

# **ORBISPHERE Model C1100 Ozone Electrochemical Sensor**

USER MANUAL

July 2009, Revision A



**LANGE** 

UNITED FOR WATER QUALITY



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# Section 1 General Information

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## 1.1 Disclaimer

The information in this manual has been carefully checked and is believed to be accurate. However, Hach Lange assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will Hach Lange be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, Hach Lange reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

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## 1.2 Safety information

Please read the entire manual before unpacking, setting up, or operating this sensor.

Pay particular attention to all warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

### 1.2.1 Use of hazard information

#### **WARNING**

*A warning is used to indicate a condition which, if not met, could cause serious personal injury and/or death. Do not move beyond a warning until all conditions have been met.*

#### **CAUTION**

*A caution is used to indicate a condition which, if not met, could cause minor or moderate personal injury and/or damage to the equipment. Do not move beyond a caution until all conditions have been met.*

*Note: A note is used to indicate important information or instructions that should be considered before operating the equipment.*

### 1.2.2 Service and repairs





None of the sensor's components can be repaired by the user. Only personnel from Hach Lange or its approved representative(s) is (are) authorized to attempt repairs to the sensor and only components formally approved by the manufacturer should be used.

Any attempt at repairing the sensor in contravention of these principles could cause damage to the sensor and corporal injury to the person carrying out the repair. It renders the warranty null and void and could compromise the correct working of the sensor and the electrical integrity or the CE compliance of the sensor.


If you have any problems with installation, or using the sensor please contact the company that sold it to you. If this is not possible, or if the results of this approach are not satisfactory, please contact the Customer Service department of Hach Lange.

### 1.2.3 Precautionary labels

Read all labels and tags attached to the sensor. Personal injury or damage to the sensor could occur if not observed.

	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol indicates the need for protective hand wear.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with European local and national regulations, European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
	Products marked with this symbol indicates that the product contains toxic or hazardous substances or elements. The number inside the symbol indicates the environmental protection use period in years.

### 1.3 Product recycling information

	<p><b>ENGLISH</b></p> <p>Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.</p> <p><b>Note:</b> For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.</p>
<p><b>DEUTSCH</b></p> <p>Elektrogeräte, die mit diesem Symbol gekennzeichnet sind, dürfen in Europa nach dem 12. August 2005 nicht mehr über die öffentliche Abfallentsorgung entsorgt werden. In Übereinstimmung mit lokalen und nationalen europäischen Bestimmungen (EU-Richtlinie 2002/96/EC), müssen Benutzer von Elektrogeräten in Europa ab diesem Zeitpunkt alte bzw. zu verschrottende Geräte zur Entsorgung kostenfrei an den Hersteller zurückgeben.</p> <p><b>Hinweis:</b> Bitte wenden Sie sich an den Hersteller bzw. an den Händler, von dem Sie das Gerät bezogen haben, um Informationen zur Rückgabe des Altgeräts zur ordnungsgemäßen Entsorgung zu erhalten.</p>	
<p><b>FRANCAIS</b></p> <p>A partir du 12 août 2005, il est interdit de mettre au rebut le matériel électrique marqué de ce symbole par les voies habituelles de déchetterie publique. Conformément à la réglementation européenne (directive UE 2002/96/EC), les utilisateurs de matériel électrique en Europe doivent désormais retourner le matériel usé ou périmé au fabricant pour élimination, sans frais pour l'utilisateur.</p> <p><b>Remarque:</b> Veuillez vous adresser au fabricant ou au fournisseur du matériel pour les instructions de retour du matériel usé ou périmé aux fins d'élimination conforme.</p>	
<p><b>ITALIANO</b></p> <p>Le apparecchiature elettriche con apposto questo simbolo non possono essere smaltite nelle discariche pubbliche europee successivamente al 12 agosto 2005. In conformità alle normative europee locali e nazionali (Direttiva UE 2002/96/EC), gli utilizzatori europei di apparecchiature elettriche devono restituire al produttore le apparecchiature vecchie o a fine vita per lo smaltimento senza alcun costo a carico dell'utilizzatore.</p> <p><b>Nota:</b> Per conoscere le modalità di restituzione delle apparecchiature a fine vita da riciclare, contattare il produttore o il fornitore dell'apparecchiatura per un corretto smaltimento.</p>	
<p><b>DANSK</b></p> <p>Elektriske apparater, der er mærket med dette symbol, må ikke bortskaffes i europæiske offentlige affaldssystemer efter den 12. august 2005. I henhold til europæiske lokale og nationale regler (EU-direktiv 2002/96/EF) skal europæiske brugere af elektriske apparater nu returnere gamle eller udtjente apparater til producenten med henblik på bortskaffelse uden omkostninger for brugeren.</p> <p><b>Bemærk:</b> I forbindelse med returnering til genbrug skal du kontakte producenten eller leverandøren af apparatet for at få instruktioner om, hvordan udtjente apparater bortskaffes korrekt.</p>	

### SVENSKA

Elektronikutrustning som är märkt med denna symbol kanske inte kan lämnas in på europeiska offentliga sopstationer efter 2005-08-12. Enligt europeiska lokala och nationella föreskrifter (EU-direktiv 2002/96/EC) måste användare av elektronikutrustning i Europa nu återlämna gammal eller uttrangerad utrustning till tillverkaren för kassering utan kostnad för användaren.

**Obs!** Om du ska återlämna utrustning för återvinning ska du kontakta tillverkaren av utrustningen eller återförsäljaren för att få anvisningar om hur du återlämnar kasserad utrustning för att den ska bortskaffas på rätt sätt.

### ESPAÑOL

A partir del 12 de agosto de 2005, los equipos eléctricos que lleven este símbolo no deberán ser desechados en los puntos limpios europeos. De conformidad con las normativas europeas locales y nacionales (Directiva de la UE 2002/96/EC), a partir de esa fecha, los usuarios europeos de equipos eléctricos deberán devolver los equipos usados u obsoletos al fabricante de los mismos para su reciclado, sin coste alguno para el usuario.

**Nota:** *Sírvase ponerse en contacto con el fabricante o proveedor de los equipos para solicitar instrucciones sobre cómo devolver los equipos obsoletos para su correcto reciclado.*

### NEDERLANDS

Elektrische apparatuur die is voorzien van dit symbool mag na 12 augustus 2005 niet meer worden afgevoerd naar Europese openbare afvalsystemen. Conform Europese lokale en nationale wetgeving (EU-richtlijn 2002/96/EC) dienen gebruikers van elektrische apparaten voortaan hun oude of afgedankte apparatuur kosteloos voor recycling of vernietiging naar de producent terug te brengen.

**Nota:** *Als u apparatuur voor recycling terugbrengt, moet u contact opnemen met de producent of leverancier voor instructies voor het terugbrengen van de afgedankte apparatuur voor een juiste verwerking.*

### POLSKI

Sprzęt elektryczny oznaczony takim symbolem nie może być likwidowany w europejskich systemach utylizacji po dniu 12 sierpnia 2005. Zgodnie z europejskimi, lokalnymi i państwowymi przepisami prawa (Dyrektywa Unii Europejskiej 2002/96/EC), użytkownicy sprzętu elektrycznego w Europie muszą obecnie przekazywać Producentowi stary sprzęt lub sprzęt po okresie użytkowania do bezpłatnej utylizacji.

**Uwaga:** *Aby przekazać sprzęt do recyklingu, należy zwrócić się do producenta lub dostawcy sprzętu w celu uzyskania instrukcji dotyczących procedur przekazywania do utylizacji sprzętu po okresie użytkowania.*

### PORTUGUES

Qualquer equipamento eléctrico que ostente este símbolo não poderá ser eliminado através dos sistemas públicos europeus de tratamento de resíduos sólidos a partir de 12 de Agosto de 2005. De acordo com as normas locais e europeias (Directiva Europeia 2002/96/EC), os utilizadores europeus de equipamentos eléctricos deverão agora devolver os seus equipamentos velhos ou em fim de vida ao produtor para o respectivo tratamento sem quaisquer custos para o utilizador.

**Nota:** *No que toca à devolução para reciclagem, por favor, contacte o produtor ou fornecedor do equipamento para instruções de devolução de equipamento em fim de vida para a sua correcta eliminação.*



## 1.4 Product disposal

*Note: The following only applies to European customers.*

Hach Lange is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) that came into force on August 13 2005 aims to reduce the waste arising from electrical and electronic equipment; and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment.



In conformity with European local and national regulations (EU Directive 2002/96/EC stated above), electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

Hach Lange will offer to take back (**free of charge to the customer**) any old, unserviceable or redundant analyzers and systems which carry the above symbol, and which were originally supplied by Hach Lange. Hach Lange will then be responsible for the disposal of this equipment.

In addition, Hach Lange will offer to take back (**at cost to the customer**) any old, unserviceable or redundant analyzers and systems which do not carry the above symbol, but which were originally supplied by Hach Lange. Hach Lange will then be responsible for the disposal of this equipment.

Should you wish to arrange for the disposal of any piece of equipment originally supplied by Hach Lange, please contact your supplier or our After Sales Service department in Geneva for instructions on how to return this equipment for proper disposal.

### 1.5 Restriction of hazardous substances (RoHS)

The European Union RoHS Directive and subsequent regulations introduced in member states and other countries limits the use of six hazardous substances used in the manufacturing of electrical and electronic equipment.

Currently, monitoring and control instruments do not fall within the scope of the RoHS Directive, however Hach Lange has taken the decision to adopt the recommendations in the Directive as the target for all future product design and component purchasing.



This product is compliant with the European Union RoHS Directive.

**Note:** The following only applies to exports of this product into the People's Republic of China.



含有有毒或者危险物质及成分的产品。

环保使用期限标记（年）

有毒或者危险物质和成分						
部件名称	铅	汞	镉	六价铬	多溴联苯	多溴联苯醚
Connector socket	X					
Central tube	X					
Support guard	X					

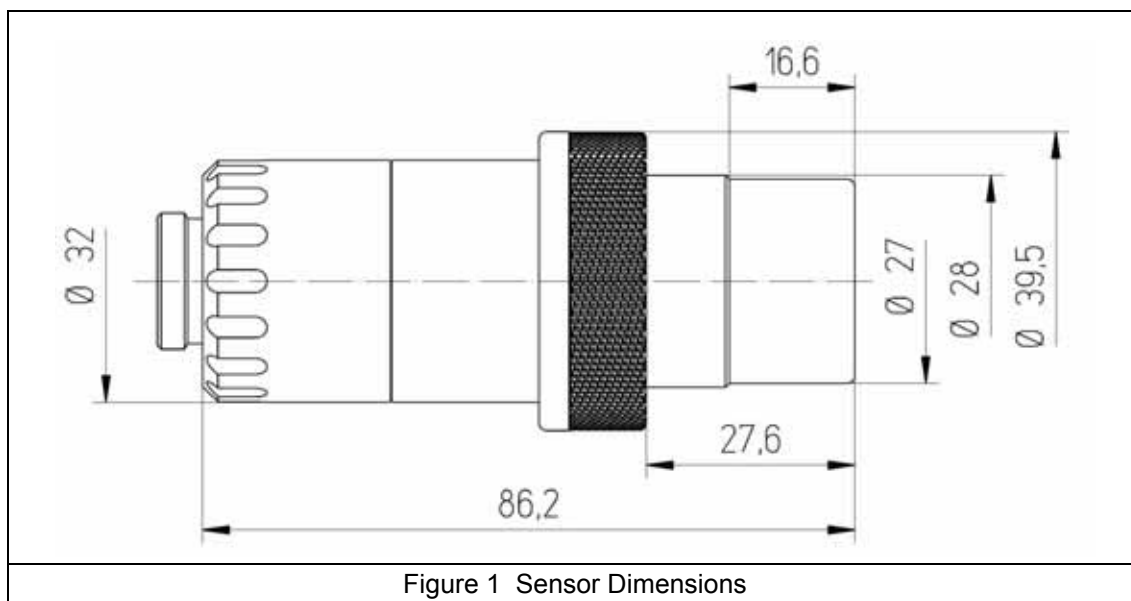
O: 表示所有此类部件的材料中所含有毒或危险物质低于限制要求  
X: 表示至少有一种此类部件材料中所含有毒或危险物质高于限制要求

## Section 2 Technical Specifications

Specifications are subject to change without notice.

### 2.1 Sensor weight and dimensions

The sensor weight is approximately 300 grams.



### 2.2 Sensor configuration

The standard sensor configurations for Beverage, Pharmaceutical and Life Science applications are:

Sensor	Membrane Cartridge	Protection Cap
C1100-S00	2956A-C	33051-SG
C1100-T00	29552A-C	33051-TG

**Note:** Sensors are delivered with one protection cap with grille as standard.

## 2.3 Sensor membrane specifications

### 2.3.1 Ozone sensors

<b>Table 1 Membrane specifications - Ozone sensors</b>		
	<b>2956A</b>	<b>29552A</b>
Recommended applications	Trace measurement	High concentration (> 1 mg/l)
Material	PFA	PTFE
Thickness [μm]	25	50
Calibration gas	Span gas or air	
Dissolved measurement range	0 ppb to 50 ppm	0 ppb to 200 ppm
Accuracy	The greater of ±1% of reading (± 5% for sensors calibrated in air) or ± 0.4 ppb, or ±1 Pa	The greater of ±1% of reading (± 5% for sensors calibrated in air) or ± 20 ppb, or ± 4 Pa
Expected current in air @ 1 bar 25°C [μA]	25.3	6.5
Temp. compensation range	– 5 to 45° C	
Temp. measuring range	– 5 to 100° C	
Response time <sup>1</sup>	25 sec.	6 min.
Recommended min. liquid flow rate <sup>2</sup> [mL/min]	350 <sup>3</sup>	100 <sup>3</sup>
Recommended min. linear flow rate <sup>2</sup> [cm/sec]	30	10

<sup>1</sup> Response time at 25°C for a 90% signal change

<sup>2</sup> Liquid flow through an ORBISPHERE 32001 flow chamber, with protection cap and no grille

<sup>3</sup> These flow rates take into account the decomposition of ozone in the tubing between the line and the flow chamber (theoretical flow rates in the absence of decomposition would be 10 times less)

## Section 3 Introduction

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### 3.1 What you have received

#### 3.1.1 C1100 electrochemical sensor

The sensor may be delivered separately or as part of an ORBISPHERE system, depending on the individual order.



Figure 2 C1100-S00 sensor with storage cap

The sensor (as illustrated in [Figure 2](#) above) will be delivered fitted with a plastic screw-on storage cap to protect the sensor head. This is held in place with a plastic collar for the C1100-S00 sensor, or a stainless steel collar for the C1100-T00 sensor.

A plastic screw-on base is also provided to protect the connection socket, and which also provides a suitable stand for the sensor during maintenance procedures, and when not in use.

**Note:** The sensor will be delivered without a pre-mounted membrane. This will be contained in the sensor recharge kit which is ordered separately.

#### 3.1.2 Protection caps



Figure 3 Protection cap

One protection cap with grille (part number 33051-SG as illustrated in [Figure 3](#) above) will be delivered as standard with each sensor.

### 3.1.3 Sensor recharge kit

A recharge kit (as illustrated in [Figure 4](#) below) should have been ordered with the sensor as this will be required to initially make the sensor operational. It is also required for sensor cleaning and membrane replacement procedures.

**Note:** The recharge kit for ozone has a **green** sticker on the front of the box.



The kit contains:

- four recharge cartridges with pre-mounted membrane and electrolyte. The type of membrane mounted in the cartridge will be specific to the kit ordered
- two anode cleaning tools
- two cathode cleaning tools
- a set of five cotton washers
- a set of replacement O-rings
- a set of replacement Dacron® mesh patches



The black anode cleaning tool ([Figure 5](#) left) is used to clean the anode of any deposits or residue that may have formed. It is doubled-ended so it can be used for two membrane replacement processes, each end being used once.

The small grey cathode cleaning tool ([Figure 5](#) right) is used for nitric acid cleaning of the cathode.

The cotton washers provide additional protection against the formation of deposits and residue on the center electrode and anode, which prolongs the time period required between sensor maintenance.

The Dacron® mesh patches provide protection to the membrane.

### 3.2 Sensor components

The following illustration shows the assembled sensor with the storage cap and sensor collar removed and the exploded view of the main sensor components. To remove the storage cap, you will first have to unscrew and remove the sensor base.

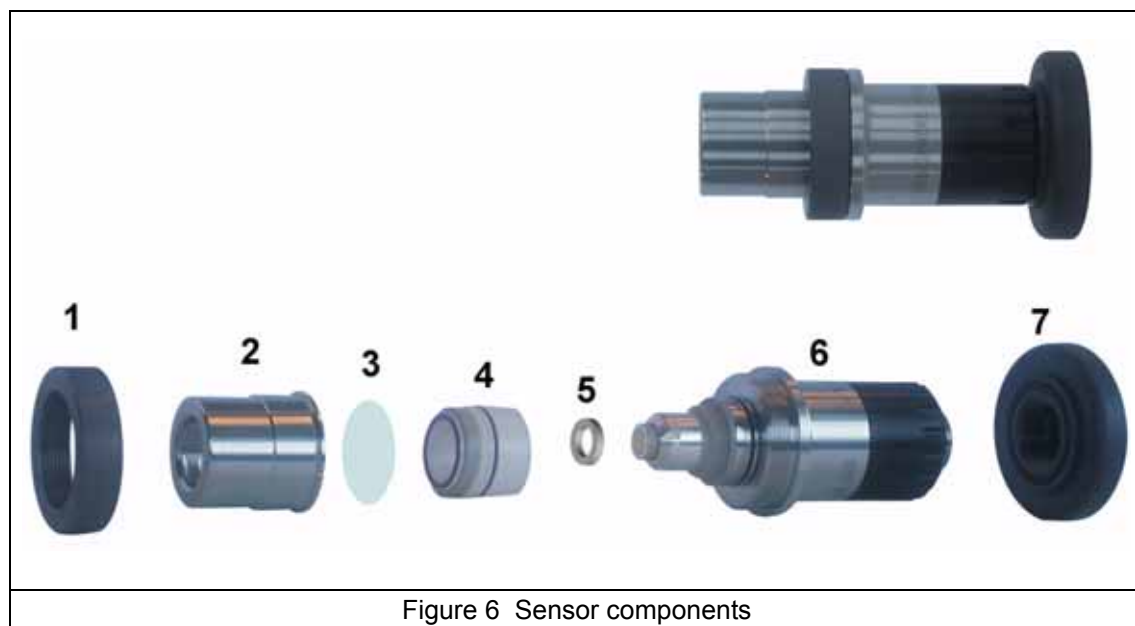


Figure 6 Sensor components

1 - Protection cap locking washer	5 - Cotton washer
2 - Protection cap	6 - Sensor body
3 - Dacron® mesh patch	7 - Plastic base
4 - Cartridge containing electrolyte and membrane	

### 3.3 Basic principle of operation

In its simplest form, the electrochemical sensor consists of one center electrode (cathode) and one counter electrode (anode) immersed in an electrolyte solution which is separated from the liquid sample by a gas permeable membrane. An electronic circuit is linked to the anode and cathode. Through an applied voltage, current will flow between the anode and the cathode.

A guard ring electrode surrounds the center electrode in order to reduce the influence of other gases on the center electrode, and therefore improving analysis stability. The sensor head is covered with a protection cap to protect the membrane.

Ozone penetrating through the membrane into the cell reacts with the electrolyte which then undergoes a reaction at the cathode, causing a measurable electric current to flow. This current is proportional to the amount of gas entering the cell, which in turn is proportional to the partial pressure of gas in the sample outside the cell.

The result is shown as gas concentration, which can then be displayed with a choice of several measuring units, according to instrument setup.

The sensor also includes “smart sensor technology”, implemented using an RS485 interface.

The sensor electronics perform four functions:

- Apply constant voltage to the anode
- Measure the current flowing through the sensor
- Compensate for temperature variation in the liquid sample
- Convert the cell's electric current into an analog signal for sensor output





## Section 4 Installation

### 4.1 Sensor preparation

Your C1100 electrochemical sensor has been thoroughly cleaned and tested at the factory before shipment. It has been shipped with a cartridge containing a membrane and electrolyte pre-installed to protect the sensor head. This cartridge must be removed and replaced with a new one prior to first use to make it fully operational. The new cartridge is included in the sensor recharge kit (see additional details in [Sensor recharge kit on page 12](#)). You will also need one of the mesh patches included with the kit.


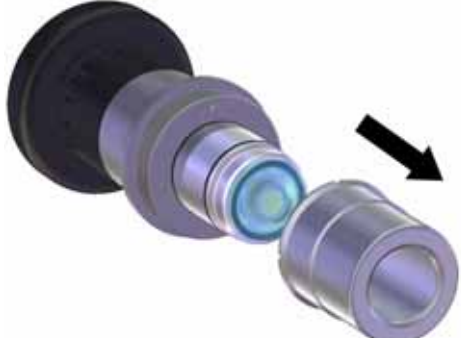
The following instructions detail the steps required to make the sensor operational. Should you have any questions, your Hach Lange representative will be pleased to help.



#### **CAUTION**

**Avoid all eye and skin contact with the electrolyte in the sensor and replacement cartridge. If eyes or skin come into contact with electrolyte, rinse immediately with water. In addition, the electrolyte can permanently stain clothing so exercise care in handling. It is highly recommended to wear protective gloves and glasses during this process.**

**Note:** It is advisable to perform this procedure with the plastic sensor base installed so as to avoid any damage to the connection socket and also to provide a suitable stand for the sensor when required.




<p>1. Hold the main body of the sensor and unscrew the protection cap locking washer by turning counter-clockwise. Remove it from the sensor and put to one side.</p>	
<p>2. Pull/twist off the protection cap and put to one side. Remove the Dacron® mesh from inside the cap and discard it.</p>	


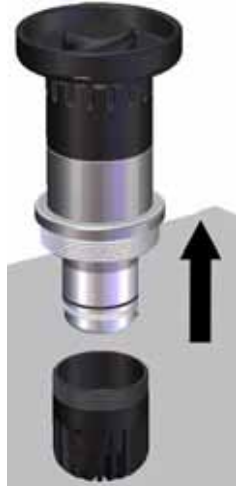

3. Hold the sensor with the membrane facing down to avoid spilling any electrolyte, then carefully unscrew the shipment cartridge. Drain the old electrolyte into a sink and flush away. Discard the shipment cartridge and membrane.
4. Remove the cotton washer from the top of the anode and discard.






5. Rinse the sensor head under a tap for 15 seconds, aiming the jet of water directly onto the sensor head.
6. Do not dry the center electrode area, as the gap between cathode and guard should be left filled with water.



<p><b>Note:</b> During this next step, it is very important to ensure your finger does <b>not</b> come into contact with the cathode (golden surface) as it could leave greasy deposits on the surface.</p> <p>7. Take a new cotton washer from the recharge kit. Hold it between thumb and forefinger and position it on top of the anode as illustrated right.</p>	
<p>8. Place the recharge cartridge container on a flat work surface and, keeping the container upright to avoid spilling any of the electrolyte inside, carefully unscrew the top.</p> <p>9. Remove the packing component from the center of the cartridge, making sure that the O-ring on top of the cartridge remains in place. If it comes away then replace it before continuing.</p> <p>10. If there are any visible bubbles in the electrolyte, remove them using a stirring motion with the packing component.</p>	
<p>11. Hold the container steady between thumb and forefinger of one hand.</p> <p>12. Lower the sensor into the container until the top of the anode is covered with electrolyte.</p> <p>13. Leave for a few seconds to ensure the cotton washer has fully absorbed some of the electrolyte and that it is no longer dry.</p>	

<p>14. Gently screw the sensor clockwise into the replacement cartridge, applying minimum pressure to avoid any damage to the screw threads.</p>	
<p>15. Continue turning until the cartridge is attached to the sensor, and the sensor is automatically released from the container.</p> <p>16. The empty container, the screw top and packing component can be discarded.</p> <p><i>Note: It is normal that some of the electrolyte will overflow from the replacement cartridge and into the plastic container.</i></p>	
<p>17. Rinse the sensor under a tap for about 5 seconds to remove any excess electrolyte, then gently wipe with a soft tissue to ensure all parts are completely dry.</p> <p>18. Drain the overflow electrolyte from the container into a sink and flush away.</p> <p>19. Discard the used container.</p>	

<p>20. Take a new Dacron® mesh patch from the box of O-rings in the recharge kit.</p> <p>21. Place the mesh in the center of the protection cap. It is very important that the mesh is in the center of the protection cap and covering the entire grille.</p> <p>22. Lower the sensor onto the protection cap making sure not to disturb the mesh.</p>	
<p>23. Push the protection cap firmly into place, making sure one of the four slots in the protection cap fits over the small locking pin (highlighted right). If it is necessary to turn the protection cap to fit over the locking pin, ensure you only turn it <b>clockwise</b> to avoid unscrewing the cartridge.</p>	
<p>24. Finally, screw the protection cap locking washer back into place in a clockwise motion, and tighten finger tight.</p>	

### 4.2 Sensor installation

#### 4.2.1 Sensor positioning information

The sensor must be installed in a socket or flow chamber that allows contact with the sample fluid to be analyzed.

The sensor and measuring instrument are connected by a cable and two 10-pin connectors. The standard sensor cable length is 3 meters though extension cables of up to 1000 meters are available. However, smart sensor technology is only available with distances of up to a maximum of 750 meters.

Ensure that the sensor will be mounted:

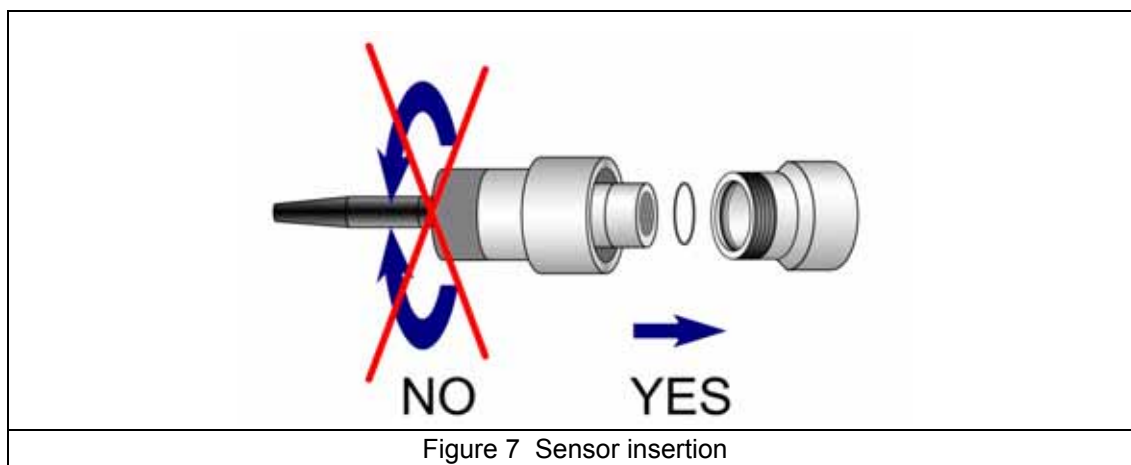
- perpendicular to the pipe
- horizontal
- on a horizontal pipe section (or on flow-ascending vertical pipe)
- minimum of 15 meters away from the pump's discharge side
- in a place where the sample flow is stable and rapid, and as far as possible from:
  - valves
  - pipe bends
  - the suction side of any pumps
  - a CO<sub>2</sub> injection system or similar

**Note:** There may be situations where not all the above conditions can be met. If this is the case, or you have any concerns, please consult your Hach Lange representative to appraise the situation and define the best applicable solution.

#### 4.2.2 Sensor insertion

- Insert the sensor straight into the flow chamber or socket. Do not twist the sensor.
- Hand tighten the attaching collar.
- Connect the sensor cable.
- Check for leaks; replace O-rings if product leaks are visible.

**Micro Volume Flow Chambers:**



**Note:** Do not twist the sensor when inserting it into a micro volume flow chamber. This rotation may twist the membrane holding ring, thus changing the membrane position. This can modify the membrane measuring conditions, and affect measurement precision.

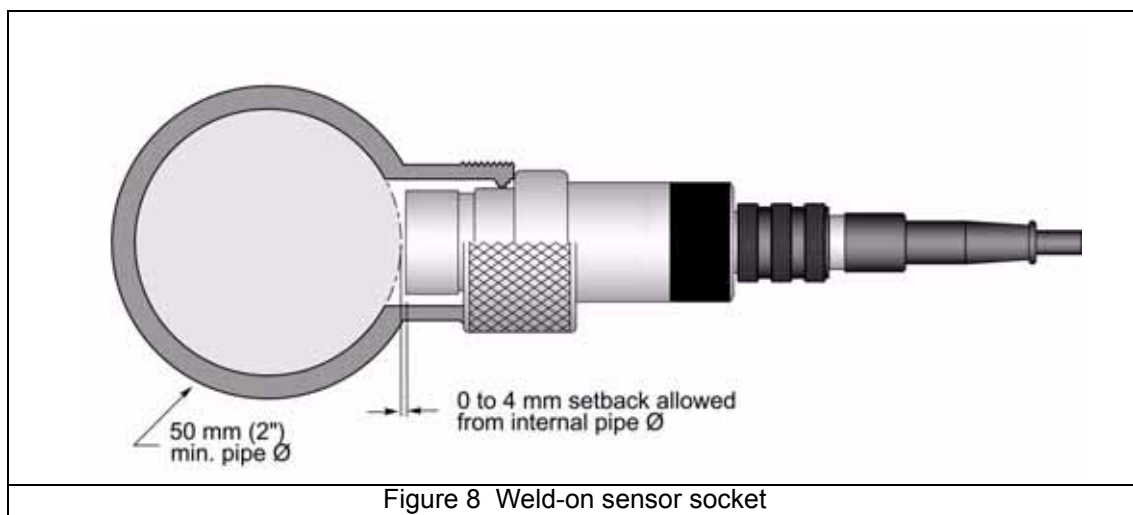
### 4.2.3 Sensor removal

- If not using the ORBISPHERE 32003 insertion/extraction valve (see details [on page 22](#)) you will need to shut off the sample flow and drain the sampling circuit of liquid.
- Remove the sensor cable connected at the sensor end.
- Hold the sensor body in one hand to avoid rotation, and unscrew the collar with the other hand.
- Pull the sensor straight out of the socket or flow chamber.
- Install the sensor storage cap and sensor base (to protect the connection).

## 4.3 Mounting accessories

### 4.3.1 Weld-on stainless steel socket

The ORBISPHERE 29501 weld-on sensor socket can be used to install a sensor into a stainless steel pipe (min.  $\varnothing$  50 mm or 2"). When welding the socket to the pipe, check that setback between the pipe's inner diameter and the sensor tip does not exceed 4 mm (see [Figure 8](#)).

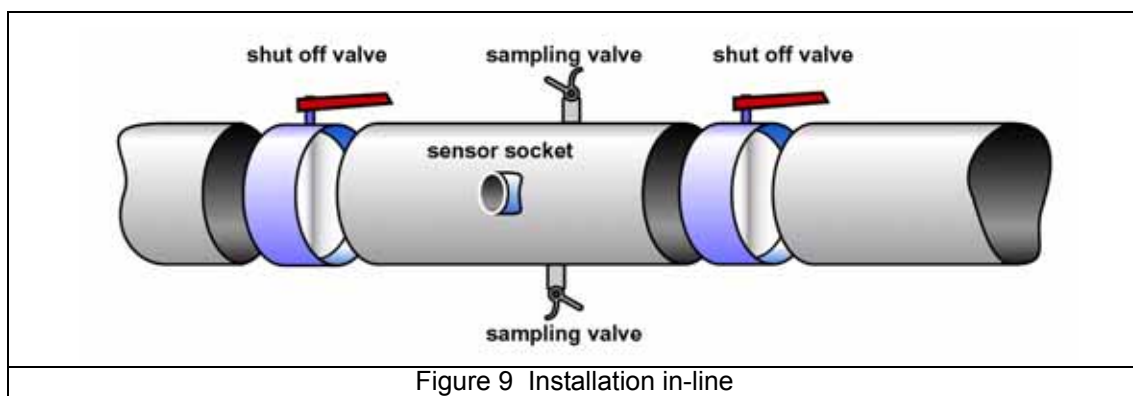


**Note:** Be sure to remove the two O-rings from the socket before welding and leave the sensor's stainless steel cap screwed on during welding to prevent thread distortion.

**Recommendation:**

To facilitate sensor removal and installation, we suggest installing the socket in a location where the liquid can be drained quickly and easily. By creating a one meter long piece of pipe (see [Figure 9 on page 21](#)) with shut off valves at both ends, just a small volume of liquid needs to be drained to enable sensor removal.

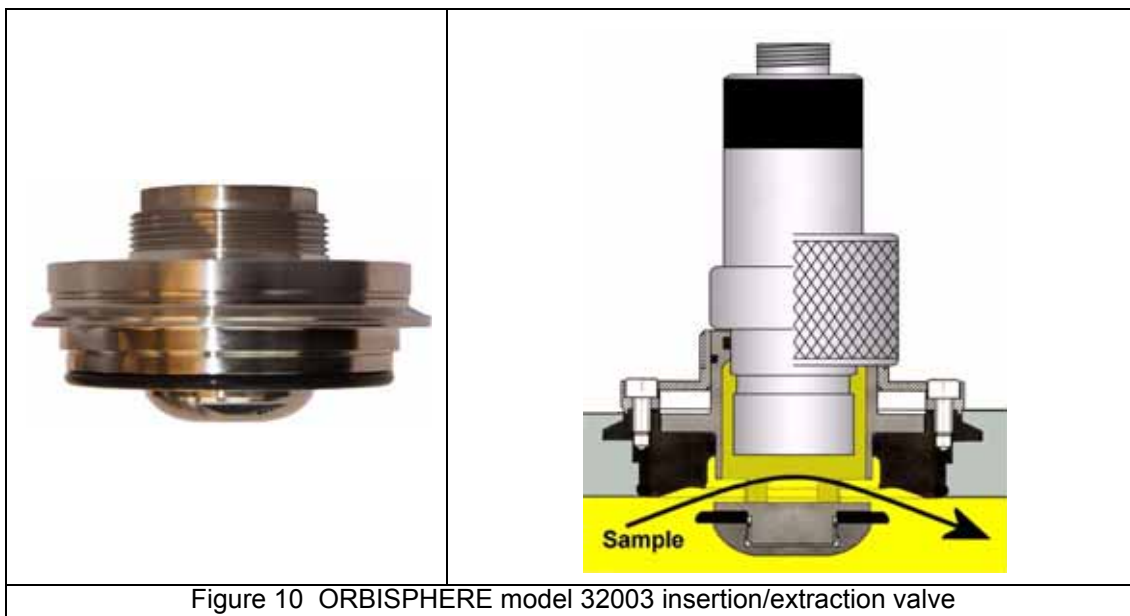
Also, a precise sensor and socket installation can be performed in the workshop, and which can then be placed in the production line with minimal down time.



### 4.3.2 The 32003 insertion/extraction valve

The ORBISPHERE 32003 insertion/extraction valve (illustrated below) allows for sensor removal and installation without having to drain the fluid in the line. It can withstand a pressure of up to 20 bars, with the sensor in place or not.

Sensor insertion is made by inserting the sensor into the housing and tightening the retaining collar until it stops. As the retaining collar is tightened, the valve will open to allow the sample to flow past the sensor head. Remove the sensor by unscrewing the collar and pulling the sensor out. As the collar is unscrewed, the valve will automatically close to avoid any sample spillage.



The diagram above right, shows the sensor in a sample line with the valve open allowing the sample to run past the sensor head.

### 4.3.3 The 33095 sensor housing

The ORBISPHERE 33095 sensor housing is also available for use with the C1100 sensor but requires that the sample flow be turned off prior to insertion or removal of the sensor.

Sensor insertion is made by inserting the sensor into the housing and tightening the retaining collar until it stops. Removal is made by unscrewing the collar and pulling the sensor out. Be sure that the sample flow has been turned off before inserting or removing the sensor.

### 4.3.4 Tuchenhausen Varivent® in-line access unit

The following illustration shows the Tuchenhausen Varivent® In-Line Access Unit.



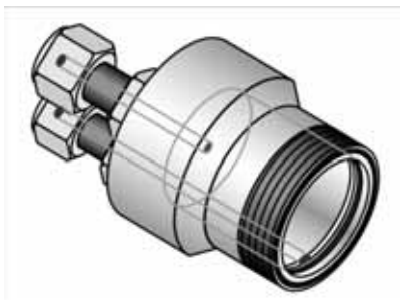
Purchasing a Tuchenhausen Varivent® in-line access unit, or an equivalent fitting with a 68 mm flange diameter from the fitting manufacturer, is required to make use of the ORBISPHERE model 32003 sensor housing device detailed above.

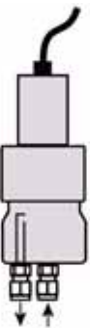


### 4.3.5 ORBISPHERE flow chambers

The ORBISPHERE 32001.xxx flow chambers are used to draw liquid samples past the sensor. They are available in several materials, depending on the application.

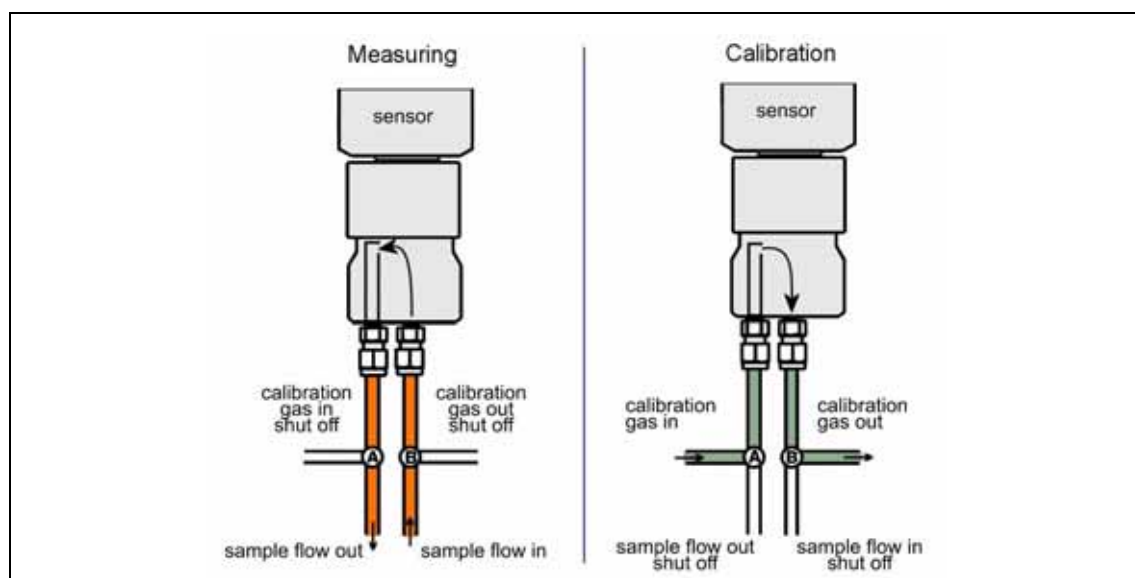
They connect to 6-mm or 1/4" stainless steel tubing by means of two Swagelok™ fittings. If necessary, copper or plastic tubing with low permeability can be substituted. Stainless steel tubing is normally enough to hold the assembly in place, but for a more stable installation, a large U-bolt can be used to mount the flow chamber to a support.

	<p>Dimensions of sensor and flow chamber assembly :</p> <ul style="list-style-type: none"> <li>• Width: 50 mm</li> <li>• Height: 210 mm</li> </ul> <p>(add 100 mm for connection length)</p>
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Orientation of flow chamber	
<p>Vertically, with connections down and sensor up</p> <ul style="list-style-type: none"> <li>- Center connection is the inlet</li> <li>- Outer connection is the outlet</li> </ul>	

The connection diagram below is a recommended installation that allows for measuring and calibrating without having to disconnect a line manually. "A" and "B" represent 3-way valves.

For measuring, calibration gas inlets and outlets are shut off. During calibration, the flow is reversed to drive the remaining sample out. The calibration gas enters at the "sample out" port and exits at the "sample in" port, as shown.





## Section 5 Maintenance and Troubleshooting

### 5.1 Maintenance

It is recommended to perform standard maintenance on the sensor about once every six months, though this will vary depending on the application. This involves sensor membrane replacement and head cleaning as described in [Membrane replacement and sensor head cleaning](#) below.

Using the ORBISPHERE 32301 cleaning and regeneration center in addition to the standard maintenance will allow for a noticeably extended sensor life (see details in [Troubleshooting on page 35](#)).

Finally, there is the option of cleaning the sensor with Nitric Acid, as over time the sensor may lose some of its sensitivity (i.e. calibration current in air becomes significantly lower than it should be). However, due to the fact that this maintenance procedure will temporarily slow down the reactivity of the sensor, it should **not** be performed more than once every two years. Details of the procedure are explained in [Electrochemical cleaning and regeneration center on page 31](#).

#### 5.1.1 Membrane replacement and sensor head cleaning


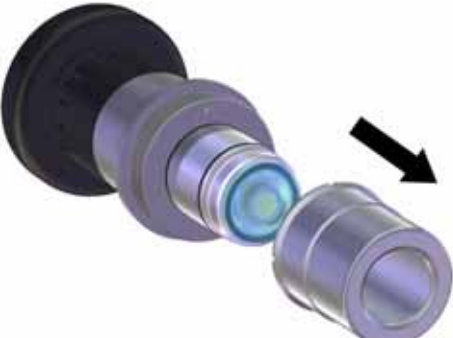
A sensor recharge kit (see additional details [on page 12](#)) is required as it contains all the components necessary for this membrane replacement and sensor head cleaning process (i.e. a cartridge containing the electrolyte and pre-installed membrane, a sensor cleaning tool, replacement O-rings, cotton washers and Dacron® mesh patches).










#### **CAUTION**

**Avoid all eye and skin contact with the electrolyte in the sensor and replacement cartridge. If eyes or skin come into contact with electrolyte, rinse immediately with water. In addition, the electrolyte can permanently stain clothing so exercise care in handling. It is highly recommended to wear protective gloves and glasses during this process.**

**Note:** It is advisable to perform this procedure with the plastic sensor base installed so as to avoid any damage to the connection socket and also to provide a suitable stand for the sensor when required.

<p>1. Hold the main body of the sensor and unscrew the protection cap locking washer by turning counter-clockwise. Remove it from the sensor and put to one side.</p>	
<p>2. Pull/twist off the protection cap and put to one side. Remove the Dacron® mesh from inside the cap and discard it.</p>	

<p><b>3.</b> Hold the sensor with the membrane facing down to avoid spilling any electrolyte, then carefully unscrew the old cartridge. Drain the old electrolyte into a sink and flush away. Discard the old cartridge and membrane.</p> <p><b>4.</b> Remove the cotton washer from the top of the anode and discard.</p>	 A diagram showing the disassembly of the sensor head. The top part is a black cap with a silver ring. Below it is the main sensor body with a green membrane at the tip. A separate silver cylindrical component is shown below, with a curved arrow indicating it is being rotated to remove a cotton washer from its top.
<p><b>5.</b> Rinse the sensor head under a tap for 15 seconds to remove any remaining electrolyte and shake dry.</p> <p><b>6.</b> With a soft tissue gently clean around the guard area (indicated right) and then wipe off any excess moisture from the sensor to ensure all parts are completely dry.</p> <p><b>7.</b> Repeat this rinse and dry process with the protection cap.</p>	 A diagram illustrating the cleaning process. On the left, a sensor head is shown under a running faucet, with blue water spraying over it. On the right, a separate silver cylindrical component is shown with two black arrows pointing to its top surface, indicating the guard area to be cleaned. A black arrow points from the sensor head to this component.
<p><b>8.</b> With the help of a pair of tweezers, remove the old O-ring from the sensor body.</p>	 A diagram showing the removal of an O-ring. On the left, a close-up of the sensor body shows a black O-ring seated in a groove. A black arrow points to the right, where the same sensor body is shown with the O-ring removed and placed on top of the body.

<p><b>9.</b> Replace the O-ring with a new one from the recharge kit.</p>	
<p><b>10.</b> Clean the anode using the cleaning tool supplied. <b>11.</b> Place the tool over the sensor head.</p>	
<p><b>12.</b> Clean by rotating the cleaning tool over the sensor head for a few seconds.</p>	
<p><b>13.</b> Remove the tool and tap it face down on a flat work surface to remove any powdery deposit. <b>14.</b> Check the sensor to ensure that all deposits have been removed from the anode. If not, repeat steps <b>12.</b> and <b>13.</b> until the anode regains its bright silver appearance.</p>	

15. Rinse the sensor head under a tap for 15 seconds, aiming the jet of water directly onto the sensor head.
16. Do not dry the center electrode area, as the gap between cathode and guard should be left filled with water.






**Note:** During this next step, it is very important to ensure your finger does **not** come into contact with the cathode (golden surface) as it could leave greasy deposits on the surface.

17. Take a new cotton washer from the recharge kit. Hold it between thumb and forefinger and place it on top of the anode.



18. Place the recharge cartridge container on a flat work surface and, keeping the container upright to avoid spilling any of the electrolyte inside, carefully unscrew the top.
19. Remove the packing component from the center of the cartridge, and make sure that the O-ring remains in place on top of the cartridge. If it comes away then replace it before continuing.
20. If there are any visible bubbles in the electrolyte, remove them using a stirring motion with the packing component.



<p>21. Hold the container steady between thumb and forefinger of one hand.</p> <p>22. Lower the sensor into the container until the top of the anode is covered with electrolyte.</p> <p>23. Leave for a few seconds to ensure the cotton washer has fully absorbed some of the electrolyte and that it is no longer dry.</p>	
<p>24. Gently screw the sensor clockwise into the replacement cartridge, applying minimum pressure to avoid any damage to the screw threads.</p>	
<p>25. Continue turning until the cartridge is attached to the sensor, and the sensor is automatically released from the container.</p> <p>26. The empty container, the screw top and packing component can be discarded.</p> <p><i>Note: It is normal that some of the electrolyte will overflow from the replacement cartridge and into the plastic container.</i></p>	

27. Rinse the sensor under a tap for about 5 seconds to remove any excess electrolyte, then gently wipe with a soft tissue to ensure all parts are completely dry.
28. Drain the overflow electrolyte from the container into a sink and flush away.
29. Discard the used container.



30. Take a new Dacron® mesh from the box of O-rings in the recharge kit.
31. Place the mesh in the center of the protection cap. It is very important that the mesh is in the center of the protection cap and covering the entire grille (as illustrated right).
32. Lower the sensor onto the protection cap making sure not to disturb the mesh.



33. Push the protection cap firmly into place, making sure one of the four slots in the protection cap fits over the small locking pin (highlighted right). If it is necessary to turn the protection cap to fit over the locking pin, ensure you only turn it **clockwise** to avoid unscrewing the cartridge.





34. Finally, screw the protection cap locking washer back into place in a clockwise motion, and tighten finger tight.



### 5.1.2 Electrochemical cleaning and regeneration center

The ORBISPHERE 32301 is a very efficient cleaning and regeneration tool for electrochemical sensors. This tool reverses the electrochemical process that is taking place in the sensor cell during normal operation. This removes oxidation and at the same time regenerates the surface of the electrodes. In addition, the regeneration center offers a continuity tester for checking the sensor electronics.



Figure 12 Model 32301 cleaning and regeneration center

Use of this tool is recommended for a noticeably extended sensor life. Detailed information on how to use the cleaning and regeneration center is included in the 32301 Operator Manual.

### 5.1.3 Nitric acid cleaning of the cathode

**Important Note:** This procedure is not recommended for normal maintenance, and should **not** be used more often than once every two years due to the fact that this type of cleaning will temporarily slow down the reactivity of the sensor.

In general, the procedure is the same as the standard membrane replacement and sensor head cleaning procedure but with additional steps included. As such this procedure refers to steps in the standard procedure, and only the additional steps for cathode cleaning are illustrated here.

A sensor recharge kit (see additional details [on page 12](#)) is required as it contains all the required components (i.e. a cartridge containing the electrolyte and pre-installed membrane, anode and cathode cleaning tools, replacement O-rings, cotton washers and Dacron® mesh patches). In addition a pipette and nitric acid (60-70%) will be required.



#### CAUTION

**Exercise great care when handling chemicals. Nitric acid is dangerous so please refer to the safety information from your chemical supplier. Avoid all eye and skin contact with both the nitric acid (as it is corrosive and can cause burning) and the electrolyte. It is highly recommended to wear protective gloves and glasses at all times. If eyes or skin come into contact with any chemical, rinse immediately with water.**

**Note:** It is advisable to perform this procedure with the plastic sensor base installed so as to avoid any damage to the connection socket and also to provide a suitable stand for the sensor when required.

1. Perform steps 1. to 7. in the standard [Membrane replacement and sensor head cleaning](#) process.

2. Take one of the cathode cleaning tools from the recharge kit and place it (protruding grooved end down) on top of the cathode making sure that the grooved end of the tool is securely positioned between the cathode and the guard ring to avoid any damage to the electrodes.



3. Place the sensor on a flat surface. Then, using a pipette gently add two drops of nitric acid into the cleaning tool.
4. Leave for 30 seconds.





5. After 30 seconds, pour the nitric acid from the cleaning tool into a sink and flush away.



6. With the cleaning tool still in place, rinse the sensor under a tap for 15 seconds to remove any remaining trace of nitric acid.



<p>7. Carefully remove the cathode cleaning tool from the sensor and discard.</p>	
<p>8. Rinse the sensor head under a tap for an additional 15 seconds to remove any remaining nitric acid and shake dry.</p> <p>9. With a soft tissue gently clean around the guard area (indicated right) and then wipe off any excess moisture from the sensor to ensure all parts are completely dry.</p>	
<p>10. Complete the maintenance procedure by performing steps 8. to 34. in the standard <a href="#">Membrane replacement and sensor head cleaning</a> process.</p>	

## 5.2 Troubleshooting

### 5.2.1 Ozone sensor

When the O<sub>3</sub> sensor has been properly calibrated using the Orbisphere measuring instrument, the sensor has to settle down for up to 24 hours when used in very low O<sub>3</sub> concentration conditions.

<b>Problem</b>	<b>Probable Cause</b>	<b>Possible Solution</b>
Sensor won't calibrate, even after cleaning and/or membrane change.	Repeated calibrations go beyond "expected limits" of instrument	Clean O <sub>3</sub> sensor with HNO <sub>3</sub> (see <a href="#">Nitric acid cleaning of the cathode on page 32</a> for details)
	Instrument internal barometric pressure sensor needs calibration.	Calibrate internal barometer against a certified barometer. Do not correct for sea level !
	Wet membrane interface.	Wipe dry with a tissue and re-calibrate.
"0000" O <sub>3</sub> levels displayed.	Wrong reading scale "XXXX" selected for display unit.	Change reading scale by selecting "X.XXX, XX.XX or XXX.X".
Unexpected/incorrect dissolved O <sub>3</sub> reading.	High residual current.	If concentration is significantly higher than low limit, try a sensor service.
	Insufficient flow rate.	Regulate flow equivalent to membrane specified levels.
	Length of sample line allows O <sub>3</sub> time to react.	Reduce length of sample tubing.
	Doesn't match lab samples.	Take samples at close proximity to sensor.



## Section 6 Accessories and Spare Parts

### 6.1 Sensor spare parts

Part N°	Description
C1100-S00	Electrochemical ozone sensor, Stainless Steel version, maximum pressure 40 bar, with Smart capability
C1100-T00	Electrochemical ozone sensor, Titanium version, maximum pressure 100 bar, with Smart capability
28104	Stainless steel sensor collar
28129	Delrin storage cap (sensor storage cap)
29006.1	Viton O-ring set for standard flow chambers (32001, 32002, 32007, 32009) and 29501 sensor socket. (34x2 mm & 28x2 mm)
29006.2	Kalrez O-ring set for standard flow chambers (32001, 32002, 32007, 32009) and 29501 sensor socket. (34x2 mm & 28x2 mm)
29006.4	Nitril O-ring set for standard flow chambers (32001, 32002, 32007, 32009) and 29501 sensor socket. (34 x 2 mm & 28 x 2 mm)
29037	Regeneration cell for 32301 electrochemical sensor cleaning and regeneration unit
32205	Sensor support (base) for ORBISPHERE 31xxx and x1100 family EC sensors
32301	Electrochemical sensor cleaning and regeneration unit
33051-SG	Stainless steel 28mm cap with grille for ORBISPHERE x1100 family EC sensors
33051-TG	Titanium 28mm cap with grille for ORBISPHERE x1100 family EC sensors

### 6.2 Recharge kits for C1100 sensors

Part N°	Description
29552A-C	Recharge kit of 4 pre-filled cartridges with premounted 29552A membranes for C1100 ozone sensors. Includes O-rings, cotton filters, cleaning tools and filter washers
2956A-C	Recharge kit of 4 pre-filled cartridges with premounted 2956A membranes for C1100 ozone sensors. Includes O-rings, cotton filters, cleaning tools and filter washers

### 6.3 Flow chambers and installation devices

Part N°	Description
29501.1	Sensor socket for welding to SS pipe, with Viton O-ring
32001.110	Flow chamber in stainless steel (316) with 6 mm fittings. Supplied with Viton O-rings
32001.111	Flow chamber in stainless steel (316) with ¼" fittings. Supplied with Viton O-rings
32001.140	Flow chamber in Hastelloy with 6 mm fittings. Supplied with Viton O-rings
32001.141	Flow chamber in Hastelloy with ¼" fittings. Supplied with Viton O-rings
32001.150	Flow chamber in Titanium with 6 mm fittings. Supplied with Viton O-rings
32001.151	Flow chamber in Titanium with ¼" fittings. Supplied with Viton O-rings
32001.170	Flow chamber in Monel with 6 mm fittings. Supplied with Viton O-rings
32001.171	Flow chamber in Monel with ¼" fittings. Supplied with Viton O-rings
32003	Sensor insertion device; for use with Tuchenhagen adapter
33095	28 mm stationary housing for installation on Varinline® access units

### 6.4 Certificates

<b>Part N°</b>	<b>Description</b>
33181	C1100 Material certificate EN 10204 2.2
33182	C1100 Material certificate EN 10204 3.1
32305	Measurement certificate, indicating that the system performs within specific measurement norms for the system in question





