

Operator Quick Guide

EC SENSOR



General Information

About This Guide

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Basic Principle of Operation

In its simplest form, an electrochemical cell consists of a metal anode and a metal cathode dipped into an electrolyte solution contacting these electrodes. An electronic circuit is linked to the anode and cathode. Through an applied voltage, current will flow between the anode and the cathode.

Gas penetrating through the membrane into the cell dissolves in the electrolyte. It 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. The amount of gas entering the cell is proportional to the partial pressure of this gas in the sample, outside the cell. The result is shown as gas concentration.

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 gaseous or liquid sample
- Convert the cell's electric current into an analog signal for sensor output

Initial Sensor Cell Cleaning

Your Orbisphere electrochemical sensor has been thoroughly cleaned and tested at the factory. To protect the electrodes from oxidation, the cell has been filled with electrolyte and a membrane has been installed.

However, shipping and storage conditions can adversely affect electrochemical sensor cells, therefore a sensor service (cell cleaning & membrane replacement) must be performed before start up.

Note :

H₂ sensors do not require a complete cleaning procedure, as dechloridization and rechloridization processes are normally not required.

Positioning Information

Unless the sensor is part of the Orbisphere equipment that includes it, the sensor must be installed in an Orbisphere socket or flow chamber, that allows the contact with the sample fluid to be analyzed.

Check that the sensor will be mounted:

- perpendicular to the pipe
- horizontal
- on a horizontal pipe section (or on flow-ascending vertical pipe)
- min. 15 meters away from the pump's discharge side
- in a place where sample flow is stable and rapid, and as far as possible from:
 - valves
 - pipe bends
 - suction side of pumps
 - CO₂ injection system or similar

Note :

There may be situations where not all the above conditions can be met. Please consult your Hach Ultra representative to appraise the situation and define the best applicable solution.

Membrane Removal

It is important to install the electrochemical sensor standing on its base. This base offers good protection for the delicate connector socket, and at the same time provides a suitable work stand.

Remove the plastic storage cap.



Unscrew the protection cap, using the tool provided in the maintenance kit (blue case).

Pay attention to the components inside the protection cap. Note the assembly order of each item.

Note :

The illustration on the right is an example only. Your configuration may differ.

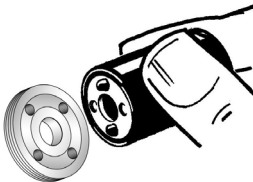


Pull up the attaching ring with the tool provided in the maintenance kit. Remove the membrane and mask (if applicable). Drain the electrolyte into a sink and rinse the sensor cavity with tap water.

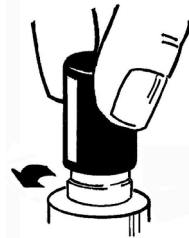


CAUTION

Avoid eye or skin contact with electrolyte which can be slightly corrosive.



Insert the prongs of the membrane support removal tool into the membrane support holes, and unscrew the membrane support.



Note :

The membrane support is individually machined and paired with the sensor. For correct sensor operation, it is ESSENTIAL to keep the membrane support with its respective sensor. Should the membrane support require replacement, contact your Hach Ultra representative.



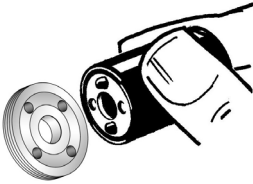
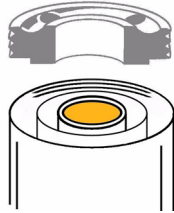
Membrane Installation

CAUTION

Install the membrane support with the groove on the upper side (as illustrated right).

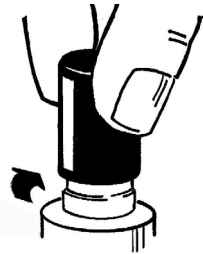
Note :

The membrane support is individually machined and paired with the sensor. Therefore make sure that the correct membrane support is used on the correct sensor.



Insert the prongs of the membrane support removal tool into the membrane support holes.

Tighten the membrane support finger tight.



CAUTION

Too much torque will damage the sensor electrodes.

The membrane mounting surface must be clean and even.
Replace the membrane O-ring on the sensor head with a new one.

Note :

The 29039.4 Nitril O-ring can be reused if it is still in good condition. Membrane O-rings are part of the protection cap kit.

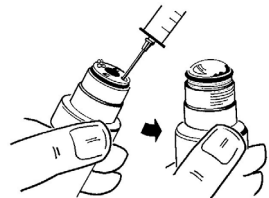


Using the syringe or bottle nozzle included in the maintenance kit, fill up the sensor cavity with electrolyte.

Note :

Be careful not to touch the electrodes with the needle, as a scratch on the surface may lead to loss of performance.

Tilt the sensor slightly and inject into the lower hole, pushing bubbles out at the upper hole. Gently tap on the sensor side to move trapped bubbles. Return the sensor to the vertical position. The last drop of electrolyte should form a cupola on top of the sensor tip.



Membrane Installation (cont)

In the maintenance kit, pick up the two part membrane mounting tool. Install the sleeve over the sensor head (end with shoulder downwards).

Note :

Once installed, a membrane cannot be reused. Avoid touching the membrane with bare fingers, as this may affect its sensitivity.



Take a few membranes out of the storage box. Using tweezers included in the kit, pick up one membrane from the stack, and gently place it on the sensor tip.

Make sure it is centered, and no bubble is trapped. If a sensor mask is used, place it directly on top of the membrane.

Note :

For correct membrane selection, please refer to the sensor specification table at the end of the EC Sensor Operator's Manual.



Note :

Distinguish the membrane from the protection paper:

- *The membrane is transparent (translucent)*
- *The protection paper is opaque*

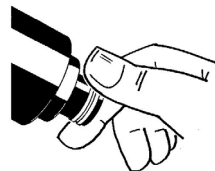
The membrane diameter is larger than the sensor head diameter. This is normal, as the membrane will fold over the sensor tip.

The membrane holding ring comes in two slightly different internal diameters, depending on the membrane(s) total thickness. For a correct membrane installation, be sure to use the correct holding ring for the application.

Place the membrane holding ring on the installation tool tip.

CAUTION

To avoid damaging the membrane, make sure that the tool tip is totally clean and its surface is even.



Membrane Installation (cont)

Insert the installation tool inside the guiding sleeve.



Push the installation tool firmly downwards. This clasps the mounting ring onto the sensor head, folding the membrane over the sensor tip.

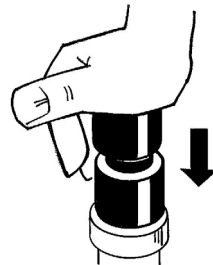
Remove the installation tool and guiding sleeve.

Visually check for correct ring placement, try to push it down with your fingers.

Check that the membrane is tight, with no wrinkles, and no bubbles are present.

Rinse the sensor with tap water and wipe dry with a clean cloth.

Check for electrolyte leaks.

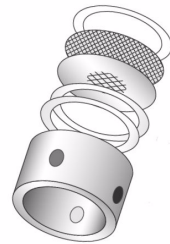


Prepare the protection cap for installation, by replacing all the parts inside the protection cap with new ones (except the grille), and place them in the order they were removed.

The Tefzel washers, under the cap, should be slightly lubricated with silicone grease.

Note :

The illustration on the right is an example only. Your configuration may differ.



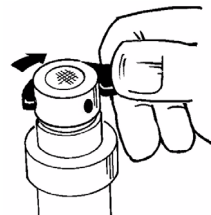
Tighten the protection cap finger tight.

Hold the grille with a finger to avoid rotation.

Using the tool provided in the maintenance kit (blue case), give it an extra 1/8 - 1/4 turn, but no more.

Always store the sensor with the storage cap and base installed.

Put a few drops of clean water in the storage cap to prevent the sensor cell from drying out.



Note :

A sensor that has been taken apart or serviced must always be calibrated. Allow the sensor to settle for 30 minutes, before performing the sensor calibration.

Chemical Cleaning

Cleaning and Regeneration Center

The **Orbisphere 32301 Cleaning and Regeneration Center** (illustrated below) is a very efficient cleaning and regeneration tool for Orbisphere 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 electrodes' surface. In addition, the regeneration center offers a continuity tester for checking the sensor electronics.



Use of this tool is recommended because the regeneration of the electrodes allows for a noticeably extended sensor life.

Detailed information on how to use the Orbisphere 32301 tool is included in the related Operator's Manual.

Note :

It is mandatory to use the 32301 tool for servicing electrochemical H₂ sensors. This process is the dechloridization and rechloridization of the electrodes.

Oxygen and Ozone Sensor Cell Cleaning

The following supposes that the sensor has been taken apart. For disassembly and assembly procedures, see the previous sections.

Wear on the membrane, and chemical reactions within the sensor, requires that the sensor be serviced regularly to restore its original sensitivity.

Service includes electrode cleaning and membrane replacement. A clear sign that a sensor maintenance is required is when measurements are noticeably less stable than usual, and when a calibration does not improve the situation.

Method description:

- Electrochemical cleaning with the 32301 tool (if available)

When the tool is not available or results are insufficient:

- Anode and cathode chemical cleaning
- Central electrode polishing
- Final rinsing

Note :

To eliminate any silver residue that ammonia cleaning cannot remove, it is sometimes required to repeat the chemical cleaning using nitric acid (HNO₃, not over 70% by weight).

Hydrogen Sensor Cell Cleaning

The hydrogen analyzer works on the principle that hydrogen molecules, passing through the membrane, generate an electric current at the platinum anode surface. For this to take place, an extremely clean metal surface is essential. If any film, grease or other impurity covers the platinum surface, the reaction is impeded and may even be stopped.

In addition, the chemical reaction that takes place on the chloridized silver cathode leads to loss of performance after a certain operation time. As a result, a sensor service must be carried out to restore its original performance.

The procedure for cleaning the H₂ electrochemical sensor requires the use of the Orbisphere 32301 tool, and is explained in full in the 32301 Operator's Manual. As an overview, it consists of the following sequence of operations:

- Dechloridization of the cathode: This process removes the chloride film from the silver cathode surface (carried out by the Orbisphere 32301).
- Rechloridization of the cathode: A layer of silver chloride is grown on the cathode's surface (carried out by the Orbisphere 32301).
- Activation of the platinum anode: The center anode surface is polished, and treated with nitric acid.

Chemical Cleaning (cont)

Membrane Support Cleaning

Empty and rinse the electrolyte reservoir under tap water.

Rinse the membrane support under water and wipe it dry.

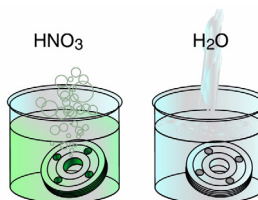
Check for the presence of any residue on the surfaces.

Residue can be removed by placing the support in a container of nitric acid (HNO_3 , not over 70% by weight) until it recovers its original appearance (normally within 30 seconds)

Rinse one minute under tap water and check again for surface cleanliness.

CAUTION

Nitric acid is dangerous ! Please refer to the safety information from your chemical supplier.



Anode and Cathode Ammonia Cleaning

Fill the sensor electrolyte reservoir with a solution of 25% by weight ammonium hydroxide (NH_4OH) in water and leave for 10 minutes.

Rinse with tap water for at least one minute.

Inspect the sensor head. The counter electrode should be a silver-white color.

If the counter electrode still shows deposits, repeat the procedure.

CAUTION

Ammonia is dangerous ! Please refer to the safety information from your chemical supplier.



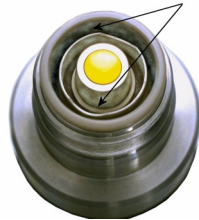
Chemical Cleaning (cont)

Anode and Cathode Nitric Acid Cleaning

Check for the absence of silver deposit on the central guard ring electrode walls (indicated right, by the arrows), as such deposits can make contact with the counter electrode.

To eliminate any silver residue inside the sensor cell, it is sometimes required to repeat the chemical cleaning using nitric acid (HNO_3 , not over 70% by weight).

Also, the 32301 electrochemical cleaning does not remove deposit on the cell's plastic parts, so nitric acid cleaning may be required.



Note :

This procedure is not recommended for normal maintenance, and should not be used more often than twice a year, as the acid degrades the metal of the counter electrode, thus reducing the sensor's life.

Place concentrated nitric acid into the sensor electrolyte reservoir, and add 1 drop on the center electrode.

Leave for no longer than 3 seconds.

Quickly empty the acid and rinse thoroughly under tap water for one minute.



CAUTION

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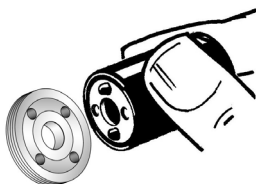
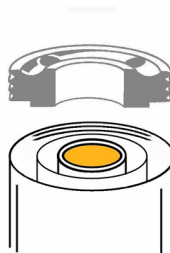
Chemical Cleaning (cont)

Sensor Face Polishing

Once the sensor has been cleaned, the face of the center electrode must be polished together with the membrane support.

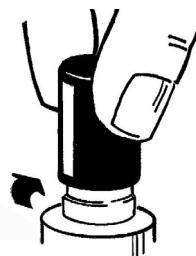
Note :

Install the membrane support with the groove on the upper side (as illustrated right). The membrane support is individually machined and paired with the sensor. Therefore make sure that the correct membrane support is used on the correct sensor.



Insert the prongs of the membrane support removal tool into the membrane support holes.

Tighten the membrane support finger tight.



CAUTION

Too much torque will damage the sensor electrodes.

Place the dish with the polishing cloth on a flat surface.

Spread a little polishing powder onto the cloth.

Mix with a few drops of water to get a white, milky liquid.

Make sure to use the correct polishing powder for your application (refer to the spare parts table at the end of the EC Sensor Operator's Manual).

Note :

Use one polishing cloth per sensor model, to prevent a possible contamination through metal particle transfer.



Holding the sensor vertically, and using a circular motion, polish the sensor face for at least 30 seconds, until the electrodes are clean and shiny.

This step may need to be repeated several times.

Make sure to avoid skin contact with the polishing cloth; it should be kept free of dust and grease.



Chemical Cleaning (cont)

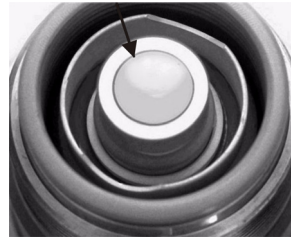
Sensor Face Polishing (cont)

Remove the membrane support with the installation tool.
Rinse the support and sensor cavity with a strong jet of clean water.
Use distilled water if the water quality is doubtful.



Carefully inspect that the tiny groove between the center electrode and the guard ring electrode (illustrated right) is totally clean and free of any polishing residue.

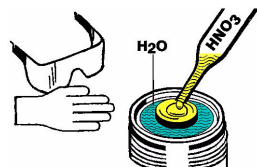
Clean only with a strong water spray. The edge of a paper sheet can be used to remove any sticking residue.



O₃ Sensor Only: Final Center Electrode Cleaning

Once the O₃ sensor has been successfully cleaned and polished, a final nitric acid treatment should be applied, as follows:

Place the sensor in a vertical position on its base.
Fill the electrolyte reservoir with a few drops of water, just enough to cover the outer electrode. The center electrode must be kept dry.
Place a drop of nitric acid on the center electrode, covering only the electrode and guard ring. Avoid spilling acid into the water.
Wait 1 minute, then rinse thoroughly under tap water.



CAUTION

Nitric acid is dangerous ! Please refer to the safety information from your chemical supplier.

Global Headquarters

6, route de Compois, C.P. 212,
1222 Vérenaz, Geneva, Switzerland
Tel ++ 41 (0)22 594 64 00
Fax ++ 41 (0)22 594 64 99

Americas Headquarters

481 California Avenue,
Grants Pass, Oregon 97526, USA
Tel 1 800 866 7889 / 1 541 472 6500
Fax 1 541 479 3057

www.hachultra.com

