Document Number DGA1100-MAN/E

ORBISPHERE A1100 Family of Oxygen Electrochemical Sensors

USER MANUAL

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HACH LANGE

UNITED FOR WATER QUALITY

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Section 1 General Information

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.

1.2 Contact information

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1.3 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 the 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.

1.3.1 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.*

1.3.2 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.

1.3.3 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.

1.4 Product recycling information

ENGLISH

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.

Note: *For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.*

DEUTSCH

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.

Hinweis: *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.*

FRANCAIS

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.

Remarque: *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.*

ITALIANO

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.

Nota: *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.*

DANSK

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.

Bemærk: *I forbindelse med returnering til genbrug skal du kontakte producenten eller leverandøren af apparatet for at få instruktioner om, hvordan udtjente apparater bortskaffes korrekt.*

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 utrangerad 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.*

ESPANOL

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 wetgegeving (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 obecie 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 użytkownia.*

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.*

1.5 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.

1.6 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					

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.

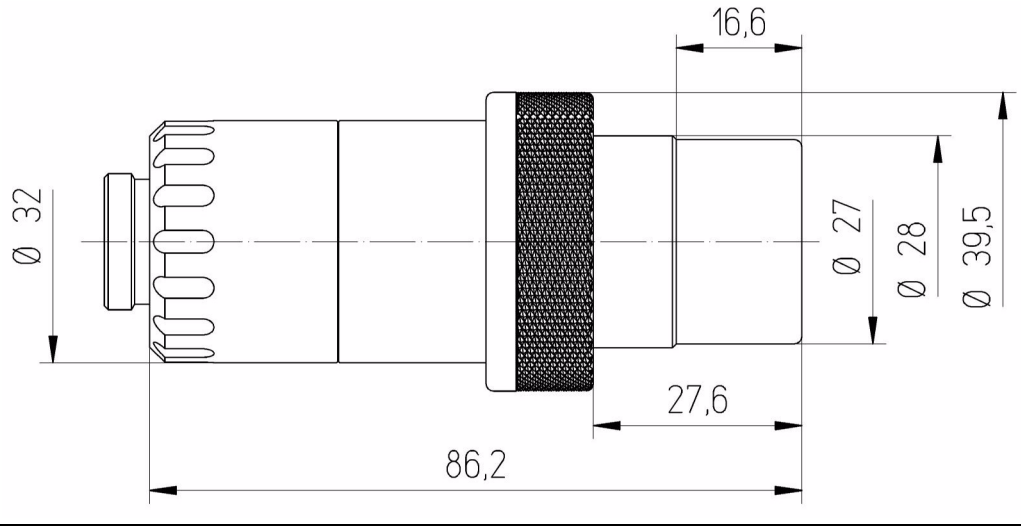


Figure 1 Sensor dimensions

2.2 ORBISPHERE family of A1100 oxygen sensors

Model A1100 non-ATEX sensors

- Electrochemical oxygen sensor
- Stainless steel
- Maximum pressure 40 bar with default PPS collar (100 bar with stainless steel collar)
- Smart capability

Model A110E ATEX sensors

- Electrochemical oxygen sensor
- Ex II 1 G, Ex ia IIC T6
- Stainless steel or hastelloy
- Viton or kalrez o-rings
- Intrinsically safe

Note: *Unlike the A1100 non-ATEX sensors, the intrinsically safe A110E ATEX sensors have no smart capability to store calibration data. However, all A110E ATEX sensors have the ATEX conformity information engraved on the sensor itself.*

2.3 Sensor configurations for standard applications

Table 1 Sensor configurations for standard applications				
	Application	**Sensor**	**Membrane Cartridge**	**Protection Cap**
Beverage	Beer with 3650 Portable	A1100-S00	2958A-A (optimized response time) 2952A-A (optimized maintenance interval)	33051-SP
	Beer in-line	A1100-S00	2952A-A	33051-SG
	Wort in-line	A1100-S00	29552A-A	33051-S0
	Wort with 3650 Portable and special flow cell 32007W.xxx	A1100-S00	29552A-A	33051-S0
	3624 Probrix	A1100-S00	2952A-A	33051-SG
	3625 Package analyzer	A1100-S00	2956A-A or 2952A-A	33051-SP
	De-aerated water	A1100-S00	2956A-A or 2952A-A	33051-S0 33051-SG (if exposed to CIP)
Pure water applications (Power - Electronics)	On-line dissolved oxygen traces in pure water	A1100-S00	2956A-A	33051-S0
	Dissolved oxygen traces with 3655 Portable	A1100-S00	2956A-A	33051-S0
ATEX		A110E-SVS	2956A-A or 29552A-A	33051-SG
		A110E-SKS		33051-SG
		A110E-HVS		33051-H0
		A110E-HKS		33051-H0

Note: *Non-ATEX sensors are delivered with two protection caps as standard, one with a grille (33051-SP) and one without (33051-S0). A third protection cap (33051-SG) is available as an option. ATEX Sensors are delivered with one protection cap as standard.*

2.4 Sensor membrane specifications

2.4.1 Oxygen sensors (Table 1)

Table 2 Membrane specifications - Oxygen sensors (1)				
	2956A-A	**2958A-A**	**29552A-A**	**2952A-A**
Recommended applications	Corrosion control, De-aerated water	Beverage, Lab. applications	In line wort, Air/O_2 injection, Sewage treatment	Corrosion control, In line beverage, De-aerated water
Material	PFA	Tefzel®	PTFE	Tefzel®
Thickness [µm]	25	12.5	50	25
Calibration gas	Air	Air	Air	Air / Pure O_2
Dissolved measurement range	0 ppb to 20 ppm	0 ppb to 40 ppm	0 ppb to 80 ppm	0 ppb to 80 ppm
Gaseous measurement range	0 Pa to 50 kPa	0 Pa to 100 kPa	0 Pa to 200 kPa	0 Pa to 200 kPa
Accuracy	The greater of ±1% of reading or ± 0.1 ppb[1], or ± 1 ppb[2], or ± 0.25 Pa	The greater of ±1% of reading or ± 1 ppb, or ± 2 Pa	The greater of ±1% of reading or ± 2 ppb, or ± 5 Pa	The greater of ±1% of reading or ± 2 ppb, or ± 5 Pa
	[1] Accuracy is ± 0.1 ppb for 410, 510, 362x, 360x and 3655 instruments [2] Accuracy is ± 1 ppb for 366x and 3650 instruments			
Integrated radiation dose limit [rads]	2×10^4	10^8	N/A	10^8
Expected current in air @ 1 bar 25°C [µA]	26.4	9.4	6.3	5.4
Expected current in pure O_2 [µA]	132	47	31.4	27
O_2 consumption in O_2 saturated water at 25°C [µg/hour]	40	14	9.4	8
Temp. compensation range	– 5 to 60° C			
Temp. measuring range	– 5 to 100° C			
Response time[1]	7.2 sec.	9.5 sec.	90 sec.	38 sec.
Recommended min. liquid flow rate[2] [mL/min]	180	120	50	50
Recommended min. linear flow rate[2] [cm/sec]	200	100	30	30
Recommended gaseous flow rate [L/min]	0.1 to 3			

2.4.2 Oxygen sensors (Table 2)

Table 3 Membrane specifications - Oxygen sensors (2)			
	2935A-A	**29521A-A**	**2995A-A**
Recommended applications	Saturated to super saturated levels	Saturated to super saturated levels	In line hot wort (up to 70°C)
Material	Halar®	Tefzel®	Tedlar®
Thickness [µm]	25	125	12.5
Calibration gas	Air / Pure O_2	Air / Pure O_2	Pure O_2
Dissolved measurement range	0 ppb to 400 ppm	0 ppb to 400 ppm	0 ppb to 2000 ppm
Gaseous measurement range	0 Pa to 1000 kPa	0 Pa to 1000 kPa	0 Pa to 5000 kPa
Accuracy	The greater of ±1% of reading or ± 10 ppb, or ± 20 Pa	The greater of ±1% of reading or ± 10 ppb, or ± 20 Pa	The greater of ±1% of reading or ± 50 ppb, or ± 100 Pa
Integrated radiation dose limit [rads]	N/A	10^8	10^8
Expected current in air @ 1 bar 25°C [µA]	0.9	0.7	0.2
Expected current in pure O_2 [µA]	4.7	3.8	0.9
O_2 consumption in O_2 saturated water at 25°C [µg/hour]	1.4	1.3	0.3
Temp. compensation range	– 5 to 60° C		
Temp. measuring range	– 5 to 100° C		
Response time[1]	2.5 min.	18 min.	80 sec.
Recommended min. liquid flow rate[2] [mL/min]	25	25	5
Recommended min. linear flow rate[2] [cm/sec]	20	60	5
Recommended gaseous flow rate [L/min]	0.1 to 3		

[1] Response time at 25 °C for a 90% signal change

[2] Liquid flow through an ORBISPHERE 32001 flow chamber, with protection cap and no grille

Section 3 Introduction

3.1 What you have received

3.1.1 A1100 electrochemical sensor

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

Figure 2 A1100 sensor with storage cap and base

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.

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.

3.1.2 Protection caps

Non-ATEX sensors (A1100)
Two protection caps will be delivered with each sensor, one without a grille (part number 33051-S0) and one with a grille (part number 33051-SP).

A third protection cap (part number 33051-SG) is also available as an option and improves the maintenance interval for beer or soft drinks process applications.

The three protection caps are illustrated below:

Figure 3 Protection caps

ATEX sensors (A110E)
Only one protection cap will be delivered with each sensor (part number 33051-SG or 33051-H0).

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* ***oxygen*** *has a* ***blue*** *sticker on the front of the box.*

Figure 4 Sensor recharge kit

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
- a set of five cotton washers
- a set of five silicone discs (available in all 2956A-XXX recharge kits only)
- a set of replacement O-rings
- a set of Dacron® mesh patches.

Figure 5 Anode cleaning tool

The black anode cleaning tool (Figure 5) 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 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 services.

The silicone discs are required for measurements in ultra-pure water or water containing ammonia.

The Dacron® mesh patches provide protection to the membrane when using a protection cap with grille.

For details of the part numbers for re-ordering, please refer to Recharge kits for A1100 and A110E sensors on page 42.

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.

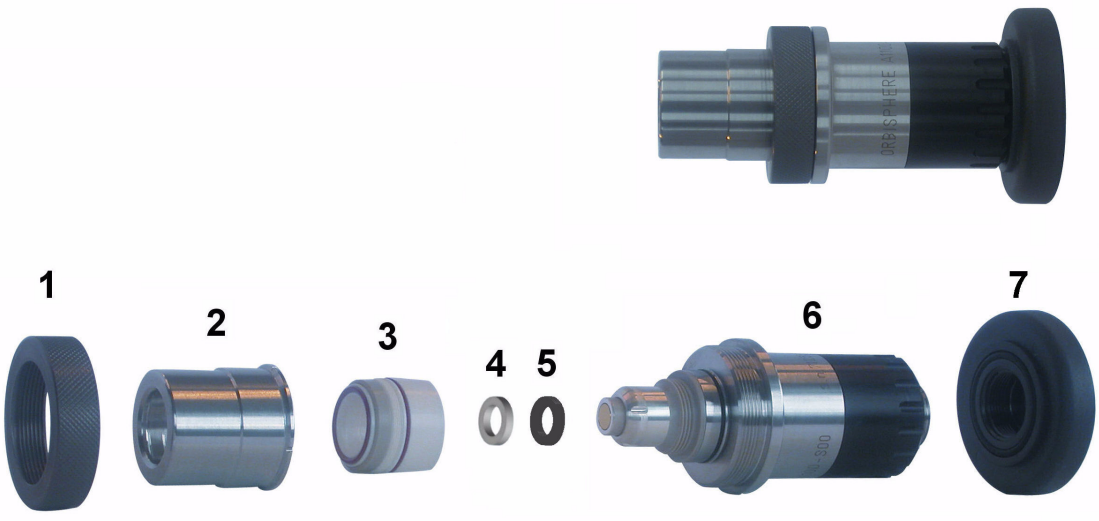


Figure 6 Sensor components

1 - Protection cap locking washer	4 - Cotton washer
2 - Protection cap (illustrated without grille)	5 - Silicone disc
3 - Cartridge containing electrolyte and membrane	6 - Sensor body
	7 - Plastic base

Note: *If a protection cap with grille is being used with the sensor, then a Dacron® mesh will be positioned between the protection cap and cartridge (components 2 and 3 in Figure 6 above).*

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 gaseous or 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 and, in some applications, a grille to protect the membrane. Materials used for the components of the sensors differ with the application.

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

Section 4 Installation

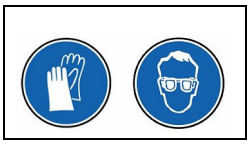
4.1 Sensor preparation

Your A1100 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 14).

Non-ATEX sensors (A1100)
The sensor has been delivered with two protection caps, one with a grille and one without. Ensure you use the correct protection cap for your application (see Table 1 on page 10 for additional information).

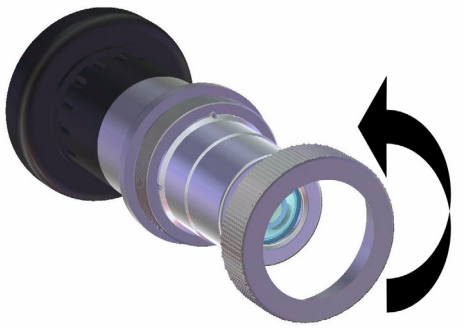
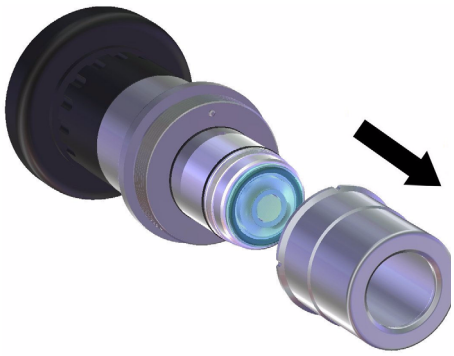
ATEX sensors (A110E)
The sensor has been delivered with a single protection cap.

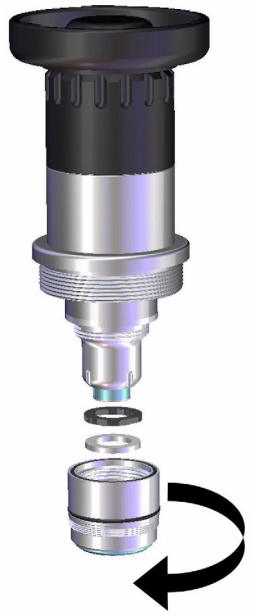
The following instructions detail the steps required to make the sensor operational. Should you have any questions, your Hach Lange representative will be pleased to help.



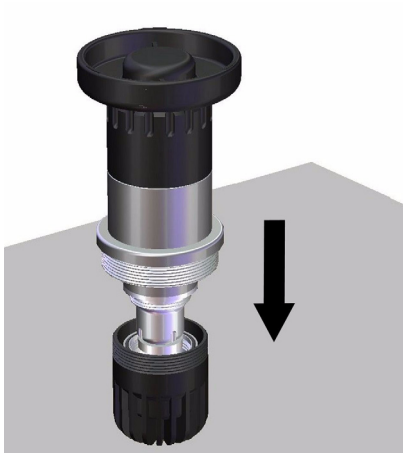
CAUTION
Avoid all eye and skin contact with the electrolyte in the sensor and replacement cartridge as it is corrosive and can cause burning. If eyes or skin come into contact with electrolyte, rinse immediately with water. In addition, the electrolyte can permanently stain clothing so exercise care 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.*

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.	
2. Pull/twist off the protection cap and put to one side.	

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.	

Note: *During this 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.* **7.** Take a silicone disc from the recharge kit, hold it between thumb and forefinger and position it on top of the anode.	
Note: *As in the previous 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.* **8.** Take a new cotton washer from the recharge kit, hold it between thumb and forefinger and position it on top of the silicone disc.	
9. 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. **10.** 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. **11.** If there are any visible bubbles in the electrolyte, remove them using a stirring motion with the packing component.	

12. Hold the container steady between thumb and forefinger of one hand. **13.** Lower the sensor into the container until the top of the anode is covered with electrolyte. **14.** Leave for a few seconds to ensure the cotton washer has fully absorbed some of the electrolyte and that it is no longer dry.	
15. Gently screw the sensor clockwise into the replacement cartridge, applying minimum pressure to avoid any damage to the screw threads.	
16. Continue turning until the cartridge is attached to the sensor, and the sensor is automatically released from the container. **17.** The empty container, the screw top and packing component can be discarded. ***Note:*** *It is normal that some of the electrolyte will overflow from the replacement cartridge and into the plastic container.*	

18. 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.

19. Drain the overflow electrolyte from the container into a sink and flush away.

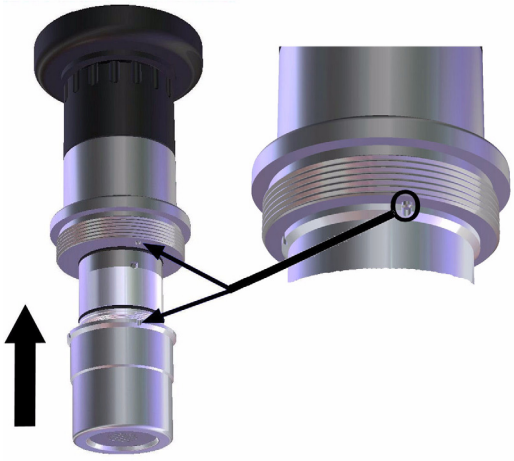
20. Discard the used container.

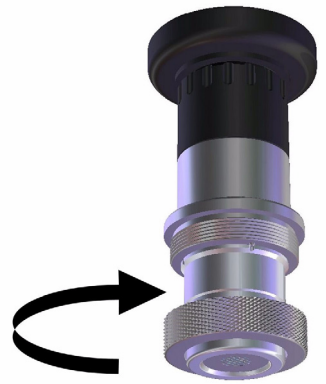
21. If not using a protection cap with grille proceed to step 24. Otherwise take a new Dacron® mesh from the box of O-rings in the recharge kit.

22. 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.

23. Lower the sensor onto the protection cap making sure not to disturb the mesh.

24. 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.



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

4.2 Sensor installation

4.2.1 Sensor 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 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.

Note: *If the model 28117 pressure sensor is used, the maximum cable length is 50 meters.*

Ensure 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 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_2 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

Note: *Check that the small O-ring at the bottom of the flow chamber is present during removal and installation of the sensor, as it may stick to the sensor head and fall.*

- Insert the sensor straight into the flow chamber or socket.
- Hand tighten the attaching collar.
- Connect the sensor cable.
- Check for leaks; replace O-rings if product leaks are visible.

Micro Volume Flow Chambers:

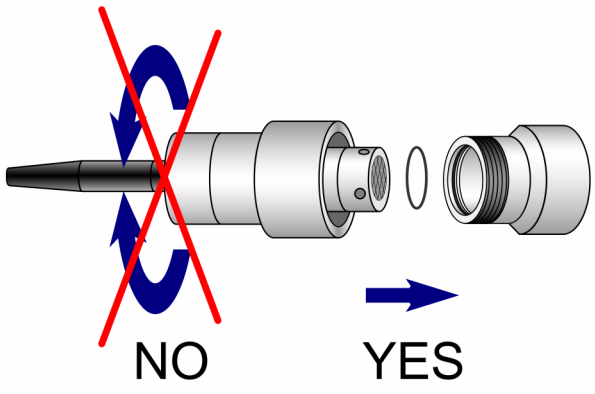


Figure 7 Sensor insertion

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

- Shut off the sample flow and drain the sampling circuit of liquid or gas.
- 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.
- Check that both O-rings remain in place inside the flow chambers.
- Install sensor storage cap and sensor base (to protect the connection).

4.3 Mounting accessories

4.3.1 External pressure sensor

The system can be fitted with an external pressure sensor. This enables a measurement of fraction of gas under variable pressure conditions during gas phase measurement.

Two models are available, depending on application:

- 28117 Pressure sensor 0 - 5 bar absolute
- 28117C Pressure sensor 0 - 1 bar absolute

Note: *Do NOT exceed the pressure range of the sensor. This would permanently deform the sensor membrane, thus delivering incorrect pressure values in the future.*

The external sensor connects to the ORBISPHERE measuring equipment with a 1 meter cable and a 4 pin connector (an optional extension cable can be used, but total length should not exceed 50 m.).

The external pressure sensor can be installed in the 32002.xxx multi parameter flow chamber. It is held in place by a blue threaded collar. Tightness is assured by the O-ring on the sensor seat.

4.3.2 Weld-on stainless steel socket

The 29501 weld-on sensor socket can be used to install a sensor into a stainless steel pipe (min.Ø 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 diagram).

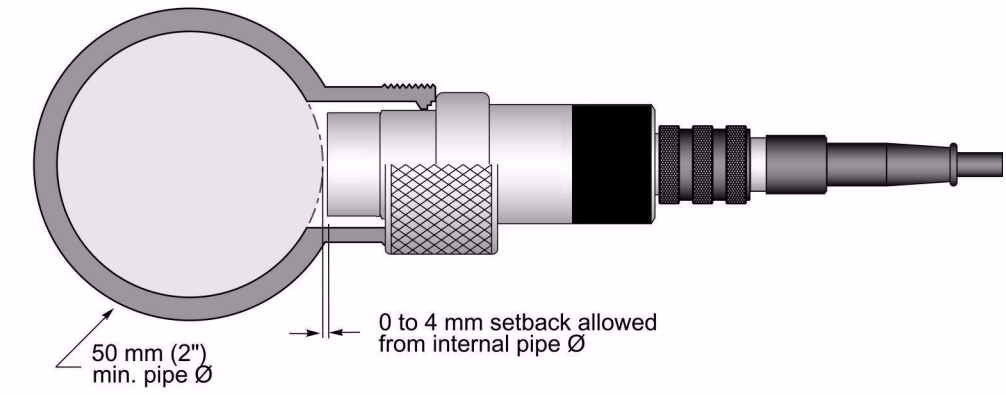


Figure 8 Weld-on sensor socket

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 (shown below) 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 this assembly can be placed in the production line with minimal down time.

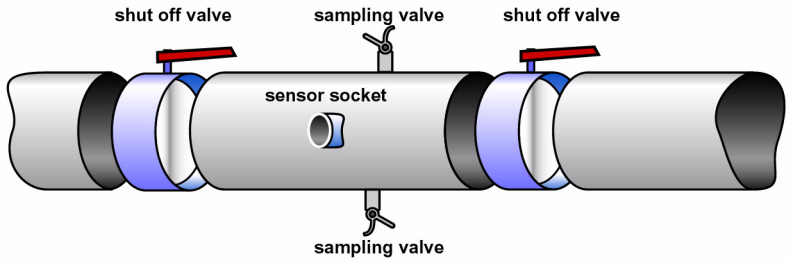


Figure 9 Installation in-line

4.3.3 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.

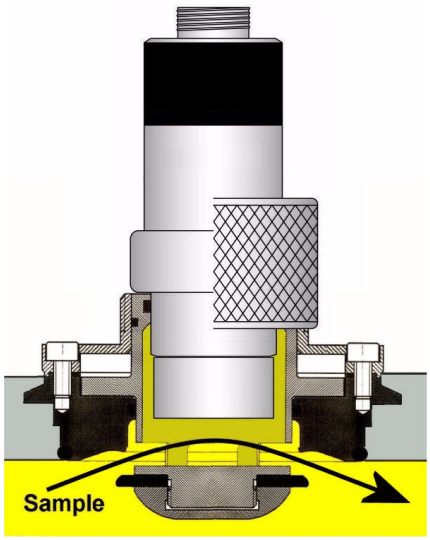


Figure 10 ORBISPHERE model 32003 insertion/extraction valve

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

4.3.4 The 33095 sensor housing

The ORBISPHERE 33095 sensor housing is also available for use with the A1100 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.

4.3.5 Tuchenhagen Varivent® in-line access unit

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

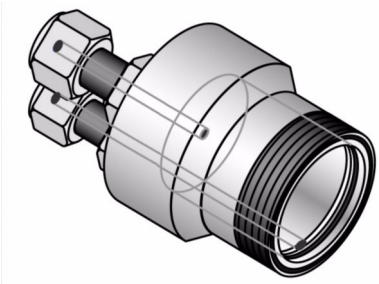
Figure 11 Tuchenhagen Varivent® in-line access unit

Purchasing a Tuchenhagen 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.

4.3.6 ORBISPHERE flow chambers

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

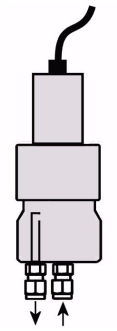
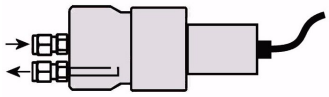
They connect to 6-mm or ¼" stainless steel tubing by means of two Swagelok™ fittings. If necessary, copper or plastic tubing with low permeability can be substituted. Stainless steel tubing is normally enough to hold the assembly in place, but for a more stable installation, a large U-bolt can be used to mount the flow chamber to a support.



Dimensions of sensor and flow chamber assembly :

- Width: 50 mm
- Height: 210 mm

(add 100 mm for connection length)

Table 4 Flow Chamber Orientation		
Sample	**Orientation of flow chamber**	
Gaseous or liquid media	Vertically, with connections down and sensor up - Center connection is the inlet - Outer connection is the outlet	
Gaseous media, with occasional liquid or vapor	Horizontally, to allow for drainage - Center connection (inlet) must be up - Outer connection (outlet) must be down	

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.

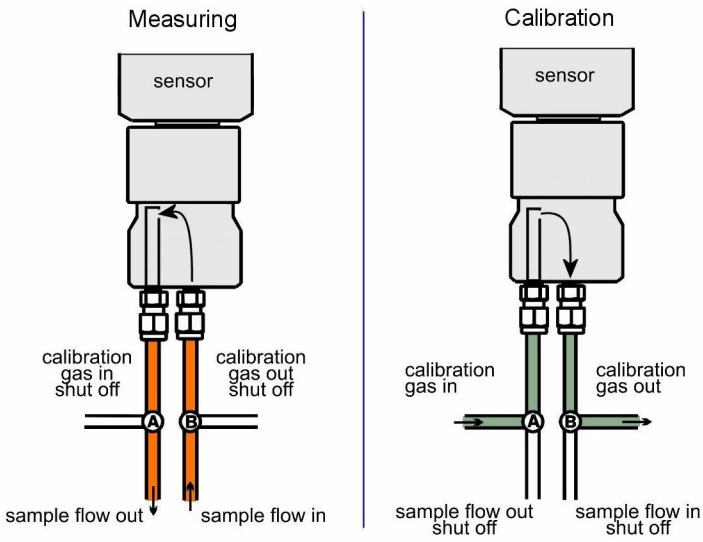


Figure 12 Flow chamber connections

4.3.7 Multi-parameter flow chamber

Note: *Suitable only for gaseous media.*

The ORBISPHERE 32002.xxx multi parameter flow chamber can accommodate one or two sensors and one sample pressure sensor. If only one gas sensor is used, the unused socket is plugged with the stainless steel plugs provided (model 28123). The flow chamber is connected to 6 mm or ¼" stainless steel tubing by two Swagelok™ fittings. If necessary, copper or plastic tubing with a very low permeability can be substituted.

The flow chamber should be mounted in such a way that the sample outlet port is located at the lowest point to allow condensation to escape with the outgoing gas. Attach the flow chamber to a vertical support with the screws supplied. The pressure sensor must be on top.

Note: *A user manufactured spacer (~15 mm thick) may be used between the flow chamber and support for improved access for sensor removal.*

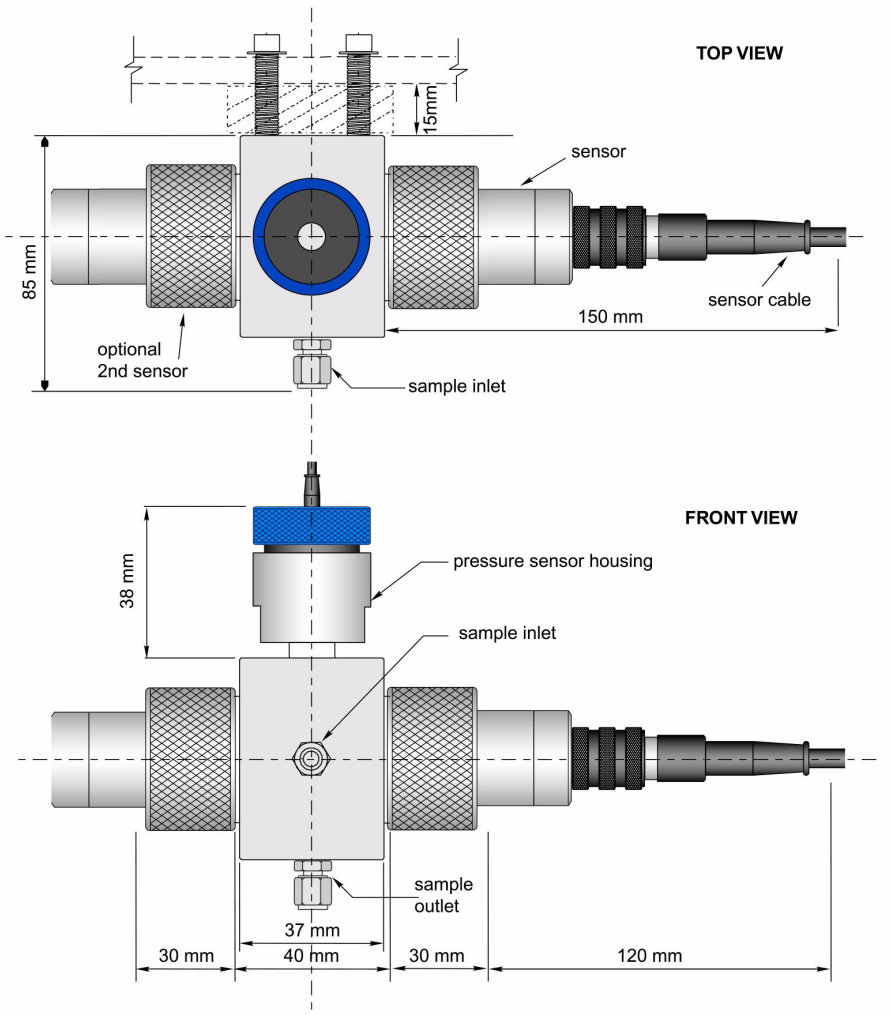


Figure 13 32002.xxx Multi parameter flow chamber

Shown here with:

- gas sensor (right),
- pressure sensor (center),
- optional second sensor (left)

Section 5 Maintenance and Troubleshooting

5.1 Maintenance

5.1.1 Maintenance schedule

The following table shows the recommended schedule for membrane replacement. The table should only be used as a guideline, as maintenance intervals will vary depending on a number of different parameters (e.g. water chemistry, CIP frequency, oxygen levels, sample temperature, etc.).

Table 5 Maintenance schedule

Application	Membrane type	Membrane replacement
Water applications (> 10ppb)	2956A	Every 3 to 6 months
Pure water applications (power and electronics < 10 ppb)	2956A	Every 3 to 6 months
Beer in-line	2952A	Every 3 to 6 months
Wort in-line	29552A or 2995A	Every 1 or 2 months
Portable or lab applications	2952A or 2958A	Every 3 to 6 months

5.1.2 Prerequisites for sensor maintenance

The following table lists the prerequisites for a sensor maintenance:

Table 6 Prerequisites for sensor maintenance

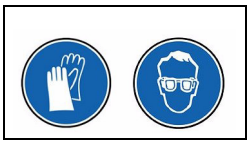
Part No.	Description
2959	Electrolyte for oxygen sensors, 50 ml. bottle.
29781	Cathode polishing powder (part no.29331) and cloth (part no. 2934).
32301	Electrochemical cleaning and regeneration center (see below)
40089	Tweezers, for maintenance kits
DG33303	Cleaning tool for sensor polishing

Important Note: *If the sensor is being used in a high level hydrogen sample, this cleaning and regeneration center is* ***not required****. In all other cases it is a* ***prerequisite****.*

The ORBISPHERE 32301 (illustrated below) 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.

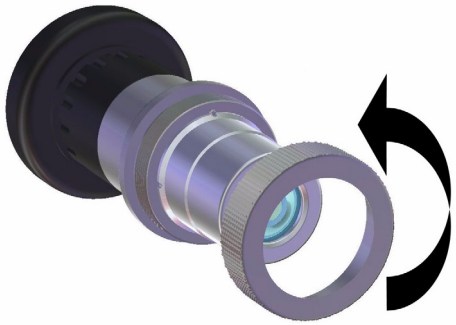
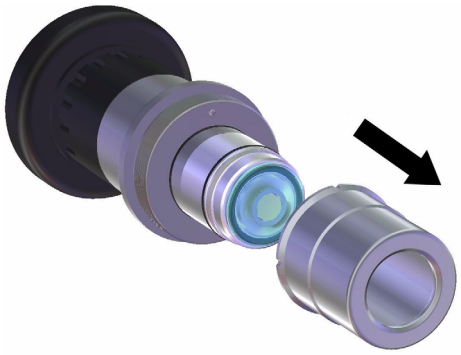
5.1.3 Membrane replacement and sensor head cleaning

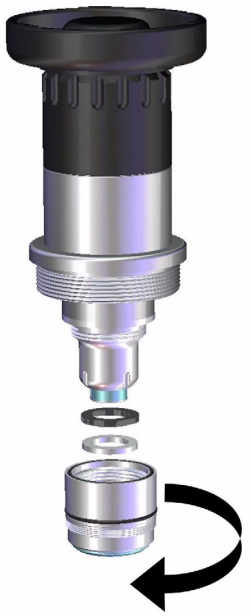
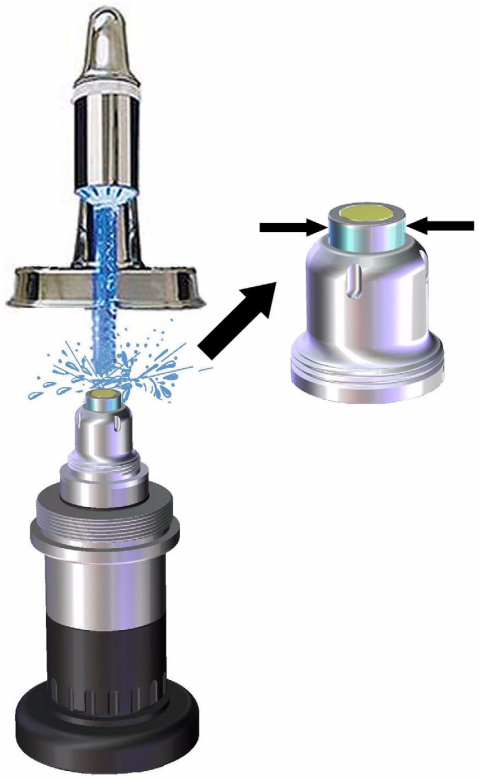
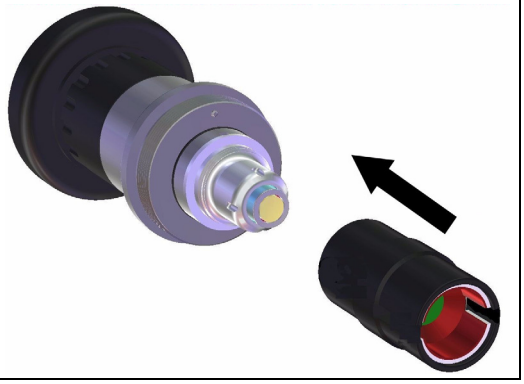
A sensor recharge kit is required as it contains all the required components necessary for this membrane replacement and sensor head cleaning process (see details in Sensor recharge kit on page 14).

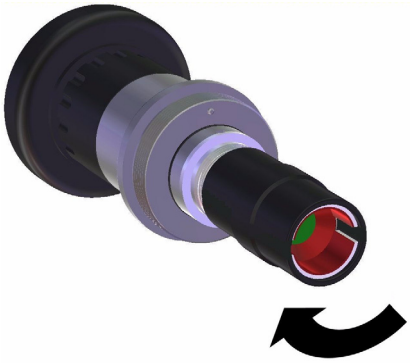
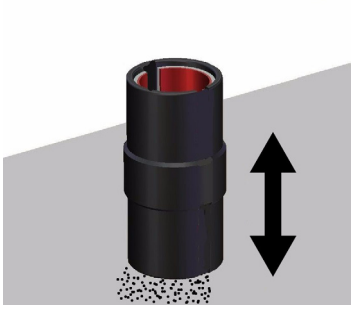


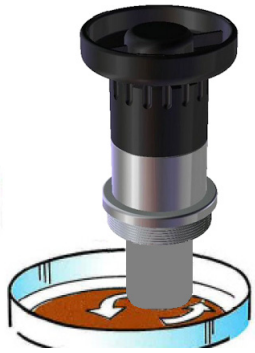
CAUTION
Avoid all eye and skin contact with the electrolyte in the sensor and replacement cartridge as it is corrosive and can cause burning. If eyes or skin come into contact with electrolyte, rinse immediately with water. In addition, the electrolyte can permanently stain clothing so exercise care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

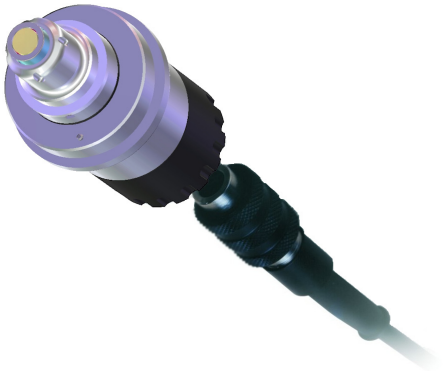
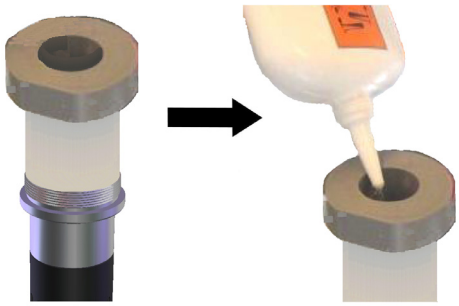
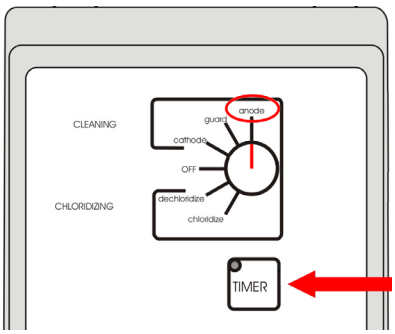
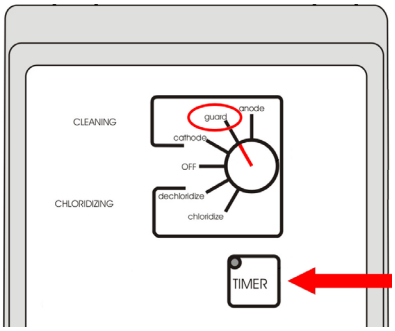
Note: *It is advisable to perform this procedure with the plastic sensor base installed so as to avoid any damage to the connection socket and also to provide a suitable stand for the sensor when required.*

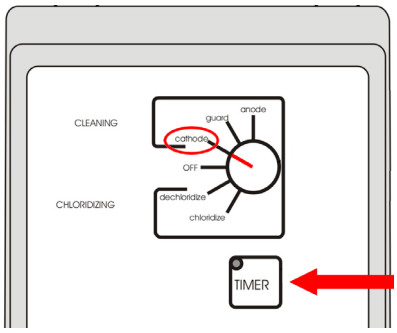
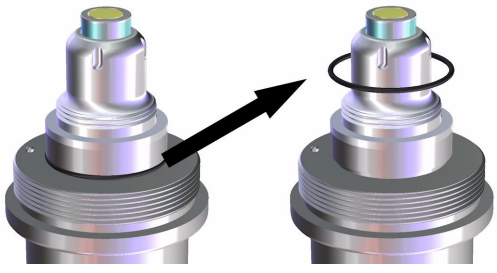
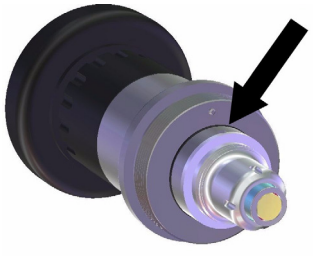
1. Hold the main body of the sensor and unscrew the protection cap locking washer by turning counter-clockwise. Remove it from the sensor and put to one side.	
2. Pull/twist off the protection cap and put to one side. If you are using a protection cap with a grille, then remove the Dacron® mesh from inside the cap and discard it.	

3. 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. **4.** Remove the cotton washer and silicone disc from the top of the anode and discard.	
5. Rinse the sensor head under a tap for 15 seconds to remove any remaining electrolyte and shake dry. **6.** 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. **7.** Repeat this rinse and dry process with the protection cap.	
8. Clean the anode using the cleaning tool supplied. **9.** Place the tool over the sensor head.	

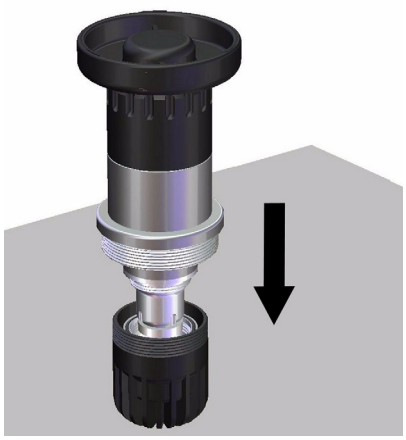
10. Clean by rotating the cleaning tool over the sensor head for a few seconds, **in a clockwise direction only**.	
11. Remove the tool and tap it face down on a flat work surface to remove any powdery deposit. **12.** Check the sensor to ensure that all deposits have been removed from the anode. If not, repeat steps 10. and 11. until the anode regains its bright silver appearance.	
13. Rinse the sensor head under a tap for 15 seconds, aiming the jet of water directly onto the sensor head. **14.** Do not dry the center electrode area, as the gap between cathode and guard should be left filled with water.	
15. Spread a little of the polishing powder (29331) onto the clean polishing cloth (2934), and add a few drops of water to form a grey, milky liquid.	

16. Screw the polishing tool (DG33303) onto the top of the sensor.	
17. Polish the electrodes by moving the sensor face in a circular direction against the liquid in the polishing cloth for about 30 seconds.	
18. Remove the polishing tool from the sensor. **19.** Remove any polish deposits by rinsing the sensor head under a tap for 30 seconds, aiming the jet of water directly onto the sensor head. ***Important Note:*** *If the sensor is used in high level hydrogen sample, do not perform the following steps but continue at step 29.*	

20. Remove the plastic base from the bottom of the sensor and connect the sensor to the sensor cleaning and regeneration center (32301).	
21. Push the cleaning tool over the sensor head. **22.** Pour enough electrolyte (2959) into the cleaning tool until it completely covers all the electrodes.	
23. On the sensor cleaning and regeneration center, turn the knob to the **Anode** position and press the **TIMER** switch. A red warning light will come on and remain on for 60 seconds while cleaning takes place.	
24. At the end of the 60 second cleaning process, check for an abundant stream of bubbles should rise from the anode.If this does not happen, press **TIMER** again. ***Note:*** *The development of bubbles is a sure sign of a clean electrode.*	
25. On the sensor cleaning and regeneration center, turn the knob to the **Guard** position and press the **TIMER** switch. Again, watch for the formation of bubbles and repeat the cleaning process if necessary.	

26. On the sensor cleaning and regeneration center, turn the knob to the **Cathode** position and press the **TIMER** switch. Again, watch for the formation of bubbles and repeat the cleaning process if necessary.	
27. When cleaning is complete, unplug the sensor from the cleaning center and re-install the plastic sensor base for the rest of the procedure. **28.** Remove any remaining electrolyte by rinsing the sensor head under a tap for 60 seconds, aiming the jet of water directly onto the sensor head.	
29. With the help of a pair of tweezers, remove the old O-ring from the sensor body.	
30. Replace the O-ring with a new one from the recharge kit.	

Note: *During this 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.* **31.** Take a silicone disc from the recharge kit, hold it between thumb and forefinger and position it on top of the anode.	
Note: *As in the previous 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.* **32.** Take a new cotton washer from the recharge kit. Hold it between thumb and forefinger and position it on top of the silicone disc.	
33. 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. **34.** 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. **35.** If there are any visible bubbles in the electrolyte, remove them using a stirring motion with the packing component.	

36. Hold the container steady between thumb and forefinger of one hand. **37.** Lower the sensor into the container until the top of the anode is covered with electrolyte. **38.** Leave for a few seconds to ensure the cotton washer has fully absorbed some of the electrolyte and that it is no longer dry.	
39. Gently screw the sensor clockwise into the replacement cartridge, applying minimum pressure to avoid any damage to the screw threads.	
40. Continue turning until the cartridge is attached to the sensor, and the sensor is automatically released from the container. **41.** The empty container, the screw top and packing component can be discarded. ***Note:*** *It is normal that some of the electrolyte will overflow from the replacement cartridge and into the plastic container.*	

42. 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.

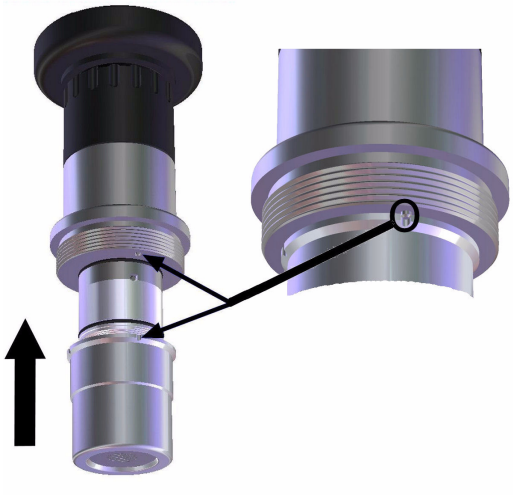
43. Drain the overflow electrolyte from the container into a sink and flush away.

44. Discard the used container.

45. If not using a protection cap with grille proceed to step 48. Otherwise, take a new Dacron® mesh from the box of O-rings in the recharge kit.

46. 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).

47. Lower the sensor onto the protection cap making sure not to disturb the mesh.

48. 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.	
49. Finally, screw the protection cap locking washer back into place in a clockwise motion, and tighten finger tight.	

5.2 Troubleshooting

Table 7 Troubleshooting

Problem	Probable cause	Possible solution
Sensor won't calibrate, even after cleaning and/or membrane change.	Instrument internal barometric pressure sensor needs calibration.	Calibrate using a certified barometer. Do not correct for sea level !
	Wet membrane interface.	Wipe dry with a tissue and recalibrate.
	"H_2S insensitivity" option enabled.	Disable from the menu on the measuring instrument.
"0000" O_2 levels displayed.	Wrong reading scale "XXXX" selected for display unit.	Change reading scale by selecting "X.XXX, XX.XX or XXX.X" on the instrument.
Shorter than expected sensor operation in relatively high dissolved O_2 concentration.	High O_2 concentrations generate deposits more quickly.	Install a less permeable membrane. Turn off the analyzer when sensor is not in a low O_2 concentration.
Unexpected or inaccurate dissolved O_2 readings.	Air leak on product sample line.	Set flow rate to 100 ml/min. Wait until stable, then slowly double the flow rate. The stable value of dissolved O_2 reading must be the same as before. A variation related to flow rate is a clear sign of an air leak in the line.
	High residual current.	Place sensor in de-aerated sample and wait for low reading. Check concentration against low measurement limit (see tables in Sensor membrane specifications on page 11). If concentration is significantly higher than low limit, try replacing the membrane.
Calibration is out of specification or response time is too slow.	Sensor incorrectly setup.	Check the sensor parameters on the instrument. Recalibrate the sensor.
	Temperature measurement incorrect.	Control the temperature with an external reference. Recalibrate the sensor.
	Barometric pressure incorrect.	Calibrate the barometric pressure sensor using the instrument. Recalibrate the sensor.
	Cartridge incorrectly assembled on sensor.	Verify the cartridge assembly is firmly screwed onto the sensor and that the membrane is tight. Recalibrate the sensor.
	Sensor electrodes are dirty.	Clean the sensor using the ORBISPHERE 32301 cleaning and regeneration center as explained in this section. Recalibrate the sensor.
	Sensor maintenance is required.	Replace the membrane by installing a new sensor cartridge as explained in this section. Recalibrate the sensor.

Section 6 Accessories and Spare Parts

6.1 Accessories

Table 8 Sensor accessories	
Part N°	**Description**
28117	Pressure sensor, 0-5 bar absolute
28117.C	Pressure sensor, 0-1 bar absolute

6.2 Flow chambers and installation devices

Table 9 Flow chambers and installation devices	
Part N°	**Description**
29501.0	Sensor socket for welding to SS pipe, with EPDM O-ring
29501.1	Sensor socket for welding to SS pipe, with Viton O-ring
29508	Multi parameter flow chamber for headspace piercing device
32001.010	Flow chamber in stainless steel (316) with 6 mm fittings. Supplied with EPDM O-rings.
32001.011	Flow chamber in stainless steel (316) with ¼" fittings. Supplied with EPDM O-rings.
32001.012	Flow chamber in stainless steel (316) with 8 mm fittings. Supplied with EPDM O-rings.
32001.030	Flow chamber in Delrin with 6 mm fittings. Supplied with EPDM O-rings.
32001.031	Flow chamber in Delrin with ¼" fittings. Supplied with EPDM O-rings.
32001.040	Flow chamber in Hastelloy with 6 mm fittings. Supplied with EPDM O-rings.
32001.041	Flow chamber in Hastelloy with ¼" fittings. Supplied with EPDM O-rings.
32001.070	Flow chamber in Monel with 6 mm fittings. Supplied with EPDM O-rings.
32001.071	Flow chamber in Monel with ¼" fittings. Supplied with EPDM O-rings.
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.
32001.151	Flow chamber in titanium with ¼" fittings (6 mm fittings not available in titanium) 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.
32001.181	Flow chamber in Kynar with ¼" fittings. Supplied with Viton O-rings.
32001.191	Flow chamber in PTFE with ¼" fittings. Supplied with Viton O-rings.
32002.010	Multi parameter flow chamber in stainless steel with 6 mm fittings. Supplied with EPDM O-rings.
32002.011	Multi parameter flow chamber in stainless steel with ¼" fittings. Supplied with EPDM O-rings.
32003	ProAcc sensor insertion device ; for use with Tuchenhagen adapter
32006	Flow chamber in stainless steel (316) for use with for model 28117 and 28117.C pressure sensors.
32007D	Flow chamber in Delrin for the 3655 portable instrument, with one meter of tubing.
32007F	Flow chamber in Delrin for the 3650 portable instrument. Includes check valve, 1 meter of inlet tubing, quarter turn flow valve, and outlet metal U-tube (6mm outside diameter).
32007W.030	Flow chamber in Delrin with 6 mm stainless steel Swagelok fittings for use with liquids with suspended particles. Supplied with EPDM O-rings.
32007W.031	Flow chamber in Delrin with ¼" stainless steel Swagelok fittings for use with liquids with suspended particles. Supplied with EPDM O-rings.
32009	Flow chamber in acrylic with 1/8" Swagelok fittings for small volume liquid phase measurements.
32011	Flow chamber in acrylic with 1/8" Swagelok fittings for small volume liquid phase measurements, with port for 32562 external temperature sensor.
32017	Flow chamber used with 29981 Pharmapack. Must be ordered separately.

6.3 Sensor spare parts

Table 10 Sensor spare parts	
Part N°	**Description**
A1100-S00	A1100 oxygen sensor, non-ATEX, stainless steel, maximum pressure 40 bar with default PPS collar (100 bar with 28104 stainless steel collar), with smart capability
A110E-SVS	A110E oxygen sensor, ATEX, stainless steel, viton o-rings, cap with grille
A110E-SKS	A110E oxygen sensor, ATEX, stainless steel, kalrez o-rings, cap with grille
A110E-HVS	A110E oxygen sensor, ATEX, hastelloy, viton o-rings, cap without grille
A110E-HKS	A110E oxygen sensor, ATEX, hastelloy, kalrez o-rings, cap without grille
28104	Stainless steel sensor collar
28105	PPS sensor collar
28129	Delrin storage cap (sensor storage cap)
32205	Sensor support (base) for 31xxx sensors
33051-S0	Stainless steel 28mm cap for ORBISPHERE A1100 family EC sensors (without grille)
33051-SG	Stainless steel 28mm cap with grille for ORBISPHERE A1100 family EC sensors. For use in beer or soft-drinks processes and ATEX configurations.
33051-SP	Stainless steel 28mm cap with grille for ORBISPHERE A1100 family EC sensors. For use with 3625 package analyzer and 3650 instrument when measuring beer or soft-drinks.
33051-H0	Hastelloy 28mm cap without grille for ORBISPHERE A110E ATEX sensors.
33052	Kit of 5 dacron mesh for protection cap with grille model 33051-SG or 33051-SP

6.4 Recharge kits for A1100 and A110E sensors

Table 11 Recharge kits for A1100 sensors	
Part N°	**Description**
2935A-A	Recharge kit of 4 pre-filled cartridges with premounted 2935A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
29521A-A	Recharge kit of 4 pre-filled cartridges with premounted 29521A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
2952A-A	Recharge kit of 4 pre-filled cartridges with premounted 2952A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
29552A-A	Recharge kit of 4 pre-filled cartridges with premounted 29552A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
2956A-A	Recharge kit of 4 pre-filled cartridges with premounted 2956A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers, silicone discs and cleaning tools
2956A-A05	Recharge kit of 4 pre-filled cartridges with premounted 2956A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers, silicone discs and cleaning tools. Special low concentrate electrolyte
2958A-A	Recharge kit of 4 pre-filled cartridges with premounted 2958A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
2995A-A	Recharge kit of 4 pre-filled cartridges with premounted 2995A membranes for A1xxx oxygen sensors. Includes o-rings, cotton washers and cleaning tools
2956A-AV	Recharge kit of 4 pre-filled cartridges with premounted 2956A membranes for A1xxx oxygen sensors. Includes viton o-rings, cotton washers, silicone discs and cleaning tools
2956A-AK	Recharge kit of 4 pre-filled cartridges with premounted 2956A membranes for A1xxx oxygen sensors. Includes kalrez o-rings, cotton washers, silicone discs and cleaning tools
29552A-AV	Recharge kit of 4 pre-filled cartridges with premounted 29552A membranes for A1xxx oxygen sensors. Includes viton o-rings, cotton washers and cleaning tools
29552A-AK	Recharge kit of 4 pre-filled cartridges with premounted 29552A membranes for A1xxx oxygen sensors. Includes kalrez o-rings, cotton washers and cleaning tools

6.5 Other spare parts

Table 12 Other spare parts	
Part N°	**Description**
28093.0	EPDM O-rings for pressure sensor 28117.X. 18.78 x 1.78mm. (5 pieces)
28093.2	Kalrez O-ring for pressure sensor 28117.X. 18.78 x 1.78mm. (1 piece)
28093.4	Nitril O-rings for pressure sensor 28117.X. 18.78 x 1.78mm. (5 pieces)
29006.0	EPDM O-ring set for standard flow chambers (32001, 32002, 32007, 32009) and 29501 sensor socket. (34x2mm & 28x2 mm).
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
2959	Electrolyte for oxygen sensors, 50 ml. bottle.
29781	Cathode polishing powder (part no.29331) and cloth (part no. 2934).
32301	Electrochemical cleaning and regeneration center
40089	Tweezers, for maintenance kits
DG33303	Cleaning tool for sensor polishing

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