



Dissolved Inorganic Carbon Analyzer

model AS-C5 (with LI-850)

Specification:

1. Typical sample volume: 1.2 mL per analysis
2. Time consumption: ~3 minutes per analysis
3. Precision: better than $\pm 0.15\%$ or $\pm 3 \mu\text{M}$ for seawater
4. Analytical range: 0.2 – 20 mM
5. Only one standard is required
6. Working environment: both land and shipboard laboratories

Description

The *Apollo SciTech's* AS-C5 DIC Analyzer has been developed and tested for total dissolved inorganic carbon analysis in a variety of aquatic environments. Advantages of this DIC analyzer include the use of small sample volumes (0.1 – 1.8 mL) with a fast analytical rate (~3 minutes per analysis). The system can work in both land and shipboard laboratories. Further, the system maintains a precision of $\pm 0.15\%$ or better.

The AS-C5 DIC analyzer is comprised of a solid state infrared CO₂ detector (LI-850, by LI-COR, USA), a digital syringe pump for precise delivery of reagent and sample solutions (Kloehn, USA), a mass flow controller to accurately regulate the carrier gas flow rate, a specifically designed CO₂ stripping reactor that allows for an efficient and smooth stripping of CO₂ from the water sample, an electronic cooling system for removing moisture, and a computer communication assembly (USB to RS232 converter with a data acquisition unit; included) (Fig. 1).

Our earlier model (AS-C3) has been used with high satisfaction by the community since 2000. While our innovative designing principle remains the same, the AS-C5 has a few improvements. 1) A more efficient CO₂ stripping reactor is implemented. 2) A multi-sampler of one standard and 8 samples is used. 3) A better computer software with an optimized procedure is developed. 4) A lower cost LI-850 is used with comparable precision with the AS-C3.

For each round of analysis, the analyzer will run three volumes of one standard (a certified reference material, CRM, or an aged seawater or NaHCO₃ solution with a known concentration). Our unique design allows this procedure to serve as a set of serial standards with three different concentrations. Then the analyzer will proceed to analyze 8 unknown samples. At the end, the standard is analyzed again while 8 new samples are prepared.

The AS-C5 DIC analyzer has a very large analytical range (0.2 – 20 mM) and therefore is ideal for DIC analysis (and has been tested) in a variety of aquatic conditions such as in river and lake waters, coastal and open ocean waters, sediment porewater, and groundwater. The sample's salt and hydrogen sulfide (H₂S) contents have had no effect on DIC analyses. This DIC analyzer is not available from any other commercial source.



Figure 1. Front view of the DIC analyzer AS-C5 with a multi-port sampler and the LI-850 CO₂ detector (inside the main analyzer)

Sample Analysis Results

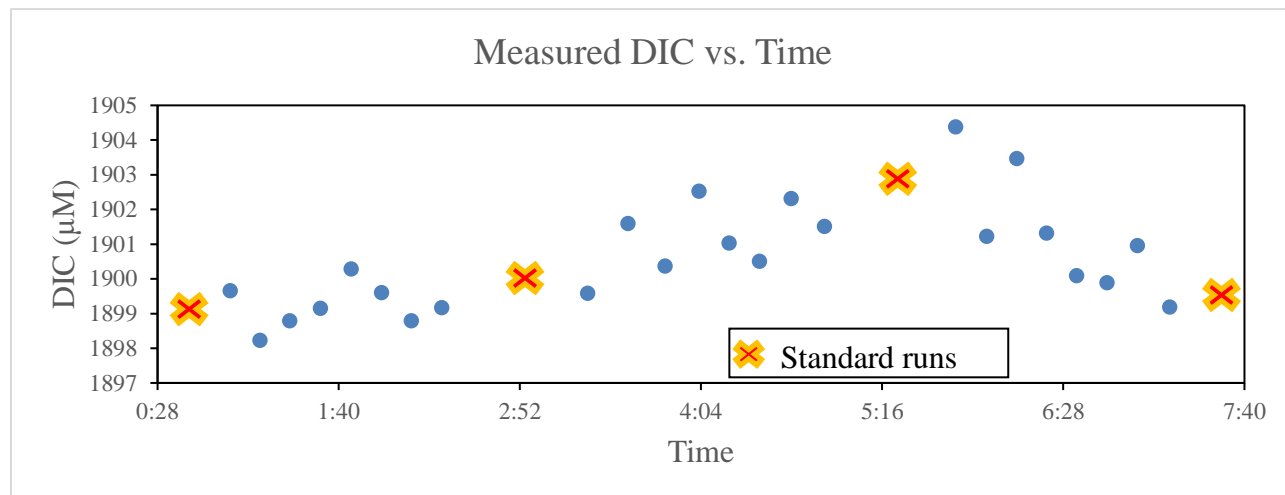


Figure 2. Measured DIC vs. time for samples. Data obtained on Nov. 29, 2018. Three groups of eight samples were measured sequentially via each sample port (D, E, F, G, H, I, J, & K) after a set of standards (Port C) is measured. This combination of a set of standards and eight samples were repeated three times. Overall standard deviations of DIC for samples via eight sample ports are 0.08% over 7 hours, despite the slight drift in standard. The set of 3 standards are created with 3 volumes of only one standard or Certified Reference Materials (CRM).

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