sercon

Thermalox TOC-TN

The modern alternative to COD and TKN

THE SERCON THERMALOX

Measuring Total Organic Carbon

TOC (Total Organic Carbon) is a measurement widely used in a number of industries to assess the organic contamination of water. Applications include Environmental Research, Industrial Process Monitoring, and Quality Assurance.

In wastewater TOC concentrations of many thousands of ppm are often found. At the other extreme, low ppb TOC levels must be measured in the Ultra-Pure water used by Pharmaceutical, Semiconductor and the Power Generation industries.

There are several Oxidation methods which have been historically utilised to measure TOC. The Sercon Thermalox uses the Thermal Catalytic Oxidation technique which gives excellent performance for a wide range of sample types and applications.

OXIDATION METHOD	SPECIFICATIONS	DISADVANTAGES
Wet Chemical	Inexpensive and robust.	Inefficient oxidation. Poor with particulate or hard to oxidise compounds. Slow speed of analysis.
UV Persulfate	Good Precision, Low detection limits. Ideal for DOC in pure waters.	Poor performace with particulate or humic material (i.e. natural waters)
Thermal Catalytic Oxidation	Near perfect recovery (oxidation). Fast.	Higher ownership costs. Trace catalyst contamination means sensitivity is compromised

THE SERCON THERMALOX TOC/TN$_B$

Complete Oxidation and detection are critical for measuring TOC and TNb. Working with one of the world's leading NDIR analyser manufacturers, has dramatically increased the sensitivity of the Sercon Thermalox CO2 detector. The Sercon Thermalox detector is now over twenty times more sensitive than its leading rival.

Additionally, the combination of catalytic combustion and unique furnace design allows efficient analysis of organic compounds whilst virtually eliminate trace carbon contamination within the reactor and catalyst.

High Sensitivity allows lower injection volumes to be used leading to less catalyst contamination, more accuracy, and faster measurements. It also provides a dramatic improvement in the detection limit for this method.

Other methods employed to reach these low detection limits result in reduced performance in terms of increased maintenance and longer analysis times.

The Sercon Thermalox NOx detector employs a number of features to ensure excellent sensitivity and stability.
An innovative NOx → NO reduction furnace is used which remains efficient over an extended life. The detection reaction for TN is heated under vacuum using precise temperature and vacuum controls guaranteeing stability and optimised sensitivity.

One of the benefits of the unique Sercon Thermalox detectors is the long-term stability of the calibration, giving the user more time on analysis and less time on set up.

These improvements combined with, the sophisticated but user-friendly software and excellent build quality, highlight the Sercon Thermalox as the most cost-effective, powerful and robust tool for the analysis of TOC and TNb anywhere in the world.

System Highlights:

- Catalytic thermal oxidation. The only way to measure complex samples containing particulate or difficult to oxidise materials
- Standard Deviation better than 20ppb on low level Carbon
- Standard Deviation better than 10ppb on low level Nitrogen
- Upper Range Limit greater than 50,000ppm for TOC
- Detection Limit of better than 40ppb for TOC and 10ppb for TNb
- Short Analysis time of less than two minutes
- Complete recovery, including Suspended Solid fraction
- Handles salts and particulate easily without sacrificing detection limits or requiring specific combustion tubes
- Capable of analysing small samples as standard.
- Holds up to 88 samples
- Complete washing between samples ensures no carry over
- Totally software driven from a Windows™ based platform
- Automatic preparation of calibration standards
- Versatile to your analysis – you can have standalone TOC, standalone TNb or combination TOC/TNb
- The Sercon Thermalox is so well automated that you can mix high and low level samples on the same vial rack

THE SERCON THERMALOX

Features included as standard

The Sercon Thermalox instrument uses an optimised XYZ autosampler. This gives maximum flexibility and allows a high degree of automation, whilst maintaining robust performance.

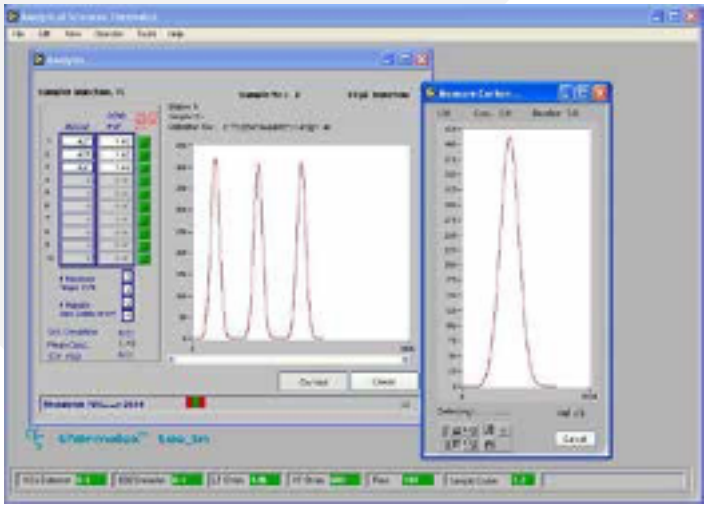
The standard vial rack holds up to 88 glass or disposable plastic vials, with or without lids. Sample racks can be chilled, and optional racks for special requirements are available.

Calibrants can be made up automatically; sparging, dilutions and sample agitation can easily be carried out all under software control.

By using a special aspiration step, samples containing particulate can be automatically agitated, ensuring that a representative sample aliquot is aspirated from the vial.

- Both TOC by subtraction and by pre-stripping of inorganic carbon methods are fitted as standard
- Carrier gas generation fitted as standard on TOC – no need for bottled gases
- Automatically prepares its own calibrants – reducing possibility of error and demands on user time
- Peltier cooler for condensate removal - no downtime or costs involved with changing desiccants
- Precise electronic mass flow control of the carrier gas – stable calibrations and results
- Highly sensitive detectors – prolongs catalyst life, lowers detection limit
- Stand-by Mode - limits carrier gas consumption and prolongs oven life improving cost of ownership
- Specially manufactured Carbon-free catalyst - virtually no blank carbon peak
- Direct Injection method - eliminates blockage or carryover contamination
- **Sample sparging and POC analysis method included as standard**

Windows Platform Software



- Intuitive functionality
- User friendly GUI
- Secure to FDA21 CFR11
- Robust
- Tailored to suit you

THE SERCON THERMALOX CARBON

Analytical Description

Analysis begins by loading samples into a vial rack. The AS8000 XYZ autosampler handles up to 88 vials.

A sample aliquot from 3µl to 250µl is injected into the TC furnace through a special carbon free septum. CO2 free Carrier gas sweeps the oxidant through to the CO2 detector. Concentration is monitored by a PC and a characteristic asymmetric peak is plotted, the area of which is proportional to the CO2 product of the oxidation. By calibration, TC is then determined from this peak area.

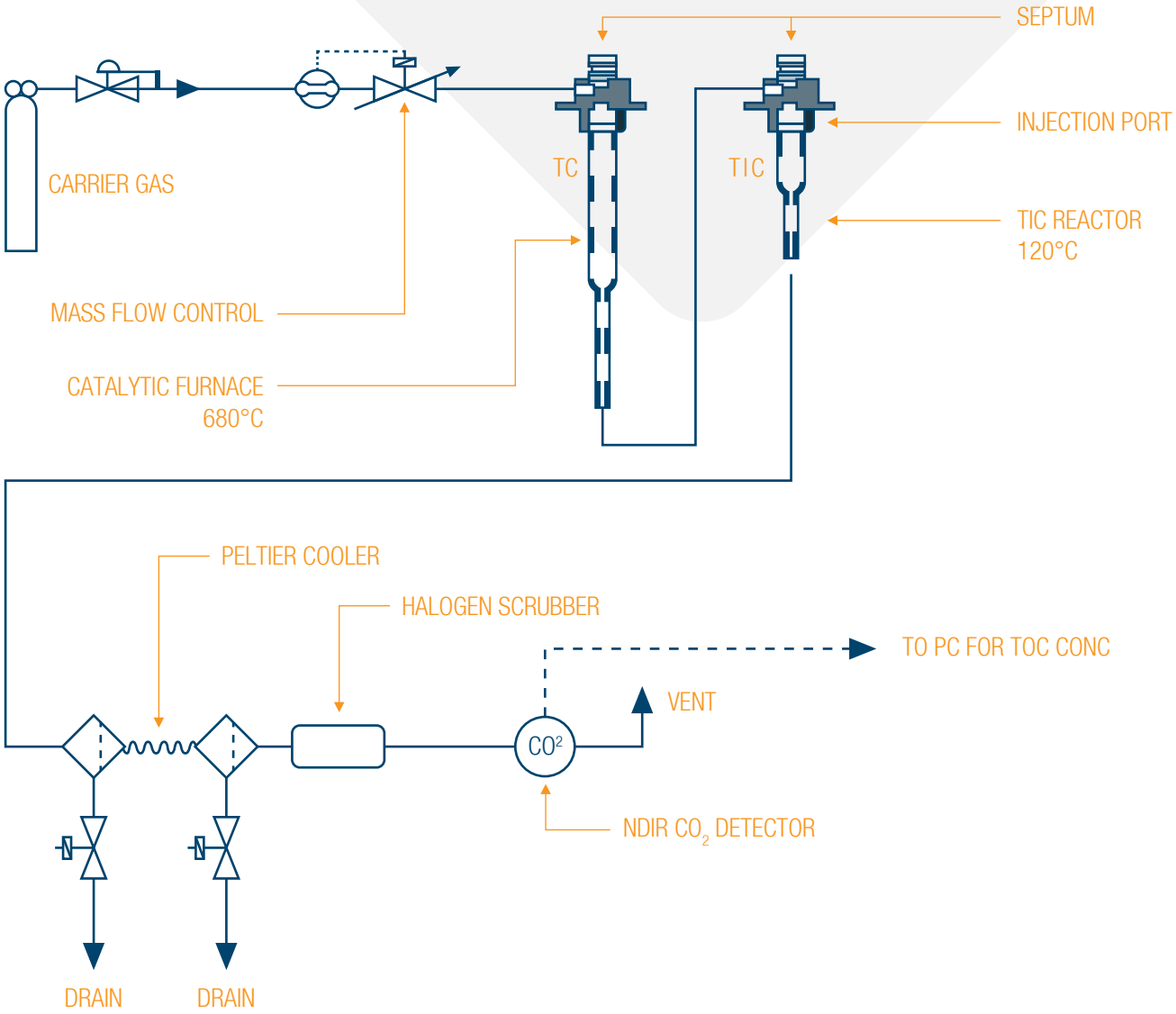
The inorganic carbon, carbonates, bicarbonates and dissolved CO2 are either stripped from the sample prior to the TC measurement, or this fraction is measured separately by introducing an aliquot of sample into the TIC reactor. This reactor contains phosphoric acid heated to 120°C which reacts with the carbonate to form CO2.

This is swept to the CO2 detector and measured in the same way as the TC fraction. Both of these methods, TOC by difference and TOC by acid stripping (sometimes known as NPOC – non purgeable organic carbon) are available on The Sercon Thermalox Instrument as standard.

The disadvantage of the difference method is that if most of the carbon present is inorganic, the inaccuracy of the difference value, TC-TIC, can be too large.

The disadvantage of the acid stripping method is that there is a risk of stripping out purgeable organic material and at low levels contaminating the sample.

To handle samples with high levels of suspended solids, and TOC such as effluents, large bore needles – up to 1.0mm - may be fitted to the autosampler.



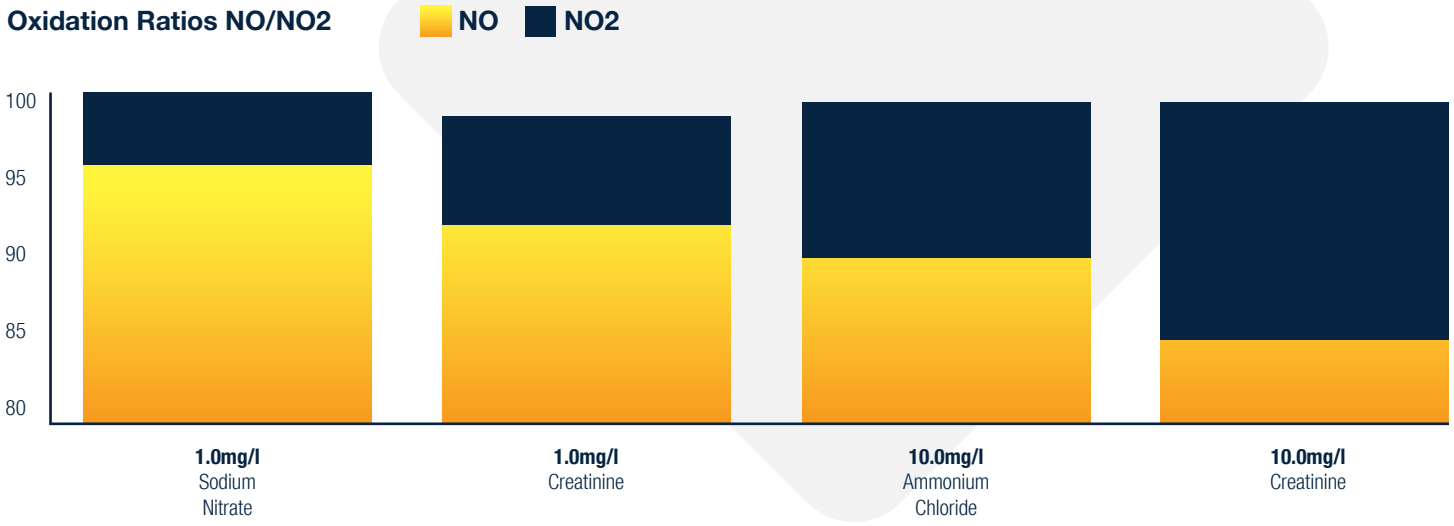
THE SERCON THERMALOX

Total Nitrogen

otal Nitrogen (TN) determination may be added to The Sercon Thermalox TOC analyser to give TOC and TN measurements from the same vial. Sercon also offer The Sercon Thermalox TNb analyser where only this analyte is required.

In the same way as TC measurements are performed, a sample aliquot is injected into a catalytic furnace. Carrier gas (oxygen) sweeps the oxidant, in this case NOx gases, through to the NOx detector.

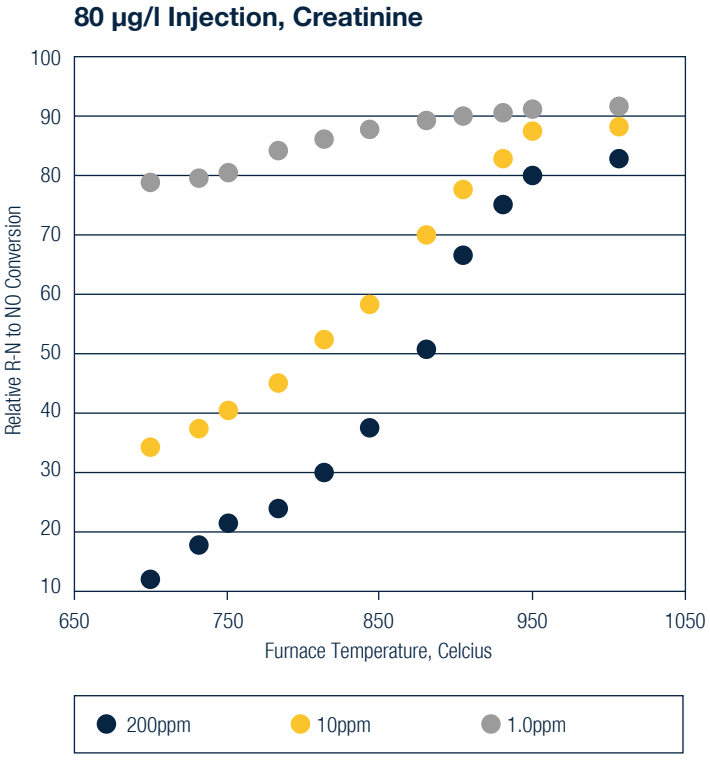
The detector utilizes the chemiluminescent reaction between NO and O3 to determine the NO concentration. As well as a reduction step to account for NO2 species present. The importance of this reduction step is illustrated by the different NO/NO2 splits of the various compounds shown below.



The unique features of the chemiluminescence detector gives The Sercon Thermalox TN analyser its remarkable sensitivity, at least an order of magnitude more than other available systems, by calibration, TNb is determined from the amount of NO measured.

As can be seen from the graph below, temperature, concentration and injection volume have a critical effect on the conversion of R-N to NO. For most applications, the TC catalytic furnace can be modified to allow it to perform both the TC and TN measurments. However, for some higher level TN applications – up to 200mg/l – or highly particulated samples, a specialised TN catalyst is added.

This overcomes the quenching effects experienced on many TN applications where larger sample volumes are needed or higher concentrations of TN are measured - for example effluent samples. Large bore needles may be used to aspirate particulated samples representatively.



THE SERCON THERMALOX TOC/TN$_B$

RANGEABILITY

Calibration – from two to 7 points may be automatically defined in the method set-up. The software then uses regression mathematics to generate a best fit curve. This may be a linear or an n-order polynomial function to give unrivalled rangeability.

AUTOMATION

Users can select a method which includes automatically preparing calibrants from a stock solution, calibration, acid stripping and measurement of TOC and TN all in one operation. The principals of FDA21 CFR11 are applied to ensure that the data is tamperproof and auditable.

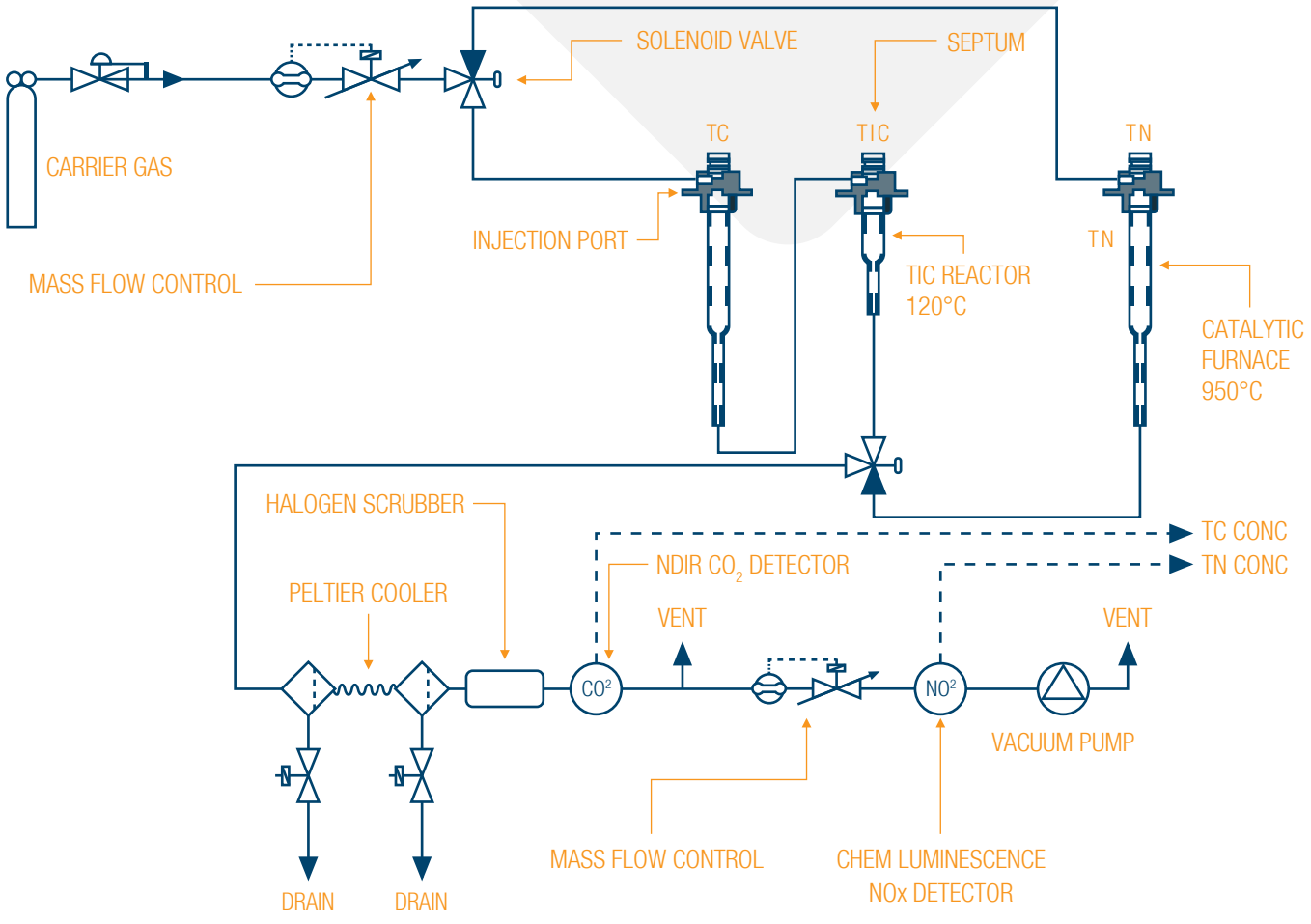
SENSITIVITY AND PRECISION

It's very hard to beat the sensitivity and precision of The Sercon Thermalox range of elemental analysers. The following results were obtained on The Sercon Thermalox TOC/TN*.

*The samples were prepared by adding each of the chemicals in the nominal concentrations to deionised water. The digestion efficiency represents the ratio of nitrogen measured compared to the amount of chemically bound nitrogen contained in the sample. Oven Temperature was 950°C. Lower oven temperatures give a wider spread of recoveries at higher concentrations but have some advantages with some matrices at low levels.

TOC/TN$_b$ TEST	TC µg/l KHP	TC mg/l KHP	TC µg/l KHP	TN µg/l NH_4Cl	TN mg/l NH_4Cl	TN mg/l NH_4Cl
Concentration	145 138 143	1.97 1.99 2.00	10,108 10,023 10,098	101 98 98	1.03 1.02 0.98	201.6 200.8 199.4
Mean Nominal Concentration SD CV	142 140 2.9µg/l 2.0%	1.99 2.00 0.01mg/l 0.5%	10,076 10,000 37.93mg/l 0.38%	99 100 1.25µg/l 1.25%	1.01 1.00 0.02mg/l 2.0%	200.6 200.00 0.91mg/l 0.45%

TN Digestion Efficiency 40µl Injection	Creatinine	NH_4Cl (Calibrant)	$NaNO_3$
Concentration (mg/lN)	98.8 98.2 98.7	100.3 99.8 100.1	102.0 101.8 101.7
Mean Nominal Concentration SD (mg/l N) Digestion Efficiency	98.6 100.00 0.26 98.6%	100.10 100.00 0.20 100.1%	101.87 100.00 0.13 101.9%



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Analyte	TC, TIC, TOC, NPOC, POC with options for measuring TN and TP
Applications	Drinking water, pharmaceutical cleaning in place water, ground water, surface water, saline waters, domestic, and industrial wastewater
Method	Total substance: Thermal catalytic oxidation at up to 1000ºC. Inorganic substance: acid stripping or injection into low temperature acid reactor (120ºC)
Range	Carbon: Various from less than a range of 40-150µg/l to greater than a range of 100-40,000mg/l: Nitrogen: From 20-100 g/l to 1.0-200mg/l
Detection limit	40 ppb for TOC, 10ppb of TN
Auto Dilution	500:1
Cycle time	Typically 120 – 180 seconds
Precision	Standard deviation: ≤ 5% of full scale for ranges to 3mg/l; ≤ 3% of full scale for ranges up to 500mg/l and 2% of full scale for ranges up to 40,000mg/l
Sample matrix	Aqueous samples including those containing suspended solids and salts. Acids, slurries, sludges and organics by special application. A solids option is available
Injection volume	3 to 250µl.Max 1,000µl (option) Needle diameters up to 1.0mm are available for particulate samples
Sample injection	Automatically from an 88 position vial tray, or manually
Carrier gas	A carrier gas generator is fitted as standard for TOC. For TN, oxygen (grade 5.5 or better) is required; flow rate is 15 litres per hour or less
Software	WindowsTM base PC control English, multi language (option)
Power supply	230V AC ± 10%, 50Hz ± 1%; or 115V AC ± 10%, 60 Hz ± 1%
Ambient temperature	5 – 35ºC
Dimension and weight	645W x 505D x 650H mm footprint (WDH) ; weight 50kg; (figures include sampler)
Protection Class	EMI class Euro 50081/50082
TOC and TN method compliance	BS and DIN EN 1484 of 1997; ISO 8245, AOAC973.47, Standard Methods 5310B, Environmental Protection Agency (EPA) Methods 415.1, EPA SW-846 Method 9060A, ASTM D2579-85. TN according to DIN38409 part 27, ENV 12260 and ISO/TR11905-2.

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ISO 9001:2015 Certified
ISO 13485:2016 Certified

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