# Continuous measurement of ultra pure water


OCT-1 with TOC-$V_{CSH}$

## The TOC-$V_{CSH}$ online Option

Ultra pure water is one of the most widely used reagents in industry and its quality is therefore of utmost importance in all industrial processes. Quality control has, for many years, been carried out and documented via conductivity measurements, which provide an assessment of the concentration of all inorganic species present in water. This detection method does not take organic pollutants into account, as they typically do not contribute to conductivity. Organic pollutants can, however, greatly influence further industrial processes and it has become increasingly more important to include quantitative determination of all organic species in quality control of water samples.

The TOC value (Total Organic Carbon) can be used as a sum parameter for organic compounds. Similar to conductivity signals composed of various ionic compounds, the TOC value is a measure of the contribution of the numerous organic compounds present in a water sample. When industrial processes require large volumes of ultra pure water, it is recommended to monitor its TOC content continuously.

### Continuous TOC determination with the TOC-$V_{CSH}$ online option

The online module was developed especially for continuous TOC determination of ultra pure water. This module features the same characteristics as the stand-alone TOC-$V_{CSH}$ model, such as catalytic combustion at 680 °C and NDIR detection (non-dispersive infrared) of the $CO_2$ formed during combustion. The instrument is operated via a keyboard and LCD monitor, which are both located on the instrument front panel. The heart of the TOC-$V_{CSH}$ is the ISP integrated sample preparation system that consists of an 8-port valve and a syringe with sparging gas connection. The popular NPOC (non purgeable organic carbon) method can now be carried out directly within the syringe. Acidification and sparging is fully automated. The ISP module also features a fully automated dilution function to carry out multi-point calibration from a single standard solution.

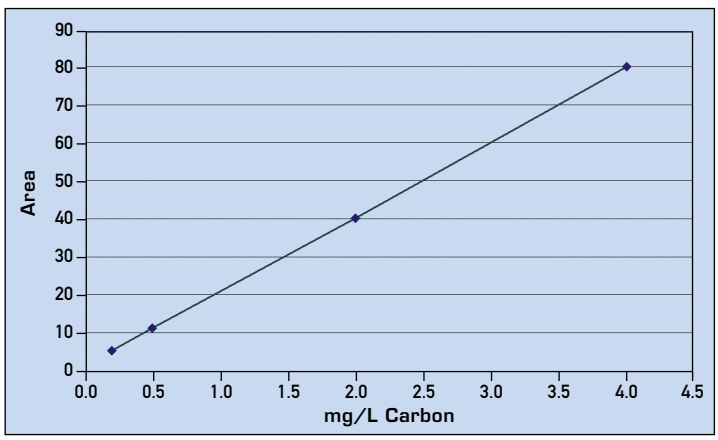


Figure 2: Calibration curve 4 mg/L

Alternatively, laboratory prepared standards can be used for multi-point calibration. This requires the additional use of an OCT-1 (autosampler for max. 8 samples/standards).

### Example of a calibration using the TOC-$V_{CSH}$ online

This calibration required four different standards measured using the OCT-1, whereby the NPOC measuring method was used:

Method parameters:
Injection volume: 204 µL
Amount of acid: 1.5 %
Sparging time: 2 min

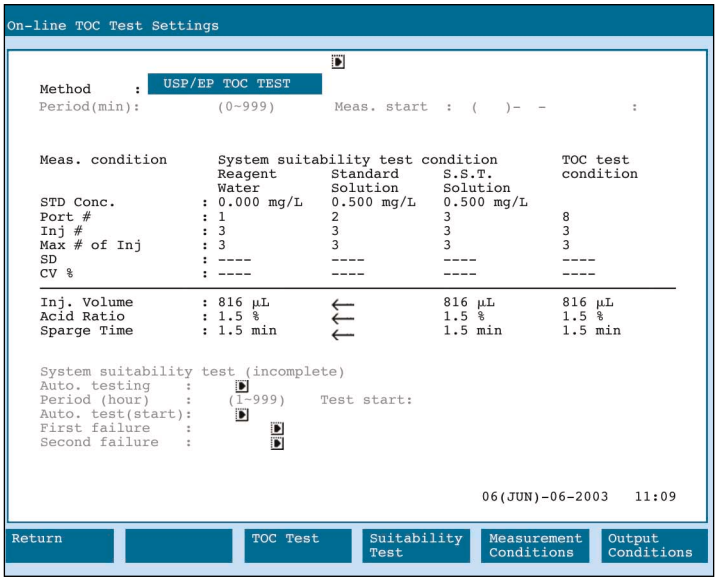


Figure 3: System Suitability Test

| Standard | Concentration (mg/L) | Area value* |
|---|---|---|
| 1 | 0.200 | 5.260 |
| 2 | 0.500 | 11.3 |
| 3 | 2.000 | 40.1 |
| 4 | 4.000 | 80.00 |

*Average value of a triplicate determination (please see also figure 2)

Calibration curve data:
$y = 19.63x + 1.284$
$r^2 = 1{,}000$

The adaptation of the OCT-1 offers another advantage: automatic implementation of the system suitability test. This test is required by USP and EP guidelines and includes the measurement of sucrose and benzochinone solutions (0.5 mg/L each) as well as the analysis of the ultra pure water used to prepare the standard solutions. All three solutions are transferred to the OCT-1, subsequently analysed and the data is stored in the software.

## Online measurement

Important for an online measurement system is its largely independent operation. This includes continuous sampling, automatic calibration and connecting to a control station. For ultra pure water measurement, sampling is not as critical, as we are dealing with a homogeneous sample that does not contain any suspended particles. In order to eliminate possible air bubbles, the sample is passed through an overflow vessel from which the measuring sample is subsequently taken. The desired measuring frequency is selected via the operating software. In order to carry out the calibration or the system suitability test, the continuous sample measurement cycle is briefly interrupted. Automatic calibration is repeated according to a user-defined cycle.

The acquired data is stored in a data report file. The data can be visualised via a trend graph that can quickly point out irregularities. The acquired data can be transferred to a process control system, either via an analogue output circuit (4 - 20 mA or 0 - 1 V) or via the RS-232 interface.

In the control station, various status signals indicate the status of the instrument: whether in the measurement or calibration cycle. When needed, the system can be started and stopped manually or a system suitability test can be initiated. Various alarm signals provide information on possible hardware problems or whether a predefined limit value has been exceeded. The control station can then react immediately to these incidents and initiate countermeasures.

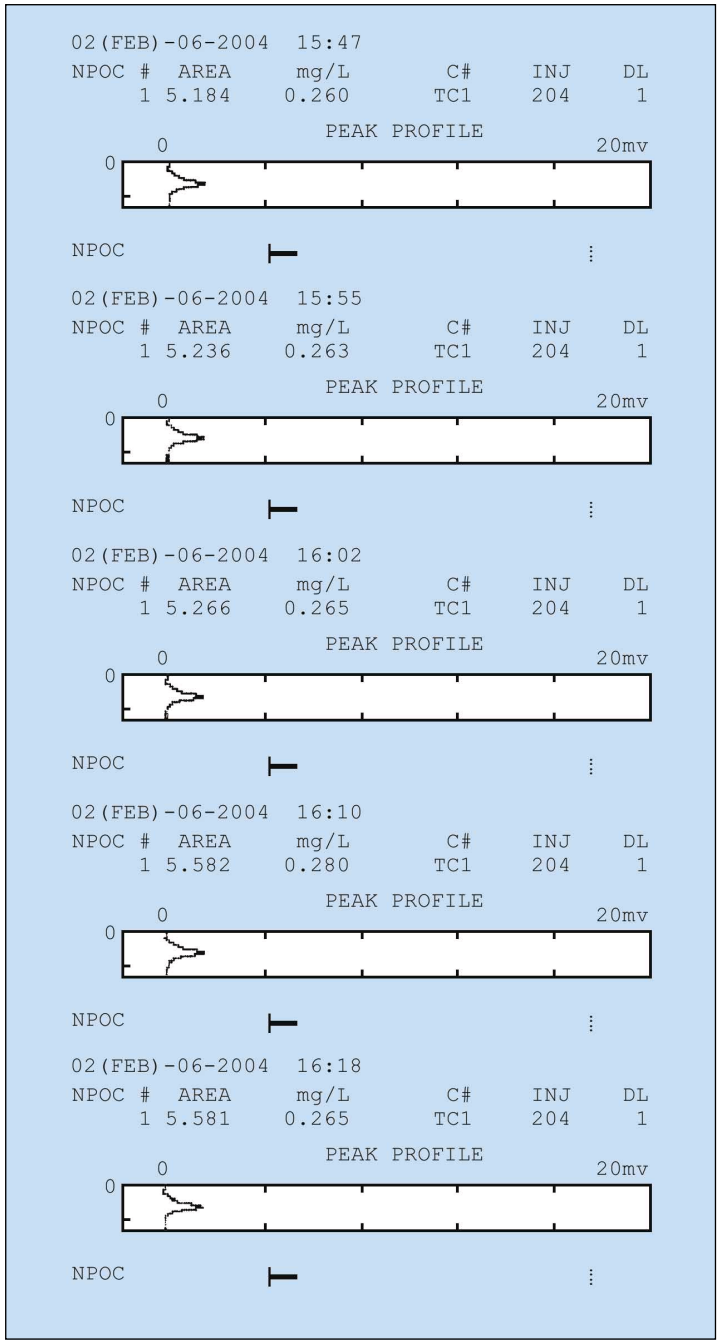


Figure 4: Print of an online measurement