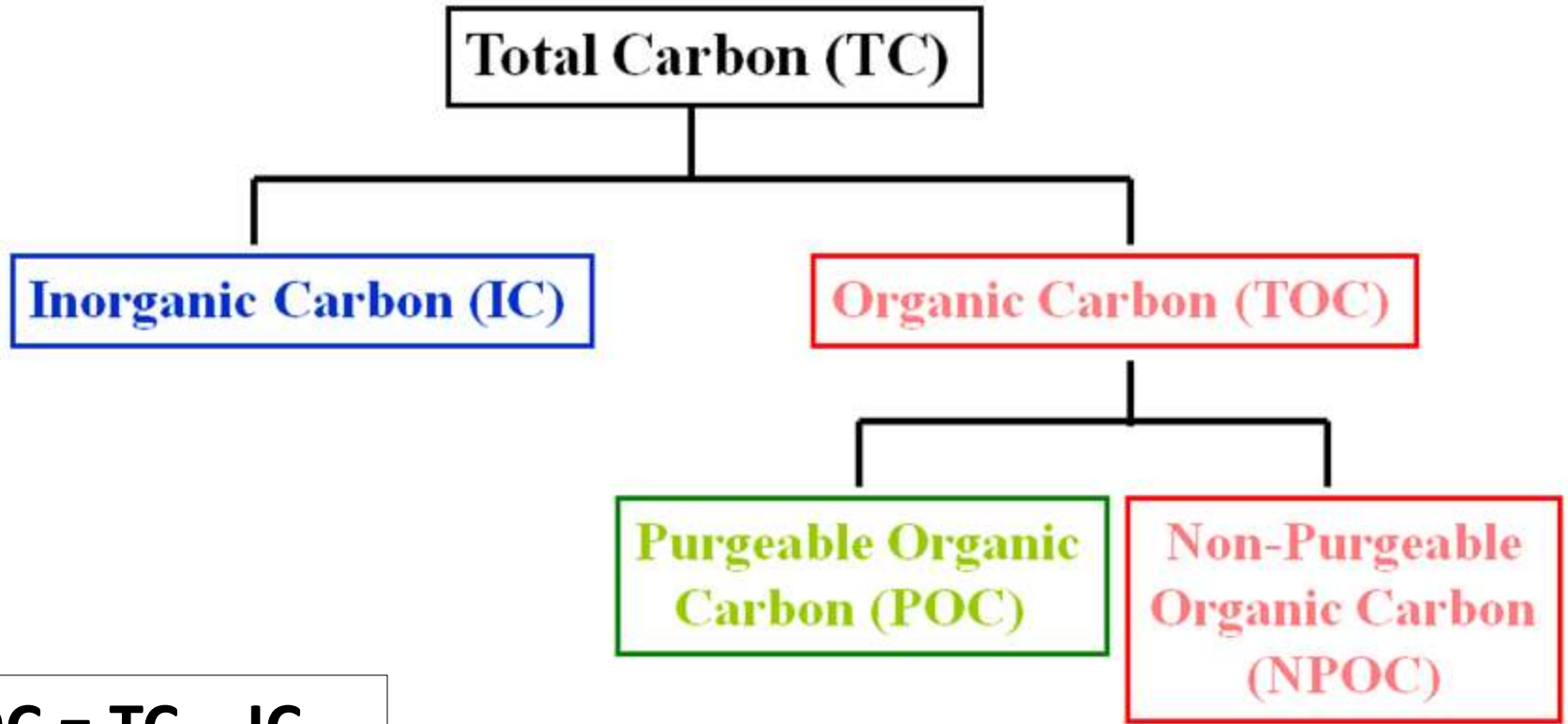


Torch Combustion TOC Instrument



TOC Methodologies

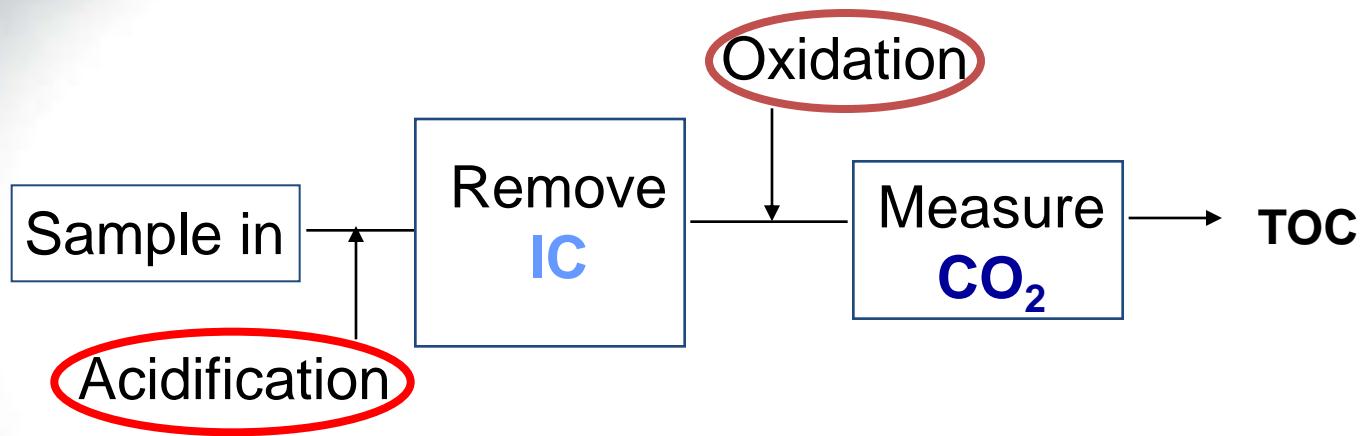
- The primary TOC concern:
 - Achieve the required limits of detection
 - Instrument accuracy
 - Minimum amount of analyst effort and supervision.
- Key to obtaining accurate low-level TOC results
 - Maximize sample carbon response
 - Minimize background carbon response.



$$\text{TOC} = \text{TC} - \text{IC}$$

or

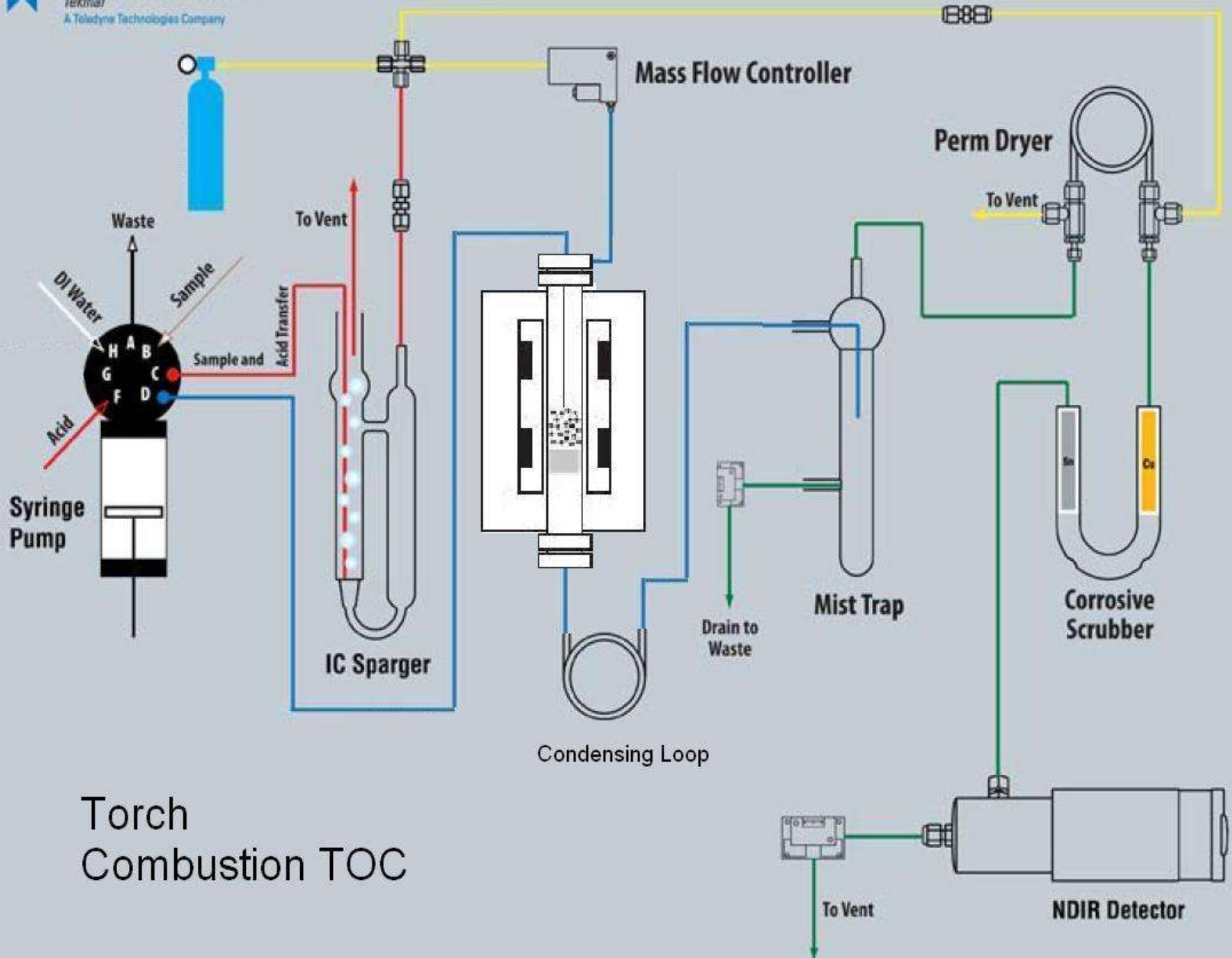
$$\text{TOC} = \text{NPOC}$$





Torch Features

- **Combustion furnace capable of 1000°C**
 - Smaller, more rugged combustion tube design.
 - New catalyst uses less.
 - Furnace is on rails for easy access and tube replacement.

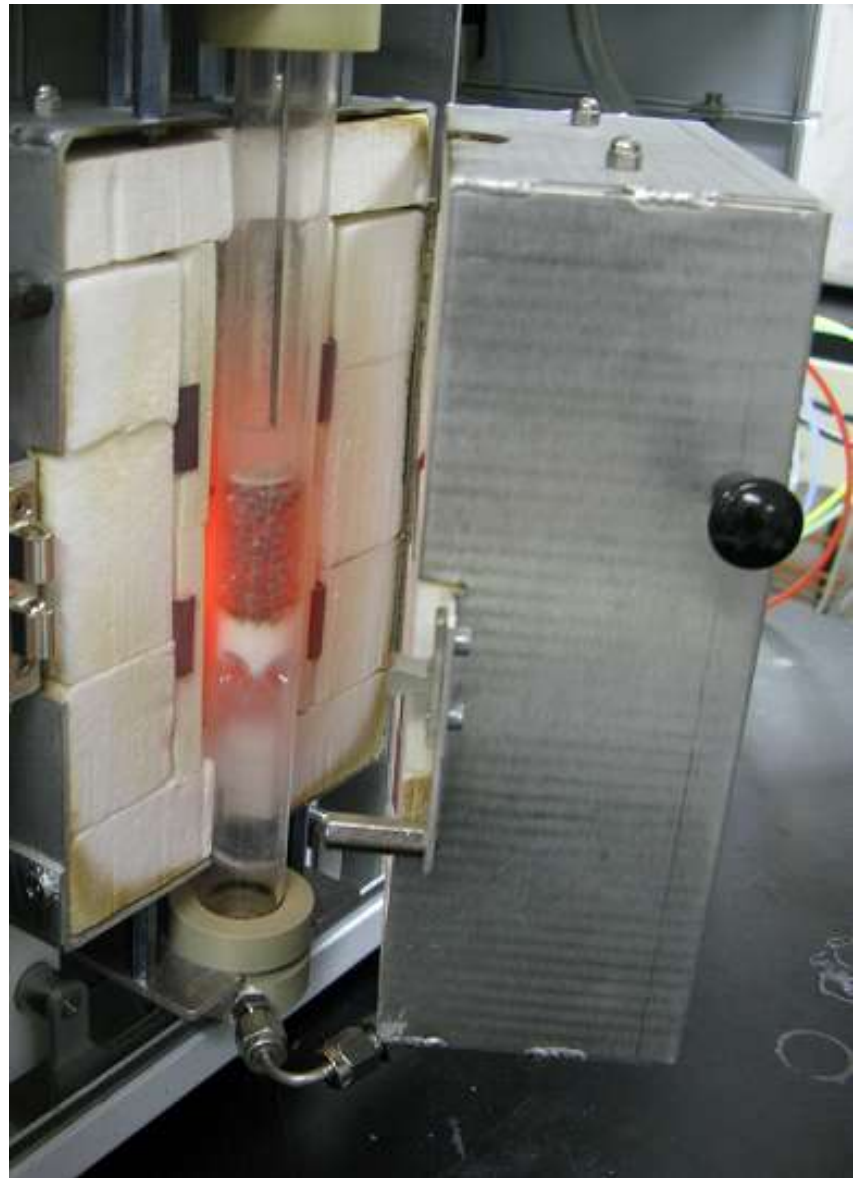


Torch
Combustion TOC

Torch Combustion Furnace



Torch Combustion Furnace

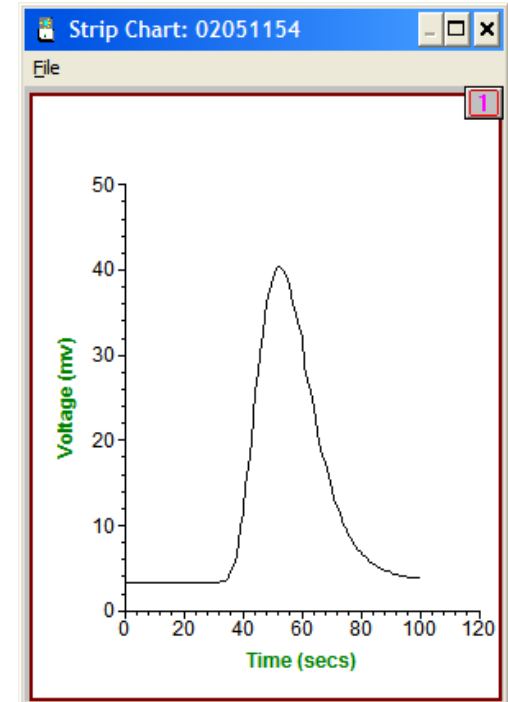


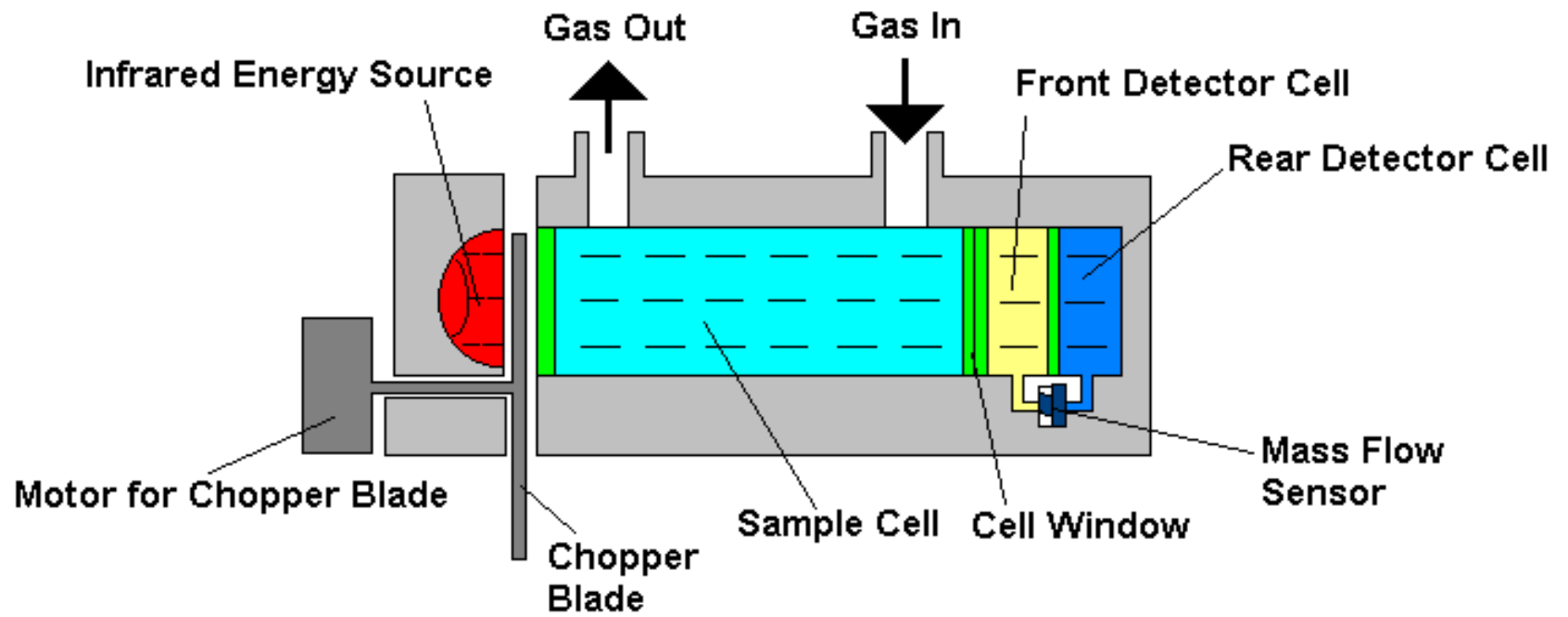
Torch Static Pressure NDIR



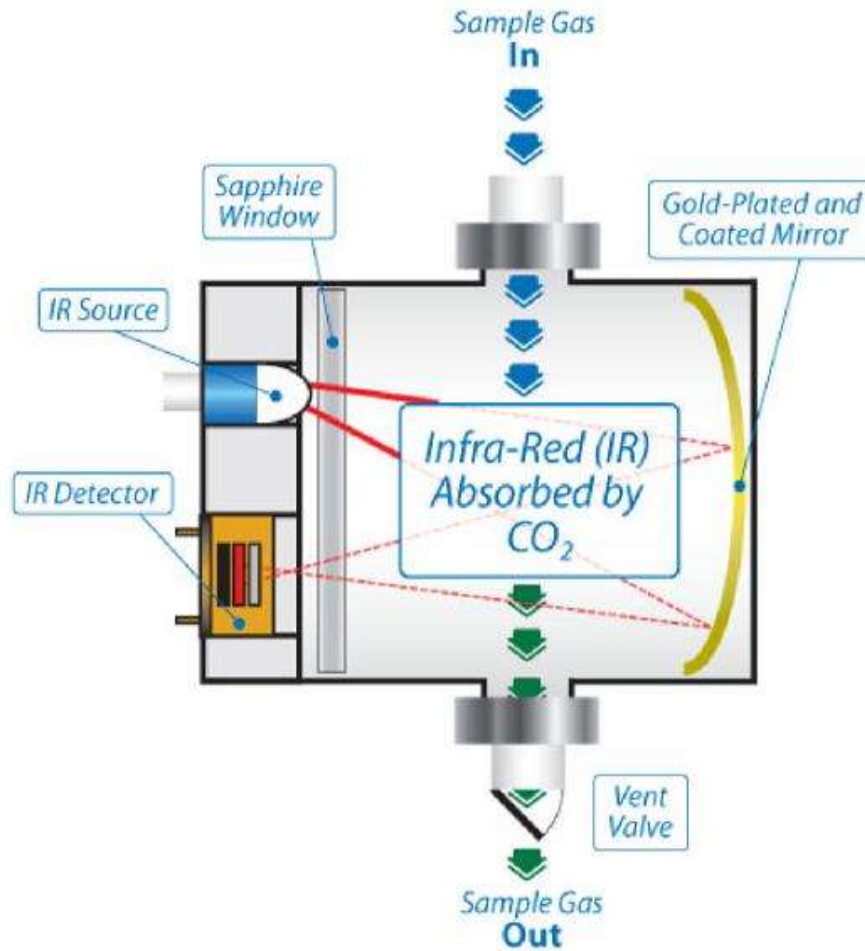
Traditional Flow Through NDIR

- Using the traditional NDIR technology, these measurements are performed by oxidation of the specific carbon component to create CO_2 , which is swept through an NDIR detector.
- The adsorption of the infrared light is measured over time as the CO_2 is swept through the detector.
- Resulting measurement correlates to a peak, which is integrated and correlated to a concentration.



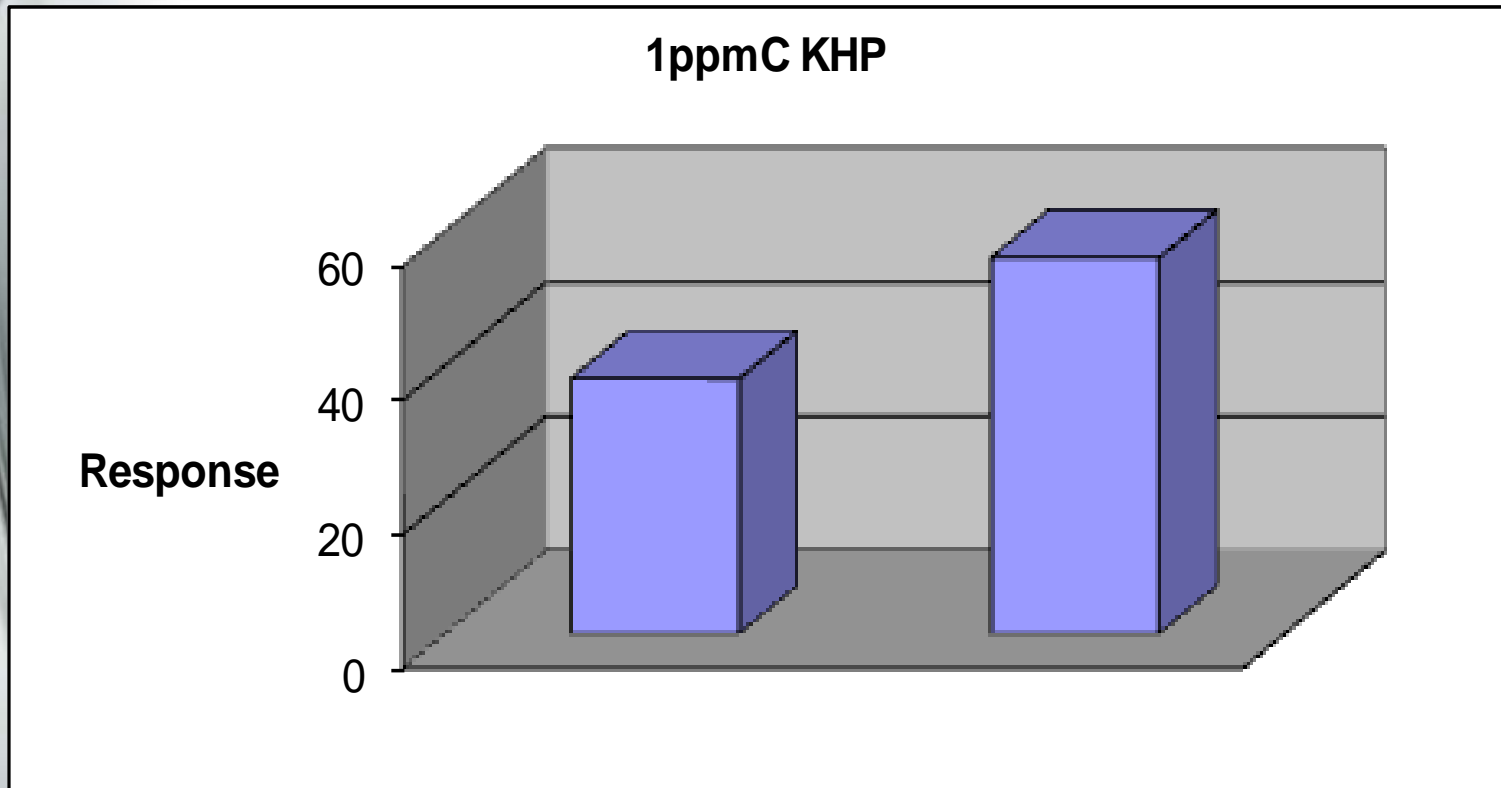


Static Pressure NDIR



Static Pressure NDIR

Comparison 1ppm TOC



Autosampler

- Built in Autosampler with mixing option
 - Standard 75 position carousel for 40mL vials.
 - 90 position carousel for 55mL test tube type vials.
 - 120 position carousel for 20mL test tube type vials.
 - 4 central positions for standards.
 - Separate rinse station location.
 - ASM sparge capabilities.

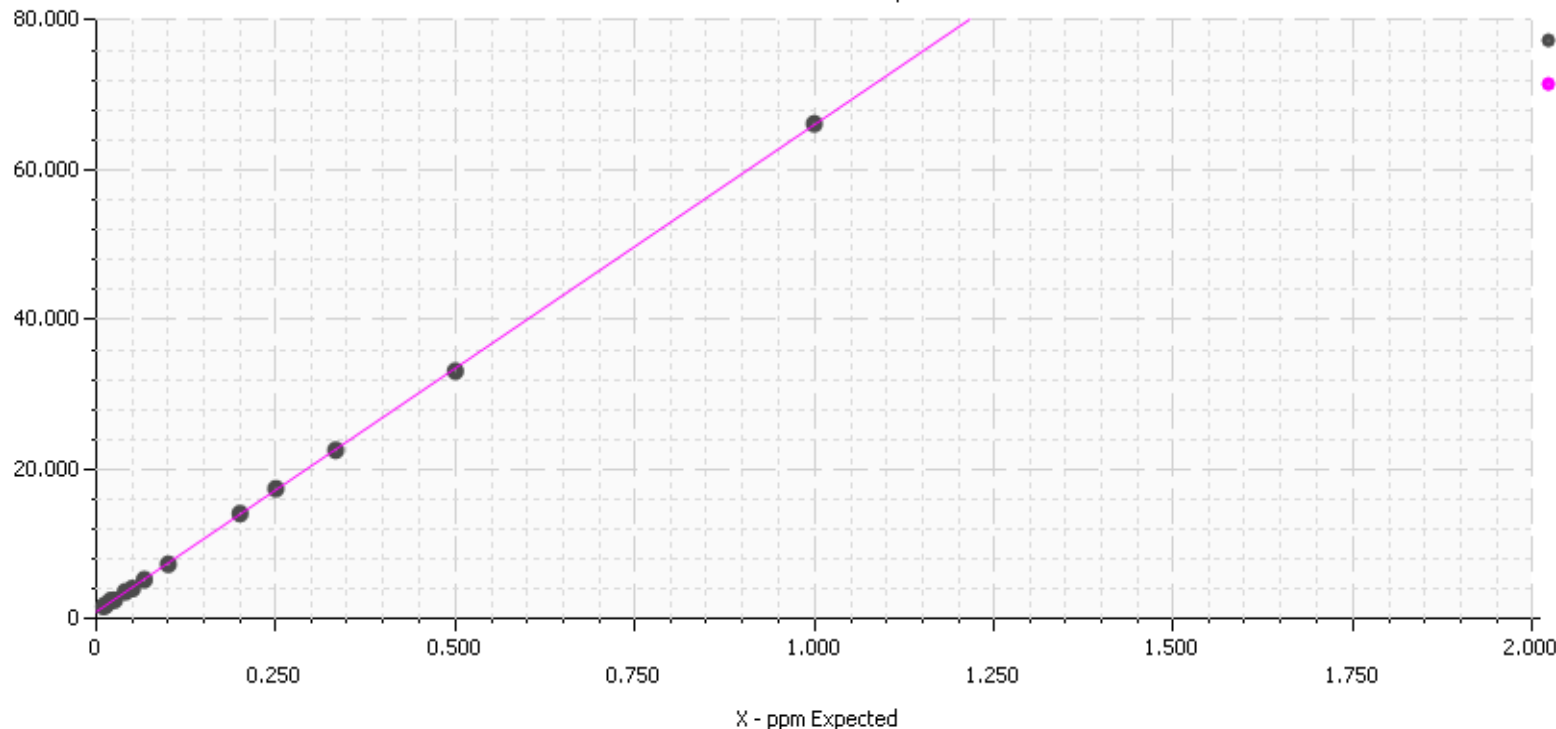
Torch Autosampler



Torch Autosampler

- Autocalibration
 - Removes the need for manual calibration set-up.
 - Blanking option.
 - Intellidilution System will automatically dilute sample to within the selected calibration range.

Calibration Graph



Analysis type: TOC Regression Calculation Method: Linear

Use	Sample ID	Y Raw Value	X Expected	RF	Message	Date
<input checked="" type="checkbox"/>	0.010 ppm	1.6370	0.0100	163.7000		1/16/2007 9:04 AM
<input checked="" type="checkbox"/>	0.013 ppm	1.8420	0.0133	138.1500		1/16/2007 9:18 AM
<input checked="" type="checkbox"/>	0.020 ppm	2.4220	0.0200	121.1000		1/16/2007 9:31 AM
<input checked="" type="checkbox"/>	0.025 ppm	2.4770	0.0250	99.0800		1/16/2007 9:44 AM
<input checked="" type="checkbox"/>	0.040 ppm	3.5770	0.0400	89.4250		1/16/2007 9:57 AM
<input checked="" type="checkbox"/>	0.050 ppm	4.0070	0.0500	80.1400		1/16/2007 10:11 AM
<input checked="" type="checkbox"/>	0.067 ppm	5.2870	0.0667	78.1950		1/16/2007 10:24 AM

Torch Mass Flow Controller

- Eliminates need for flow restrictors and step down regulators.
- Allows entire pathway to be leak checked.
- Controls detector and system pressurization and flow rates.

Torch Mass Flow Controller



Torch Diagnostics

Diagnostics

Valves & Flows | Pumper | Autosampler | Benchmark | Analog Brd

Valves

ValveA	Off
ValveB	Off
ValveC	Off
ValveD	Off
ValveE	Off
ValveF	Off
ValveG	Off
ValveH	Off

MFC - Flow Rates (ml/min)

Absolute Pressure (psi) 14.14
Current Flow Rate (ml/min) 0.0
Setpoint Flow Rate (ml/min)
(Range: 0 - 500) 0

New Setpoint

Mixer Speed

Mixer Speed - Off

Fans

Fan1	On
Fan2	On
Fan3	On

Diagnostics

Valves & Flows | Pumper | Autosampler | Benchmark | Analog Brd

Valve

Clockwise Rotation

Syringe

Syringe Volume (mL)

Current	New
0.0	0.0

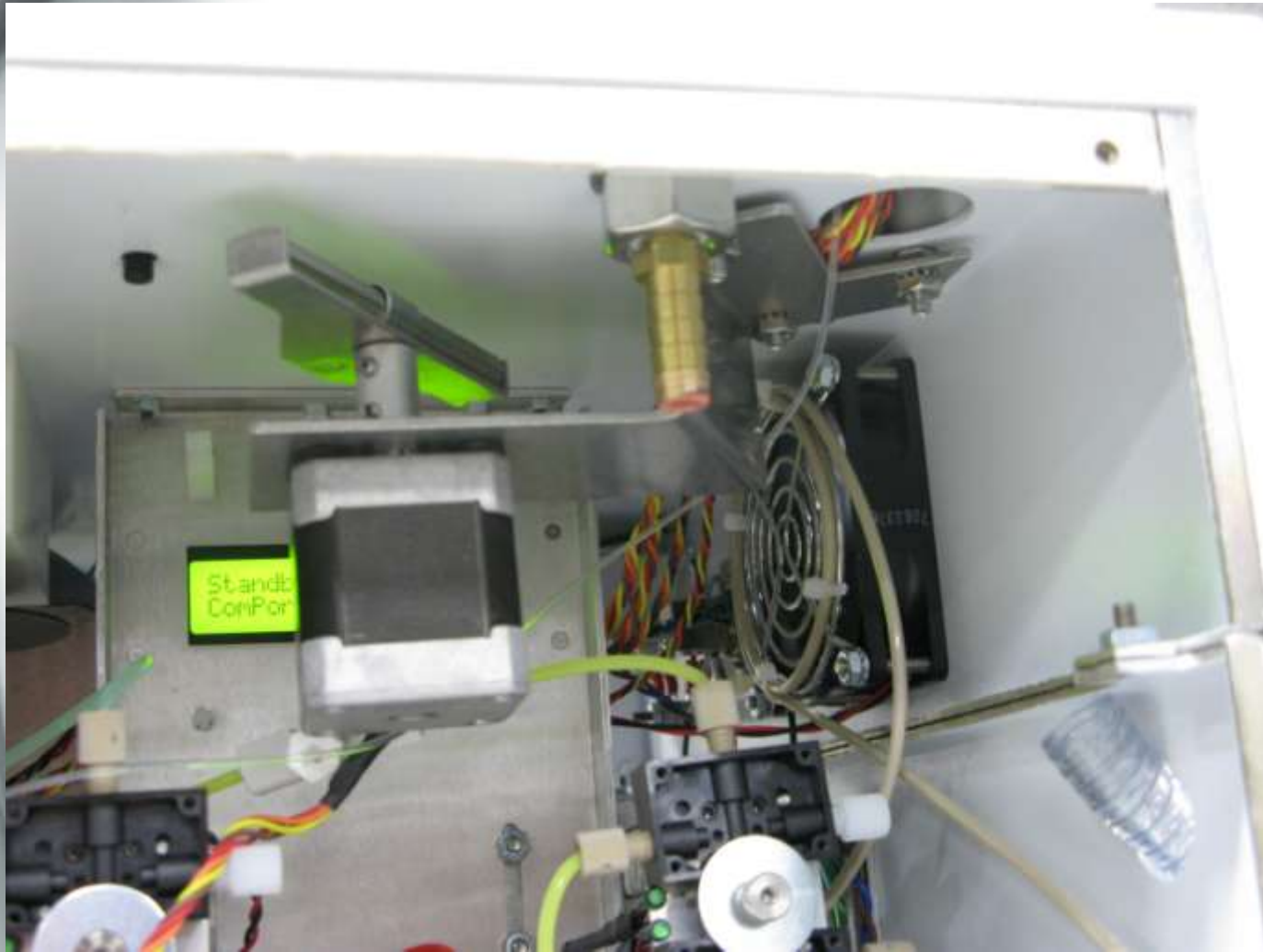
Encoder: 0

Syringe Speed: 6

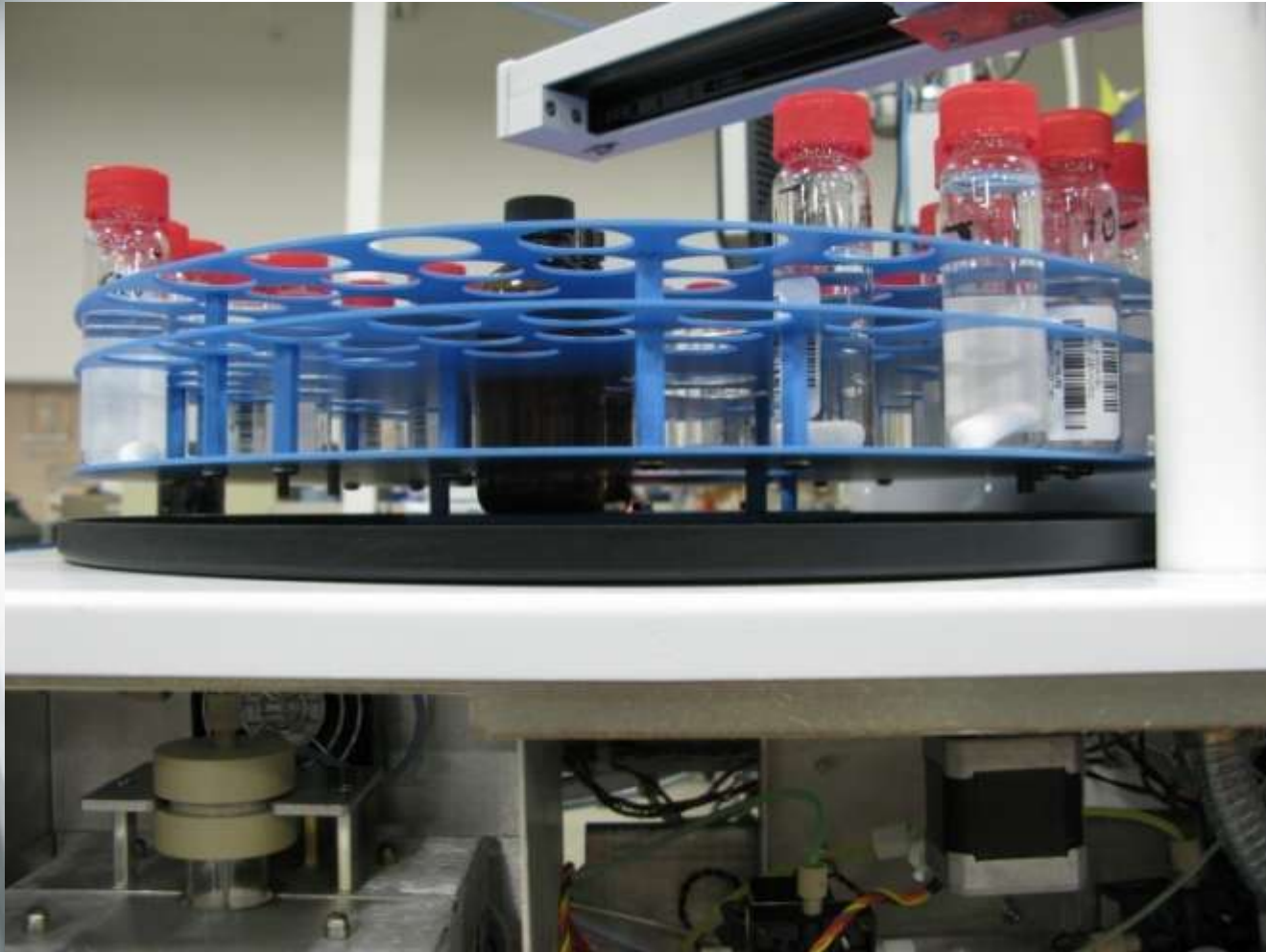
Torch Diagnostics

- Benchmark Test
 - Allows for complete, automatic testing of entire system.
 - Includes Leak Check
 - Tests every component on the instrument.

Torch Stirring Option



Torch Stirring Option



Total Nitrogen Module

- Optional Nitrogen module
 - Manufactured by Teledyne Tekmar.
 - 50ppb to 2000ppm working range.
 - Simultaneous Carbon and Nitrogen analysis.
 - Uses Chemilluminescence Detector.
 - Does require oxygen supply for ozonation.



Torch Features

- Detection levels
 - 50 ppb to 30,000ppm C
 - 50 ppb to 2,000 ppm N
- Pre Set Methods
 - Drinking water.
 - Wastewater.
 - Particulated Water.
 - Brines or high level samples.

Application Notes

Choosing the appropriate TOC Analyzer

Understanding Intellidilution for Use with the Torch High Temperature Combustion Analyzer

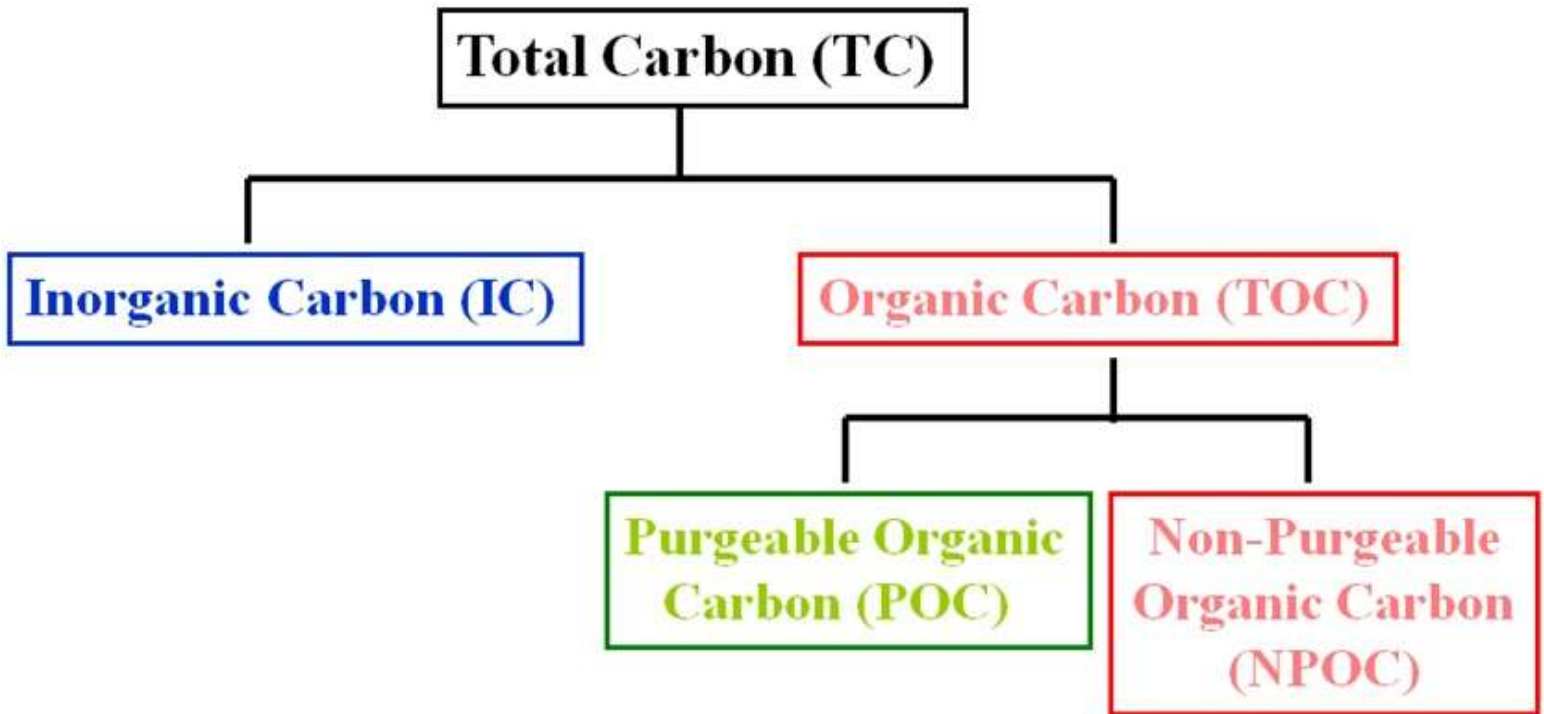
The Effects of Furnace Configuration Using The Torch High Temperature Combustion Analyzer

Fusion UV/Persulfate TOC Instrument



TOC Methodologies

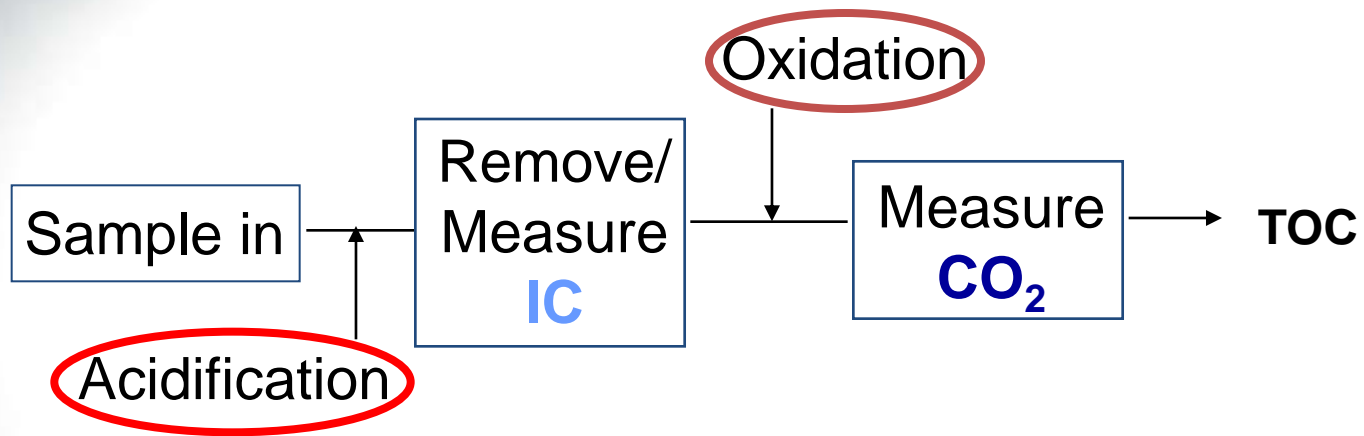
- The primary TOC concern:
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 - Minimize background carbon response.



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or

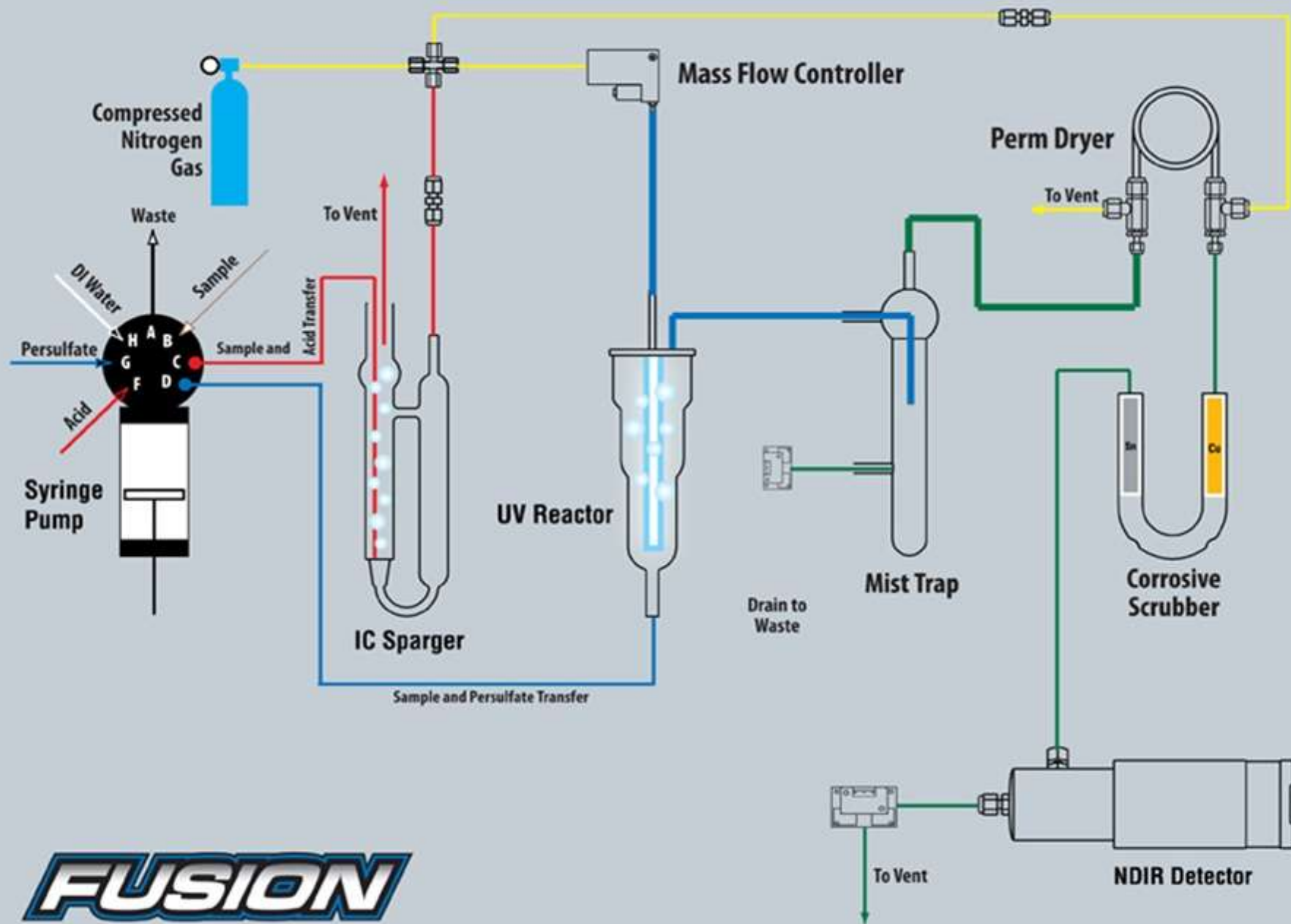
$$\text{TOC} = \text{NPOC}$$



TOC Fusion

5th Generation UV
Persulfate

TOC Analyzer for Tekmar
(Dohrmann)



FUSION

Mass Flow Controller

The MFC allows for mode to mode changes to the flow rate.

- Allows for higher flows to be used for clean up between samples and allows the user to optimize the sparge flow of the sample.
- Allows for automatic leak check of entire system.

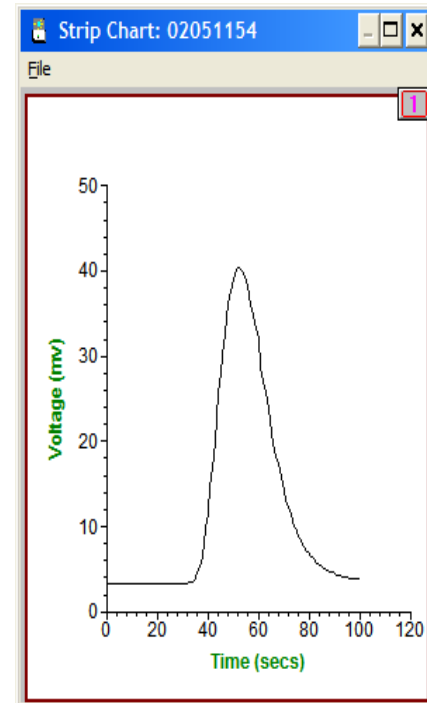


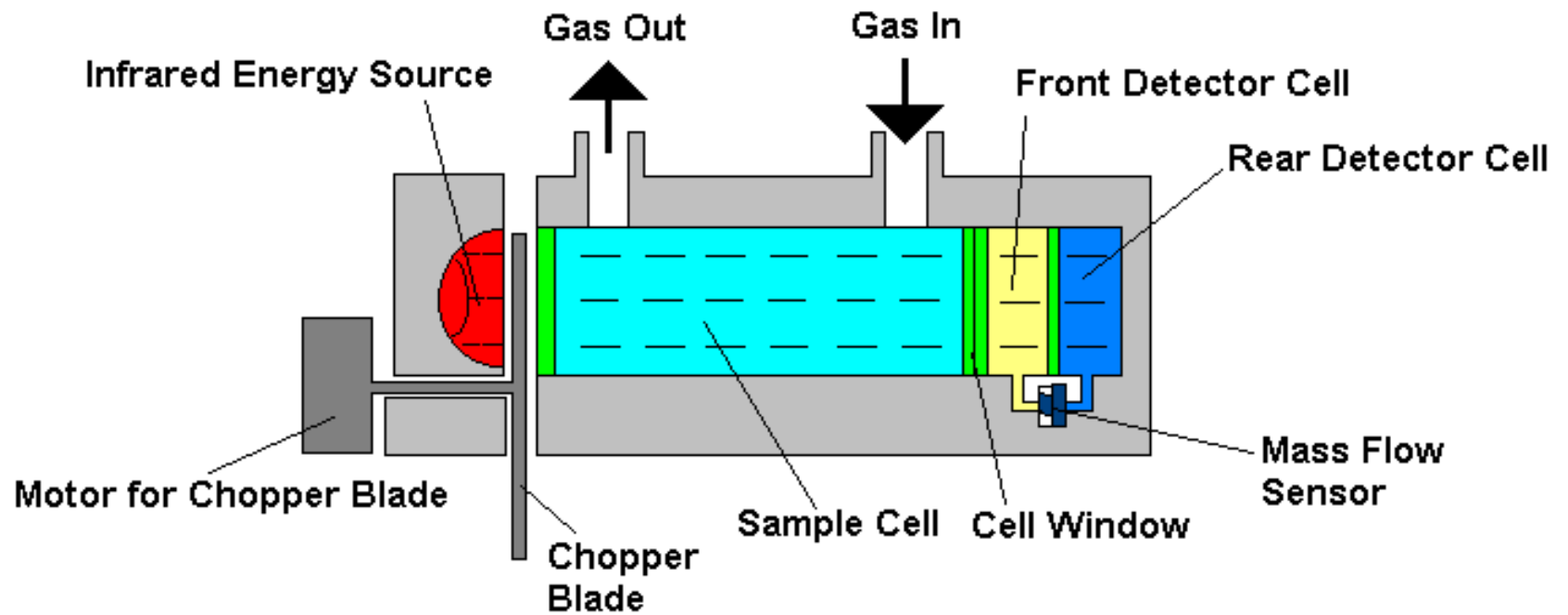
Static Pressure Concentration (SPC) NDIR Detection

Better Performance under Pressure

Traditional Flow Through NDIR

- Uses infrared adsorption technology.
- The adsorption of the infrared light is measured over time as the CO₂ is swept through the detector.
- Resulting measurement correlates to a peak, which can be integrated and correlated to a concentration.

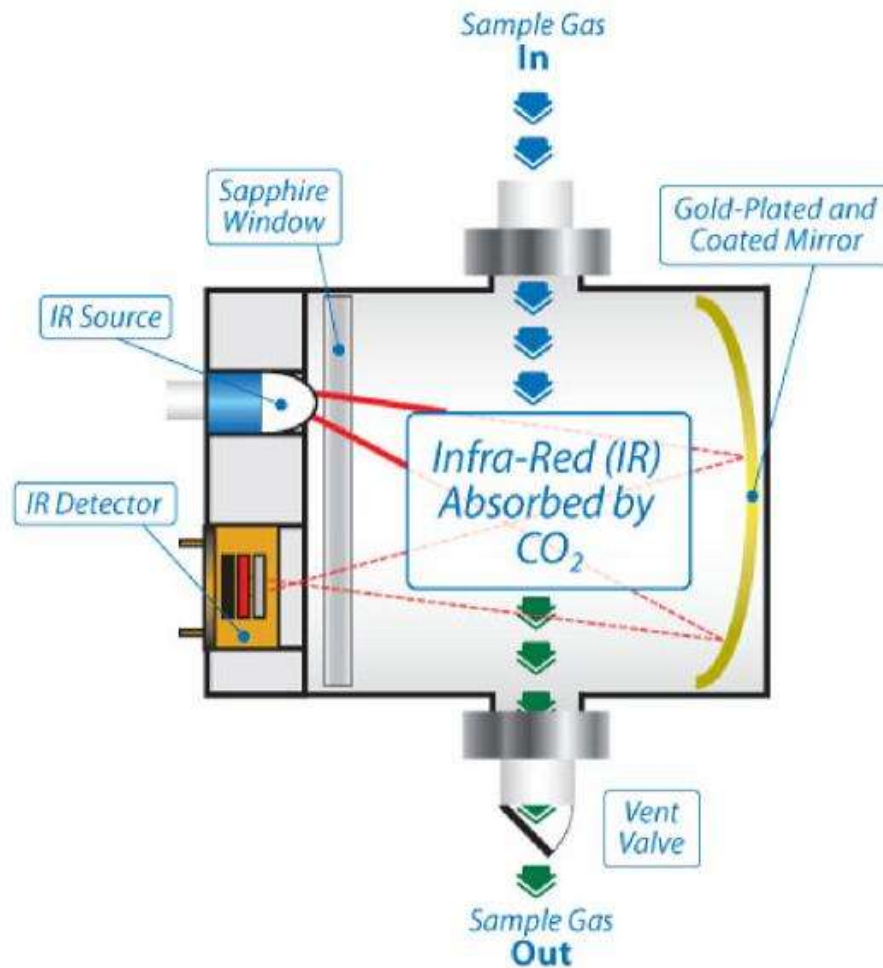




Static Pressure NDIR

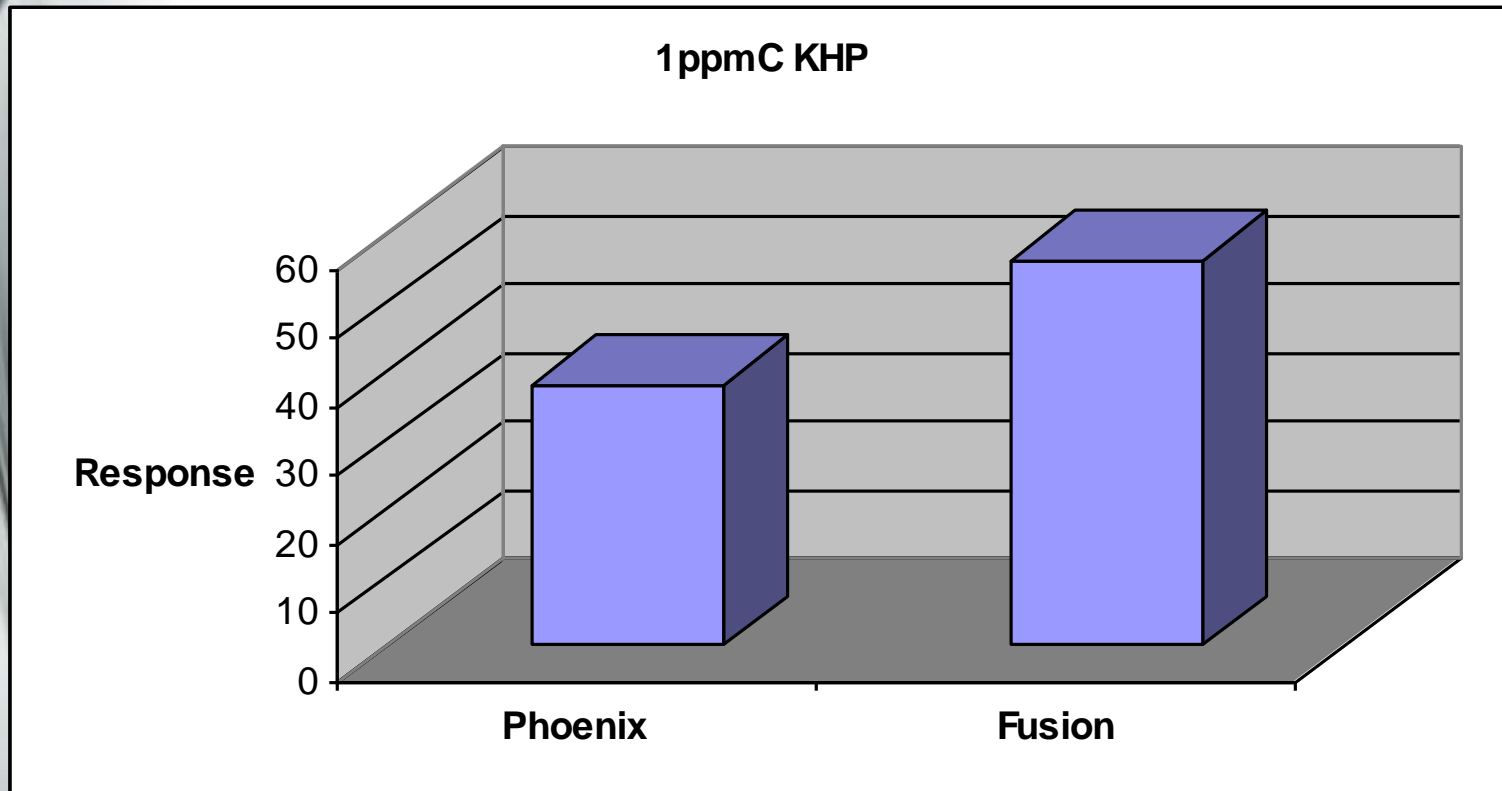
- The exit valve from the NDIR is closed to allow the detector to become pressurized.
- The oxidation products are swept into the NDIR detector, which is CO₂ selective.
- Once the gases in the detector have reached equilibrium, the concentration of the CO₂ is measured.

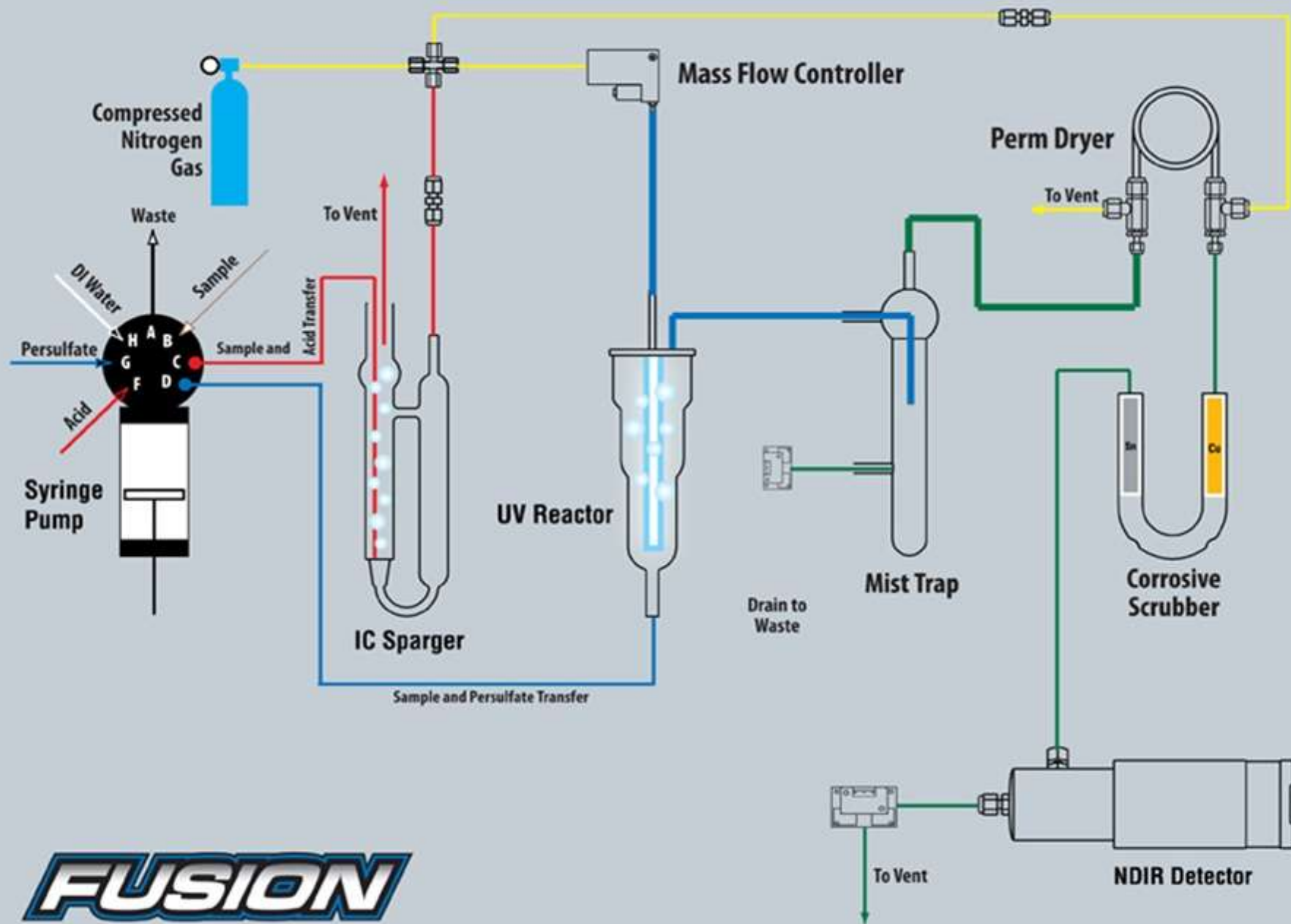
Static Pressure NDIR



Static Pressure NDIR

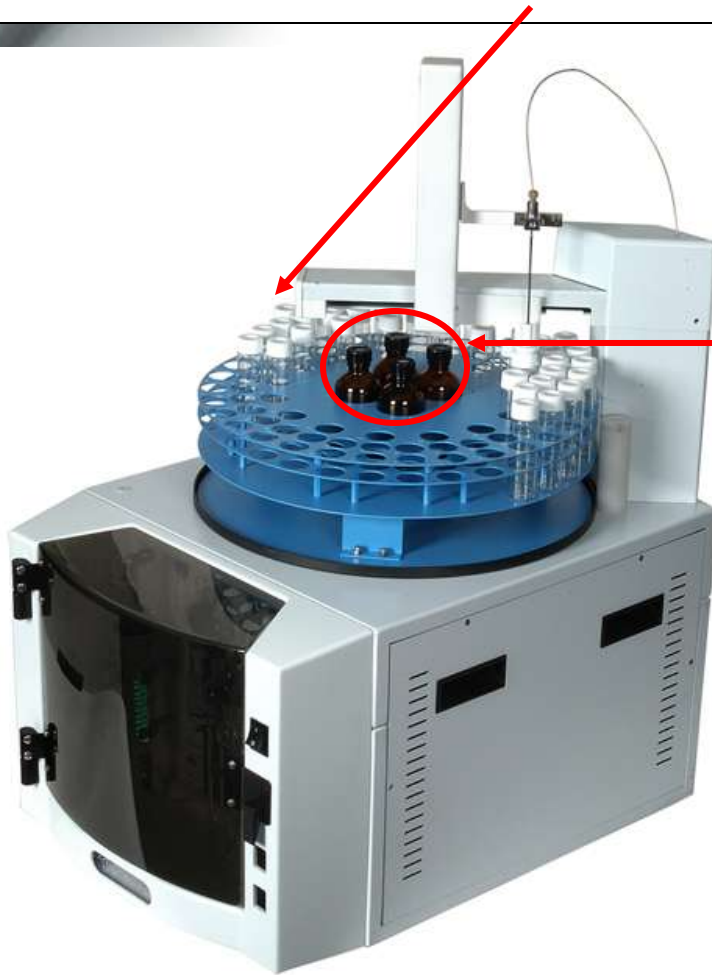
Comparison 1ppm TOC





FUSION

- **Autosampler: (75) positions for 40 mL vials**

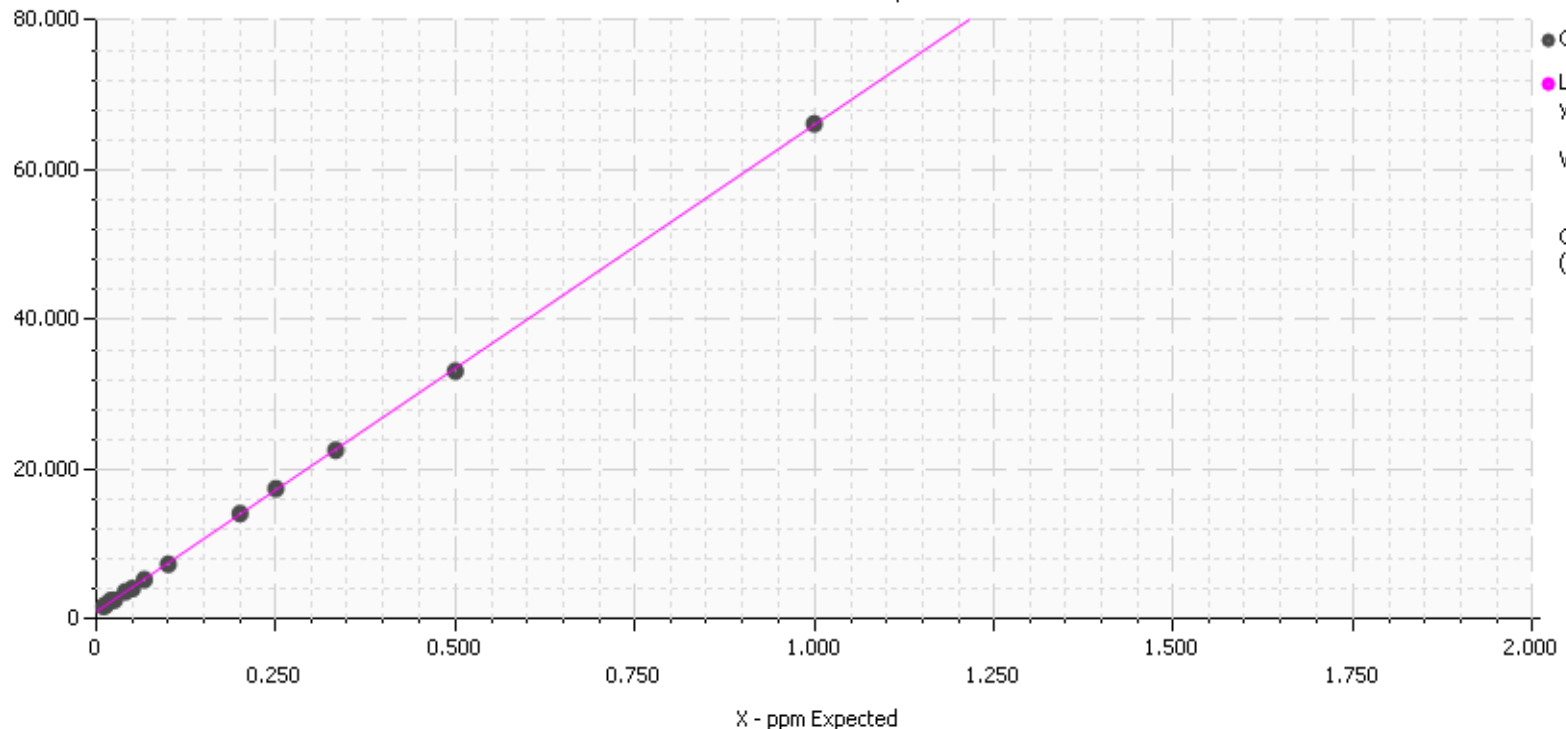


- (4) 125 mL stock solution positions

Calibration Improvements with Fusion

- **Auto-dilution of samples/standards**
- Auto calibration by vials or diluting from stock standard
- One calibration for all ranges

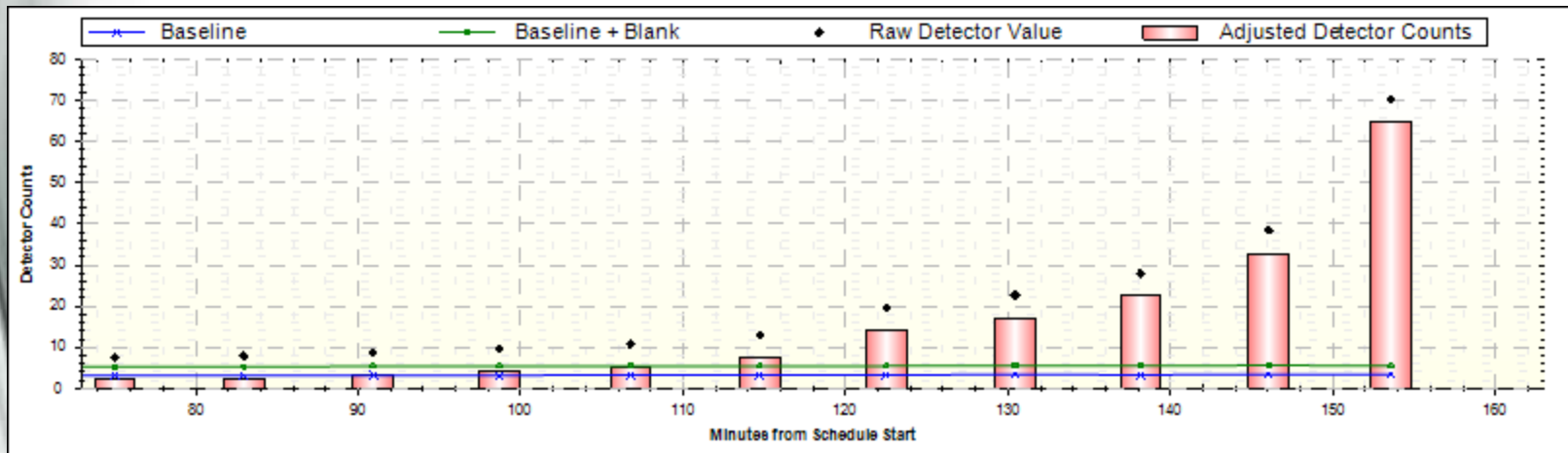
Calibration Graph



Analysis type: TOC Regression Calculation Method: Linear

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Graphical Display of Results Over Entire Run



Performance

Concentration (ppm C)	Result (ppm C)	Std. Dev. (+/- ppm C)	RSD	Dilution	Min / Max Criteria (ppmC) (85 - 115% dev)
0.005	0.0046 (PASS)	0.0017	35.92%	1:200	.0043 / .0058
0.01	0.0095 (PASS)	0.0021	22.27%	1:100	.0085 / .0115
0.013	0.0126 (PASS)	0.0004	2.88%	1:75	.0113 / .0153
0.02	0.0172 (PASS)	0.0008	4.90%	1:50	.0170 / .0230
0.025	0.0224 (PASS)	0.002	9.00%	1:40	.0213 / .0288
0.04	0.0349 (PASS)	0.0013	3.64%	1:25	.0340 / .0460
0.05	0.0468 (PASS)	0.003	6.44%	1:20	.0425 / .0575
0.067	0.0608 (PASS)	0.0026	4.22%	1:15	.0567 / .0767
0.1	0.0939 (PASS)	0.0013	1.39%	1:10	.0850 / .1150
0.2	0.1957 (PASS)	0.0024	1.25%	1:5	.1700 / .2300
0.25	0.2439 (PASS)	0.0021	0.87%	1:4	.2125 / .2875
0.333	0.3294 (PASS)	0.0038	1.16%	1:3	.2833 / .3833
0.5	0.5074 (PASS)	0.0024	0.47%	1:2	.4250 / .5750

Processing Benefit

- Self Cleaning Technique on every repetitions.
- Fast Analysis Processing Time.
- < 1% cross contamination / carryover
- Visual Display of Reaction.

TOC Fusion

- UV-Persulfate TOC Analyzer

Methods: TOC, TC-IC, TC, IC

Range: 0.2 ppb - 4,000 ppm

RSD: < 1.0% or 2.0 ppb

TOC Fusion

- UV-Persulfate TOC Analyzer

Analysis Time: 3-5 min

Carry-over: < 1.0 %

Autosampler: 75 positions/40 mL vials
+ 4 125 mL center
stock positions

Fusion Total Organic Carbon (TOC) Analyzer Application Notes



Meeting the US Environmental Protection Agency Drinking Water Requirements with a UV/Persulfate Analyzer



Analysis of Cleaning Validation Compounds using the TOC Fusion Analyzer



Choosing the appropriate TOC Analyzer



Understanding Intellidilution for use with a UV/Persulfate Analyzer



A Guide for Analyzing Low-Level Total Organic Carbon Using a UV/ Persulfate Analyzer