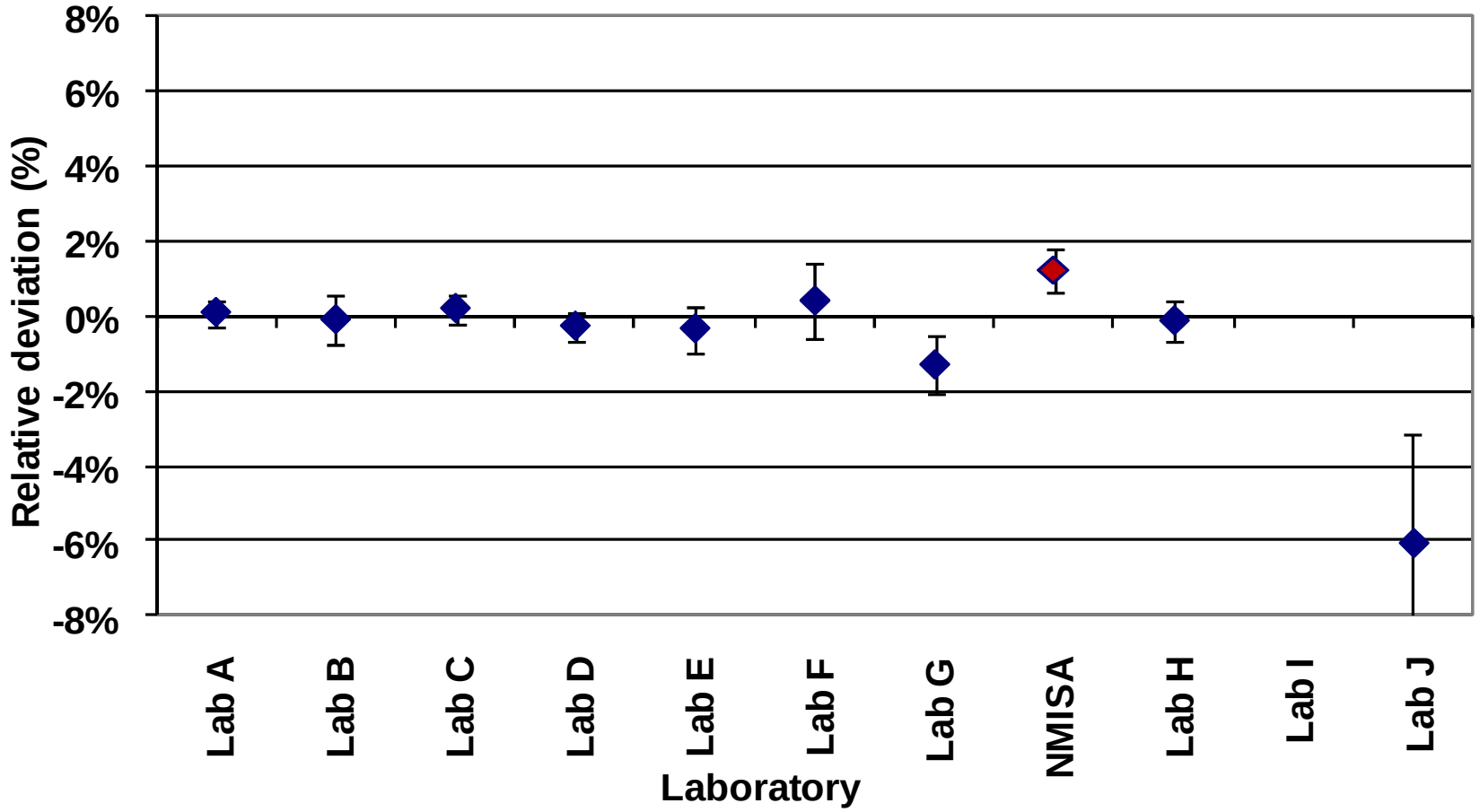
Results C_3H_8

GC- FID/Methaniser: C_3H_8: 6.048ppm, Reference: 5.976ppm
Deviation: 1.20%



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Conclusion

- SO_2 and CO_2 good results
- CO, GC may be better method; revisit estimation of uncertainty
- NO, possible quenching from CO_2, look at improving reaction efficiency
- C_3H_8, revisit the estimation of uncertainty

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Acknowledgements

NMISA – GAS LABORATORY STAFF

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