

# Fusion

UV/Persulfate TOC Analyzer

 **TELEDYNE TEKMAR**  
A Teledyne Technologies Company

# Unparalleled Results with the Fusion

## UV/Persulfate TOC Analyzer

### Description

The Fusion Total Organic Carbon (TOC) Analyzer utilizes powerful Ultra Violet (UV) Persulfate oxidation allowing superior carbon liberation from even the most challenging matrixes. By implementing the patent pending Static Pressure Concentration (SPC) technology, the Fusion TOC Analyzer is able to achieve unprecedented low-end sensitivity from a Non-Dispersive Infrared (NDIR) detector. The Fusion TOC Analyzer is designed to offer productivity for a wide variety of applications.

### How It Works

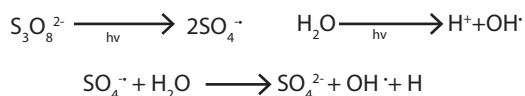
The Fusion is designed to determine the carbon content in water and other solutions. Using safe and proven UV promoted persulfate oxidation of carbonaceous material to carbon dioxide (CO<sub>2</sub>) followed by NDIR detection of the CO<sub>2</sub> product, the Fusion is sensitive from 0.2ppbC - 4,000ppmC. Varieties of carbon can be independently determined by selecting a pre-defined instrument method. These include:

- Total Carbon (TC)
- Inorganic Carbon (IC)
- Total Organic Carbon (TOC = TC-IC)
- Non-Purgeable Organic Carbon (NPOC or TOC by sparging)

To determine TOC by the NPOC method, the Fusion uses a syringe driver and 7-port valve to accurately transfer samples and reagents to the reactor. It then uses carrier gas to transfer the reaction product (CO<sub>2</sub>) from the sample either to vent or to the NDIR detector in the following sequence:

1. Removal and venting of IC and POC by acidification and sparging in the IC sparger.
2. Following IC removal, an aliquot of the sparged sample is transferred to the UV reactor and persulfate reagent is added to oxidize the organic carbon, based on the following chemical reactions:

a. Free radical oxidants formed



b. Excitation of organics



c. Oxidation of organics



The oxidation products in Step 2 are swept into the CO<sub>2</sub> selective NDIR detector.

The exit valve from the NDIR is closed to allow the detector to become pressurized. Once the gases in the detector have reached equilibrium, the concentration of the CO<sub>2</sub> is analyzed. This pressurization of the sample gas stream in the NDIR, Static Pressure Concentration, allows for increased sensitivity and precision. It measures the all of the oxidation products in the sample in one reading, compared to flow-through technology. The output signal is proportional to the concentration of CO<sub>2</sub> in the carrier gas, from the oxidation of the sample.

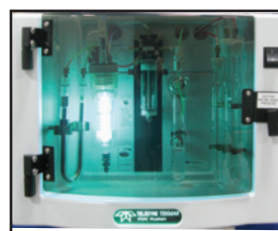
The PC workstation uses the TOC TekLink™ software to control the above sequence of operations, process the detector signal, and report the final concentration of the sample based on linearized, multi-point calibration data.

## Applications and Industries

- Pharmaceutical
- Environmental

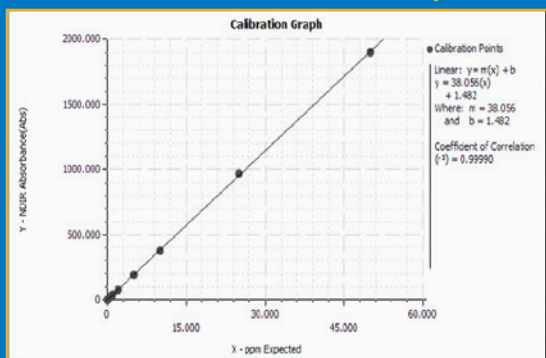
## Methods

EPA 415.1- 415.3, 9060A, Standard Method 5310C, ASTM D4779 and D4839, and prENV 13370, Cleaning Validation / USP TOC Method <643> / EP 2.2.44 / JP



Fusion UV<sup>1</sup> Oxidation Reactor

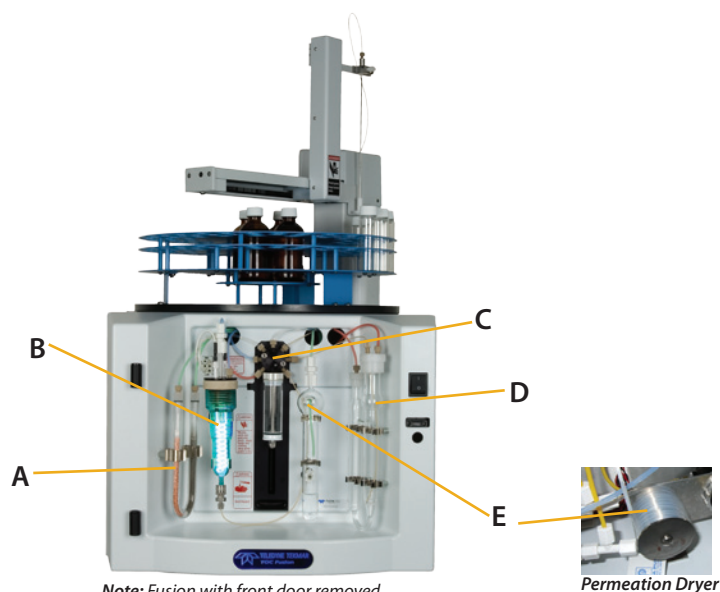
## Unmatched Linearity



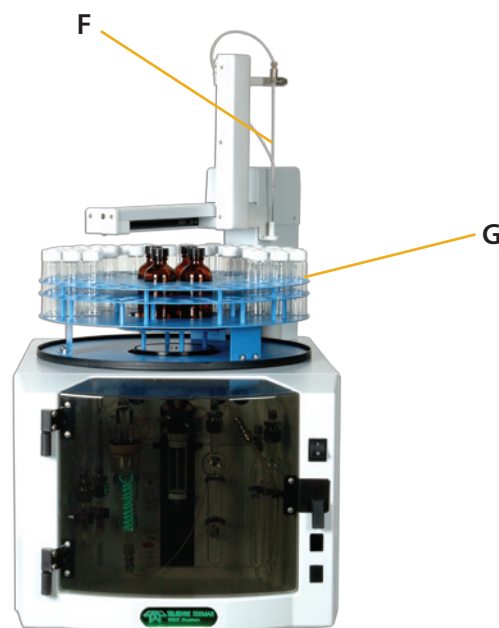
This screen shot demonstrates the excellent linearity achieved using Teledyne Tekmar's patent pending Static Pressure Concentration for unparalleled results.

# Fusion

## Features and Benefits



Note: Fusion with front door removed.



**A. Halogen Scrubber** - The detector, which measures  $\text{CO}_2$ , can be affected by halogens. To prevent analytical errors, the halogen scrubber removes chlorine and other halogens from the  $\text{CO}_2$  before it enters the detector.

**B. UV Oxidation Reactor<sup>1</sup>** - The UV reactor is composed of a glass vessel and a UV light source. The Fusion introduces the sample and persulfate reagent into the UV reactor. The persulfate reagent, combined with UV light, oxidizes carbon in the sample. Tekmar's improved UV reactor increases sample conservation and improves radiation interaction with water samples and oxidant.

**C. Syringe and Valve** - The syringe driver is a precision measuring instrument that draws in and dispenses fluid. The syringe driver has a volume delivery range of 125 $\mu\text{L}$  to 25mL and sample delivery between 2mL and 10mL depending on the applied method.

**D. IC Sparger** - The IC sparger is a glass fritted vessel that holds the sample while purging the Inorganic Carbon (IC) out of the sample and preparing it for analysis. After the addition of acid, purge gas flows through the sparger, removing the IC from the sample. The Fusion can report IC for both IC only and TC-IC modes, or vent it into the atmosphere while in the TOC mode.

**E. Moisture Control System (MCS)** - The Fusion MCS consists of a mist trap and permeation dryer, both of which are designed to remove moisture from the sample. After oxidation of the sample, carrier gas sweeps  $\text{CO}_2$  and water vapor out of the UV reaction chamber. Next, the  $\text{CO}_2$  travels through the mist trap, where most of the moisture is collected and removed. The gases then travel to the permeation dryer, which removes the rest of the moisture from the sample gas.

**F. Septum Piercing Needle** - The septum piercing needle allows for the use of vial caps with a septa thus eliminating sample exposure time to the atmosphere.

**G. Autosampler** - The Fusion has a standard 40mL vial, 75-position integrated autosampler with an arm and carousel for position selection. Optional carousels are available with 90-position; 55mL vials or 120-position; 20mL vials.

## Additional Features

**Mass Flow Controller (MFC)** - The patented MFC regulates either flow or pressure depending on the mode of operation. It allows for higher flows for clean up between samples and allows the user to optimize the sparge flow for each sample. Because of the MFC, the instrument automatically validates the system integrity by recording the pressure each time a sample is run. The MFC also performs pneumatic integrity tests on valves to make sure they are leak tight.

**Intellidilution** - This intelligent feature detects when a sample is out of range and will dilute it back to within the calibration range. Intellidilution also has the ability to meet individual analytical needs due to pre-set ranges (non-dilution methods only).

**Autocalibration** - Using a single stock solution, the system will automatically dilute final volumes based on the users linearizing concentration requirements, thus eliminating the need for multiple manual preparations of the calibration standard concentration levels. This feature eliminates the likelihood of human error and minimizes labor time.

**Static Pressure Concentration (SPC)** - After the sample oxidizes, it is swept into the detector and pressurized with carrier gas ensuring the entire sample is present. The Non-Dispersive Infrared (NDIR) detector (*patent pending*) then measures the concentration of carbon dioxide. As a whole, this patent pending sensing technology enables the Fusion to reach new levels of detection required by today's demanding analytical requirements.

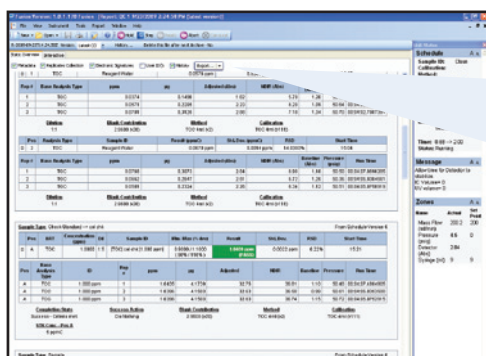
<sup>1</sup>UV Lamp Contains Mercury, Do Not Put In Trash. Recycle or Dispose as Hazardous Waste.



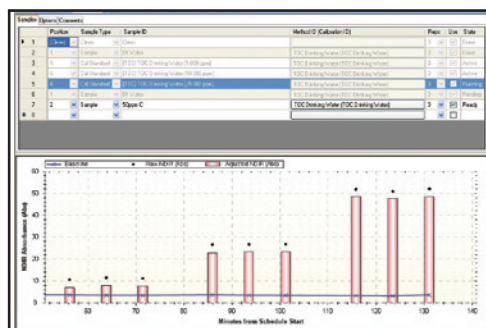
# TOC TekLink™

## Fully Optimized User Interface

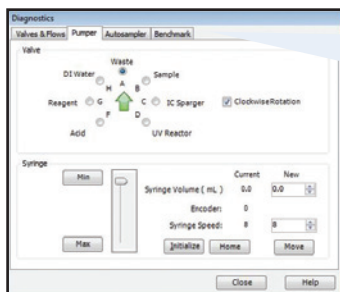
Tekmar TOC TekLink™ software allows the user to enter all analysis parameters and then once activated, will continuously monitor the system ensuring operating limits are not exceeded. TOC TekLink™ is capable of performing useful diagnostics such as leak and benchmark tests for validation. All instrument parameters, method scheduling, and editing can be programmed. TOC TekLink™ provides pre-developed methods, allowing startup with little or no modifications and also contains 21 CFR Part 11 compliance tools.



**Schedule Report Screen** - The Schedule Report screen demonstrates flexibility in reporting, which allows the user to define what is captured in the report.



The sample run screen shown here shows a blue status bar indicating that the current sample has exceeded the defined calibration range and the intelligidilution feature has been initiated.



**Diagnostics Screen** - This screen demonstrates full control diagnostics, which allows for manipulation of all hardware components.

Sample History, Electronic Signatures, Metadata, Replicates Collection and User IDs are some options you can choose with the exporting data function.

The tabs on this screen show features that can be controlled from the diagnostic menu. (i.e.: motor movement and valve control)

# Fusion Specifications

<b>Chemistry:</b>	Photochemical Oxidation via UV-Persulfate <sup>1</sup>	
<b>Detector:</b>	Nondispersive Infrared (NDIR) with Static Pressure Concentration (SPC) - <i>Patent Pending</i>	
<b>Analytical Modes:</b>	TOC (NPOC), TC- IC, TC,IC	
<b>Analytical:</b>	Limit of Detection: 0.2ppb Maximum Measurable Concentration: 4,000ppm (sample volume and dilution dependent) Carryover: = 1.0% Cross Contamination Precision*: = 1.0% RSD, +/-2ppb or +/- 0.02µgC, typical of a mid-range standard (Whichever is greater over seven replicates). * Analytical performance affected by laboratory water, reagent and gas purity, as well as sample container cleanliness, sample matrix, gas regulator cleanliness and precision, and operator skill.	
<b>Complete Process and Analysis Time:</b>	4-8 minutes typical for TOC analysis; Typically 12-22 minutes for Triplicate TOC Analysis	
<b>Controller:</b>	PC, Interface through Windows® XP and Vista or greater	
<b>21 CFR Part 11 Software Control:</b>	TOC Teklink™ Software is a 21 CFR Part 11 tool for your laboratory compliance	
<b>Data Handling:</b>	<ul style="list-style-type: none"> <li>• Pre-defined Industry Standard Methods and Customized User Defined Methods</li> <li>• Priority samples via schedule interrupt</li> <li>• Real-time and Historical graphical display of NDIR detector data</li> <li>• Reports exportable XML and HTML format</li> <li>• Recalculation of data, outlier deletions, and precision performance criteria controls</li> <li>• Ability to view historical results from multiple schedules on one graphical display</li> </ul>	
<b>Calibration:</b>	<ul style="list-style-type: none"> <li>• Auto-Calibration from Single Stock Standards or User Calibration Standards</li> <li>• Multi-point (Linear or Quadratic) and auto-blanking</li> <li>• Ability to use one calibration curve and blank for entire instruments' analytical range</li> <li>• Auto-Check Standards from Single Stock Standards or User Calibration Standards               <ul style="list-style-type: none"> <li>- Pass / Fail Criteria</li> <li>- Decision Control upon Failure (Halt, Re-Calibrate, or Continue)</li> </ul> </li> </ul>	
<b>Other Features:</b>	<ul style="list-style-type: none"> <li>• Auto-System Suitability with Performance Measurements</li> <li>• Auto-dilution of samples/standards</li> <li>• Validation Support Package Available</li> <li>• Pre-programmed point and click method setup</li> <li>• Programmable flow rate and pressure control and monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Auto-Leak Check</li> <li>• Automatic shutdown/standby</li> <li>• Self-cleaning sample handling process that cleans reactor chambers on every repetition</li> <li>• Intellidilution</li> </ul>
<b>Official Methods:</b>	EPA 415.1- 415.3, 9060A, Standard Method 5310C, ASTM D4779 and D4839, and prENV 13370, Cleaning Validation / USP TOC Method <643> / EP 2.2.44 / JP	
<b>Dimensions:</b>	18 inches (45.7 cm) W x 24.5 inches (62.2 cm) D x 32 inches (81.3 cm) H	
<b>Carrier Gas Supply:</b>	99.99% pure nitrogen cylinder;99.5+% nitrogen (with optional Piccolo Nitrogen Generator)	
<b>Inlet Carrier Gas Pressure:</b>	65 to 100 psi	

Windows® is a registered trademark of Microsoft, TekLink™ is a registered trademark of Teledyne Tekmar Company. Covered by one or more of the following patents: 7,651,866 and other patent pending.

<sup>1</sup>UV Lamp contains Mercury, Do Not Put In Trash. Recycle or Dispose as Hazardous Waste.

## Service and Support You Can Count On

Teledyne Tekmar can help with your instrument installation. Our team of trained service professionals can provide extended on site training for successful operation and instrument maintenance. For those needing documentation on analytical performance and operating procedures, Tekmar offers validation packages. These packages come complete with Installation Qualification (IQ), Operational Qualification (OQ), and Operating guidelines. Our validation packages are ideal to help you comply with your specific methodology. We also provide on-site validation packages performed by factory trained and certified engineers.

Our experience in state-of-the-art instrument design translates to the most capable support available. From a fully staffed applications laboratory to our worldwide network of technical professionals, we are ready to be your partner and assure that you achieve the maximum productivity from your instrument. Our outstanding customer service is a natural extension of our world class, ISO 9001 Certified Quality System.

