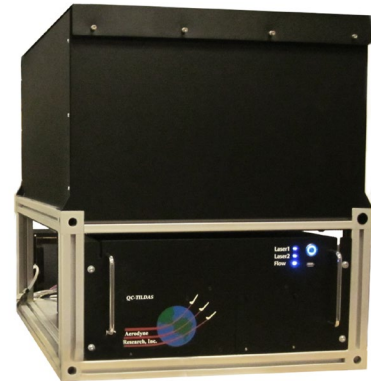




Clumped Isotope Monitor for CO₂ Derived from Carbonate

Direct Spectroscopic Measurement of ¹³C¹⁸O¹⁶O with No Isobaric Interference



- Direct measurement of ¹⁶O¹³C¹⁸O (⁶³⁸Δ) rather than mass 47 (⁴⁷Δ)
- Precision for ⁶³⁸Δ better than 0.02 ‰ for 4 minute measurement with less than 0.4 mg calcite
- Precision for ⁶³⁸Δ better than 0.01 ‰ for 16 minute measurement with less than 1.6 mg calcite
- Low operating costs
- Suitable for CO₂ samples derived from carbonate via acid digestion

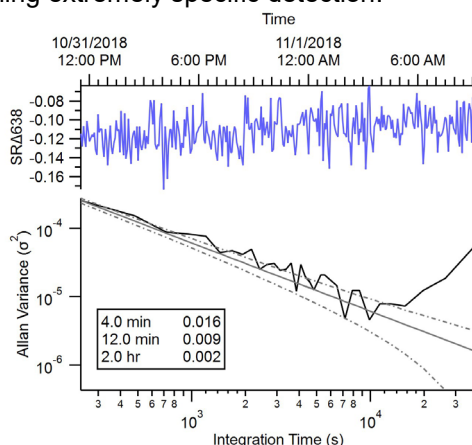
Rugged, field-ready instruments

Direct absorption spectroscopy allows for highly specific and accurate gas detection

Mid-IR detection enables maximum measurement sensitivity

TILDAS Technology

Aerodyne instruments use tunable infrared laser direct absorption spectroscopy (TILDAS) at mid-IR wavelengths to probe molecules at their strongest “finger-print” transition frequencies. We further enhance sensitivity by employing a patented multi-pass broad-band absorption cell that provides optical path lengths up to 400 m. Direct absorption spectroscopy allows for fast (<1 sec) absolute trace gas concentrations without need for elaborate calibration procedures. Moreover, TILDAS instruments are free of measurement interference from other molecular species, enabling extremely specific detection.



Applications

- Paleothermometry
- Geologic Altimetry
- Burial, Diagenesis and Metamorphism
- Analysis of diverse concentrated CO₂ samples
- Analysis of diverse concentrated CO₂ samples derived from marine carbonate.
- Analysis of diverse concentrated CO₂ samples

Aerodyne Clumped CO₂ Isotope Advantages

- Measurement precision comparable to much larger and more expensive IRMS instruments.
- Powerful TDLWintel software provides flexible instrument control, and real-time data analysis.
- Valve control capable of complex scheduling and automatic background and calibrations.
- Optional automated sample handling systems.
- Turn-key design allows unattended operation.

Performance Specifications:

Discrete Sample Specifications for CO₂ Clumped Isotope Monitor

| | CO ₂ | $\Delta^{13}\text{C}^{18}\text{O O}$ |
|--|-----------------|--------------------------------------|
| One sample: <5 μ -moles CO ₂ 4 min measurement | 0.02 ppm | 0.035‰ |
| 10 Samples: <50 μ -moles CO ₂ 40 min measurement | 0.01 ppm | 0.01‰ |

Note: These measurements are normalized to a working reference and the time to do so is included in the quoted measurement time. The working reference has a mixing ratio, pressure and matrix composition similar to the sample.

Related Instruments

Single laser isotope monitor for $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ of CO₂

Single laser isotope monitor for $\delta^{18}\text{O}$ and $\Delta^{17}\text{O}$ of CO₂

Dual laser monitor for CO₂ ($\delta^{13}\text{C}$, $\delta^{18}\text{O}$) and water ($\delta^{18}\text{O}$, δD) isotopes

Dual laser monitor for CO₂ ($\delta^{13}\text{C}$, $\delta^{18}\text{O}$ and $\Delta^{17}\text{O}$)

Data Outputs

RS-232, USB drive, ethernet

Size, Weight, Power

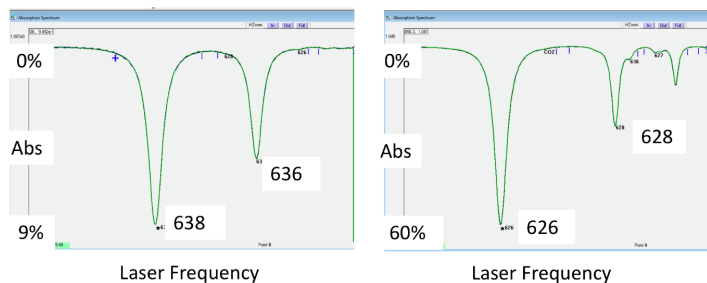
Dimensions: 560 mm x 770 mm x 640 mm (W x D x H)

Weight: 75 kg

Electrical Power: 250-500 W, 120/240 V,

50/60 Hz (without pump)

Infrared Spectroscopy for Clumped Isotope Determination



Laser #1 measures 638 and 636.

Laser #2 measures 626 and 628.

Installation

19" rack mountable or benchtop

Flushing the optics with CO₂-free gas is recommended

Instrument Operations

Operating temperature: 10 to 35 °C

Sample flow rate: 0 to 20 slpm

Instrument Components

Core instrument

Thermoelectric chiller

Keyboard, mouse, and monitor

Vacuum pump (customer specified)

Inlet sampling system (customizable)

Aerodyne specializes in collaboration and custom design. Please contact us if you would like to discuss additional measurement options and applications.

RELATED REFERENCES:

Wehr, R., Munger, J.W., McManus, J.B., Nelson, D.D., Zahniser, M.S., Davidson, E.A., Wofsy, S.C. and Saleska, S.R., 2016. Seasonality of temperate forest photosynthesis and daytime respiration. *Nature*, 534(7609), pp.680-683.

Sakai, S., Matsuda, S., Hikida, T., Shimono, A., McManus, J.B., Zahniser, M., Nelson, D., Dettman, D.L., Yang, D. and Ohkouchi, N., 2017. High-Precision Simultaneous ¹⁸O/¹⁶O, ¹³C/¹²C, and ¹⁷O/¹⁶O Analyses for Microgram Quantities of CaCO₃ by Tunable Infrared Laser Absorption Spectroscopy. *Analytical chemistry*, 89(21), pp.11846-11852.

McManus, J. Barry, David D. Nelson, and Mark S. Zahniser. "Design and performance of a dual-laser instrument for multiple isotopologues of carbon dioxide and water." *Optics express* 23.5 (2015): 6569-6586.

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