

**PRODUCT INFORMATION**  
PROCESS ANALYSIS  
AMPEROMETRIC SENSORS



## Smart amperometric free chlorine, chlorine dioxide and ozone sensors

- **Stable measuring results thanks to flow optimisation**
- **Premounted flow cell, easy to install**
- **Special accessories for optimal operation**
- **Compatible with multi-parameter digital SC controllers**
- **Minimal maintenance with automatic cleaning**

### **Simple installation and operation**

The all-inclusive systems come pre-assembled on a panel. Just mount the panel in the desired location, install the sensors, and connect the controller to get started. There are no chemicals used for measurement. Membranes are premounted on retaining caps so the maintenance and the operational costs are minimal. Two years of typical maintenance items are included with the system.

### **Options for optimised operation**

For all amperometric sensors several accessories are available:

#### → **Acidification unit**

This can be used for sample pH adjustment or for cleaning. It is fully programmable.

#### → **Intermittent flow unit**

This free programmable unit reduces the amount of sample water which is sent to waste.



**LANGE** 

## Free chlorine

### Low detection limit for efficient residual chlorine monitoring

The 9184 sc amperometric free chlorine sensor has a detection limit of 5 ppb or 0.005 mg/l hypochlorous acid (HOCl). Together with pH and temperature measurements, free chlorine concentration is calculated using dissociation curves stored in the instrument.

### Wide measurement range

Due to its 0 to 20 ppm measurement range, the 9184 sc free chlorine sensor is particularly useful for drinking water distribution monitoring, chlorination applications, demineraliser systems or cooling water processes.

### Three forms of chlorine

Measurements are made continuously by the sensor and reported to the controller.

Depending on model, the 9184 sc sensor can measure:

- Hypochlorous acid (HOCl) only
- HOCl via acidification
- Total free chlorine (TFC) by measuring temperature and pH together with HOCl to calculate hypochlorite ions ( $\text{OCl}^-$ ). HOCl combined with  $\text{OCl}^-$  equals total free chlorine.

### Active chlorine operations

Active chlorine (HOCl) or hypochlorous acid is a powerful disinfectant – up to 100 times more efficient than hypochlorite ions.

- Total free chlorine (TFC) is composed of dissolved chlorine (at low pH values), hypochlorous acid gas, and

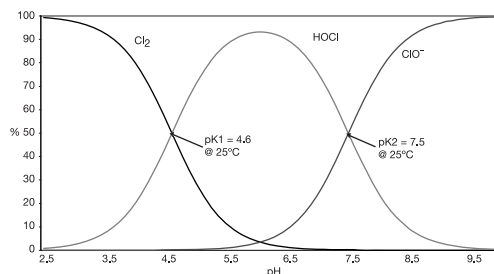


Fig. 1: Dissociation curve

hypochlorite ion ( $\text{ClO}^-$ ) coexisting in the sample.

Their relative proportion depends on pH and temperature (see figure 1 above).

- Total combined chlorine (TCC) results from the addition of total free chlorine and chloramines (mono-, di- and tri-chloramines).\*

\* 9184 sc does not measure TCC.

## Ozone

### Wide measurement range with few interferences

Bromine, chloramines, chlorine, chlorine dioxide, hydrogen peroxide, and pH do not interfere with ozone measurements when using the 9185 sc amperometric ozone sensor which can measure from 0 to 2 mg/l ozone.

### Ideal for low conductivity samples

The 9185 sc ozone system has a low minimum detection limit of 0.005 mg/l ozone. And because the amperometric cell is separated from the sample by the membrane and is immersed into an electrolytic medium, the

9185 sc ozone sensor is suitable for use in water with low conductivity.

### Ozone operations

Ozone is highly soluble in water – up to 13 times more soluble than oxygen. Ozone is also highly unstable in water with stability decreasing with increasing temperature.

Ozone reacts with hydroxide ions ( $\text{OH}^-$ ). As the concentration of  $\text{OH}^-$  increases (pH increases), reaction with ozone increases (see figure 2). The hydroxide ion  $\text{OH}^-$  is a by-product of

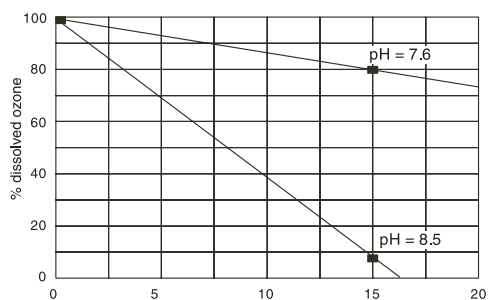


Fig. 2: Time of breakdown (mn) of dissolved ozone

ozone breakdown in water and the reaction between  $\text{OH}^-$  and  $\text{O}_3$  can be sustained until ozone is completely removed.

## Chlorine dioxide

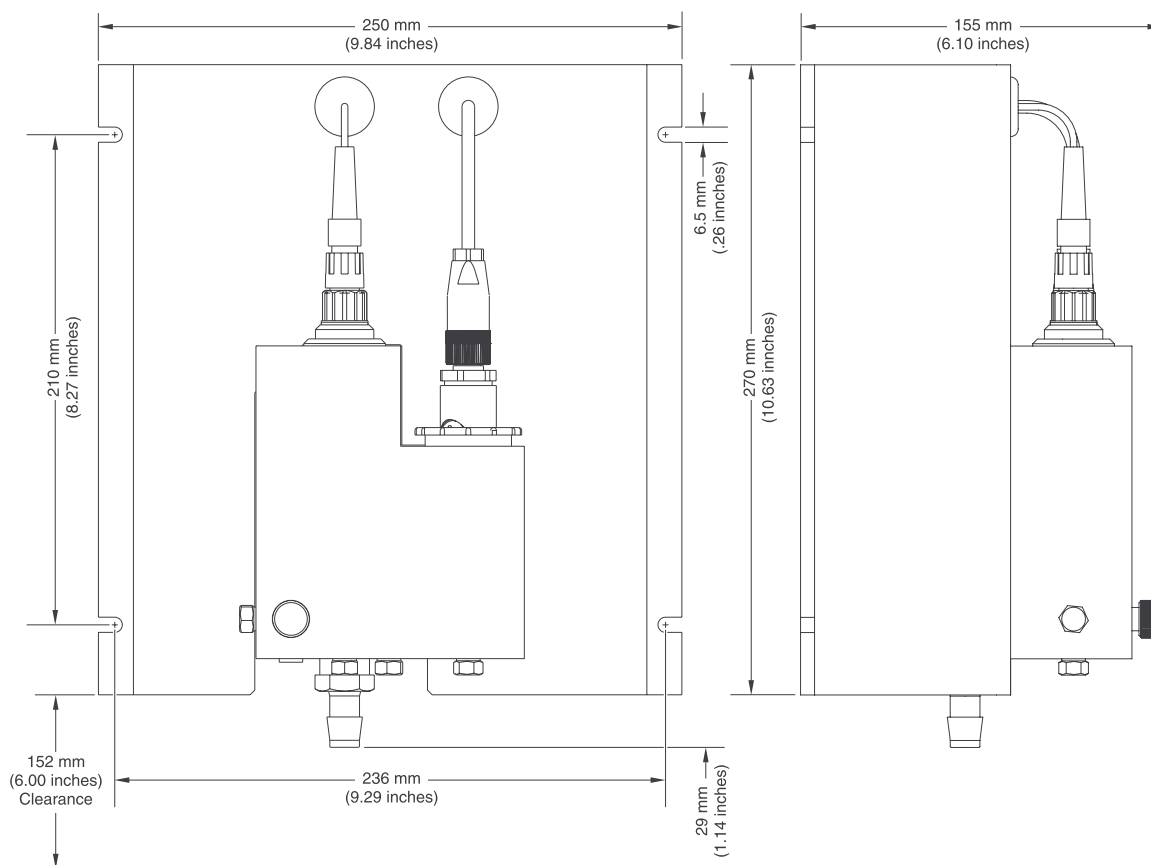
### Selective membrane avoids interference from chlorine

The 9187 sc amperometric chlorine dioxide sensor uses a membrane that is selective for chlorine dioxide molecules. There are no interferences from bromine, chlorine, or hydrogen peroxide.

The only potential interference is from ozone, which is rarely present in water treated with chlorine dioxide.

The oxidation potential of chlorine dioxide is 2.5 times higher than chlorine. It is relatively independent from the pH value and therefore suitable for disinfection of alkaline water.

The electrochemical reaction and diffusion through the membrane are temperature dependent. The measurement cell contains a temperature sensor for automatic temperature compensation to prevent measurement errors.



The sensor should be installed in an accessible location. It can be mounted on a flat, vertical surface (such as a panel, stand, etc.). It should allow for access for any checking or maintenance. Sample flow should meet the specifications on the last page.

**Note:** The optional pH probe is used for the 9184 sc free chlorine TFC sensor only.

**Technical data**

PARAMETER	9184 sc – FREE CHLORINE	9185 sc – OZONE	9187 sc – CHLORINE DIOXIDE
Measurement range	0 to 20 ppm (mg/l) as HOCl	0 to 2 ppm (mg/l) O <sub>3</sub>	0 to 2 ppm (mg/l) as ClO <sub>2</sub>
Minimum detection limit	5 ppb or 0.005 mg/l HOCl	5 ppb or 0.005 mg/l O <sub>3</sub>	10 ppb or 0.01 mg/l ClO <sub>2</sub>
Accuracy	2% or ±10 ppb HOCl, whichever is greater	3% or ±10 ppb O <sub>3</sub> , whichever is greater	5% or ±10 ppb ClO <sub>2</sub> , whichever is greater
Response time	90% in less than 90 seconds		
Measurement interval	Continuous		
Minimum flow rate	14 l/h (200 to 250 ml/min) auto-regulated by flow through cell		
Pressure range	0.1 to 2 bar in flow cell		
Sample temperature	2 °C to 45 °C		
Temperature compensation	Automatic over sample temperature range		
Sample pH	4 to 8 (acidification unit available for pH greater than 8)	–	–
Measurement technology	Amperometric/membrane		
Interferences	No interference from chloramines, chlorine dioxide and ozone interfere with measurement	No interference from bromine, chloramines, chlorine, chlorine dioxide, or hydrogen peroxide	Ozone
Mounting	Flat, vertical surface (panel, stand, etc.)		
Connections	Sample line: 1/4 inch O.D., drain line: 1/2 inch I.D. (supplied)		
Materials	Electrode: gold cathode/silver anode, measuring cell: acrylic, probe body: PVC		
Controller	SC 100 / SC 1000		Integrated
Environmental ratings	IP 66/NEMA 4X		
Dimensions	299 x 250 mm (11.77 x 9.84 inch)		

Subject to change without notice.

**Ordering information**

DESCRIPTION	ART. NO.
9184 sc free chlorine HOCl sensor	LXV430.99.00001
9184 sc free chlorine TFC sensor	LXV432.99.00001
9185 sc ozone sensor	LXV433.99.00001
9187 sc chlorine dioxide sensor	LXV434.99.00001
<b>ACCESSORIES</b>	
Digital extension cable 1 m (other lengths available)	61224-00
Digital termination box*	58670-00
9180 sc acidification unit	LZY051
9180 sc intermittent flow unit	LZY052
<b>REPLACEMENT PARTS</b>	
pH electrode	Z368416,00000
9184 sc electrode	Z09184=A=1001
- Premounted membranes, qty. 4	Z09184=A=3500
- Electrolyte	Z09184=A=3600
9185 sc electrode	Z09185=A=1000
- Premounted membranes, qty. 4	Z09185=A=3500
- Electrolyte	Z09185=A=3600
9187 sc electrode	Z09184=A=1001
- Premounted membranes, qty. 4	Z09187=A=3500
- Electrolyte	Z09187=A=3600

\* Required when the length of cable between the digital sensor and SC 100 or SC 1000 controller exceeds 100 m.

**HACH LANGE Services**

Ordering, information and advice:  
 UK: +44 (0)161 872 14 87  
 EU: +49 (0)2 11 52 88-0  
 IRL: +353(0)1 4602522



On-site support by our technical field staff.



Quality assurance, complete with standard solutions, instrument checks and test solutions.



www.hach-lange.com – up to date and secure, with downloads, information and shop.

**HACH LANGE GMBH & CO. KG**  
 Willstätterstraße 11  
 D-40549 Düsseldorf  
 Tel. +49 (0)2 11 52 88-0  
 Fax +49 (0)2 11 52 88-143  
 info@hach-lange.de  
 www.hach-lange.com

**HACH LANGE LTD**  
 Pacific Way  
 Salford  
 Manchester, M50 1DL  
 Tel. +44 (0)161 872 14 87  
 Fax +44 (0)161 848 73 24  
 info@hach-lange.co.uk  
 www.hach-lange.co.uk

**HACH LANGE LTD**  
 Unit 1, Chestnut Road  
 Western Industrial Estate  
 IRL-Dublin 12  
 Tel. +353 (0)1 460 25 22  
 Fax +353 (0)1 450 93 37  
 info@hach-lange.ie  
 www.hach-lange.ie

**HyXo Oy**

P.O. Box 16 (Palokorvenkatu 2)  
 FI-04261 Kerava, Finland  
 Tel. +358 10 417 4500  
 Fax +358 10 417 4501  
 hyxo@hyxo.fi • www.hyxo.com

**LANGE**