100 GP, 100 ULTRA, 500 PRO

¾ in pH/Redox (ORP) sensors

Measurement made easy

Introduction

The 100 GP, 100 ULTRA and 500 PRO pH/ORP sensors offer a rugged, built-for-purpose design targeting applications ranging from high-purity to light industrial.

The **analog** sensors are designed for use with ABB's AWT210 and AWT420 transmitters with analog-capable inputs.

The **digital** sensors are designed for use with ABB's AWT420 and AWT440 multi-input transmitters featuring EZLink connectivity. EZLink enables new or replacement sensors to be connected easily without the need to power down the transmitter.

The digital sensors feature advanced warning of electrode poisoning giving the user notice of imminent electrode failure.

For more information

Publications for the associated transmitters are available for free download from:

www.abb.com/measurement

or by scanning these codes:

AWT420

AWT440

	Search for or click on:
Data Sheet AWT210 2-wire conductivity, pH/ORP pION transmitter	DS/AWT210-EN
Data Sheet AWT420 Universal 4-wire, dual-input transmitter	DS/AWT420-EN
Data Sheet Aztec AWT440 Multi-input transmitter	DS/AWT440-EN
Operating Instruction AWT210 2-wire conductivity, pH/ORP pION transmitter	OI/AWT210-EN
Operating Instruction AWT420 Universal 4-wire, dual-input transmitter	OI/AWT420-EN
Operating Instruction Aztec AWT440 Multi-input transmitter	OI/AWT440-EN
Parts List Sensor accessories pH/ORP, turbidity, dissolved oxygen	PL/ANAINST/001-EN

Sales

Service

Contents

1 Health & Safety

Document symbols

Symbols that appear in this document are explained below:

⚠ WARNING

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

NOTICE

The signal word '**NOTICE**' indicates potential material damage.

Note
'Note' indicates useful or important information about the product.

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.

Potential safety hazards

The sensor operates on 3.3 V DC. There are no hazardous voltages present in the sensor.

⚠ WARNING

Before removing a sensor from the process, reduce process pressure to zero and ensure the sensor is cool enough to handle.

⚠ WARNING

ATEX/IECEx

All 500 PRO and 500 PRO-D elecrodes are certified to ATEX/IECEx. The plastic enclosure is a potential electrostatic hazard. Clean with a damp cloth only and **do not** mount in a high-velocity dust laden atmosphere.

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)


Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August 2005. To conform to 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. 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.

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.

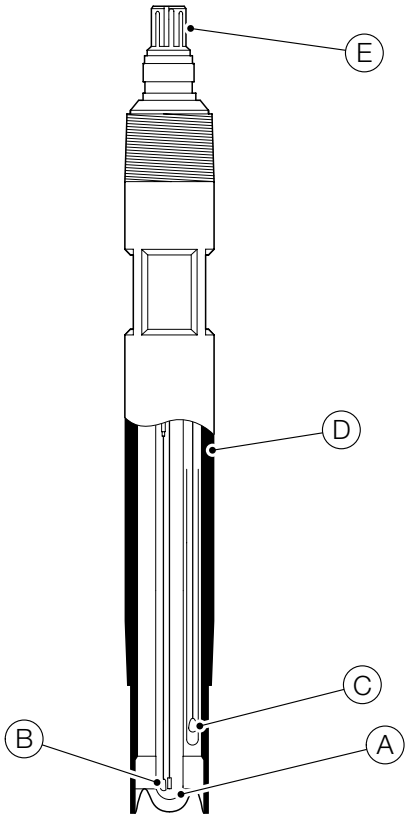
Information on RoHS Directive 2011/65/EU (RoHS II)

ABB, Industrial Automation, Measurement & Analytics, UK, fully supports the objectives of the ROHS II directive. All in-scope products placed on the market by IAMA UK on and following the 22nd of July 2017 and without any specific exemption, will be compliant to the ROHS II directive, 2011/65/EU.

2 Preparation for use

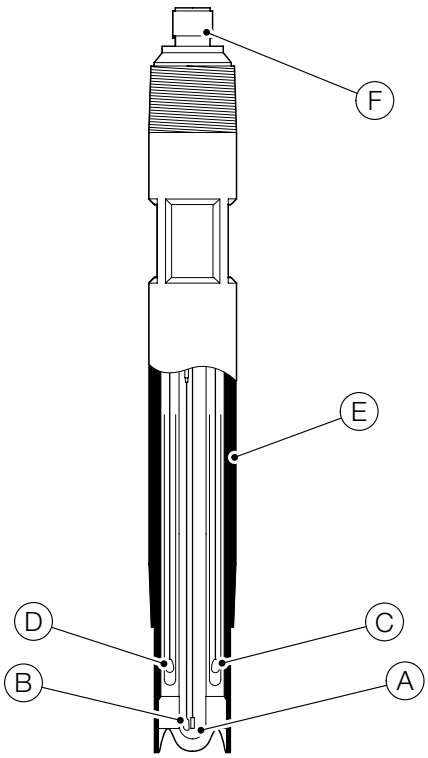
When required for use, remove the sensor from its packaging and the sensor storage bottle and rinse the end of the sensor with clean water.

3 System overview



Item	Component
A	Glass electrode
B	Temperature sensor (Pt100)
C	Reference electrode
D	Sensor body
E	VarioPin (VP) connector (illustrated) or integral cable

Figure 1 Analog pH sensor components



Item	Component
A	Glass electrode
B	Temperature sensor (Pt1000)
C	Reference electrode
D	Dual reference electrode
E	Sensor body
F	EZLINK connector (illustrated) or integral cable

Figure 2 Digital pH sensor components

4 Dimensions

Dimensions in mm (in)

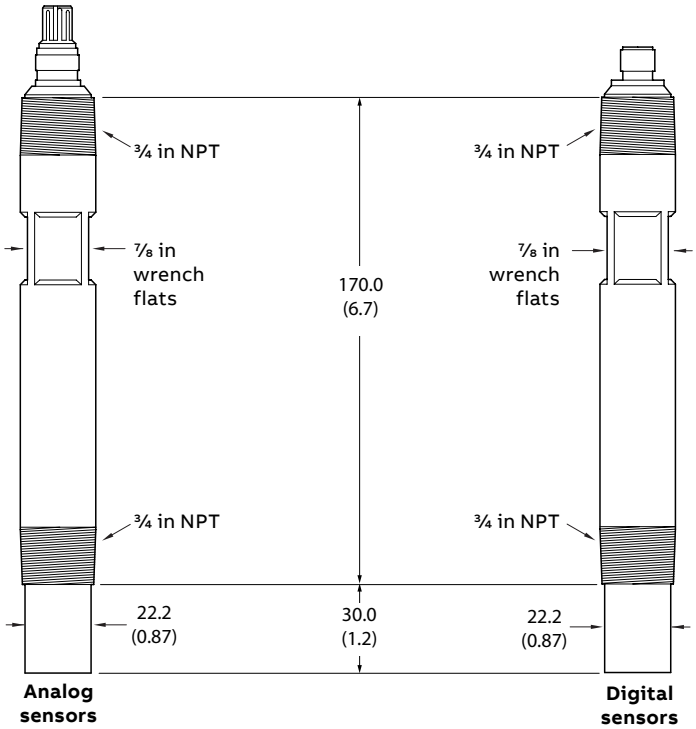


Figure 3 Flush sensor body dimensions

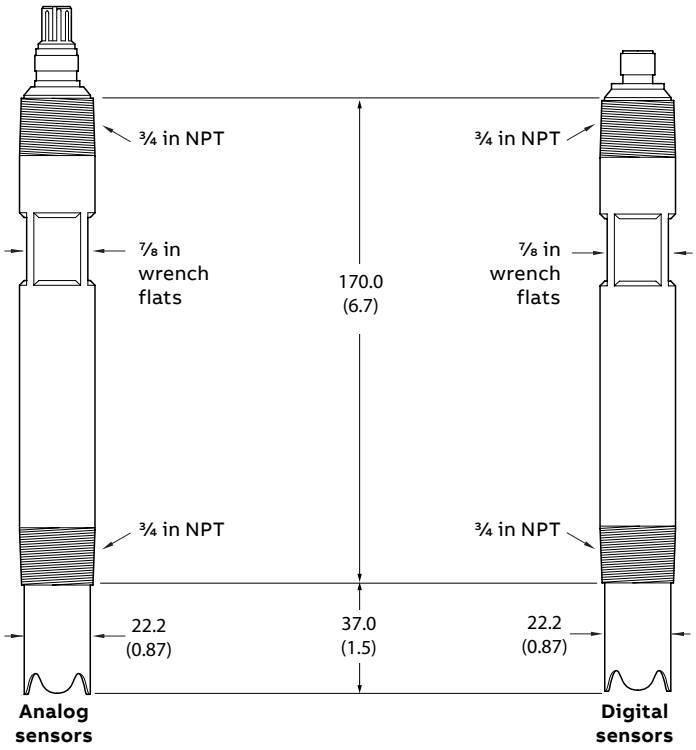


Figure 4 Notched sensor body dimensions

ASME B1.20.1 ¾ in NPT thread is compatible with ASME B16.11 ¾ in NPT threaded fittings including: couplings, half couplings, bosses, couplets.

5 Installation

⚠ WARNING

- Sensors must be installed and maintained by suitably trained personnel only.
- Shut down and de-pressurize process lines before inserting or removing sensors.

The 100 GP, 100 ULTRA and 500 PRO sensors are threaded style sensors suitable for in-line, immersion or flow-through applications. The mounting thread size is ¾ in NPT and the sensor body is made from chemically resistant PVDF (Kynar).

Do not use sensors with notched sensor guards on in-line applications where fouling of the sensor is to be expected (for example, fibrous coatings). Use an in-line flush sensor body with a flat glass sensor, mounted at 90° for optimal self-cleaning

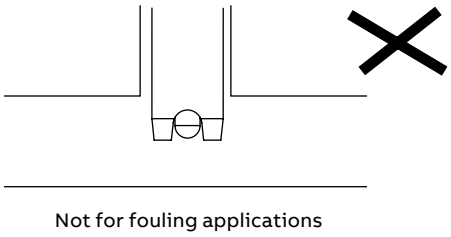


Figure 5 Recommendations for fouling applications

Note.

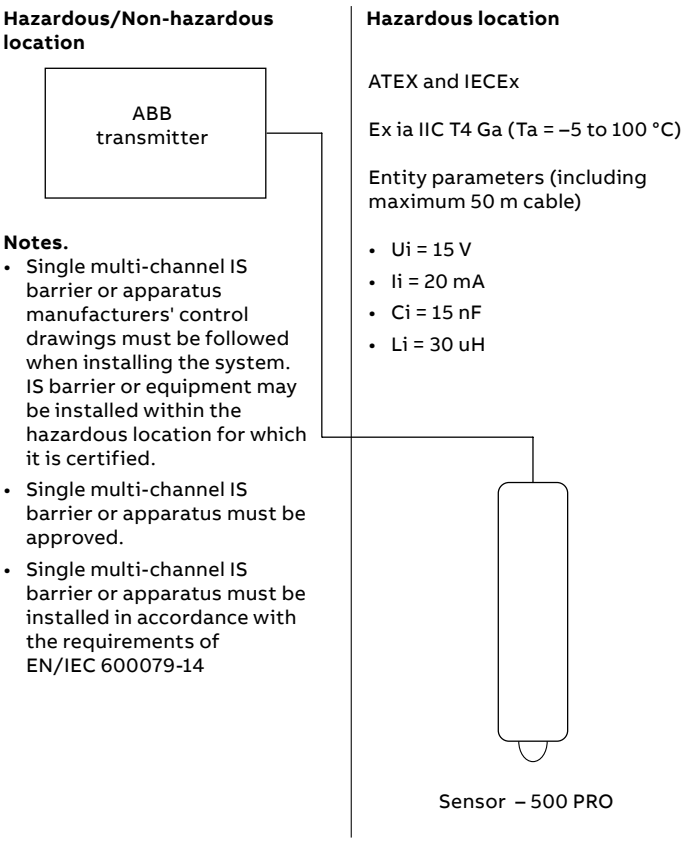
- The flow of sample passing the sensor helps to keep the sensor clean
- Position sensors such that they are immersed in sample at all times

For horizontal pipe, the preferred mounting position is in the shaded area. Allowable mounting is anywhere within the full circumference of the pipe.

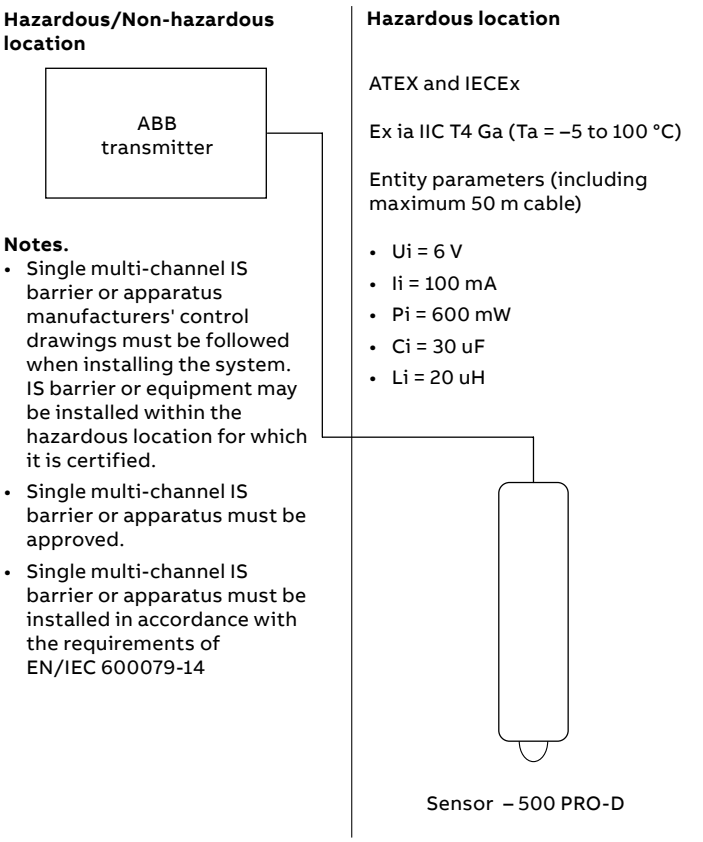
Figure 6 Horizontal pipe mounting position

ATEX/IECEx installation

500 PRO (analog)



500 PRO-D (digital)



Note.
If a VP cable is used, the stainless steel threaded connector **must** be connected to earth with a wire minimum diameter 0.4 mm (0.02 in). A tag is provided on the connector that may be soldered or crimped to provide this connection.

Conditions of safe use
The following conditions of safe use are required to meet ATEX/IECEx requirements.

1. The plastic enclosure is a potential electrostatic hazard. Clean only with a damp cloth and do not mount in a high velocity dust laden atmosphere
2. The stainless steel threaded connector is a potential electrostatic hazard. Ensure that the earth connection on the connector is provided with an earth connector as described in the instructions.

...5 Installation

FM hazardous area considerations

Note.
The hazardous area designation is displayed on the certification label.

Factory Mutual (FM) for USA - intrinsic safety
Class I, Div 1, Group A, B, C, D T4
Class I, Zone 0, AEx ia IIC T4

Ingress protection classification
IP67

Ambient temperature range
-5 °C < Ta < 100 °C (23 °F to 212 °F)

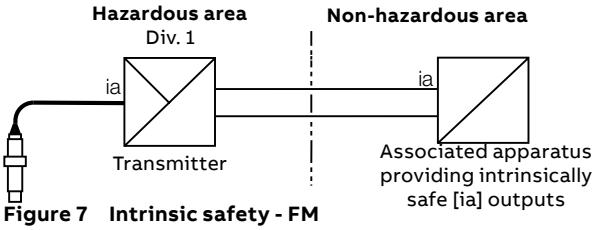


Figure 7 Intrinsic safety - FM

FM intrinsic safety control drawing
Click here to download the FM intrinsic safety control drawing, or scan this code:

Sensor input entity parameters

Input parameters	500Pro	500Pro-D
Maximum Voltage Ui	15 V	6 V
Maximum input current Ii	20 mA	100 mA
Maximum power Pi	120 mW	600 mW
Internal Inductance Ci	15 nF	30 uF
Internal Capacitance Li	30 uH	20 uH

Factory Mutual (FM) for USA - non-incendive
Class I, Div 2, A, B, C, D T4
Class I, Zone 2, AEx ic IIC T4

Ingress protection classification
IP67

Ambient temperature range
-5 °C < Ta < 100 °C (23 °F to 212 °F)

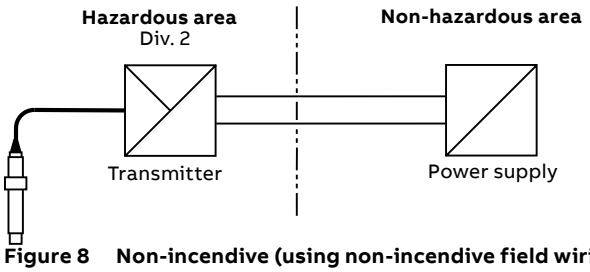


Figure 8 Non-incendive (using non-incendive field wiring) – FM

FM non-incendive safety control drawing
Click here to download the FM **non-incendive** safety control drawing, or scan this code:

Factory Mutual (FM) for Canada - intrinsic safety
Class I, Div 1, Group A, B, C, D T4
Class I, Zone 0, AEx ia IIC T4

Ingress protection classification
IP67

Ambient temperature range
-5 °C < Ta < 100 °C (23 °F to 212 °F)

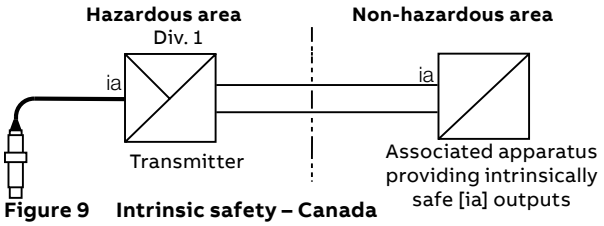


Figure 9 Intrinsic safety – Canada

Canada intrinsic safety control drawing
Click here to download the Canada intrinsic safety control drawing, or scan this code:

Sensor input entity parameters

Input parameters	500Pro	500Pro-D
Maximum Voltage Ui	15 V	6 V
Maximum input current Ii	20 mA	100 mA
Maximum power Pi	120 mW	600 mW
Internal Inductance Ci	15 nF	30 uF
Internal Capacitance Li	30 uH	20 uH

Factory Mutual (FM) for Canada - Non Incendive

Class I, Div 2, A, B, C, D T4

Class I, Zone 2, AEx ic IIC T4

Ingress Protection

IP67

Ambient temperature range

-5 °C < Ta < 100 °C (23 °F to 212 °F)

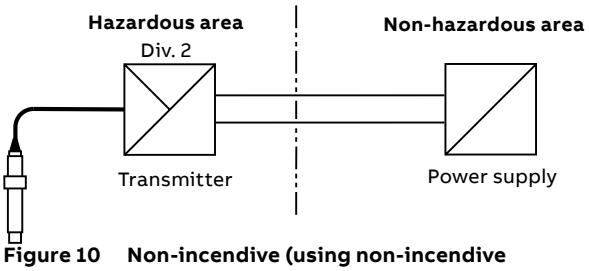


Figure 10 Non-incendive (using non-incendive field wiring) – Canada

Canada non-incendive safety control drawing

Click here to download the Canada non-incendive safety control drawing, or scan this code:

…5 Installation

Mounting options

Item	Mounting option
Ⓐ	Dip pole assembly 1¼ in NB comprising: dip pole, pole mounting adapter and end cap assembly: 3KXA163000L0021: 2.5 m (8.2 ft) 3KXA163000L0022: 1 m (3.3 ft) Pole mounting adapter kit for user-supplied pole comprising: pole mounting adapter, end cap assembly and O-ring (excludes dip pole) 3KXA163000L0023 **Note.** Handrail mounting brackets are not supplied with this kit and must be purchased separately.
Ⓑ	Protective shroud: 3KXA163000L0024
Ⓒ	Handrail mounting bracket – tilt action only: ATS4000760 for 40 mm or 1¼ in NB dip pole, suitable for 42 or 51 mm (1.7 or 2.0 in) dia handrail
Ⓓ	BSP screw T-piece: 3KXA163000L0006 NPT screw T-piece: 3KXA163000L0008
Ⓔ	BSP bayonet T-piece: 3KXA163000L0002 NPT bayonet T-piece: 3KXA163000L0004
Ⓕ	NPT flow-cell and ¾ in adapter: 3KXA163000L0012 NPT stainless steel flow-cell and ¾ in adapter: 3KXA163000L0011
Ⓖ	Automatic cleaning system (liquid): 3KXA163000L0025
Ⓗ	Calibration kit: 3KXA163000L0120

Note.
Sample levels in tanks, sumps and channels may vary. The sensor must be immersed to the lowest anticipated level to ensure the senor is always immersed in the sample.W

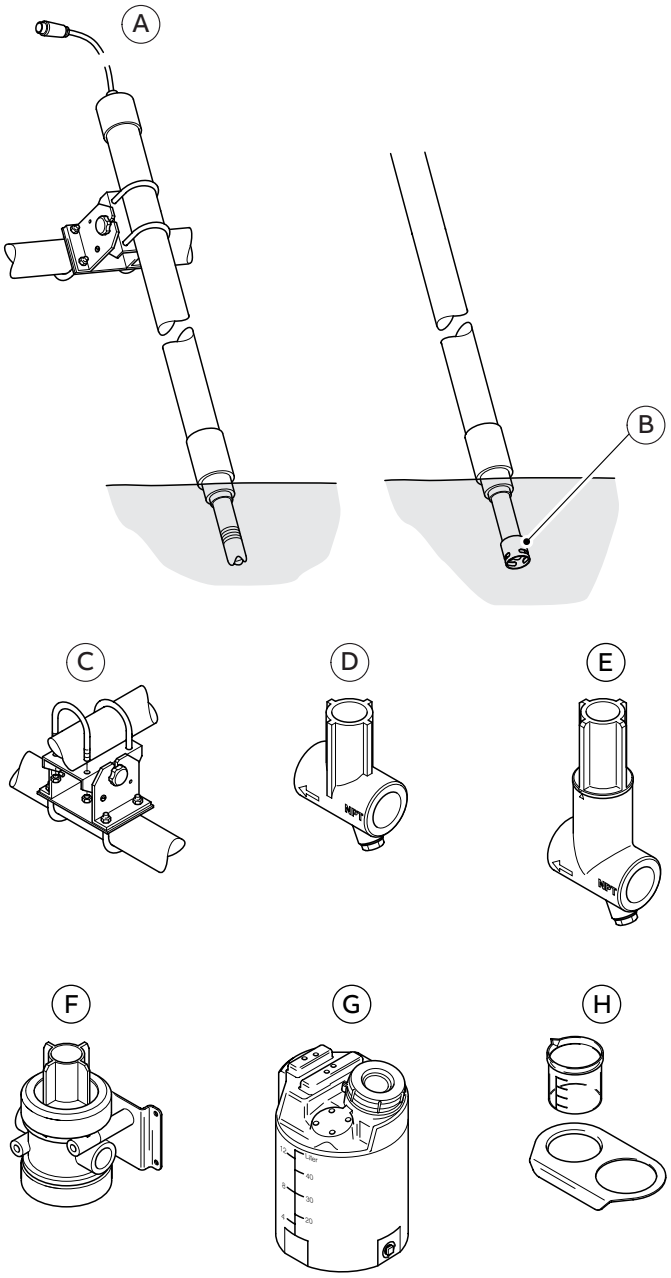


Figure 11 Mounting options

Electrical connections

Digital sensors

All digital sensors come with EZLink connectivity

Analog sensors – pH/ORP with temperature compensation

Wire color	Function
Blue	Glass electrode/ORP
Yellow	Guard
Black	Reference electrode
Red	2-wire compensation
White	2-wire compensation
Grey	3rd wire

6 Cleaning solutions

The spray jet tube is available in 316 stainless steel. Some typical cleaning solutions are:

Coating	Cleaning Agent
Grease and oils	Alkaline detergents or water-soluble solvents such as alcohols
Resins	Dilute alkalis
Limestone/Carbonates	Dilute acid
Metal hydroxides	Dilute acid
Cyanides	
Heavy biological	
Proteins	Mixture of 1M sulphuric acid and pepsin (saturated)
Fibers	Pressurized water with or without wetting agents
Light biological	Pressurized water
Latex (see Notice below)	Pressurized cold water

NOTICE

If the jet wash system is removed from a latex process, all traces of latex must be removed quickly and completely before it hardens.

General cleaning

⚠ WARNING

Before removing a sensor from a flow line, ensure that all isolating valves have been closed.

To ensure accurate monitoring, keep the sensor free of contaminants by periodic cleaning, the frequency of which depends on the particular application.

Methods of removing various types of deposits are detailed below. Use a soft, non-abrasive material to clean the sensor tip. Replace the sensor if its performance does not improve after cleaning.

Contaminant	Cleaning agent
Grease and oils	Alkaline detergents or water soluble solvents such as alcohols
Resins	Dilute alkalis
Limestone/Carbonates	Dilute acid
Metal hydroxides, cyanides, heavy biological	Dilute acid
Proteins	Mixture of 1M sulphuric or nitric acid and pepsin (saturated)

7 Sensor setup

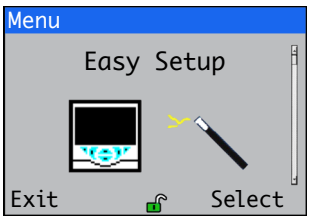
Notes.

- Perform this procedure when connecting a new/replacement sensor to an AWT420 or AWT440 transmitter.
- If connecting to a transmitter other than an AWT420 or AWT440, refer to the appropriate Operating Instruction.

1 Connect the sensor to the transmitter. The following menu prompt is displayed:

To enter Easy Setup level, press the key (below the ✓ icon).

The Easy Setup start screen is displayed:



2 Press the key (below the **Select** prompt).

3 Press the key (below the **Edit** prompt) to change the default value to the required value/selection.

4 Press the key (below the **Next** prompt) to accept the value/selection displayed and advance to the next configuration parameter.

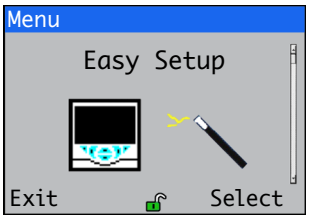
The following Configuration parameters are set at Easy Setup level:

Parameter	Options
Tag	16-character user-defined tag
Range High	Customizable range high
Range Low	Customizable range low
Analog output	Configure the analog output channels

Note. Refer to page 13 for parameter details – not all parameters are displayed at Easy Setup level.

5 Continue with configuration of the required parameters.

6 On completion the Easy Setup start screen is displayed:



7 To exit Easy Setup, press the key (below the **Exit** prompt) to display the Operator Page.

Pressing the key (below the **Select** prompt) re-enters the Easy Setup level where parameters can be reviewed or modified after first-time connection.

After completing the Easy Setup level, pressing the or key enters the Advanced Configuration level, where all available sensor and transmitter parameters can be reviewed or modified.

Menu	Comment	Default
S1(to 4):pH/Redox(ORP)	Select the pH/Redox sensor to set up.	
Tag	Enter an alphanumeric sensor tag (16 characters maximum) to identify the sensor on the **Operator Pages**	TAG1
Filter Type	Set the filter type: • Off • Low • Medium • High	Off
Temp. Compensation	Set the temperature compensation type * • Automatic Sol. (Nernstian with solution sample coefficient) • Automatic (Nernstian without solution sample coefficient)	Automatic Sol
Sample Coefficient	Set the sample coefficient for solution compensation *	0.0 pH/10 °C
Low pH Slope Limit	Set the low slope level for pH calibrations. Calibrations fail at this level. Diagnostic warning is displayed at 20 % above this level	40 %
pH Diagnostics	Enable/disable the following diagnostics: • Out of solution • Broken glass • Dual reference warning • Dual reference failure	 Disabled Enabled Enabled Enabled
Clean Interval	Set the interval between cleans: Off/15 mins/30 mins/45 mins/1 to 24 hours	Off
Clean Type	None or External The external option enables the transmitter to control an external cleaning device through the digital I/O lines **Note.** Refer to Aztec ADS430 EZCLEAN Operating Instructions (OI/ADS430/EZCLN-EN) for an example of the use of this facility	None
Clean Type	Set the clean type: Continuous/Pulsed	Continuous
Clean On Time	Set the duration of the clean: 1 to 60s	30 s
Clean Off Time	Set the duration between cleans: 1 to 60s	30 s
Recovery Time	Set the time delay between the completion of cleaning and the display of a new reading on the operator page: 1 to 10 min	1 min
Clean Duration	Display the total duration of the clean: Clean type set to continuous = clean on time + recovery time Clean type set to pulsed = (clean on time + clean off time) * number of pulses + recovery time	
Clean Output	Displays the output signal the clean is assigned to. This can be set to relay 1 to 6 or digital output 1 to 6	Not assigned
Restore Defaults	Restores the sensor back to default configuration	

* Available only for pH sensors

8 Calibration

This section describes how to calibrate the sensor and involves measuring the sensor's sensitivity to pH and temperature by exposing the sensor to samples of known pH/temperature values.

Calibrations are initiated via the **Cal** prompt displayed on the main page or via the **Operator** pages or **Calibrate** and **Advanced** menu items on the **Access Level** page – refer to the transmitter's Operating Instruction OI/AWT210-EN, OI/AWT420-EN or OI/AWT440-EN for all transmitter menu options.

Note. Before removing the sensor for calibration purposes, set the currents outputs and alarms to **Hold** (enabled via the **Operator Menu/Manual Hold** function).

Calibration procedure

pH sensor
When the sensor has been correctly connected and all electrical connections made to the transmitter, the sensor is ready for calibration by immersing the sensor (using suitably sized beakers) in either:

- a calibration solution (buffer) of known pH value for a single-point calibration

or

- sequentially in two separate calibration solutions of known pH values for a two-point calibration

For sensors already in use:

⚠ WARNING

Before removing a sensor from a flow line, ensure that all isolating valves have been closed.

1 Remove the sensor from the flow line.

2 Wash the sensor surface of the electrode with a soft, non-abrasive material and a cleaning solution. Refer to **Cleaning solutions** on page 11 for additional information.

3 Perform a single- or two-point calibration.

To have agreement with a measured sample, there may be times when an in-process calibration is necessary.

1 Perform a buffer calibration.

2 Return the sensor to the process for a minimum of 10 minutes before performing an in-process calibration.

3 To minimize solution temperature effects, measure the sample at the same temperature as the process.

Refer to the Operating Instruction for the pH transmitter for full details of the calibration procedures.

Note. To ensure measurement accuracy when buffering:

- clean the visible surfaces of the electrodes using demineralized water or cleaning solution (see **Cleaning solutions** on page 11) using a soft, non-abrasive material.
- wash the electrodes and dry them carefully using a soft tissue when moving from one buffer solution to the next

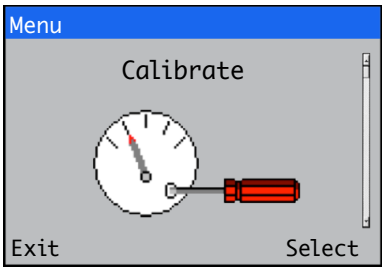
Redox/ORP sensor
When the sensor has been correctly connected and all electrical connections made to the transmitter, the sensor is ready for calibration. Follow the calibration procedure in the transmitter instruction manual.

For sensors that are connected to transmitters that do not have Redox calibration capabilities, it is possible to check the response as follows:

1 Prepare standard 4 and 7 pH buffer solutions. Add one gram (heaped spatula) of analar quinhydrone to 100 ml of each buffer solution. Let them stand for 30 minutes.

2 Immerse the sensor in each solution in turn and note the mV value when stable.

Calibrate menu



Used to calibrate the sensor.
Access to the **Calibrate** menu is 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):pH/Redox(ORP)	Select the pH/Redox (ORP) sensor to calibrate.	
Sensor Cal	Perform a sensor calibration.	
1 Point Manual	Perform a 1-point manual calibration	
2 Point Manual	Perform a 2-point manual calibration	
1 Point Auto	Perform a 1-point automatic calibration using standard buffers with automatic temperature compensation. **Note.** Available only on pH	
2 Point Auto	Perform a 2-point automatic calibration using standard buffers with automatic temperature compensation. **Note.** Available only on pH	
Edit Cal	Manually edit the calibration values	
pH Slope	Edit the pH slope **Note.** Displayed only if pH sensor connected	
pH Offset	Edit the pH offset **Note.** Displayed only if pH sensor connected	
mV Slope	Edit the mV slope **Note.** Displayed only if Redox (ORP) sensor connected	
mV Offset	Edit the mV offset **Note.** Displayed only if Redox (ORP) sensor connected	
Sample Collection	Perform the sample collection procedure	
Sample Complete	Perform the sample complete procedure	
Restore Defaults	Restores values to default factory settings	
Set Auto pH Buffers	Sets the buffer type to be used. Also enables a custom buffer to be defined.	
Hold Outputs	Enable/disable the hold outputs function. The current outputs and alarm functions are held during calibrations.	Enabled

...8 Calibration

Automatic calibration

Note. Automatic calibration is applicable only to pH sensors.

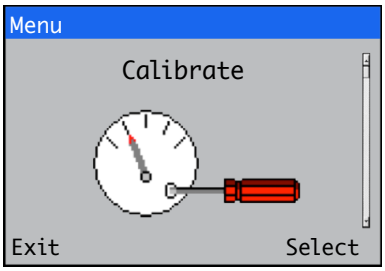
Automatic calibration calibrates the sensor to measure pH using pH buffers. Automatic calibration provides automatic temperature compensation to the selected buffer. There are two possible calibration modes:

- 1-point calibration
- 2-point calibration

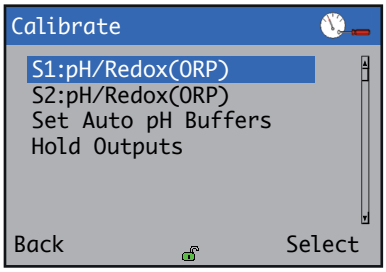
A 1-point calibration adjusts the calibration offset value.
A 2-point calibration adjusts the calibration offset and slope values.

Before starting the calibration procedure ensure that the automatic buffer is set to the correct buffer (see **Automatic calibration buffers** on page 17)

1 At the **Calibrate** level, press the key (below the **Select** prompt)

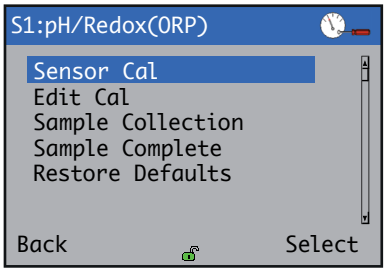


The sensor selection menu is displayed:

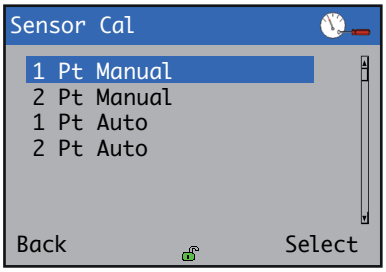


2 Highlight the sensor to be calibrated (for example, **S1:pH/Redox(ORP)**) and press the key (below the **Select** prompt)

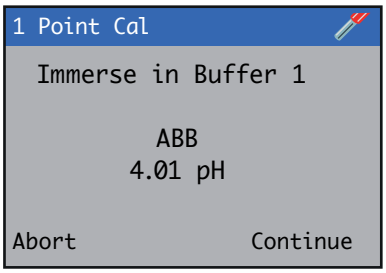
The menu options for **S1:pH/Redox(ORP)** are displayed:



3 Select **Sensor Cal**



4 Select **1 Point Auto** or **2 Point Auto** as required



5 Immerse the sensor in the buffer of the value displayed on the screen.

6 Press the key (below the **Continue** prompt) to perform the calibration. The calibration process screen is displayed. The calibration can be canceled at any time during the process by pressing the key (below the **Abort** prompt)

If **1 Point Cal** was selected, the result screen is displayed. If **2 Point Cal** was selected repeat steps 5 and 6 for the second buffer.

On completion of the calibration the result is displayed on the screen automatically. If the calibration passes, the slope and offset is displayed. If the calibration fails, the reason for failure is displayed on the screen. See **pH/Redox calibration failure reasons** on page 25 for explanation of calibration failure reasons.

Automatic calibration buffers

Automatic calibration uses buffer tables programmed into the sensor to provide more accurate calibrations.

The following buffers are supported by the sensor:

ABB capsules
- 4.01
- 7.00
- 9.00
- 10.00

NIST
- 4.001
- 6.881
- 9.225
- 10.062

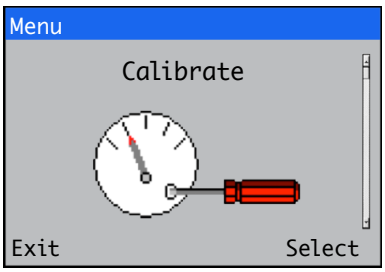
Technical
- 4.01
- 7.00
- 10.01

Phthalate free
- 4.00

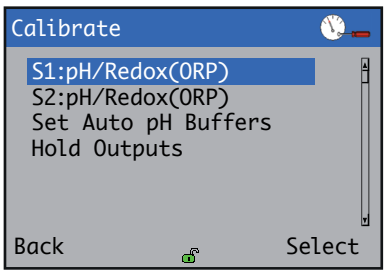
DIN19266
- 1.679
- 4.005
- 6.865
- 9.180
- 10.012

ABB sachets
- 4.01
- 7.00
- 9.18

1 At the **Calibrate** level, press the key (below the **Select** prompt)

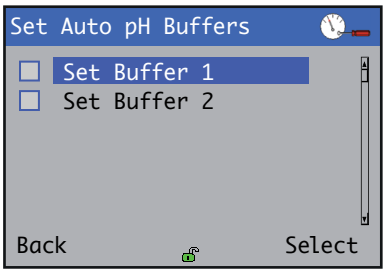


The sensor selection menu is displayed:

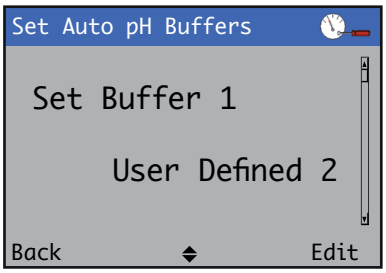


2 Highlight **Set Auto pH Buffers** and press the key (below the **Select** prompt)

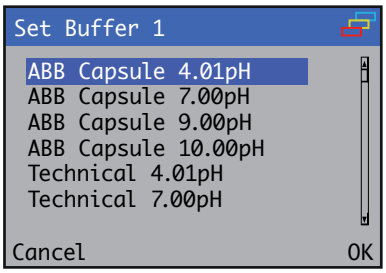
The menu options for **Set Auto pH Buffers** are displayed:



3 Select the buffer to be set and press the key (below the **Select** prompt). The **Set Buffer X** menu is displayed:



4 Press the key (below the **Edit** prompt). The buffer selection menu is displayed:



5 Highlight the buffer to use.

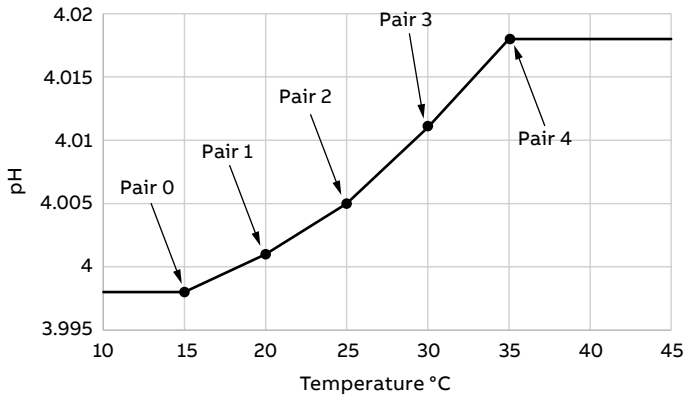
6 Repeat for buffer 2 if performing a two point calibration.

Note. Buffer 1 is used for single point calibrations

...8 Calibration

User-defined automatic calibration buffers

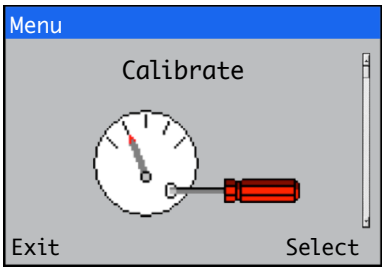
Two user-defined buffers may be used for automatic calibrations. Automatic buffers are defined using a table that relates the value of the buffer to a given temperature point. The software extrapolates between the user-defined points during the calibration. The graph below shows an example of the data required to define a buffer



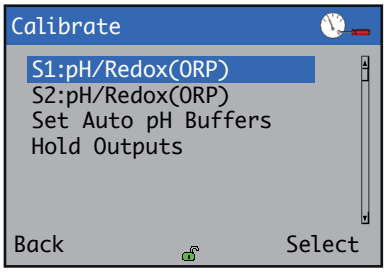
Note.

- If the temperature of the buffer is below the minimum value entered, the pH of the buffer is set to the value that corresponds with the minimum temperature value entered.
- If the temperature of the buffer is above the maximum value entered, the pH of the buffer is set to the value that corresponds with the maximum value entered.
- pH/Temperature pairs must be entered such that the temperature increases from pair 0 to pair 4.

1 At the **Calibrate** level, press the key (below the **Select** prompt)

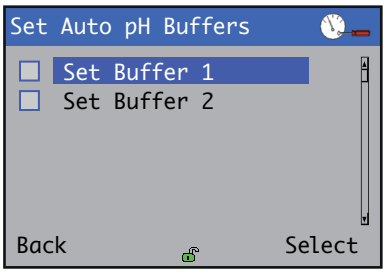


The sensor selection menu is displayed:

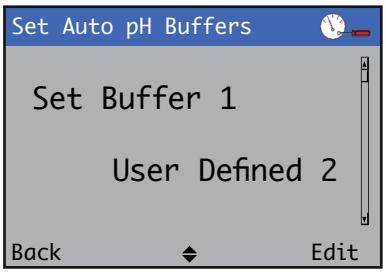


2 Highlight **Set Auto pH Buffers** and press the key (below the **Select** prompt)

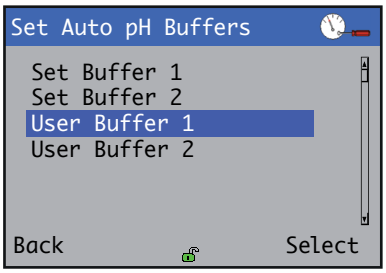
The menu options for **Set Auto pH Buffers** are displayed:



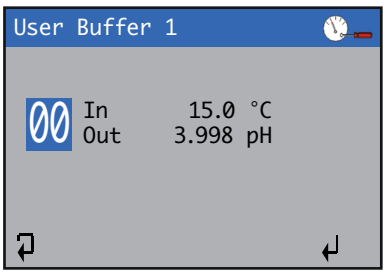
3 Select the buffer to be set and press the key (below the **Select** prompt). The **Set Buffer X** menu is displayed:



4 Select **User Defined X** and press the key (below the **Edit** prompt). The buffer selection menu is displayed:

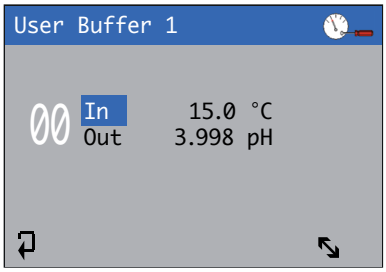


5 Select **User Buffer 1** and press the key (below the **Select** prompt). The buffer edit screen is displayed:

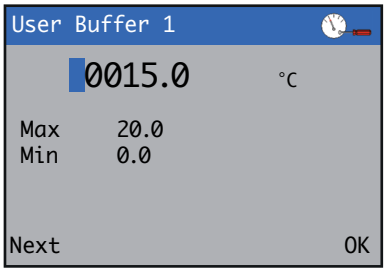


Note. Pressing the key cycles between the point number, temperature input and pH input.

6 With point 00 selected, press the key to select the temperature input and press the key to edit the temperature.



7 Use the / keys to select a required temperature value between the limits shown on the screen and press the key to accept it



8 Repeat steps 6 and 7 to select a required pH value.

9 Press the key to highlight the point number followed by the / keys to select the next point to edit and press the key.

10 Repeat steps 6 to 9 to edit the remaining points as required or press the key to exit the buffer edit page.

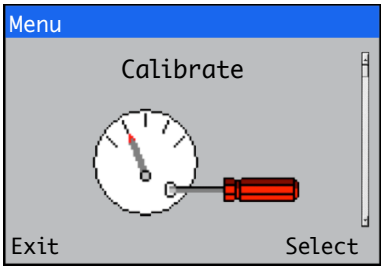
Manual calibration

Manual calibration calibrates the pH or Redox (ORP) value to a value defined by the user. There are two possible calibration modes:

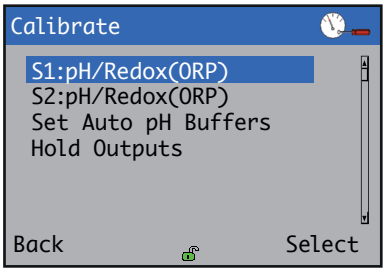
- 1-point calibration
- 2-point calibration

A 1-point calibration adjusts the pH offset value.
A 2-point calibration adjusts the pH offset and slope values.

1 At the **Calibrate** level, press the key (below the **Select** prompt).

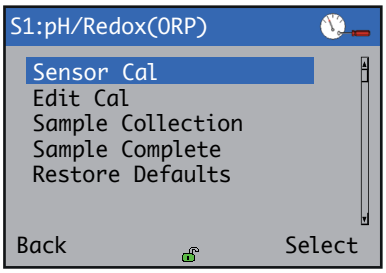


The sensor select menu is displayed:



2 Highlight the sensor to be calibrated (for example, **S1:pH/Redox(ORP)**) and press the key (below the **Select** prompt)

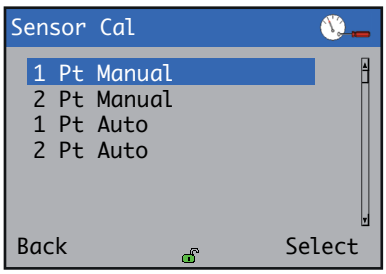
The menu options for **S1:pH/Redox(ORP)** are displayed:



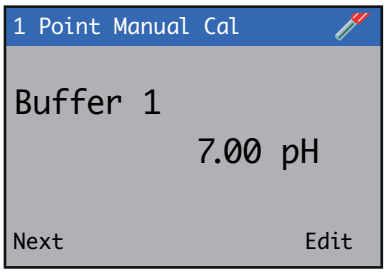
…8 Calibration

…Manual calibration

3 Select **Sensor Cal**.



4 Select **1 Point Manual** or **2 Point Manual** as required.



5 Immerse the sensor in buffer of the value displayed on the screen and press the key (below the **Next** prompt).

6 Press the key (below the **Continue** prompt) to perform the calibration. The calibration process screen is displayed. The calibration can be canceled at any time during the process by pressing the key (below the **Abort** prompt)

If **1 Point Cal** was selected, the result screen is displayed. If **2 Point Cal** was selected repeat steps 5 and 6 for the second buffer.

On completion of the calibration the result is displayed on the screen automatically. If the calibration passes, the slope and offset are displayed. If the calibration fails, the reason for failure is displayed on the screen. See **pH/Redox calibration failure reasons** on page 25 for explanation of calibration failure reasons.

Edit calibration

Edit calibration enables the user to enter the calibration coefficients directly. The following calibration coefficients can be entered:

- **pH slope and offset**
  Note. Available only if a pH sensor is connected to the transmitter
  – The following formula is used to calculate pH from the measured millivolts:

$$pH = offset - \frac{slope \times mv}{100 \times 59.15296}$$

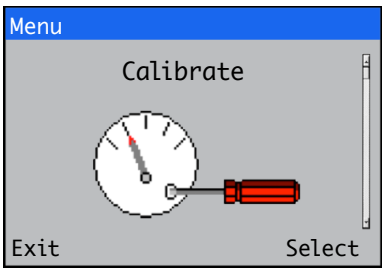
  Where:
  pH = the measured pH of the solution
  offset = calibration offset (an ideal sensor has an offset value of 7.00 pH)
  slope = calibration slope (an ideal sensor has a slope value of 100.0 %)
  mV = measured millivolts of the solution
  kT = slope factor at the temperature of the solution

- **ORP slope and offset**
  Note. Available only if an ORP sensor is connected to the transmitter.
  – The following formula is used to calculate ORP from the measured millivolts:

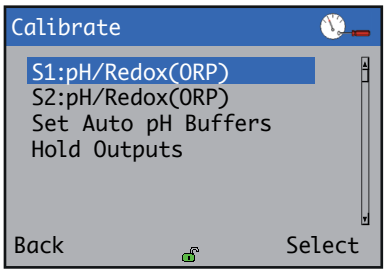
$$ORP = offset + \frac{slope \times mv}{100}$$

  Where:
  ORP = the calibrated ORP mV of the solution
  offset = calibration offset (an ideal sensor has an offset value of 0.0 mV)
  slope = calibration slope (an ideal sensor has a slope value of 100.0 %)
  mV = measured millivolts of the solution

1 At the **Calibrate** level, press the key (below the **Select** prompt)

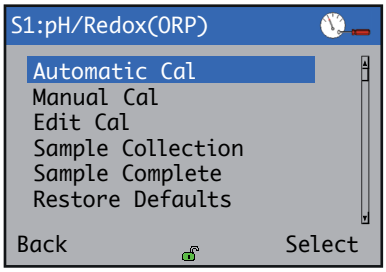


The sensor selection menu is displayed:



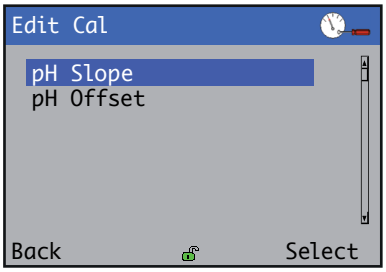
2 Highlight the sensor to be calibrated (for example, **S1:pH/Redox(ORP)**) and press the key (below the **Select** prompt)

The menu options for **S1:pH/Redox(ORP)** are displayed:

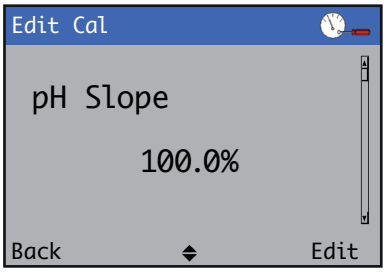


3 Select **Manual Cal**

4 To enter a coefficient, select the required coefficient from the menu and press the key (below the **Select** prompt).



5 Press the key (below the **Edit** prompt) to enter the value of a coefficient and press the key (below the **OK** prompt) when complete.



...8 Calibration

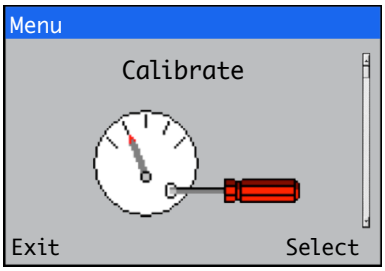
In-process calibration

In-process calibration is used when it is not possible to remove the sensor from the process to perform the calibration. In this calibration mode the sample is used to calibrate the sensor.

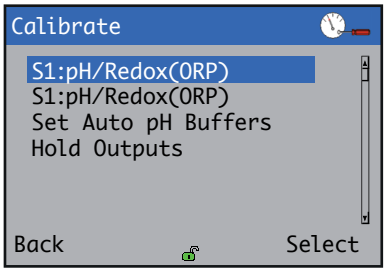
In-process calibration takes place in two steps. During the first step, a grab sample is taken from the process and the sensor records the measured value of the sample at that time. The pH of the sample is then measured in the laboratory and entered into the transmitter in the second step.

Note.
- An in-process calibration adjusts the calibration offset only.
- Take care when collecting, transferring and storing the collected sample; any contamination could result in an inaccurate calibration. This is especially important for low conductivity solutions.

1 At the **Calibrate** level, press the key (below the **Select** prompt)

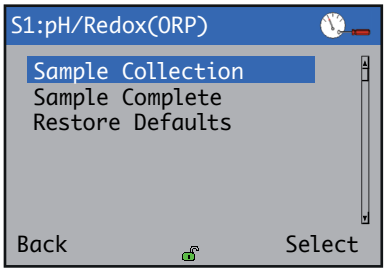


The sensor selection menu is displayed:



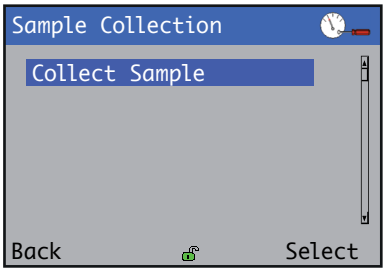
2 Highlight the sensor to be calibrated (for example, **S1:pH/Redox(ORP)**) and press the key (below the **Select** prompt)

The menu options for **S1:pH/Redox(ORP)** are displayed:

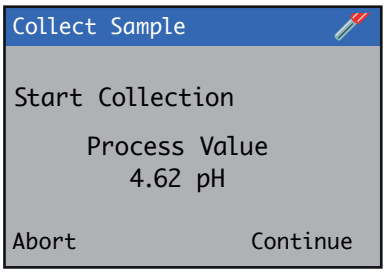


3 Select **Sample Collection** and press the key (below the **Select** prompt).

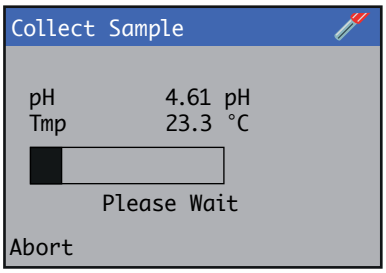
Note. Performing this step erases any sample data stored previously for the selected sensor. Only the data from the last sample collection is stored in each sensor.



The **Collect Sample** screen is displayed:

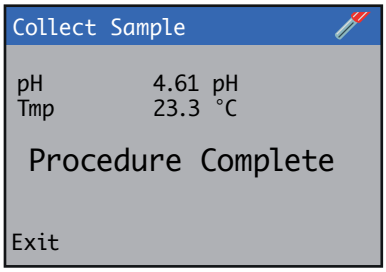


4 Press the key (below the **Continue** prompt) to initiate sample collection.



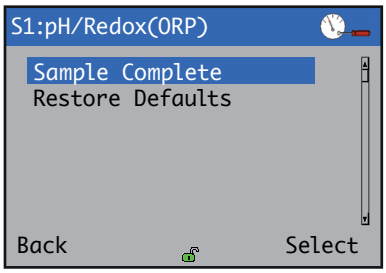
5 Collect a sample from the process for laboratory analysis as close to the sensor as possible to ensure accurate results.

6 When acquisition is complete, press the key (below the **Exit** prompt) to return to the main menu.

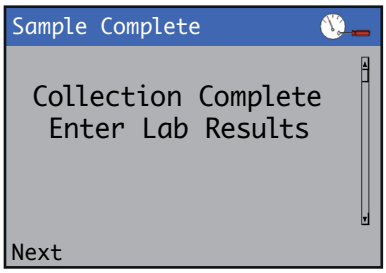


The process pH and temperature values are now stored in the sensor.

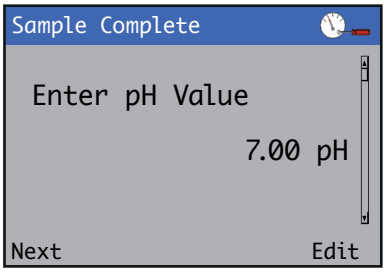
7 When the result of the laboratory analysis has been obtained, select **Sample Complete**:



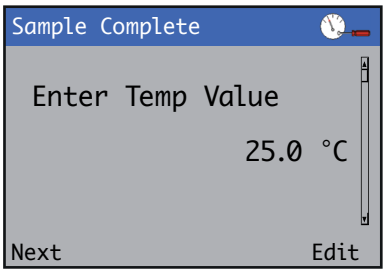
8 Press the key (below the **Next** prompt).



9 Enter the lab pH value.



10 Enter the lab temperature value



In-process calibration is now complete.

9 Calibration log (digital sensors)

The calibration log stored in the sensor holds a record of the last 15 sensor calibration operations performed. To view the calibration log in the transmitter, logs must be enabled. Refer to the transmitter's Operating Instruction OI/AWT420-EN or OI/AWT440-EN for details of how to enable logs.

When logs are enabled, a calibration log page is available for each of the sensors connected to the transmitter. To access the calibration log, press the View key on the transmitter's keypad to display the result from the first most recent calibration.

Use the group key on the keypad to cycle through the calibration logs for each sensor. Calibration results can be:

- **Calibration aborted**
  the calibration was stopped by the user
- **Calibration failed**
  the log entry displays the reason for the calibration failure
- **Calibration successful**
  the log entry displays the new calibration parameters

Each entry displays the date and time of the calibration.

Note. The date and time are taken from the transmitter. To ensure the date and time stored in the log are accurate, ensure the date and time set in the transmitter are correct.

10 Device information (digital sensors)

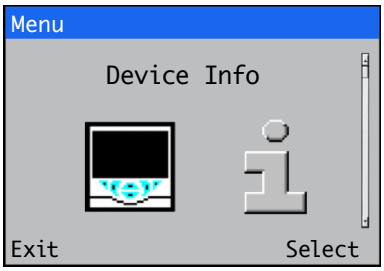
This section describes the information available within the **Device Information** menu for digital pH sensors.

1 Connect the sensor to the transmitter's EZLink connector – refer to the transmitter's Operating Instruction OI/AWT420-EN or OI/AWT440-EN.

2 Press the transmitter's key to display the **Operator Page** menu, then select **Enter Configuration** to display the **Access Level** page.

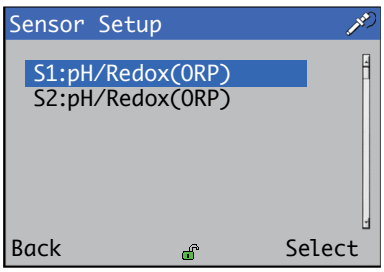
Use the key to select **Advanced** and press the key (below the **Select** prompt).

If the **Device Information** menu is not displayed use the / keys to scroll to it:



3 Press the key (below the **Select** prompt)

The Sensor Setup page is displayed



4 Select the desired sensor and press the key (below the **Select** prompt)

The sensor's device information page is displayed:

Menu	Comment
Type	Sensor type (pH/Redox)
Sensor Type	Sensor type (100GP/100Ultra/500Pro)
Electrode Type	Electrode type (pH/Redox)
Glass Type	Glass type (standard/low temperature)
Serial Number	Factory programmed serial number (3KXA…)
Date of Manufacture	Sensor's date of manufacture
Hardware revision	Sensor's hardware revision
Software revision	Sensor's software revision
Product code	Sensor's product code for reorder.

11 Diagnostics

Diagnostic messages

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

Note. The diagnostic icons in the following table conform to NAMUR 107.

For transmitter-specific diagnostic messages, refer to the transmitter's Operating Instruction OI/AWT210-EN, OI/AWT420-EN or OI/AWT440-EN.

Icon	Message	Possible cause	Remedial action
	ADC failure	An error has been reported by the on board ADC.	Cycle power to the sensor.
	NV failure	Failure of non-volatile memory on the sensor board.	Cycle power to the sensor. If power cycling fails, reset the sensor configuration to default and reconfigure as required.
	Temperature failure	Failure detected in the temperature measurement circuit.	Cycle power to the sensor.
	Calibration failed	The last calibration failed.	Check buffer solutions Repeat the calibration procedure.
	PV out of range	The measured process value is out of range.	Change the PV of the sample to a value that is within the sensor's operating range.
	Process temperature out of range	The measured process temperature is out of range.	Change the process temperature to a value that is within the electrode's operating range.
	Internal temperature out of range	The internal temperature of the electronics is out of range.	Move the sensor to a position where the temperature is within the sensor's operating range.
	Out of solution*	The sensor has detected it is out of solution.	Move the sensor into the solution.
	Broken glass*	The sensor has detected that the pH glass is broken.	Replace the sensor.
	Reference warning*	The sensor has detected that the reference will be poisoned imminently.	Prepare to replace the sensor.
	Reference failure*	The sensor has detected that the reference is poisoned.	Replace the sensor.
	Low pH slope warning	The last calibration slope was below the user set level.	Prepare to replace the sensor.

* These diagnostics may be enabled/disabled by the user.

pH/Redox calibration failure reasons

The table below shows the various reasons for pH/Redox calibration failure together with possible causes/remedial action.

Failure reason	Possible cause	Remedial action
No response*	No difference in millivolts was seen between the two calibration points.	Ensure that two different buffers were used.
Low slope*	The slope is below the user-set low slope limit.	Re-calibrate with fresh buffers Clean the sensor Replace the sensor.
High slope*	The slope exceeds 110 %.	Replace the sensor.
Unstable temperature	Stability could not be achieved within 1 minute due to temperature variations.	Clean the sensor and ensure probe and solution are at the same temperature.
Unstable mV	Stability could not be achieved within 1 minute due to millivolt variations.	Clean the sensor.
Slow response	A response has been detected but it has not reached steady state within 1 minute.	Clean the sensor.

* These failure reasons are applicable only to 2-point calibrations.

12 Fault finding

Listed below are some common symptoms of sensor malfunction together with possible cures.

- **Short scaling (low slope) or sluggish response**
  - Glass sensor membrane dirty or coated – clean sensor
  - Poor insulation on cable connectors, possibly due to moisture – dry connector with warm dry air (analog sensor only)
  - Replace the sensor if no improvement is seen. It may also be necessary to replace the extension cable (analog sensor only)
  - In some situations, it may be possible to reactivate the membrane glass by soaking in 0.1 mol hydrogen chloride for 24 hours, before rinsing and recalibrating
  - Ensure connectors are clean and free from any particulate
- **No response to pH buffer or sample**
  - Check the sensor has been connected correctly to the transmitter (analog sensors only)
  - Check the glass sensor membrane is not broken or cracked
  - Replace the sensor if no improvement
- **Unstable readings or drift**
  - Check the sensor has been connected correctly to the transmitter (analog sensors only)
  - Dry or dirty reference junction – clean the junction
  - Replace the sensor if no improvement
- **Stable but incorrect readings**
  - Recalibrate using fresh buffer solutions
  - Check temperature compensation settings are correct

Note. All the above symptoms could be caused by a faulty cable (analog sensors only).

13 Storage

NOTICE

- Always store the sensor in its original packaging until required for use.
- Store the sensor between 15 and 35 °C (59 and 95 °F).
- For long term storage, store the sensor in the original sensor storage bottle.
- Ensure that the glass membrane and the reference junction do not dry out as this may irreversibly affect the response of the electrode.
- Do not store electrodes in de-ionized water.

If it is necessary to remove the electrode from the sample line, fill the sensor storage bottle with storage solution and fit it to the sensor.

14 Specifications

100 GP/100 GP-D

Measurements

- pH/ORP (Platinum)
- Temperature

Measurement range

High performance (S) glass

0 to 14 pH;

Low temperature (LT) glass

0 to 10 pH

ORP

–2000 to 2000 mV

Temperature range

High performance (S) glass (bullet)

0 to 60 °C (32 to 140 °F)

(typical glass impedance at 25 °C (77°F) = 250 MΩ)

High performance (S) glass (flat)

5 to 60 °C (41 to 140 °F)

(typical glass impedance at 25 °C (77°F) = 600 MΩ)

Low temperature (LT) glass

–5 to 50 °C (23 to 122 °F)

(typical glass impedance at 25 °C (77 °F) = 25 MΩ)

ORP platinum electrode

0 to 60 °C (32 to 140 °F)

Temperature sensor

100 GP

Pt100 (Class B, IEC 60751)

100 GP-D

Pt1000 (Class B, IEC 60751)

Maximum pressure

6 bar (90 psi)

Recommended minimum sample conductivity

50 µS/cm

Recommended sensor storage

Between 15 and 35 °C (59 and 95 °F)

Isothermal point at 25 °C (77 °F)

pH 7

Reference system

Ag/AgCl with KCl gel electrolyte, double junction plus ion trap

Process connections

¾ in NPT

Wetted materials

Electrode body

PVDF (Kynar)

Reference junction system

Porous PTFE and Viton O-rings

Measure system

pH: Glass

ORP: Platinum

Approvals, certification and safety

CE Mark

Covers EMC+LV directives

(including latest version of EN61010)

Regulation 31

Drinking water approval:	Complies to DWI Regulation 31(4)(b)
Additional tests:	BS6920 parts 2.2 and 2.4 on all wetted parts

EMC

Meets requirements of IEC61326 for an industrial environment

CRN approval

Maximum allowable working pressure (MAWP): 5.58 bar (81 psi)

Design temperature: –5 °C to 105 °C (23 °F to 212 °F)

CRN number: 0F22557

DS/100GP-EN Rev. C

DS/100GPD-EN Rev. C

…14 Specifications

100 ULTRA/100 ULTRA-D

Measurements
- pH/ORP (Platinum)
- Temperature

Measurement range
High performance (S) glass
0 to 14 pH;
Low temperature (LT) glass
0 to 10 pH
ORP
–2000 to 2000 mV

Temperature range
High performance (S) glass (bullet)
0 to 100 °C (32 to 212 °F)
(typical glass impedance at 25 °C (77°F) = 250 MΩ)
High performance (S) glass (flat)
5 to 100 °C (41 to 212 °F)
(typical glass impedance at 25 °C (77°F) = 600 MΩ)
Low temperature (LT) glass
–5 to 50 °C (23 to 122 °F)
(typical glass impedance at 25 °C (77 °F) = 25 MΩ)
ORP platinum electrode
0 to 60 °C (32 to 140 °F)

Temperature sensor
100 ULTRA
Pt100 (Class B, IEC 60751)
100 ULTRA-D
Pt1000 (Class B, IEC 60751)

Maximum pressure
6 bar (90 psi)

Recommended minimum sample conductivity
2 µS/cm

Recommended sample flowrate
≥100 ml/min

Recommended sensor storage
Between 15 and 35 °C (59 and 95 °F)

Isothermal point at 25 °C (77 °F)
pH 7

Reference system
Ag/AgCl with KCl gel electrolyte, double junction plus ion trap

Process connections
¾ in NPT

Wetted materials
Electrode body
PVDF (Kynar)
Reference junction system
Porous PTFE and Viton O-rings
Measure system
pH: Glass
ORP: Platinum

Approvals, certification and safety
CE Mark
Covers EMC+LV directives
(including latest version of EN61010)
Regulation 31

Drinking water approval:	Complies to DWI Regulation 31(4)(b)
Additional tests:	BS6920 parts 2.2 and 2.4 on all wetted parts

EMC
Meets requirements of IEC61326 for an industrial environment

CRN approval
Maximum allowable working pressure (MAWP): 5.58 bar (81 psi)
Design temperature: –5 °C to 105 °C (23 °F to 212 °F)
CRN number: 0F22557

DS/100ULTRA-EN Rev. C
DS/100ULTRAD-EN Rev. C

500 PRO/500 PRO-D

Measurements
- pH/ORP (Platinum)
- Temperature

Measurement range
High performance (S) and high temperature (HT) glass
0 to 14 pH
Hydrofluoric acid-resistant (HF) glass
0 to 12 pH
Low temperature (LT) glass
0 to 10 pH
ORP
–2000 to 2000 mV

Temperature range
High performance (S) glass (bullet)
0 to 100 °C (32 to 212 °F)
(typical glass impedance at 25 °C (77°F) = 250 MΩ)
High performance (S) glass (flat)
5 to 100 °C (41 to 212 °F)
(typical glass impedance at 25 °C (77°F) = 600 MΩ)
High temperature (HT) glass
0 to 105 °C (32 to 221 °F)
(typical glass impedance at 25 °C (77°F) = 800 MΩ)
Hydrofluoric acid-resistant (HF) glass
0 to 80 °C (32 to 176 °F)
(typical glass impedance at 25 °C (77°F) = 700 MΩ)
Low temperature (LT) glass
–5 to 50 °C (23 to 122 °F)
(typical glass impedance at 25 °C (77 °F) = 25 MΩ)
ORP platinum electrode
0 to 100 °C (32 to 212 °F)

Temperature sensor
500 PRO
Pt100 (Class B, IEC 60751)
500 PRO-D
Pt1000 (Class B, IEC 60751)

Maximum pressure
10 bar (145 psi)

Recommended minimum sample conductivity
50 µS/cm

Recommended sensor storage
Between 15 and 35 °C (59 and 95 °F)

Isothermal point at 25 °C (77 °F)
pH 7

Reference system
Ag/AgCl with triple junction, KCl gel electrolyte plus ion trap

Process connections
¾ in NPT

Wetted materials
Electrode Body
PVDF (Kynar)
Reference junction system
Porous PTFE and Viton extreme O-rings
Measure system
pH: Glass
ORP: Platinum

Approvals, certification and safety
CE Mark
Covers EMC+LV directives
(including latest version of EN61010)
Regulation 31

Drinking water approval:	Complies to DWI Regulation 31(4)(b)
Additional tests:	BS6920 parts 2.2 and 2.4 on all wetted parts

EMC
Meets requirements of IEC61326 for an industrial environment
ATEX/IECEx

500 PRO	500 PRO-D
Certificate numbers:	Certificate numbers:
IECEx BAS 18.0047X	IECEx BAS 18.0055X
Bassefa18ATEX0071X	Baseefa18ATEX0081X
Entity parameters:	Entity parameters:
Ui = 15.0 V	Ui = 6.0 V
Ii = 20 mA	Ii = 100 mA
Ci = 5 NF	Ci = 30 uF
Li = 30 uH	Li = 20 uH
Pi = 120 mW	Pi = 600 mW

…14 Specifications

…Approvals, certification and safety

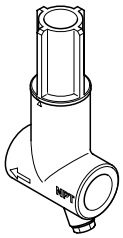
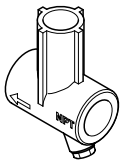
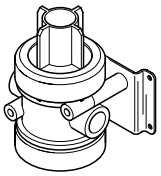
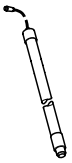
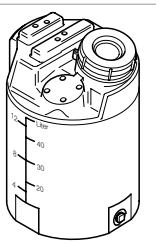
CRN approval

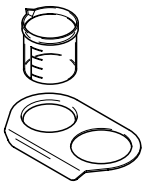
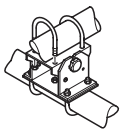
Maximum allowable working pressure (MAWP): 5.58 bar (81 psi)
Design temperature: –5 °C to 105 °C (23 °F to 221 °F)
CRN number: 0F22557

DS/500PRO-EN Rev. D
DS/500PROD-EN Rev. D

15 Accessories and spares

Accessories

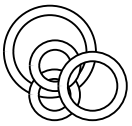
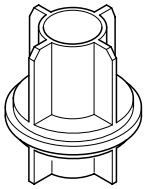
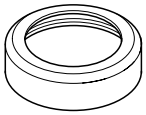
Part number	Description	
3KXA163000L0002	1 in BSP bayonet polycarbonate T-piece	
3KXA163000L0004	1 in NPT bayonet polycarbonate T-piece	
3KXA163000L0006	1 in BSP screw polycarbonate T-piece	
3KXA163000L0008	1 in NPT screw polycarbonate T-piece	
3KXA163000L0012	½ in NPT polycarbonate flow-cell and ¾ in adapter	
3KXA163000L0011	½ in NPT stainless steel flow-cell and ¾ in adapter	
3KXA163000L0024	Protective shroud for ¾ in body	
	1¼ in NB dip pole assembly	
3KXA163000L0021	2.5 m (8.2 ft)	
3KXA163000L0022	1m (3.3ft)	
3KXA163000L0023	Dip pole kit (customer-supplied 1¼ in NB tube)	
3KXA163000L0025	Automatic cleaning system (liquid)	

Part number	Description	
3KXA163000L0026	T-piece cleaning adapter	
3KXA163000L0120	Calibration kit (includes calibration beaker and holder)	
ATS4000760	Rail mounting kit (tilt only)	

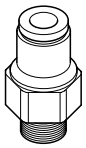
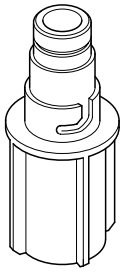
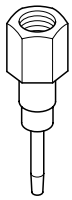
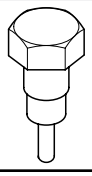
…15 Accessories and spares

Spares

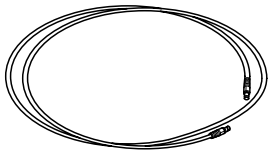
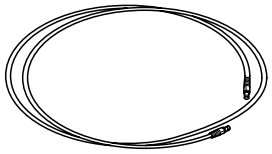
Flow cell

Part number	Description	
3KXA163000L0113	Pack of flow-cell O-rings	
3KXA163000L0118	Flow-cell ¾ in NPT adapter	
3KXA163000L0116	Flow-cell locking ring	

T-piece and bayonet adapter

Part number	Description	
3KXA163000L0121	Straight adapter, R ⅛ male, push-in 6 mm	
3KXA163000L0111	pH bayonet adapter	
3KXA163000L0112	Bayonet adapter O-rings	
3KXA163000L0114	pH cleaning adapter nozzle	
3KXA163000L0115	pH T-piece blanking plugs	

Extension cables

Part number	Description	
	VP cable	
3KXA163000L0051	1 m (3.3 ft)	
3KXA163000L0052	3 m (9.9 ft)	
3KXA163000L0053	5 m (16.4 ft)	
3KXA163000L0054	10 m (32.8 ft)	
3KXA163000L0055	15 m (49.2 ft)	
3KXA163000L0056	30 m (98.4 ft)	
	EZLink cable	
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 ft)	
AWT4009500	50 m (164 ft)	

Acknowledgements
Kynar is a registered trademark of Arkema Inc.
Viton is a registered trademark of The Chemours Company

Notes

Notes

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/measurement

3KXA163100R4201

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