

## Carbon Analysis (TC/TIC/TOC)

**By Combustion, Acidification and Coulometric Detection**

**Applications include:**

*Pharmaceuticals, Sea water, Amines and hydrazines, Black liquors, Food, Soils and sediments, Geological materials, Sludges, Sulfur, Liquids containing particulates, Water and waste-water, Brines, Process Fluids, Corrosive Agents, Acids*



**CONFORMS TO ASTM D 513 AND D 4129**

**The CM150 Total Carbon Analyzer** is a complete analytical system capable of measuring total carbon, total organic carbon and total inorganic carbon in solid and/or liquid samples. Combining a high-temperature combustion furnace, self-contained acidification module and a highly sensitive CO<sub>2</sub> detector, the CM150 offers the flexibility to analyze most any sample type and concentration with a precision un-matched by other analytical techniques. The CM150 system includes the following components pictured above:

**CM5015 CO<sub>2</sub> Coulometer**

- No user calibration
- Wide, linear dynamic range
- Readability to 0.01 ug Carbon
- User selectable display units
- 10" LCD Touch Screen
- SD Card data storage
- LIMS Compatible

**CM5300 Horizontal Furnace**

- Programmable up to 1100°C
- Pre-combustion scrubbers for removal of interferences from oxygen carrier gas
- Post-combustion scrubbers for removal of interfering gases formed during sample combustion

**CM5230 Acidification Module**

- 10, 25, 50 or 100 ml reaction vessels
- Selectable volume acid dispenser
- Internal air pump with flow controller
- Pre-acidification scrubber for removal of CO<sub>2</sub> from carrier gas
- Post-acidification scrubber for removal of interferences released during sample digestion
- Controlled sample heating and stirring

**Instrument Capabilities**

A major advantage of the CM150 Total Carbon Analyzer is the use of coulometric detection. Employing the principles of Faraday's Law, the CM5015 CO<sub>2</sub> Coulometer automatically measures the absolute mass amount of carbon dioxide resulting from sample combustion or acidification.

No user-calibration is required and linear detection is available from less than 1 ug carbon to over 10,000 ug carbon. Using this 100% efficient coulometric process, relative standard deviations of 0.2% or better are common for standard material. For smaller concentrations, an absolute deviation of approximately 1 ug C is typical.

Oxidation times vary with sample type and temperature although 5 to 7 minute analyses are typical.

### Carbon Analysis Overview

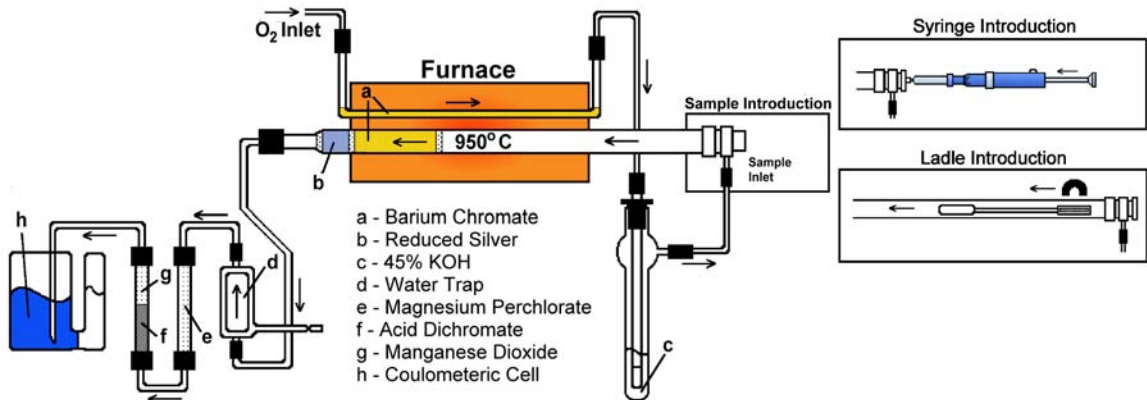
Although our CM5015 CO<sub>2</sub> Coulometer is sensitive to all carbon dioxide entering the coulometric reaction cell, the various carbon forms (TC, TOC and TIC) are distinguished by the manner in which the CO<sub>2</sub> is formed – either combustion or acidification.

To better understand the full capabilities of the CM150 Carbon Analyzer, consider that total carbon (TC) is recognized as the sum of the inorganic (TIC) and organic (TOC) components. Thus,  $TC = TIC + TOC$ . By either direct measurement, sample pre-treatment, or difference techniques, all of these components can be measured with the CM150 on solid or liquid samples.

Specifically, total carbon can always be measured directly by the combustion of a sample while total inorganic carbon can always be measured directly by the acidification of a sample. However, the measurement of total organic carbon for most sample types requires either a pre-treatment step or the separate analyses of TC and TIC in order to obtain TOC by difference ( $TOC = TC - TIC$ ).

For homogeneous liquids, the pre-treatment method is most commonly used. This step involves acidifying the sample and purging it of all TIC. The resulting solution is then analyzed by combustion to obtain the TOC result. On the other hand, liquids containing particulates and solids are most commonly analyzed by calculating the difference between separate TC and TIC analyses.

### Principles of Operation

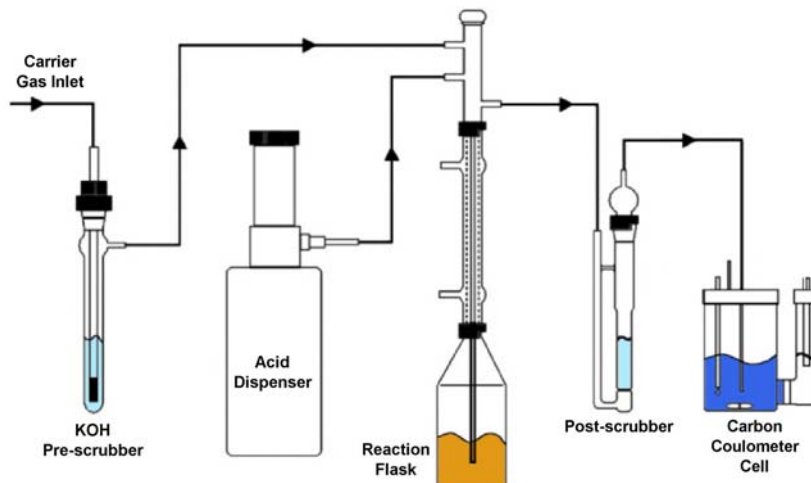


### Total Carbon (TC)

The sample is initially weighed into a platinum or porcelain “boat”. The boat is then placed into a quartz ladle which is introduced into the high temperature oxygen atmosphere (typically 950°C) within the sample combustion zone. In that environment, all carbon within the sample is rapidly oxidized to CO<sub>2</sub>. Interfering reaction products (including sulfur oxides, halides, water and nitrous oxides) are removed by the post-combustion scrubbers. The resulting carbon dioxide is then swept into the CM5015 CO<sub>2</sub> Coulometer where it is automatically measured using absolute coulometric titration.

### Total Organic Carbon (TOC)

Prior to injection into the furnace, liquid samples are acidified and purged of CO<sub>2</sub> and carbonate carbons. This “pre-treated” sample is then reacted as described above. (Note: Although the direct TOC analysis of solids is occasionally performed using various sample pre-treatment methods, we generally recommend calculating TOC by difference, where TOC = TC – TIC.)



### Total Inorganic Carbon (TIC)

Upon introducing a sample into the sample flask, the system is purged with a CO<sub>2</sub>-free carrier gas to eliminate atmospheric carbon dioxide. At that point, the analysis is initiated by adding an aliquot of acid through the acid dispenser into the sample flask, causing inorganic carbon to be evolved as CO<sub>2</sub>. Using the built-in heater and magnetic stirrer to facilitate the fast evolution of inorganic carbon, the CO<sub>2</sub>-free carrier gas transports the reaction products through a post-scrubber (to remove potential interferences) and ultimately into the reaction cell within the CM5015 Coulometer. There, the resulting carbon dioxide is automatically measured using absolute coulometric titration.

### Data Handling

Names, weights and sizes of up to 50 samples can be entered, to be used by the CM5015 in calculating the final result. Analytical progress is displayed on the 10" LCD touch screen in user-selectable units. Detailed analysis information is automatically saved to an on-board SD card after each sample. Data can also be transmitted through the standard serial and Ethernet ports to be captured on a personal computer or LIMS. In addition, a detailed report can be printed to the optional small format printer while each sample is running.

## Ordering Information

### CM150 – TC/TOC/TIC Analyzer

**Includes:** CM5015 CO<sub>2</sub> Coulometer, CM5300 Horizontal Furnace and CM5230 Acidification Module with tools and accessories. *Must also choose* Furnace Kit CM5321 (Liquids) and/or CM5322 (Solids). If selecting CM5322 must also choose Sample Introduction Kit CM5323 (Small Volume) and/or CM5324 (Large Volume). *Must also choose* Acidification Sample Kit CM5131 (10ml), CM5132 (25ml), CM5133 (50ml) and/or CM5134 (100ml) to be included with system. (P/N CM150-01 110V, 50/60Hz) (P/N CM150-02 220V, 50/60Hz)

### Optional Equipment:

**Printer** – 3" format impact printer. Includes cable, power supply, paper and ribbon. (P/N CM124-078)



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