

## Application Note

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### Abstract

Using safe and proven High Temperature Combustion (HTC), oxidation of carbonaceous material to carbon dioxide followed by Non-Dispersive Infrared (NDIR) detection of the CO<sub>2</sub> product allows varieties of carbon to be independently determined using a predefined 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)

This application note evaluates the ability of the Lotix TOC Analyzer to determine TOC using the measurement by difference approach, also known as TC-IC.



### Introduction

The TOC measurement by difference approach requires two calibration curves for analysis: one to measure TC and another to measure IC.

### Experimental Instrument Conditions

The calibration for TC was created by making a 1000 ppmC stock standard of anhydrous Potassium Hydrogen Phthalate (KHP) and diluting to make calibration standards. The 1000 ppmC stock standard was made by measuring 2.125 grams of KHP into a 1 liter volumetric flask, filling to volume with deionized water, and then mixing thoroughly. The stock standard was then diluted to create calibration concentrations of 0, 1.0, 5.0, 10.0, 25.0, 50.0, and 100.0 ppmC.

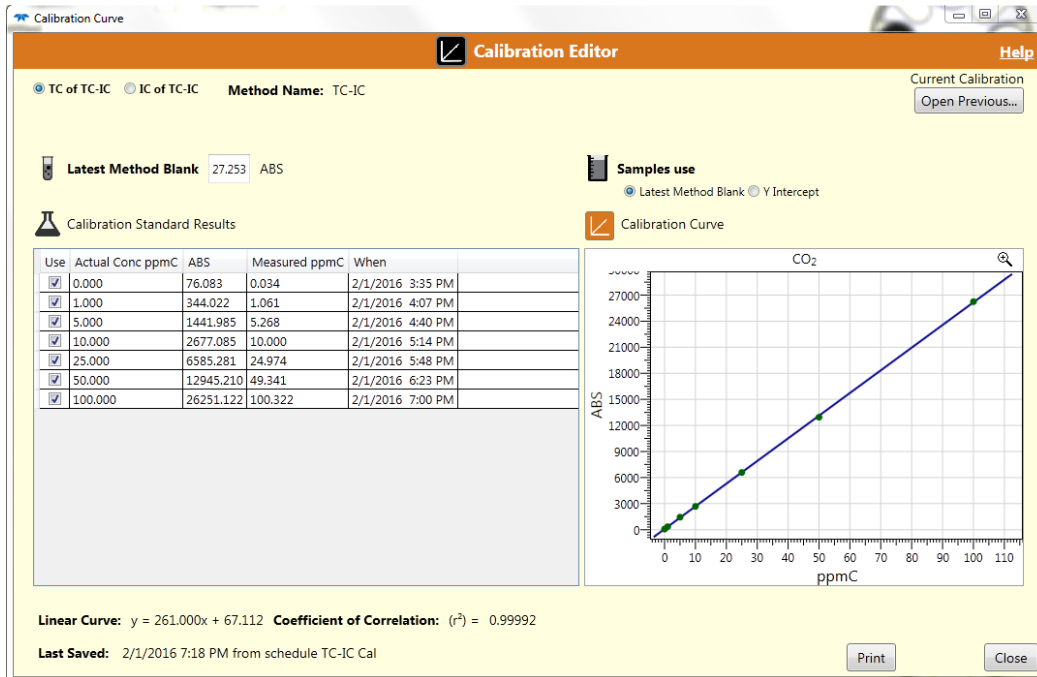
The calibration for IC was created by making a 1000 ppmIC stock standard of anhydrous Sodium Carbonate and anhydrous Sodium Bicarbonate. The 1000 ppmIC stock standard was made by measuring 4.4122 grams of Sodium Carbonate and 3.497 grams of Sodium Bicarbonate into a 1 liter volumetric flask, filling to volume with deionized water, and then mixing thoroughly. The stock standard was then diluted to create calibration concentrations of 0, 1.0, 5.0, 10.0, 25.0, 50.0, and 100.0 ppmIC.

This calibration was performed by using the TC-IC default method in [Table I](#):

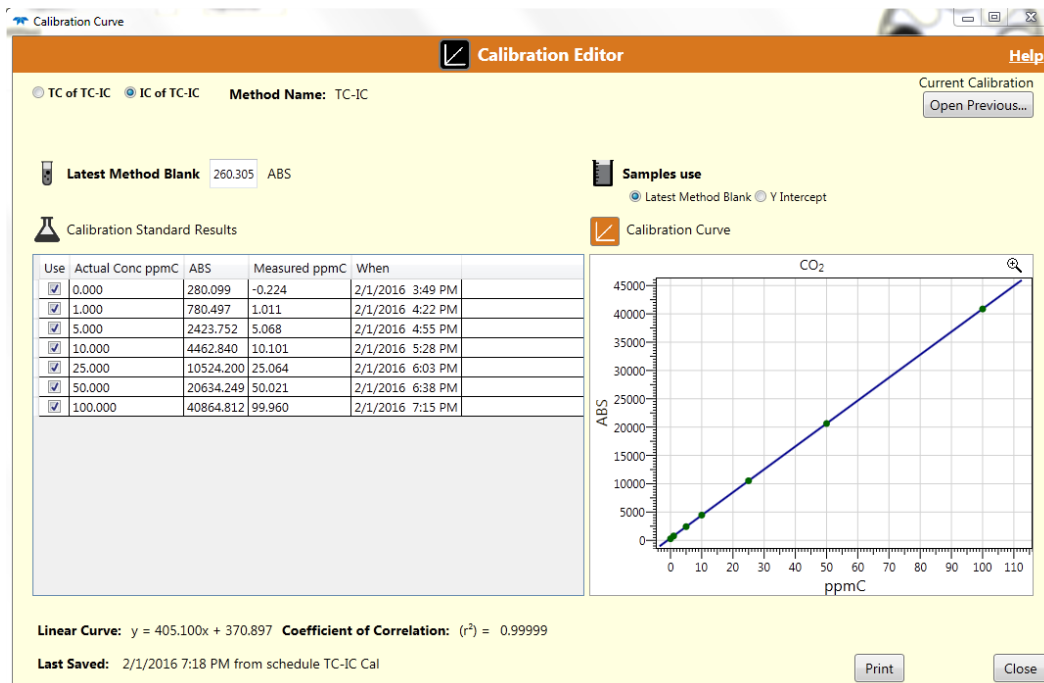
Table I TC-IC Method Parameters	
Parameter	Value
Acid Volume	0.2 mL
Carrier Gas Delay Time	60 seconds
Furnace Temperature	680°C

The calibration curve data is listed in [Figure 1](#) and [Figure 2](#).

**Figure 1** The Total Carbon (TC) calibration curve shown below has an equation of  $y=261.000x + 67.112$  with a coefficient of correlation ( $r^2$ ) value of 0.99992.



**Figure 2** The Inorganic Carbon (IC) calibration curve shown below has an equation of  $y=405.100x + 370.897$  with a coefficient of correlation ( $r^2$ ) 0.99999.



## Results

Check standards were analyzed against the TC-IC calibration. Both the TC and IC check standards on the low and high end quantitated within 10% of the true value as shown in [Table II](#).

Table II Check Standards Results				
Method	Expected Value	Analyzed Value	Standard Deviation	%RSD
TC	5.00 ppmC	5.210	0.062	1.194
IC	5.00 ppmC	5.183	0.215	4.143
TC	50.00 ppmC	50.793	0.609	1.200
IC	50.00 ppmC	50.533	1.399	2.768

Samples spiked with 20 ppm of KHP and 20 ppm of the inorganic carbon created a sample with a value of 40 ppm TC and 20 ppm IC (a sample with 20 ppm of TOC). Samples quantitated within the 10% TOC expected value as shown in [Table III](#).

Table III Sample Results				
Method	Expected Value	Analyzed Value	Standard Deviation	%RSD
TC-IC	20 ppm TOC	20.706	1.498	7.237
TC-IC	20 ppm TOC	20.423	1.007	4.933

## Conclusion

The Teledyne Tekmar Lotix TOC analyzer is a simple to use, and highly efficient laboratory instrument with excellent accuracy and reproducibility. The analyzer quantitated TOC, using the measurement by difference approach with excellent results. Both TC and IC check standards were within 10% of the true value and samples were within the 10% TOC expected value. The Lotix's Non-Dispersive Infrared (NDIR) Detector is highly sensitive and can reproducibly quantitate a wide linear range with a single 0.5 mL injection volume. The Lotix is the ideal instrument for any laboratory that needs to analyze a variety of samples quickly and accurately, with the flexibility of four different types of TOC analysis.