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LENNTECH
WATER TREATMENT SOLUTIONS

Technical Information
TOCII CA72TOC

Analyzer for online measurement of TOC in aqueous media using thermic catalytic combustion

Application

- Monitoring of industrial wastewater, in the inlet and outlet
- Control of process wastewater
- Monitoring of surface run-off in industrial systems
- Monitoring of surface run-off in airports
- Municipal wastewater monitoring
- Measurement of carbon load for nutrient dosing

Your benefits

- Optimized for industrial applications even with fluctuating pH values and high salt loads
- Fast and easy maintenance due to easy accessibility of all components
- Available measuring ranges between 0.25 mg/l and 12,000 mg/l TOC, can be extended by predilution
- pH-controlled acid dosing for TIC stripping minimizes acid consumption
- Measurement performed using "double-batch" method
- One- and two-channel measurement available
- Heated salt trap significantly increases operating time
- Externally controlled self-monitoring with TOC standard, e.g. for limit violation

Endress+Hauser
People for Process Automation

Function and system design

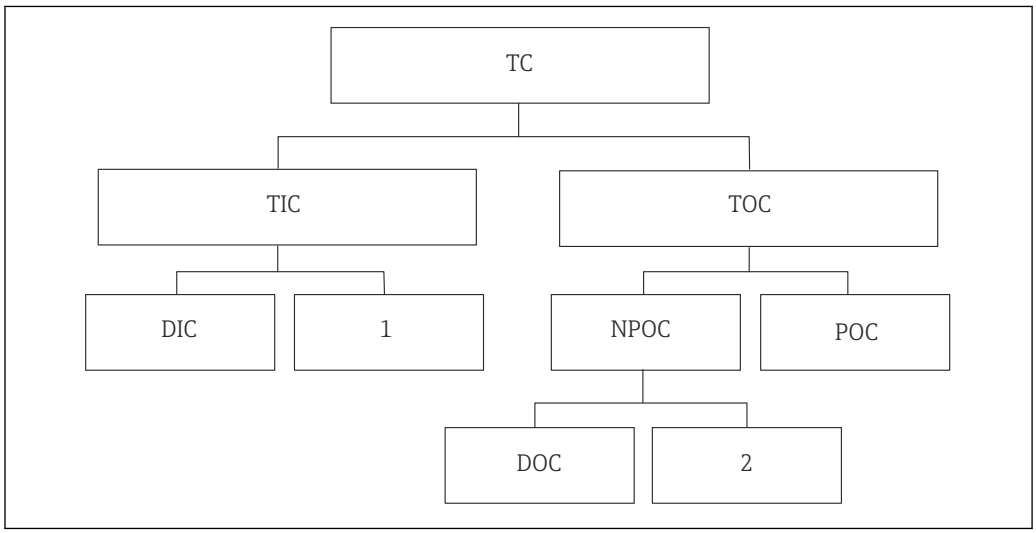
Measuring principle

TOC as sum parameter

The total carbon (TC) of an aqueous sample is divided into total inorganic carbon (TIC) and total organic carbon (TOC).

TOC can be divided into three groups:
- Dissolved organic carbon (DOC)
- Non-purgeable organic carbon (NPOC)
- Purgeable organic carbon (POC)

It is important to note the difference between POC and VOC (volatile organic carbon). POC is actively eliminated during TOC online analysis (e.g. during stripping). VOC is a scientific term that describes the properties of volatile organic carbons. The volatility of substances is a passive process and is strongly influenced by temperature and pressure.



1 Classification of carbon parameters

TC	*Total carbon*	*NPOC*	*Non-purgeable organic carbon (NPOC)*
TIC	*Total inorganic carbon*	*POC*	*Purgeable organic carbon*
TOC	*Total organic carbon*	*DOC*	*Dissolved organic carbon*
DIC	*Dissolved inorganic carbon*	*2*	*Particulate organic carbon*
1	*Particulate inorganic carbon*		

Measurement method

The analyzer determines the TOC (total organic carbon) content of an aqueous sample. This is done through thermic catalytic combustion followed by NDIR (non-dispersive infrared) detection of the resulting CO2. The TOC parameter describes the total organic load of water, is an indicator of water quality and can serve as the basis for calculating wastewater charges.

The analyzer works with two interconnected circuits, the liquid circuit and the gas circuit, to determine TOC using the direct method. In the liquid circuit, the sample is fed into the analyzer where it can be optionally diluted in the event of high salt loads or TOC values. The sample is then acidified and the inorganic carbon is eliminated by purging (stripping). The sample is then passed through a rotating slit filter, in which the particulate solids are removed in compliance with DIN standards, and dosed into the combustion furnace. The sample is incinerated in the combustion furnace at 850 °C (1550 °F). The combustion gas is then cooled in stages and the CO2 content is determined in the NDIR detector. Using the "double-batch" method, the reactor and the gas circuit are flushed with CO2-free carrier gas prior to the next measurement and the baseline is determined while the next sample is prepared in the liquid circuit.

Measurement, calibration and adjustment

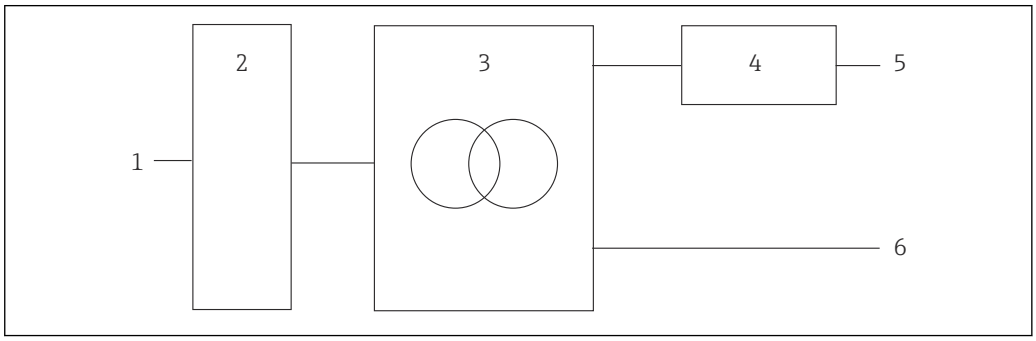
To monitor the measurement, a single-point calibration can be triggered externally or by a timer. A two-point adjustment can be used to adapt the analyzer to system changes.

Two-channel measuring principle

Two-channel measurement makes it possible to measure two different sample streams in a device, e.g. two inlets of a wastewater treatment plant. This option is recommended for sample streams with similar measuring ranges.

Measuring system

A complete measuring system comprises:
- Sample preparation system
- CO_2 scrubber
- Analyzer



2 Complete measuring system

1 Sample
2 Sample conditioning
3 Analyzer
4 CO_2 scrubber
5 Gas supply
6 Water supply

Dependability

Reliability

Heated salt trap

The heated salt trap option is used for easy maintenance in the case of samples with high salt loads. Incineration of these samples can lead to buildup on the catalyst and furnace and thus compromise the results.

With the heated salt trap, it is possible to remove salts from the furnace quickly and efficiently. This results in a dramatic increase in availability. Furthermore, operating costs are reduced through longer maintenance cycles and easy operation of the salt trap. The salt trap can be easily removed from the furnace, without having to switch off the furnace. The salts in the trap can be easily removed and the cleaned trap reattached.

pH-controlled acid dosing

One advantage of pH-controlled acid dosing is that only the quantity of acid needed to reach a pH value of 2.5 is added to the sample. Excess dosing does not occur. This reduces the amount of acid needed while also minimizing the salt that is released into the furnace through excess acid. In municipal wastewater treatment plants, the absence of humic acid precipitation is guaranteed. This rules out the potential for readings to be higher than expected.

Integrity

Double-batch method

With the patented double-batch method, the two circuits (water and gas) are linked. The aqueous sample stream is continuously prepared in the analyzer and fed into the furnace in batches. During measurement, the CO_2-containing gas is circulated and accumulated in the gas circuit. This makes it possible to record large sample volumes (1200 µl), which results in a high level of sensitivity. Once measurement is complete, the gas circuit is flushed with CO_2-free carrier gas and the baseline for the next measurement is determined.

Input

Measured variable

Total organic carbon (TOC)

Measuring range

- CA72TOC-A: 0.25 to 600 mg/l TOC
- CA72TOC-B: 1 to 2400 mg/l TOC
- CA72TOC-C: 2.5 to 6000 mg/l TOC
- CA72TOC-D: 5 to 12 000 mg/l TOC

With optional predilution, the measuring range can be expanded by a factor of 20.

Input signal

8 signal inputs 24 V DC, active, load max. 500 Ω

Input #1	Service, trigger calibration
Input #2	Service, trigger adjustment
Input #3	Service, trigger screen flush
Input #4	Service, trigger power flush
Input #5	Not assigned
Input #6	Not assigned
Input #7	Trigger standby
Input #8	Trigger channel switchover (optional)

Output

Output signal

Measuring channel 1

0/4 to 20 mA, galvanically isolated

Measuring channel 2 (optional)

0/4 to 20 mA, galvanically isolated

Signal on alarm

4 outputs:
- Limit value alarm
- Fault message
- Standby message
- Operational control

Floating, normally closed (max. 0.25 A / 50 V)

Load

Max. 500 Ω

Data interface

- RS 232 C, proprietary, for data output and remote operation (optional)
- USB

Power supply

Supply voltage

115/230 V AC, 50/60 Hz

Power consumption

800 VA

Fuses

Power distribution
2.5 A, slow-blow, design: fine-wire fuse 6.3 x 32

Relays
4 A per relay, slow-blow, design: TR5

Power unit
2 A, slow-blow, design: fine-wire fuse 5 x 20

Performance characteristics [1)]

Measured value resolution	1.1 %, resolution limit at 20 % of the measuring range (LDC) 4.6 %, resolution limit at 80 % of the measuring range (LDC)
Maximum measured error	0.4 %, systematic measured value deviation at 20 % of the measuring range (BIAS) 2.4 %, systematic measured value deviation at 80 % of the measuring range (BIAS)
Repeatability	0.4 %, repeatability precision at 20 % of the measuring range 1.6 %, repeatability precision at 80 % of the measuring range
Short-term drift	0.5 %/day
Limit of detection LOD	0.75 % of end of measuring range
Limit of quantification LOQ	2.5 % of end of measuring range

Installation

Mounting location

The analyzer can be mounted in three different ways:
- Bench mounting
- Wall mounting
- On a base frame

► Mount the device in such a way that it is also accessible from the rear for maintenance purposes.

Installation instructions

The analyzer requires a drain beneath the device.
► Use a 6/8 mm drain pipe made of PTFE. No backpressure should form in the drain.

Halogens or other vapors may not build up in enclosed spaces.
► Use an exhaust gas connection. No backpressure should form in the 4/6 mm exhaust gas hose.

► Avoid exposure to direct sunlight.

► Observe ambient conditions (technical data).

Compressed air and water supply

Compressed air supply

► Only use CO_2-free air to operate the analyzer.

The air must be dry and oil-free and must meet the following conditions:
- < 3 ppm CO_2
- < 3 ppm hydrocarbons
- Constant pressure of 2 bar (29 psi)
- Pressure tolerance ± 5 %

1) The performance characteristics have been determined in accordance with ISO 15839, Annex B. 300 µl of sample were metered into the CA72TOC-B1A0B1 per measurement. This resulted in a measuring range from 4 to 800 mg/l. The following data refer to this device. Slight deviations should be factored in if applying the performance characteristics to other measuring ranges.

The compressed air supply must be fitted with a CO_2 scrubber and a pressure regulator.
- Connection: 4/6 mm DN
- Required quantity of compressed air:
  - 600 l/h (21.2 ft^3/h) for the gas generator CO_2 adsorber (Domnick Hunter, inlet pressure 5 to 16 bar (73 to 232 psi))
  - 60 l/h (2.12 ft^3/h) for the soda-lime CO_2 scrubber (inlet pressure 4 to 10 bar (58 to 145 psi))

Water supply
A water connection is absolutely essential for the correct operation of the CA72TOC analyzer.
- The water is connected via a 6/8 mm DN or G3/8 coupling
- Pressure is between 2 and 4 bar (29 to 58 psi), except for the version with sample dilution
- Version with sample predilution:
  - Use deionized water (DI water) or drinking water with a water hardness level < 10 °dH (< 179 ppm $CaCO_3$).
  - Pressure 3 ± 0.2 bar (43.5 ± 3 psi)

Gas flow

Circuit gas
The flowmeter for the circuit gas is used to perform function checks and is set at the factory. The flow rate during operation is between 0.7 and 1.2 l/min (1.5 to 2.5 ft^3/h).

Carrier gas
The volume flow for the carrier gas is regulated using a precision restrictor. The flow is approx. 0.8 l/min (1.7 ft^3/h) at a pressure of 2 bar (29 psi).

Stripping gas
The volume flow for the stripping gas is regulated also using a precision restrictor. The flow is approx. 0.15 l/min (0.3 ft^3/h) at a pressure of 2 bar (29 psi).

Environment

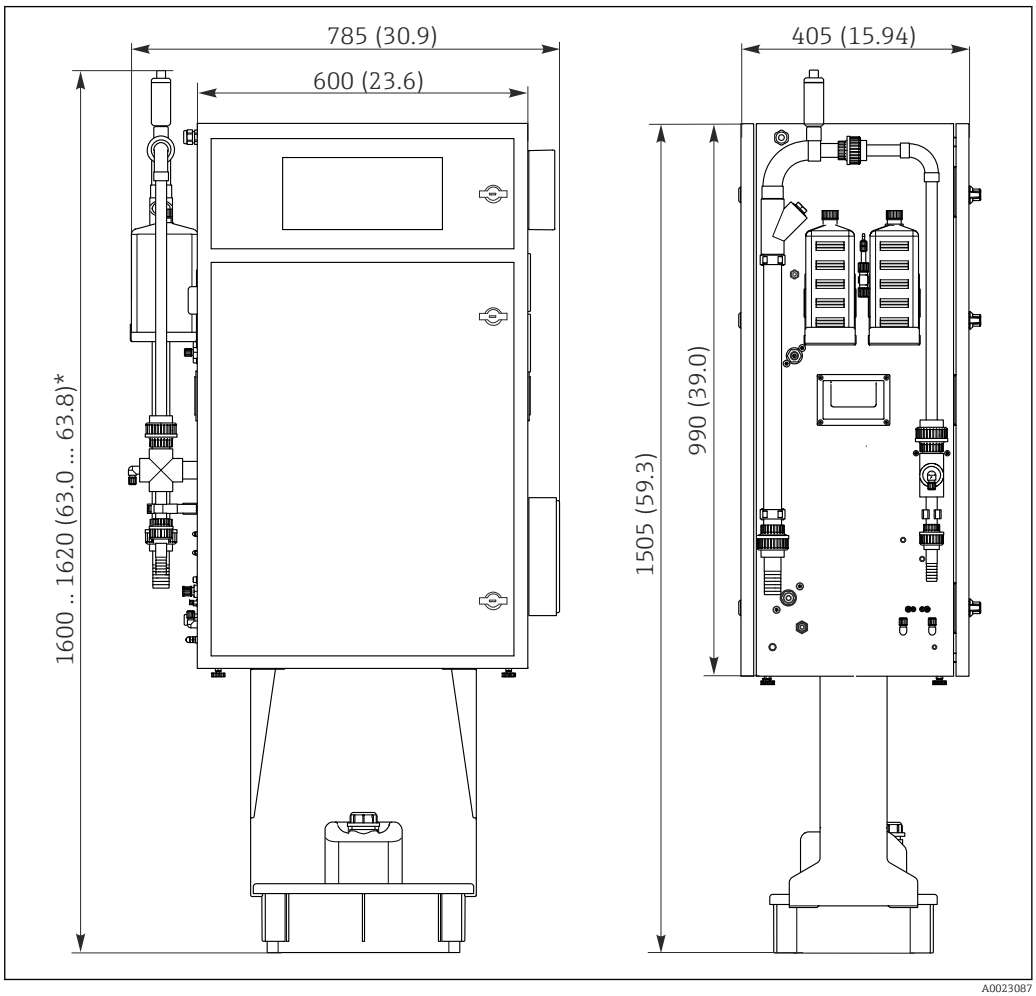
Ambient temperature range	+5 to 35 °C (41 to 95 °F)
Humidity	20 to 80 %, non-condensing
Degree of protection	IP54
Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326-1:2013, Class A for Industry

Process

Medium temperature range	4 to 40 °C (39 to 104 °F)
Medium pressure range	Non-pressurized infeed to the analyzer from sample preparation
Sample flow rate	20 ml/min (0.32 US gal/h)
Sample consistency	Water-based Flammable substances must not occur in combustible concentrations. Sample dilution is then necessary.
Sample feeder volume	90 ml (3 fl.oz)

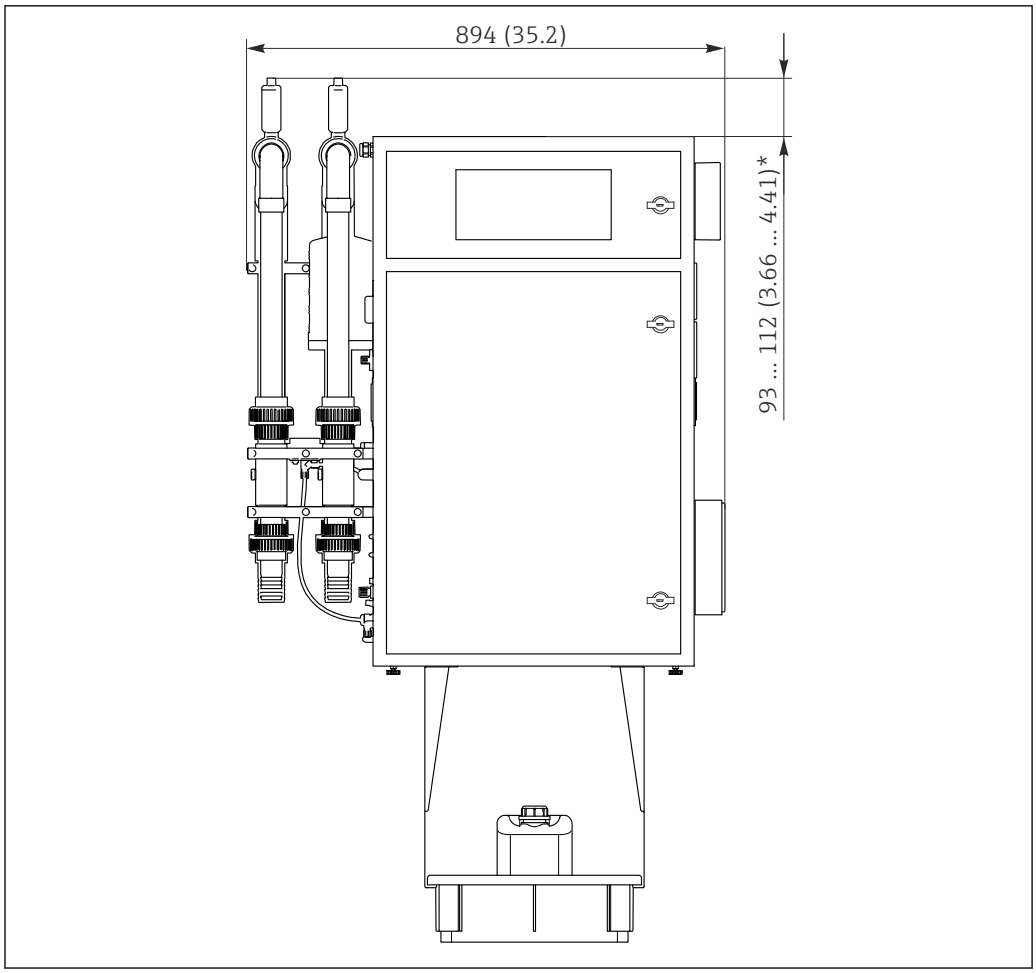
Mechanical construction

Design, dimensions



3 Dimensions in mm (in)

* *Depending on sample preparation*



4 *Dimensions in mm (in)*

* *Depending on sample preparation*

Weight

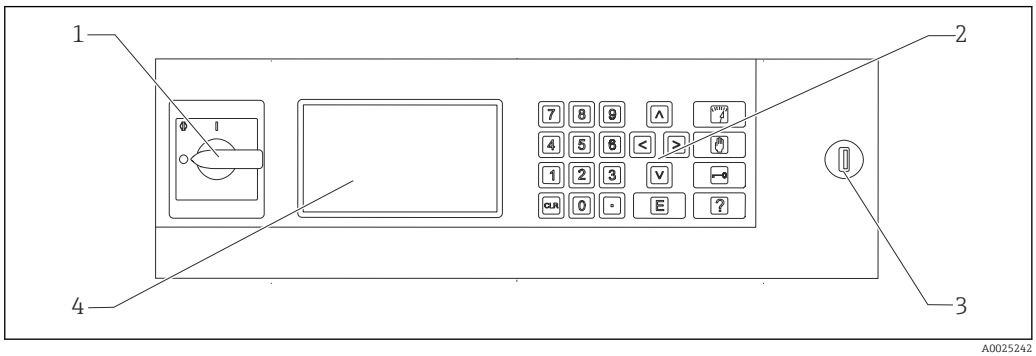
Approx. 75 kg (165 lbs)

Materials

Housing	Aluminum, powder-coated
Front window	Glass, conductive coating
Valve seals	EPDM, FPM, FFKM
Pump hoses	Ismaprene
Pump and pump seals	PTFE, FFKM
Reagent and sample hoses	PTFE, PE
Exhaust gas and ventilation hoses	PTFE, PE
Outflow hoses	PTFE

Operability

Local operation



5 *Operating elements*

1 *Main switch*
2 *Numerical keypad*
3 *USB port*
4 *Screen, 16 lines with 40 characters per line*

Certificates and approvals

Current certificates and approvals for the product are available via the Product Configurator at www.endress.com.

1. Select the product using the filters and search field.
2. Open the product page.

The **Configuration** button opens the Product Configurator.

Ordering information

Product page

www.endress.com/CA72TOC

Product Configurator

On the product page there is a **Configure** button to the right of the product image.

1. Click this button.
   ↳ The Configurator opens in a separate window.
2. Select all the options to configure the device in line with your requirements.
   ↳ In this way, you receive a valid and complete order code for the device.
3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.

For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

Scope of delivery

The scope of delivery comprises:
- 1 analyzer in the version ordered
- 1 accessories package for leak test
- Tool kit for glass ball and media removal
- Accessories for acid filter
- Accessories for commissioning the strip and separation chamber
- Accessories for combustion furnace maintenance
- Hose set
- 1 canister, 5 liter
- 2 canisters, 2 liter
- Set of cabinet keys

- 10 ml graduated cylinder
- Sponge cloth
- Protective goggles
- Gloves, acid-proof and base-proof
- Protective gloves, heat-resistant
- Silicone grease
- 1 x Operating Instructions

▶ If you have any queries:
Please contact your supplier or local sales center.

Accessories

The following are the most important accessories available at the time this documentation was issued.

▶ For accessories not listed here, please contact your Service or Sales Center.

Device-specific accessories

Retrofitting of dilution unit
- To be used in the event of high salt loads or high measured values
- Order number: 71189243

Retrofitting of salt trap, type II
- To be used in the event of high salt loads
- Order number: 71375329

Conversion of PA-2 to PA-3
- To be used with sample flow volumes of 0.1 – 1 m^3/h
- Order number: 71295866

Sample conditioning PA-9 PP
- Recommended for problematic wastewater due to its high chemical resistance properties (except in the case of oxidizing acids and halogens)
- Order number: 71101588

CO_2 scrubber, soda lime
- Can be used as a replacement for the Parker CO_2 adsorber
- Order number: 71232260

Pipe backflushing
- To be used in the event of severe deposit formation in the inlet from the bypass to the MV 1
- Order number: 71414592

Service-specific accessories

Reagent and parent solutions
- CAY450-V10AAE, 1000 ml stripping reagent for CA72TOC
- CAY451-V10C01AAE, 1000 ml parent solution (KHP) 5 000 mg/l TOC
- CAY451-V10C10AAE, 1000 ml parent solution (citric acid) 100 000 mg/l TOC

High-quality buffer solutions from Endress+Hauser - CPY20
The secondary buffer solutions have been referenced to primary reference material of the PTB (German Federal Physico-technical Institute) or to standard reference material of NIST (National Institute of Standards and Technology) according to DIN 19266 by a laboratory accredited by the DAkkS (German accreditation body) according to DIN 17025.
Product Configurator on the product page: www.endress.com/cpy20

System components

Kit CA72TOC heated salt trap
- For replacement for maintenance tasks (shortens the maintenance time) or as a substitute
- Order number: 71101532

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