

Calibration of equipment for analytical measurement in the laboratory or at customer

ANALYTICAL MEASUREMENT



LAT N° 143

The LAT Center can calibrate analytical measuring equipment, gas chromatographs and analyzers. The main calibrated detectors are indicated below

Gas chromatographs with:

- *FID* detector for hydrocarbons;
- *TCD* and *PDD* detectors for oxygen, carbon dioxide, nitrogen, carbon monoxide;
- *SCD* and *AED* detectors for sulfur compounds.

Analyzers with:

- *IR* cell for carbon dioxide, carbon monoxide, nitrogen oxide;
- *UV* cell for sulfur dioxide, nitrogen oxide;
- *chemiluminescence* for nitrogen oxide and nitrogen dioxide;
- *paramagnetic* for oxygen;
- *cooled mirror cell* for humidity.

THE CALIBRATION IS PERFORMED IN ACCORDANCE WITH STANDARD ISO 6143, USING THE METHOD OF GENERALIZED LEAST SQUARES (GLS).

It is important to define the correct calibration conditions so that they reflect the actual use of the instrument.

It is therefore necessary to request calibration in the most suitable range and to indicate the matrix gas in which the instrument is to be used.

SIAD technicians assist the customer in defining the correct conditions in which the calibration

must be carried out according to: type of detector, calibration range, analysis function (e.g., quadratic or linear), linearity of response of the instrument.

The number of traceable mixtures necessary for calibrating the equipment will depend on these variables being correctly defined.

The accreditation table gives the calibration ranges and the minimum uncertainty that can be certified

for each type of detector. The main recommended applications are:

- checking the state of calibration of analytical equipment (for example, checking the measurement line or re-alignment);
- compliance of the instrument with standards (legislative parameters, specifications of supply, etc.).

Calibration of equipment for analytical measurement: at LAT center and external calibration

Table

MEASURAND	CALIBRATION CAPABILITY Amount fraction range mol/mol		RELATIVE EXPANDED UNCERTAINTY (*)
	From	To	
GAS CHROMATOGRAPHY AND ANALYZER DETECTORS			
TCD and FID for			
Acetylene (C ₂ H ₂)	1·10 ⁻⁶	0,4·10 ⁻²	2%
Butane (C ₄ H ₁₀)	1·10 ⁻⁶	5·10 ⁻²	2%
Ethane (C ₂ H ₆)	1·10 ⁻⁶	35·10 ⁻²	1%
Ethanol (C ₂ H ₆ O)	100·10 ⁻⁶	1000·10 ⁻⁶	5%
Ethylene (C ₂ H ₄)	1·10 ⁻⁶	16·10 ⁻²	1%
Hexane (C ₆ H ₁₄)	1·10 ⁻⁶	3,5·10 ⁻²	2%
Isobutane (C ₄ H ₁₀)	1·10 ⁻⁶	5·10 ⁻²	2%

AT LAT CENTER AND EXTERNAL CALIBRATIONS

MEASURAND	CALIBRATION CAPABILITY Amount fraction range mol/mol		RELATIVE EXPANDED UNCERTAINTY (*)
	From	To	
GAS CHROMATOGRAPHY AND ANALYZER DETECTORS			
Isobutene (C ₄ H ₈)	1·10 ⁻⁶	5·10 ⁻²	2%
Isopentane (C ₅ H ₁₂)	50·10 ⁻⁶	3.5·10 ⁻²	1%
Methane (CH ₄)	1·10 ⁻⁶	50·10 ⁻²	2%
	50·10 ⁻²	99.8·10 ⁻²	0.1%
Neopentane (C ₅ H ₁₂)	50·10 ⁻⁶	3.5·10 ⁻²	1%
Pentane (C ₅ H ₁₂)	50·10 ⁻⁶	3·10 ⁻²	1%
Propane (C ₃ H ₈)	1·10 ⁻⁶	18·10 ⁻²	1%
Propylene (C ₃ H ₆)	0.05·10 ⁻²	7·10 ⁻²	0.3%
1-3 butadiene (C ₄ H ₆)	1·10 ⁻⁶	3·10 ⁻²	2%
1-butene (C ₄ H ₈)	1·10 ⁻⁶	5·10 ⁻²	2%
PID and FID for			
Benzene (C ₆ H ₆)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
Ethylbenzene (C ₈ H ₁₀)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
Toluene (C ₇ H ₈)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
m-Xylene (m-C ₈ H ₁₀)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
o-Xylene (o-C ₈ H ₁₀)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
p-Xylene (p-C ₈ H ₁₀)	5·10 ⁻⁹	200·10 ⁻⁹	2.5%
AED, PFPD, SCD, TCD and ELECTROCHEMICAL for			
Carbonyl sulphide (COS)	1·10 ⁻⁶	100·10 ⁻⁶	5%
Ethyl mercaptan (C ₂ H ₆ S)	0.5·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Hydrogen sulphide (H ₂ S)	1·10	1·10 ⁻⁶	5%
Isopropyl mercaptan (C ₃ H ₈ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Methyl ethyl sulphid (CH ₄ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Methyl mercaptan (CH ₄ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Methyl sulphide (C ₂ H ₆ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
N-Propyl mercaptan (C ₃ H ₈ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Tert-butyl mercaptan(C ₄ H ₁₀ S)	1·10 ⁻⁶	10·10 ⁻⁶	10%
	10·10 ⁻⁶	100·10 ⁻⁶	5%
Tetrahydrothiophene (C ₄ H ₈ S)	1·10 ⁻⁶	10·10 ⁻⁶	5%
	10·10 ⁻⁶	100·10 ⁻⁶	3%
PDD and TCD for			
Carbon dioxide (CO ₂)	10·10 ⁻⁶	50·10 ⁻²	1%
	50·10 ⁻²	99.8·10 ⁻²	0.3%
Carbon monoxide (CO)	1·10 ⁻⁶	10·10 ⁻²	1%
	10·10 ⁻⁶	90·10 ⁻²	0.3%

AT LAT CENTER AND EXTERNAL CALIBRATIONS

MEASURAND	CALIBRATION CAPABILITY Amount fraction range mol/mol		RELATIVE EXPANDED UNCERTAINTY (*)
	From	To	
GAS CHROMATOGRAPHY AND ANALYZER DETECTORS			
Helium (He)	100·10 ⁻⁶	50·10 ⁻²	3%
Hydrogen (H ₂)	500·10 ⁻⁶	20·10 ⁻²	1%
	20·10 ⁻⁶	90·10 ⁻²	0.3%
Nitrogen (N ₂)	500·10 ⁻⁶	10·10 ⁻²	3%
	10·10 ⁻²	99·10 ⁻²	0.3%
Nitrous oxide (N ₂ O)	1·10 ⁻⁶	0.1·10 ⁻²	1%
Oxygen (O ₂)	10·10 ⁻⁶	25·10 ⁻²	1%
	25·10 ⁻²	99.8·10 ⁻⁶	0.3%
FID – METHANIZER for			
Carbon dioxide (CO ₂)	10·10 ⁻⁶	2000·10 ⁻⁶	1%
Carbon monoxide (CO)	1·10 ⁻⁶	4000·10 ⁻⁶	1%
Methane (CH ₄)	1·10 ⁻⁶	2000·10 ⁻⁶	1%
INFRARED (NDIR and FTIR) for			
Ammonia (NH ₃)	5·10 ⁻⁶	500·10 ⁻⁶	3%
Carbon dioxide (CO ₂)	1·10 ⁻⁶	50·10 ⁻²	1%
	50·10 ⁻²	99.8·10 ⁻²	0.3%
Carbon monoxide (CO)	1·10 ⁻⁶	10·10 ⁻²	1%
	10·10 ⁻²	90·10 ⁻²	0.3%
Sulphur dioxide (SO ₂)	0.1·10 ⁻⁶	1·10 ⁻⁶	5%
	1·10 ⁻⁶	100·10 ⁻⁶	2%
	100·10 ⁻⁶	3000·10 ⁻⁶	1%
Nitrogen dioxide(NO ₂)	5·10 ⁻⁶	100·10 ⁻⁶	3%
Nitric oxide (NO)	0.4·10 ⁻⁶	2500·10 ⁻⁶	1%
Nitrous oxide (N ₂ O)	1·10 ⁻⁶	0.1·10 ⁻²	1%
CHEMILUMINESCENCE for			
Nitrogen dioxide (NO ₂)	5·10 ⁻⁶	100·10 ⁻⁶	5%
Nitric oxide (NO)	0.4·10 ⁻⁶	2500·10 ⁻⁶	1%
ULTRAVIOLET for			
Ammonia (NH ₃)	5·10 ⁻⁶	500·10 ⁻⁶	3%
Hydrogen sulphide (H ₂ S)	1·10 ⁻⁶	1·10 ⁻⁶	5%
Nitrogen dioxide(NO ₂)	5·10 ⁻⁶	100·10 ⁻⁶	5%
Nitric oxide (NO)	0.4·10 ⁻⁶	2500·10 ⁻⁶	1%
Sulphur dioxide (SO ₂)	0.1·10 ⁻⁶	3000·10 ⁻⁶	1%

AT LAT CENTER AND EXTERNAL CALIBRATIONS

MEASURAND	CALIBRATION CAPABILITY Amount fraction range mol/mol		RELATIVE EXPANDED UNCERTAINTY (*)
	From	To	
GAS CHROMATOGRAPHY AND ANALYZER DETECTORS			
ELECTROCHEMICAL. ELECTROLYTIC AND CATALYTIC for			
Carbon dioxide (CO ₂)	10·10 ⁻⁶ 50·10 ⁻²	50·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Carbon monoxide (CO)	1·10 ⁻⁶ 10·10 ⁻²	10·10 ⁻² 90·10 ⁻²	1% 0.3%
Methane (CH ₄)	1·10 ⁻⁶ 50·10 ⁻²	50·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Nitric oxide (NO)	0.4·10 ⁻⁶	2500·10 ⁻⁶	1%
Oxygen (O ₂)	10·10 ⁻⁶ 25·10 ⁻²	25·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Sulphur dioxide (SO ₂)	0.1·10 ⁻⁶ 1·10 ⁻⁶ 100·10 ⁻⁶	1·10 ⁻⁶ 100·10 ⁻⁶ 3000·10 ⁻⁶	5% 2% 1%
Water (H ₂ O)	10·10 ⁻⁶	100·10 ⁻⁶	3%
CAPACITIVE and CHILLED MIRROR for			
Water (H ₂ O)	10·10 ⁻⁶	100·10 ⁻⁶	3%
PARAMAGNETIC and ZIRCONIUM OXIDE for			
Oxygen (O ₂)	10·10 ⁻⁶ 25·10 ⁻²	25·10 ⁻² 99.8·10 ⁻²	1% 0.3%
LASER (TDL, QCL, OA-ICOS, CRDS) for			
Ammonia (NH ₃)	5·10 ⁻⁶	500·10 ⁻⁶	3%
Carbon dioxide (CO ₂)	10·10 ⁻⁶ 50·10 ⁻²	50·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Carbon monoxide (CO)	1·10 ⁻⁶ 10·10 ⁻²	10·10 ⁻² 90·10 ⁻²	1% 0.3%
Methane (CH ₄)	1·10 ⁻⁶ 50·10 ⁻²	50·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Nitric oxide (NO)	0.4·10 ⁻⁶	2500·10 ⁻⁶	1%
Nitrogen dioxide(NO ₂)	5·10 ⁻⁶	100·10 ⁻⁶	3%
Nitrous oxide (N ₂ O)	1·10 ⁻⁶	0.1·10 ⁻²	1%
Oxygen (O ₂)	10·10 ⁻⁶ 25·10 ⁻²	25·10 ⁻² 99.8·10 ⁻²	1% 0.3%
Sulphur dioxide (SO ₂)	0.1·10 ⁻⁶ 1·10 ⁻⁶ 100·10 ⁻⁶	1·10 ⁻⁶ 100·10 ⁻⁶ 3000·10 ⁻⁶	5% 2% 1%
Water (H ₂ O)	10·10 ⁻⁶	100·10 ⁻⁶	3%

(*) The relative expanded uncertainties reported in the table are the minimum values that can be stated on the certificate. The expanded uncertainty of the measurement is expressed as standard uncertainty multiplied by a coverage factor $k=2$ which, for a t -distribution characterized by calculated effective degrees of freedom, provides a level of confidence of approximately 95%. For gases whose concentrations are in consecutive measurement ranges, the certified relative expanded uncertainty is the highest.