ADS420

Optical dissolved oxygen sensor



—
ADS420
dissolved oxygen sensor

Measurement made easy

Introduction

The ADS420 sensor is a rugged, reliable instrument designed to deliver accurate dissolved oxygen (DO) data across a wide measurement range, using the latest optical technology for DO measurement.

The probe is designed for use with ABB multi-input transmitters, such as the AWT420 and AWT440, which feature 'hot-plugging' capability.
Hot-plugging lets new or replacement sensors to be connected without needing to power down the transmitter.

When used in conjunction with the optional EZClean compressed air supply unit (connected to an ABB adapter nozzle or T-piece), a schedule can be configured to provide automatic in-situ cleaning of the sensor.

For more information

Further publications and publications for the associated AWT420 and AWT440 transmitters are available for free download from:
www.abb.com/measurement
or by scanning this code:

	Search for or click on
Data Sheet ADS420 – Optical dissolved oxygen sensor	DS/ADS420
Commissioning Instruction – AWT420 Universal 4-wire, dual-input transmitter	CI/AWT420
Operating Instruction – AWT420 Universal 4-wire, dual-input transmitter	OI/AWT420
Commissioning Instruction – AWT440 Multi-input transmitter	CI/AWT440
Operating Instruction – AWT440 Multi-input transmitter	OI/AWT440
Parts list – Sensor accessories	PL/ANAINST/001

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1 Health & Safety

Document symbols

Symbols that appear in this document are explained below:

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

'Note' indicates operator tips, particularly useful information or important information about the product or its further uses. **'Note'** does not indicate a dangerous or harmful situation.

Safety precautions

Be sure to read, understand and follow the instructions contained within this manual before and during use of the equipment. Failure to do so could result in bodily harm or damage to the equipment.

⚠ WARNING

Installation, operation, maintenance and servicing must be performed:

- by suitably trained personnel only
- in accordance with the information provided in this manual
- in accordance with relevant local regulations

Potential safety hazards

ADS420 sensor – electrical
The sensor operates on 24 V DC supplied from the transmitter. There are no hazardous voltages present.

Safety standards

This product has been designed to satisfy the requirements of IEC61010-1:2010 3rd edition 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.

Product symbols

Symbols that may appear on this product are shown below:

⎓ Direct current supply only.


This symbol identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.


This symbol indicates the need for protective eye wear.


This symbol indicates the need for protective hand wear.


Recycle separately from general waste under the WEEE directive.

Product recycling and disposal (Europe only)


ABB 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 that initially 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, electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

NOTICE

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

Information on RoHS Directive 2011/65/EU (RoHS II)



ABB, Process Automation, Measurement & Analytics, UK, fully supports the objectives of the RoHS II directive. All in-scope products placed on the market by PAMA UK on and following the 22nd of July 2017, will be compliant to the RoHS directive, 2011/65/EU.

...1 Health & Safety

Cybersecurity

This product is designed to be connected to and to communicate information and data via a network interface. It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be). Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

2 System overview

ADS420 cable attached

ADS420 sensor components (cable attached) are shown in Figure 1:

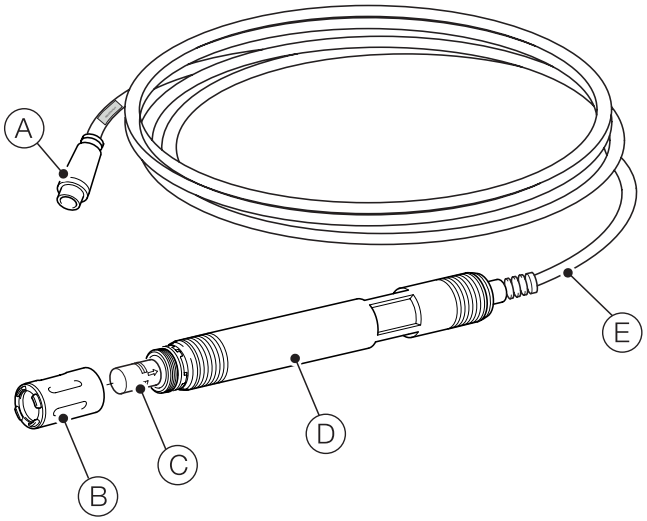


Figure 1 ADS420 sensor components (cable attached)

Table 1 Sensor components (cable attached)

Part	Description
A	EZLink™ digital sensor connector
B	Shroud
C	SmartCap (supplied unfitted in sealed factory-supplied container) **Note.** The SmartCap serial number is programmed on the memory chip inside the SmartCap.
D	Sensor body (including temperature sensor)
E	10 m (39.3 ft) fixed cable

ADS420 cable detached

ADS420 sensor components (cable detached) are shown in Figure 2:

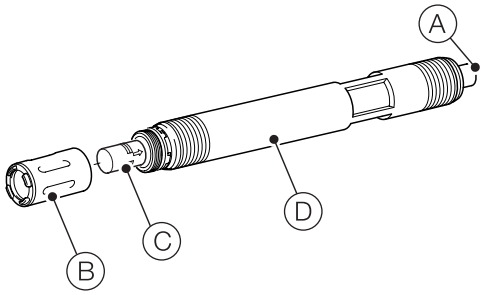


Figure 2 ADS420 sensor components (cable detached)

Table 2 Sensor components (cable detached)

Part	Description
A	EZLink digital sensor connector
B	Shroud
C	SmartCap (supplied unfitted in sealed factory-supplied container) **Note.** The SmartCap serial number is programmed on the memory chip inside the SmartCap.
D	Sensor body (including temperature sensor)

3 Sensor setup menu

Dissolved oxygen

Menu	Comment	Default
Tag	Enter an alphanumeric sensor tag (16 characters maximum) to identify the sensor on the **Operator Pages**.	TAG1
Measurement Type	Select the required probe type: • Dissolved Oxygen / % Saturation **Note**. If a change is made the I/O sources are reset.	Dissolved Oxygen
Units	Select the measurement units: • mg/L / ppm	ppm
PV Resolution	Select the PV Resolution: • Normal / High	Normal
Range High	Set the span value in **Chart** and **Bargraph** views.	50 ppm (200 %)
Range Low	Set the zero value in **Chart** and **Bargraph** views.	0
Filter Type	Select the signal filtering type: • None / Low / Medium / High	None
Salinity Unit	Select the required salinity units: • PSU (Practical Salinity Units) or ppt (parts-per-thousand).	PSU
Salinity Correction	Required when monitoring water containing high quantities of dissolved salts: • enter the required value between 0 and 42 Practical Salinity Units (PSU). • leave at the default value of 0 PSU if salinity correction is not required.	0 PSU
Pressure Unit	Select the required barometric pressure units: • mbar / mmHg	mbar
Barometric Pressure	Barometric pressure compensation. Set the local barometric pressure to 506 to 1114 mbar (380 to 835 mmHg). If the barometric pressure is unknown, leave at the default sea-level value of 1013 mbar (760 mmHg).	1013 mbar
Slope Limit	0.85 to 1.20	N/A
Offset Limit	-0.2 to 0.2	N/A
Reset To Defaults	Select to reset all **Sensor Setup** parameters to their default values.	N/A

4 Calibration

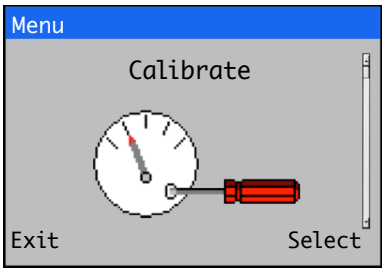
This section describes how to calibrate the sensor and involves measuring the sensor's sensitivity to oxygen by exposing the sensor to water-saturated air.

Calibrations are initiated via the **Cal** prompt displayed on Operator pages or via the **Calibrate** and **Advanced** menu items on the **Access Level** page – refer to transmitter Operating instructions OI/AWT420 for all transmitter menu options.

Note.

- Do not perform a calibration until the sensor and transmitter are installed and ready for operation.
- Before removing the sensor for calibration purposes, set the currents outputs and alarms to Hold (enabled via the Operator Menu/Manual Hold function).
- After calibration and sensor replacement, reset the currents outputs and alarms – see **Calibrate menu** below.

Calibrate menu



Used to calibrate the sensor.
Access to the Calibrate menu is permitted via the **Calibrate** and **Advanced** levels only.
Note. During calibration, current outputs and alarms are set to **Hold** automatically if **Hold Outputs** is enabled (see below).

Menu	Comment	Default
S1 (to 4) :DO	Select the optical dissolved oxygen sensor to calibrate.	
Probe Calibration		
Calibration Type		
1-Point Cal	Select to perform a 1-point calibration in water-saturated air (100% saturation):	
2-Point Cal	Select to perform a 100 % saturation calibration in water-saturated air and a 0 % saturation calibration in an oxygen-depleted solution, e.g. sodium sulfite (Na_2SO_3).	
Hold Outputs	Enable/disable the **Hold Outputs** function. If enabled, the current outputs and alarm functions are held during calibrations.	Enabled

...4 Calibration

1-Point calibration (water-saturated air)

1 Using a customer-supplied calibration pot, place a wet sponge at the bottom of the container.

2 Ensure the probe and sensing element are completely dry. If necessary use a paper towel to remove any water or debris from the sensor or sensing element.

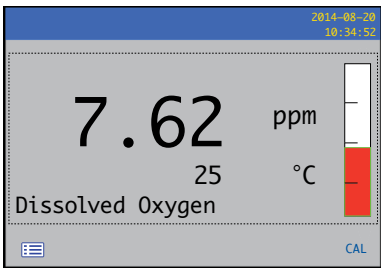
3 Slide sensor into calibration chamber until the sensing element is approximately 25 mm (1 in) above water-saturated sponge.

4 Allow 5 to 10 minutes for temperature stabilization prior to continuing the calibration procedure.

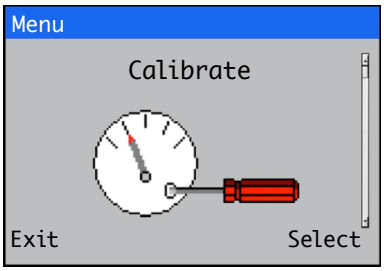
NOTICE

- Do not leave the sensor in the calibration chamber for more than 30 minutes – this can allow condensation to form on the surface of the sensing element, producing false low readings after calibration.
- If condensation occurs, remove the sensor, thoroughly dry the sensing element, probe and thermistor before performing the calibration procedure.
- Ensure the calibrations are performed in a vented but enclosed chamber, to prevent pressure building up in the container.
- Minimize ambient airflow across the sensor head during the calibration.

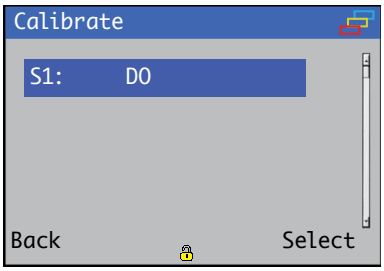
5 At the transmitter perform a 1-point calibration from an **Operator** page as follows:



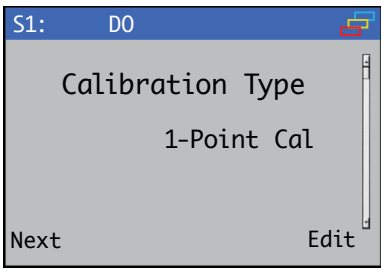
6 Press the key (below the **Cal** prompt).
The Calibrate page is displayed:



7 Press the key (below the **Select** prompt).
The **Calibrate** page is displayed with all available sensors shown:

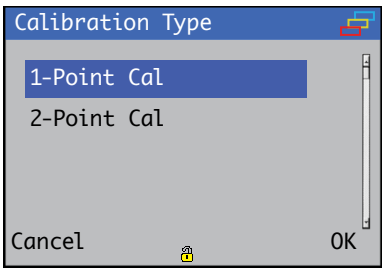


8 Use the / keys to select the sensor to be calibrated and press the key (below the **Select** prompt).
The **Calibration Type** page is displayed:

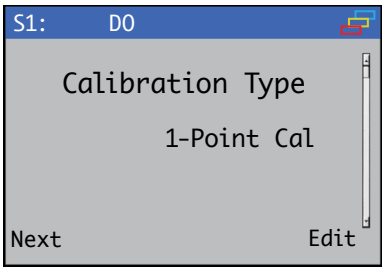


9 If **1-Point Cal** is displayed, go to step 12.

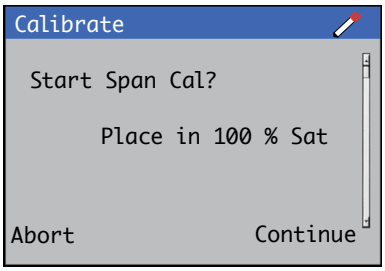
If **1-Point Cal** is not displayed, press the key (below the **Edit** prompt).
The **Calibration Type** selection page is displayed:



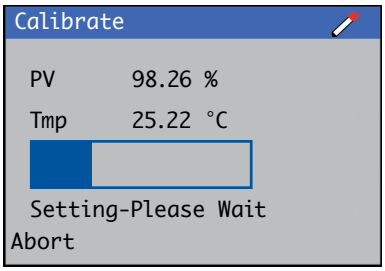
10 Use the / keys to select **1-Point Cal** and press the key (below the **OK** prompt).
The **Calibration Type** page is displayed:



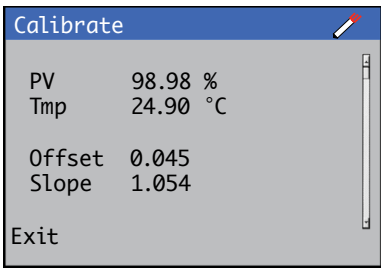
11 Press the key below the **Next** prompt).
The **Calibrate/Start Span Cal?** page is displayed:



12 Press the key (below the **Continue** prompt).
The **Calibrate** page is displayed:

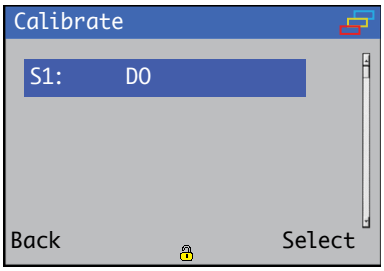


13 When span calibration is complete, a results page is displayed:

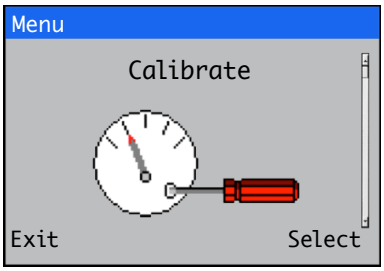


In the event of a calibration failure, the message **Calibration Failed** is displayed with an indication of the reason for failure, for example '**Result Out Of Bounds**'.

14 Press the key (below the **Exit** prompt).
The **Calibrate page** is displayed:



15 Press the key (below the **Back** prompt).
The **Calibrate page** is displayed:



16 Press the key (below the **Exit** prompt) to return to the **Operator page**.

...4 Calibration

2-Point calibration (100 % and 0 % saturation)

Note. This calibration procedure requires 60 mL (2.0 US fl oz) of fresh sodium sulfite solution.

1 Using a customer-supplied calibration pot, place a wetted sponge at the bottom of the container.

2 Ensure the probe and sensing element are completely dry. If necessary use a paper towel to remove any water or debris from the probe or sensing element.

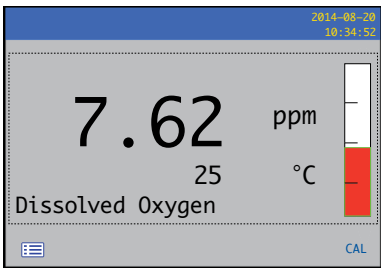
3 Slide probe into calibration chamber until the sensing element is approximately 25 mm (1 in) above water-saturated sponge.

4 Allow 5 to 10 minutes for temperature stabilization prior to continuing the calibration procedure.

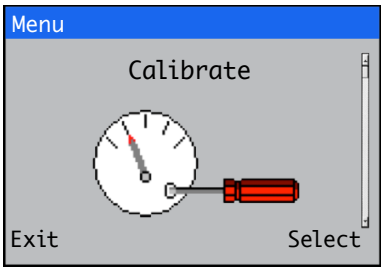
NOTICE

- Do not leave the probe in the calibration chamber for more than 30 minutes – this can allow condensation to form on the surface of the sensing element, producing false low readings after calibration.
- If condensation occurs, remove the probe, thoroughly dry the sensing element, probe and thermistor before performing the calibration procedure.
- Ensure the calibrations are performed in a vented but enclosed chamber, to prevent pressure building up in the container.
- Minimize ambient airflow across the sensor head during the calibration.

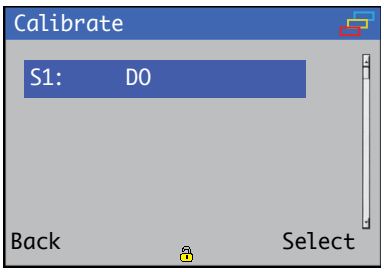
5 At the transmitter perform a 2-point calibration from an Operator page as follows:



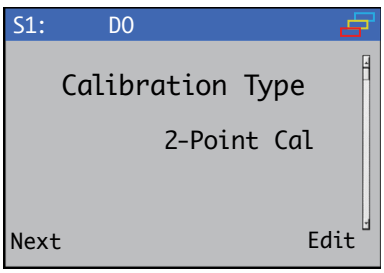
6 Press the key (below the **Cal** prompt).
The Calibrate page is displayed:



7 Press the key (below the **Select** prompt).
The **Calibrate** page is displayed with all available sensors shown:

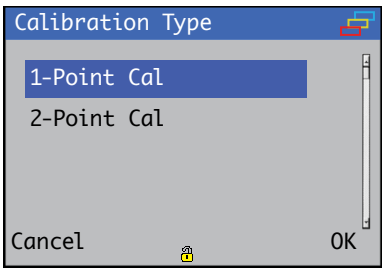


8 Use the / keys to select the probe to be calibrated and press the key (below the **Select** prompt).
The **Calibration Type** page is displayed:

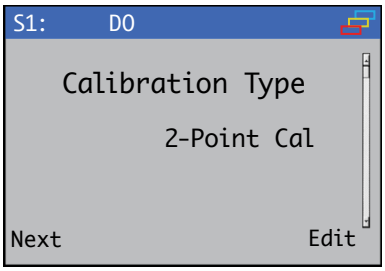


9 If **2-Point Cal** is displayed, go to step 11.

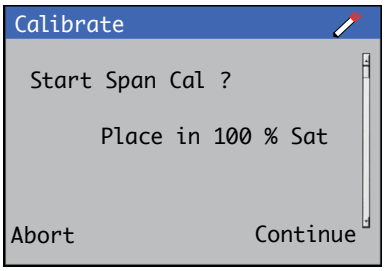
If **2-Point Cal** is not displayed, press the key (below the **Edit** prompt).
The **Calibration Type** selection page is displayed:



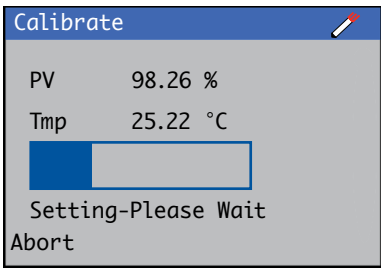
10 Use the / keys to select **2-Point Cal** and press the key (below the **OK** prompt).
The **Calibration Type** page is displayed:



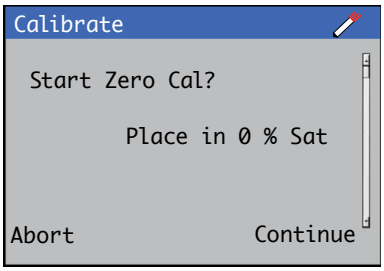
11 Press the key below the **Next** prompt).
The **Calibrate/Start Span Cal?** page is displayed:



12 Press the key (below the **Continue** prompt).
The **Calibrate** page is displayed:



13 When span calibration is complete, the **Calibrate/Start Zero Cal?** page is displayed:

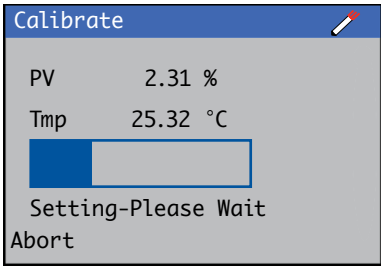


14 Remove the sponge wafer from the calibration pot.

15 Fill calibration chamber with fresh sodium sulfite solution, leaving at least 13 mm (0.5 in) between the surface of the sensing element and the bottom of the chamber.

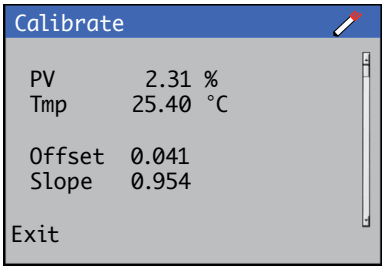
16 Allow 5 to 10 minutes for temperature stabilization prior to continuing the calibration procedure.

17 Press the key (below the **Continue** prompt).
The **Calibrate** page is displayed:

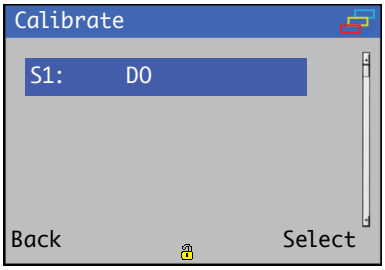


...4 Calibration

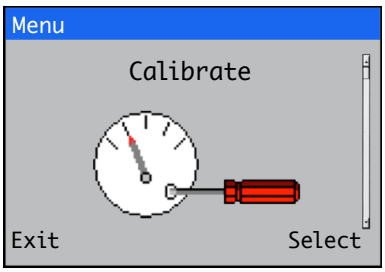
18 When zero calibration is complete, a results page is displayed:



19 Press the key (below the **Exit** prompt).
The **Calibrate page** is displayed:



20 Press the key (below the **Back** prompt).
The **Calibrate page** is displayed:



21 Press the key (below the **Exit** prompt) to return to the **Operator page**.

22 Once the calibration is complete, remove the sensor from the chamber and rinse thoroughly to remove all of the sodium sulfite.

Abort calibration

A calibration is aborted by pressing the key below the **Abort** prompt displayed on the **Calibrate** pages (refer to the transmitter Operating Instructions OI/AWT420).

The Calibration Log displays the message **Cal Aborted** – refer to OI/AWT420 for Calibration Log entries.

Calibration timings

Stability period

The temperature and concentration readings are monitored for up to 10 minutes until a stable reading is achieved. When stability is achieved, the calibration (slope and offset) values are determined.

Slow sensor response

If the output from the sensor does not stabilize during the Stability Period the calibration is not accepted and a **Cal Failed** diagnostic is displayed, the Calibration Log is updated with a **Cal Failed** message.

Calibration troubleshooting

Slow sensor calibration or no response to dissolved oxygen changes

1 Check sensor configuration/recalibrate sensor.

If the fault persists:

2 Clean the SmartCap and lens – refer to **Maintenance** on page 13.

If the fault persists:

3 Replace the SmartCap – refer to **Spares** on page 18.

If the fault persists:

4 Replace the sensor.

5 Maintenance

Cleaning the SmartCap

1 Remove the sensor from the process.

Referring to Figure 3:

2 Unscrew the shroud Ⓐ from the sensor body Ⓑ.

3 Rinse SmartCap Ⓒ with clean water from a spray bottle.

4 Gently wipe SmartCap Ⓒ with a soft-bristled brush or, if biofouling is present, a soft cloth.
If necessary, use a grease remover to remove grease.

5 Refit shroud Ⓐ by screwing it onto the sensor body Ⓑ.

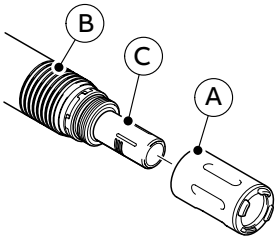


Figure 3 Cleaning the SmartCap

Cleaning the lens

1 Isolate the transmitter and remove the sensor from the process.

Referring to Figure 4:

2 Unscrew the shroud Ⓐ from the sensor body Ⓑ.

3 Grip the SmartCap Ⓒ between your thumb and forefinger and carefully slide it off the sensor Ⓓ.

NOTICE

- Do not touch the end of the SmartCap Ⓒ.
- Do not allow moisture or atmospheric humidity inside SmartCap Ⓒ.
- Do not wet the lens area Ⓔ with water or any solution. Use only the supplied lens cloth for cleaning.

4 Gently wipe the lens Ⓔ with a lens cloth (not supplied).

5 Refit the shroud Ⓐ by screwing it securely onto the sensor body Ⓑ.

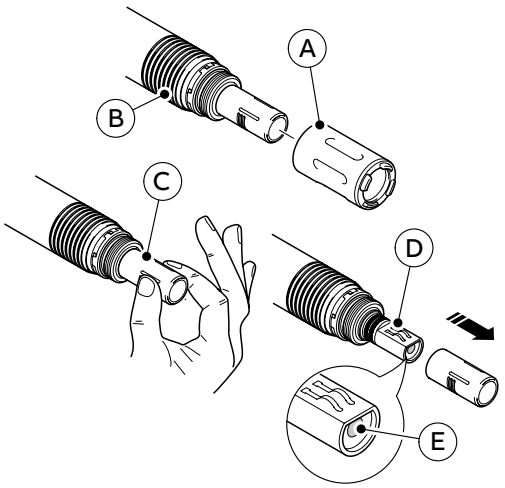


Figure 4 Cleaning the optical lens

…5 Maintenance

Cleaning the sensor body

Note. Make sure that the shroud (A) is installed tightly before you start to clean the sensor body.

1 Isolate the transmitter and remove the sensor from the process.

Referring to Figure 5:

2 Gently scrub the shroud (A) and the sensor body (B) with a soft-bristled brush or a nylon dish scrubber.
If it is necessary, use a grease remover to remove grease or other matter from the sensor body, or soak in vinegar and deionized water to remove mineral deposits or extensive fouling.

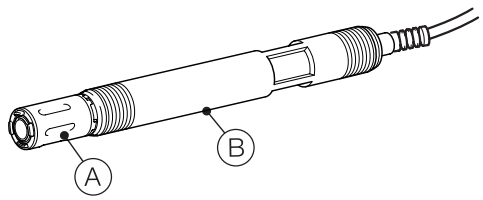


Figure 5 Cleaning the sensor body

6 Diagnostics

The table below shows sensor-specific icon types, diagnostic messages and possible causes/suggested remedial action.

Note.
- The diagnostic icons in the following tables conform to NAMUR 107.
- For transmitter-specific diagnostics messages, refer to OI/AWT420.

NAMUR 107 diagnostic icons

			
Failure	**Check function**	**Out of specification**	**Maintenance required**
Process value invalid due to malfunction in sensor or transmitter	Process value temporarily invalid due to specified action	Process value unreliable due to sensor operating outside specified range/limits	Process value valid – intervention required to correct operational conditions

S(n): PT failure

Diagnostic message

 S(n): PT failure

Cause
The measurement taken from the temperature sensor is invalid indicating that the temperature sensor has failed, or the associated connections are either open-circuit or short-circuit.

Recovery action
1. Visually inspect the sensor/temperature sensor for signs of damage. A damaged sensor must be replaced.
2. Cycle the power to the transmitter.
3. If the failure persists, contact the local service organization.

S(n): D.O. Conc Meas Error

Diagnostic message

 S(n): D.O. Conc Meas Error

Cause
The DO sensor cannot provide a valid dissolved oxygen measurement due to a sensor error.

Recovery action
1. Cycle the power to the sensor.
2. If the failure persists, contact the local service organization.

S(n): %Sat Meas Error

Diagnostic message

 S(n): %Sat Meas Error

Cause
The DO sensor cannot provide a valid % saturation measurement due to a sensor error.

Recovery action
1. Cycle the power to the sensor.
2. If the failure persists, contact the local service organization.

S(n): Calibrating

Diagnostic message

 S(n): Calibrating

Cause
Sensor calibration in progress.

Recovery action
This diagnostic clears when the calibration is complete.

S(n): Internal Comms Error

Diagnostic message

 S(n): Internal Comms Error

Cause
The DO sensor cannot provide a valid dissolved oxygen measurement due to an error in the communication between the sensor and the SmartCap.

Recovery action
1. Make sure that the SmartCap is installed and correctly seated.

S(n): Cap Removed

Diagnostic message

 S(n): Cap Removed

Cause
The SmartCap has been removed from the sensor or is not being recognized. A valid measurement cannot be made.

Recovery action
1. Make sure that the SmartCap is installed correctly.

...6 Diagnostics

S(n): Cal Failed

Diagnostic message



Cause
The most recent sensor calibration has failed, calibration coefficients have not been updated, and the previous values continue to be applied.

Recovery action
1. Make sure that the sensor is clean and fully submerged in the solution.
2. Do the calibration again.
3. If the failure persists, consider replacing the sensor.

S(n): User Cal Expired

Diagnostic message



Cause
Recalibration of the DO sensor is required. The sensor deteriorates over time, and recalibration is necessary to maintain accuracy.

Recovery action
1. Perform a calibration.

S(n): Factory Cal Expired

Diagnostic message



Cause
Recalibration of the DO sensor is required. The sensor deteriorates over time, and recalibration is necessary to maintain accuracy.

Recovery action
1. Perform a calibration.

S(n): Sensor Warm-up

Diagnostic message



Cause
The DO sensor is warming up and cannot provide a valid DO measurement until the internal electronics have stabilized.

Recovery action
This diagnostic clears when the internal electronics have stablized.
If the diagnostic persists, contact the local service organization.

S(n): Sensor Warning

Diagnostic message



Cause
PV measured from the DO sensor but does not meet normal quality criteria. The sensor has sustained moderate damage, or the recommended lifespan has been reached

Recovery action
1. Visually inspect the sensor for signs of damage.
2. If the sensor appears to be in good condition and is within its recommended lifespan, it may help to clean the sensor and the optical lens.
3. If there are sign of damage or the diagnostic persists, contact the local service organization.

S(n): Cap Expired

Diagnostic message



Cause
The SmartCap in the DO sensor has reached or exceeded its expiry date. The SmartCap may continue to operate but its accuracy degrades and cannot be guaranteed to meet specification.

Recovery action
1. Replace the SmartCap.

S(n): Replace Cap

Diagnostic message


S(n): Replace Cap

Cause

The SmartCap in the DO sensor reaches its expiry date within 4 weeks. After its expiry date, the SmartCap may continue to operate, but its accuracy degrades and cannot be guaranteed to meet specification.

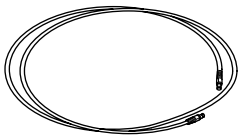
Recovery action

1 Replace the SmartCap.

7 Spares

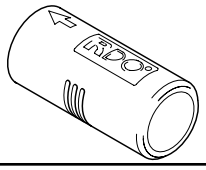
EZLink extension cables

Part number	Description
AWT4009010	1 m (3.3 ft)
AWT4009050	5 m (16.4 ft)
AWT4009100	10 m (32.8 ft)
AWT4009150	15 m (49.2 ft)
AWT4009250	25 m (82.0 ft)
AWT4009500	50 m (164.0 ft)



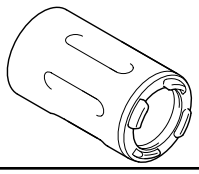
SmartCap spare parts

Part number	Description
3KXA494400L0019	SmartCap replacement kit



Shroud spare parts

Part number	Description
3KXA494400L0020	Shroud replacement kit



Acknowledgements

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