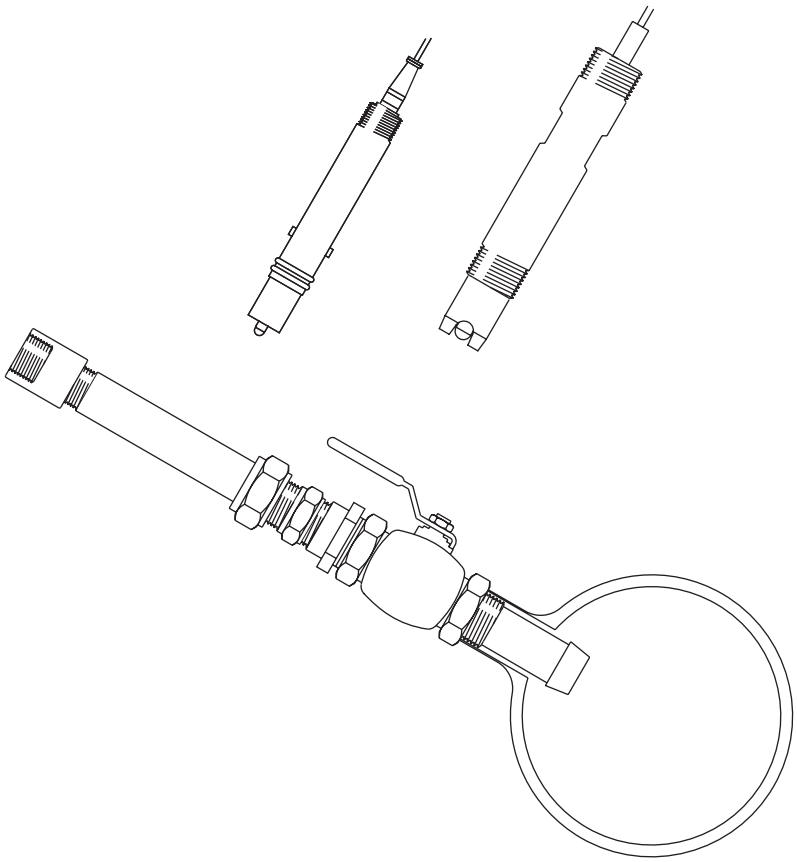
AP300 Series
pH/Redox (ORP) Electrode
Systems

Operating Instructions

Models AP301, AP302, AP303,
AP304 and AP305



ABB

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The NAMAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company, and is indicative of our dedication to quality and accuracy.

BS EN ISO 9001

Cert. No. Q5907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although Warning hazards are related to personal injury, and Caution hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all Warning and Caution notices.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Marketing Communications Department.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

CONTENTS

1 INTRODUCTION

1.1 Purpose

This instruction manual describes the installation and maintenance of the AP300 Series Industrial pH and Redox (ORP) Electrode Systems.

1.2 Sensors and Systems

There are three main sensor types:

AP301	Standard lock nut – insertion/immersion (dip)
AP302/3	Screw in – insertion/immersion (dip)
AP304/5	Ball valve insertion

1.3 Sensor Descriptions

1.3.1 AP301 – Fig. 1.1

Model AP301 sensors are in-line, flow-through or general purpose, twist-lock style. The sensor body is molded from chemically resistant PPS (Ryton).

The sensor can be adapted to 1 inch fittings by either a threaded Ryton or twist-lock adaptor. The twist-lock adaptor is available in epoxy or stainless steel.

An optional electrode guard protects the electrode in immersion applications.

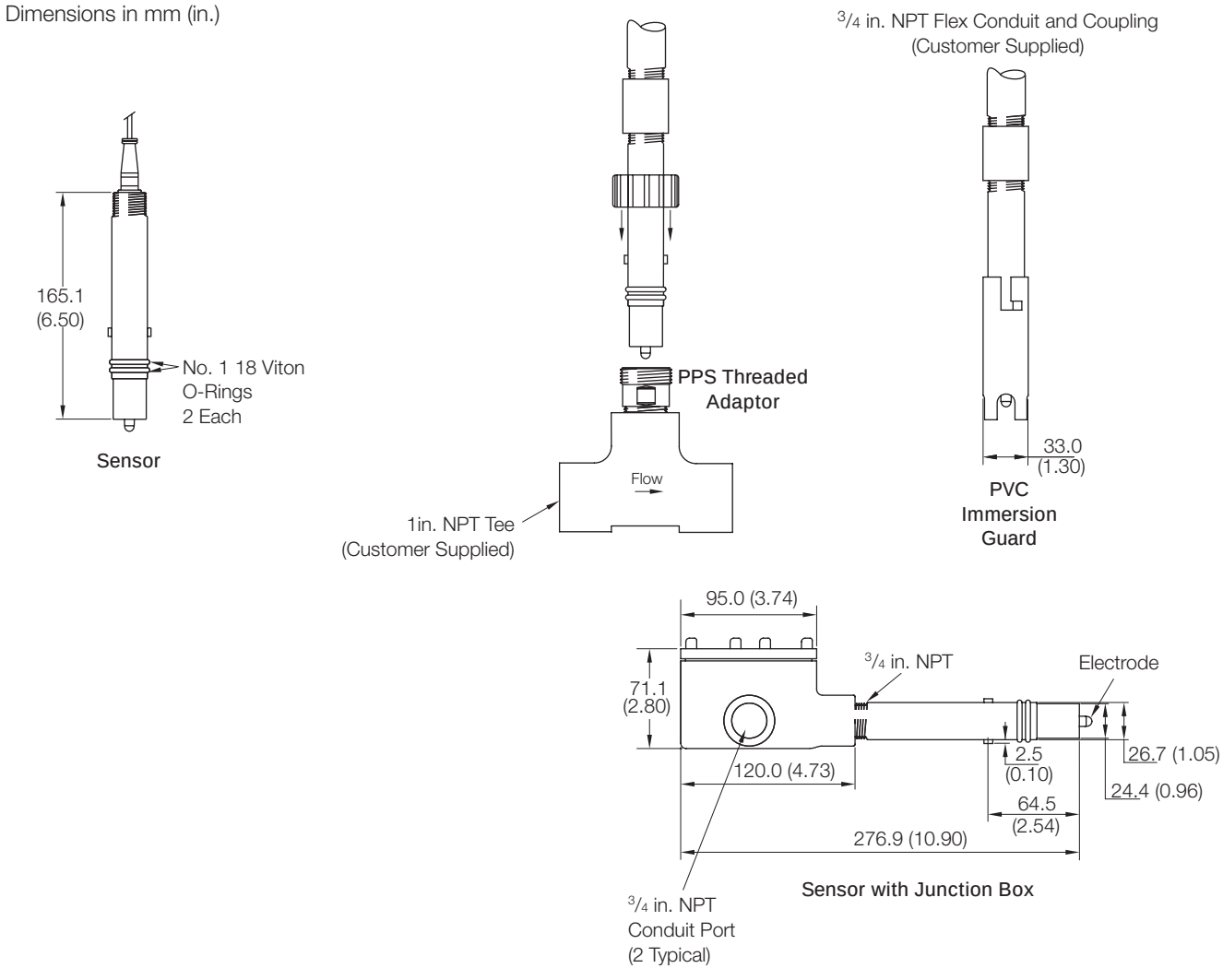


Fig. 1.1 AP301 Sensors and Dimensions

1.3.2 AP302/3 Sensors – Fig. 1.2

These sensors are threaded style suitable for immersion/dip applications and insertion into process pipes.

Mounting thread size: 3/4 inch NPT.

The sensor body is chemically resistant PVDF (Kynar).

AP302 models have no sensor guard (flush).
AP303 models have a notched sensor guard.

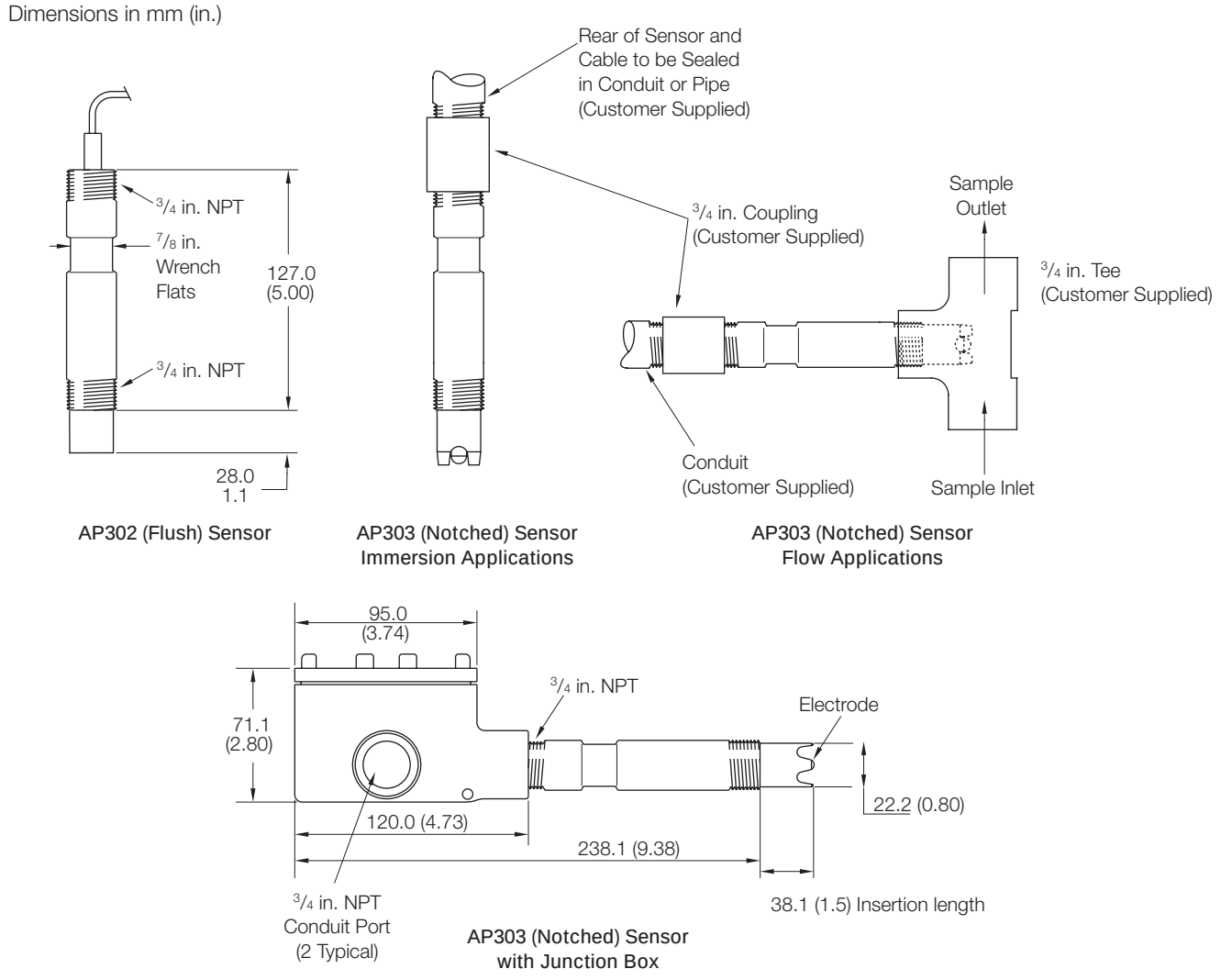


Fig. 1.2 AP302/3 Sensors and Dimensions

1.3.3 AP304/5 Sensors – Figs 1.3 and 1.4

These sensors are hot tap, ball valve insertion types. They enable sensor maintenance or replacement without interrupting the process.

An integral safety anti-blowout lip is incorporated into the sensor design preventing accidental sensor removal. Unlike chain restraints, this safety-by-design is an integral part of the construction.

The sensor is inserted through a standard 1¼ in. full port or 1½ in. ball valve. Ease of disassembly aids sensor replacement.

Connection to the ball valve is by compression fitting which is available in either hand-tight with 1¼ in. NPT threads or wrench-tight with 1 in. NPT threads.

Additional fittings enable the assembly to be flushed and drained in situ and uses a 1½ in. NPT thread for connection to the ball valve.

AP304 models have no sensor guard (flush).
AP305 models have a notched sensor guard.

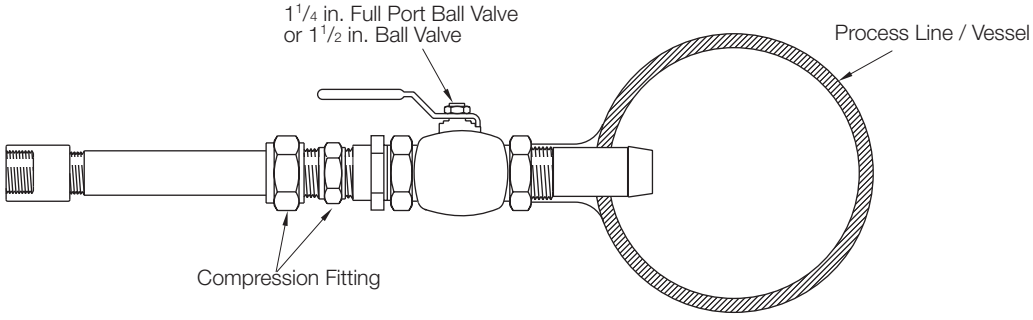


Fig 1.3 AP304/5 Ball Valve Dimensions

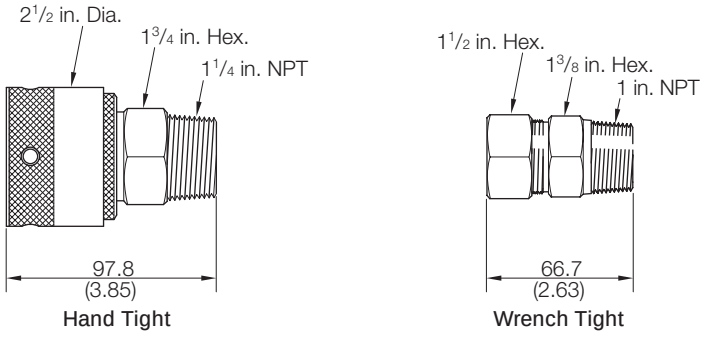


Fig 1.4 AP304/5 Compression Fitting Dimensions

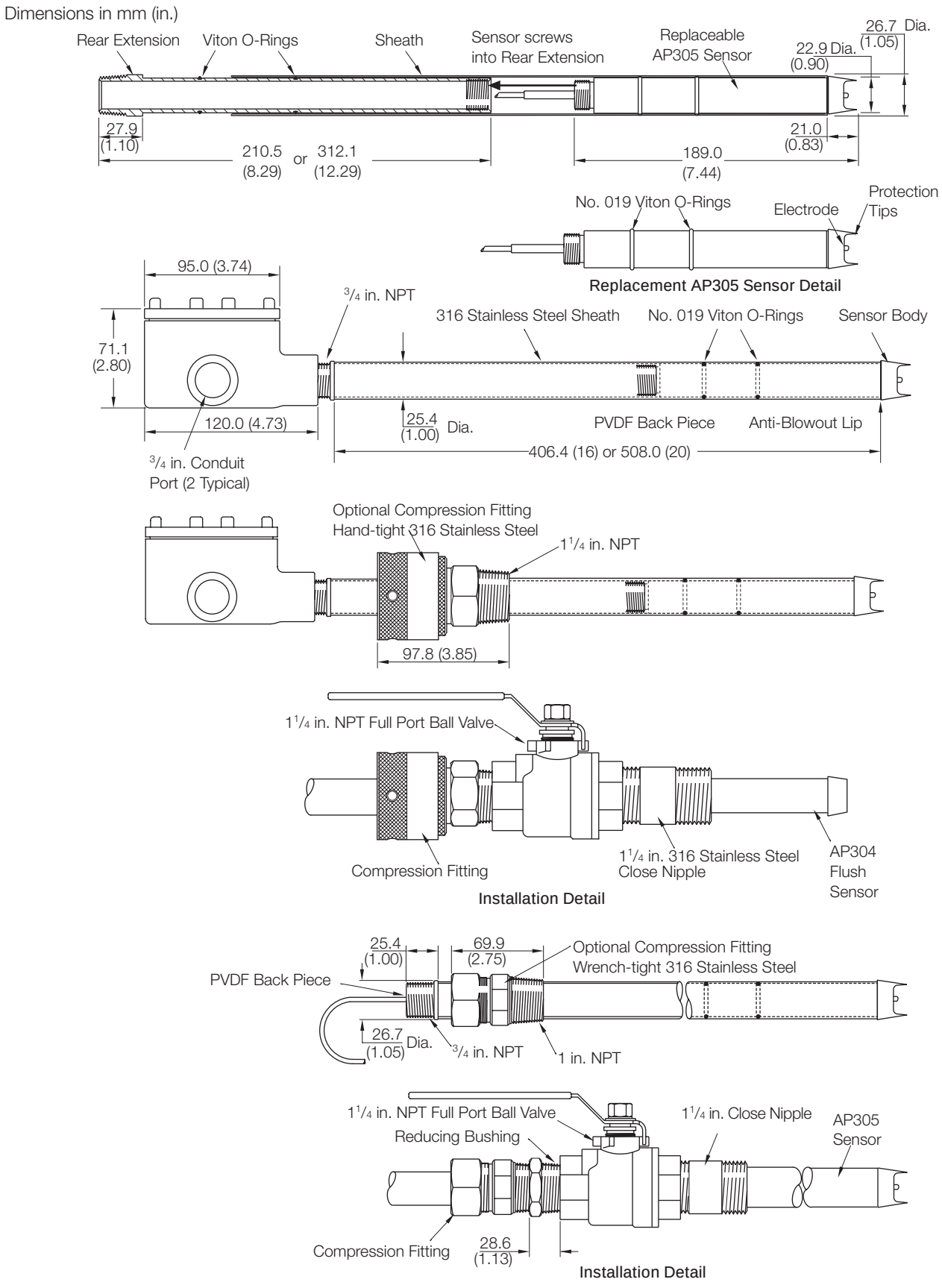


Fig 1.5 AP304/5 Sensors and Overall Dimensions

2 MECHANICAL INSTALLATION

2.1 Recommended Installation

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

Not for fouling applications | For fouling applications

Notes.

- The flow of sample passing the sensor helps to keep the sensor clean.
- Sensors should be positioned such that they are always immersed in the sample.

2.1.1 AP301 Sensors – Fig. 2.1

Insertion/Flow Type

1) Depressurize and drain the process line before inserting or removing the sensor to prevent spillage.
2) Insert the sensor into the threaded sensor adaptor and rotate it one-quarter of a turn to prevent the sensor from being blown out when the process lines are pressurized.
3) Install the safety catch into the slot of the sensor adaptor to prevent accidental rotation of the sensor.
4) Do not overtighten the threaded sensor adaptor as the inner diameter of the fitting can be compressed making sensor insertion or removal impossible. Use teflon tape or other sealing compounds on the adaptor threads and tighten only as tight as necessary to stop leakage around the threads. Lubricate sensor O-rings before insertion.
5) Sensors are sometimes mounted upright into a tee in a line that is not full. The sensor can then be suspended above the liquid or may become air-locked. Both occurrences will cause erratic and erroneous measurement. Most of the time this can prevented by rotating the sensor to ensure that it is fully immersed in sample.

Immersion/Dip Type

1) The use of an immersion/dip guard is recommended to protect the glass sensor.
2) Levels in many tanks, sumps and channels vary. The sensor must be immersed to the lowest representative level to ensure the sensor is always immersed in sample.
3) Sensor cables on immersion sensors should be of adequate length for the BNC to be attached to an extension cable outside the immersion area.

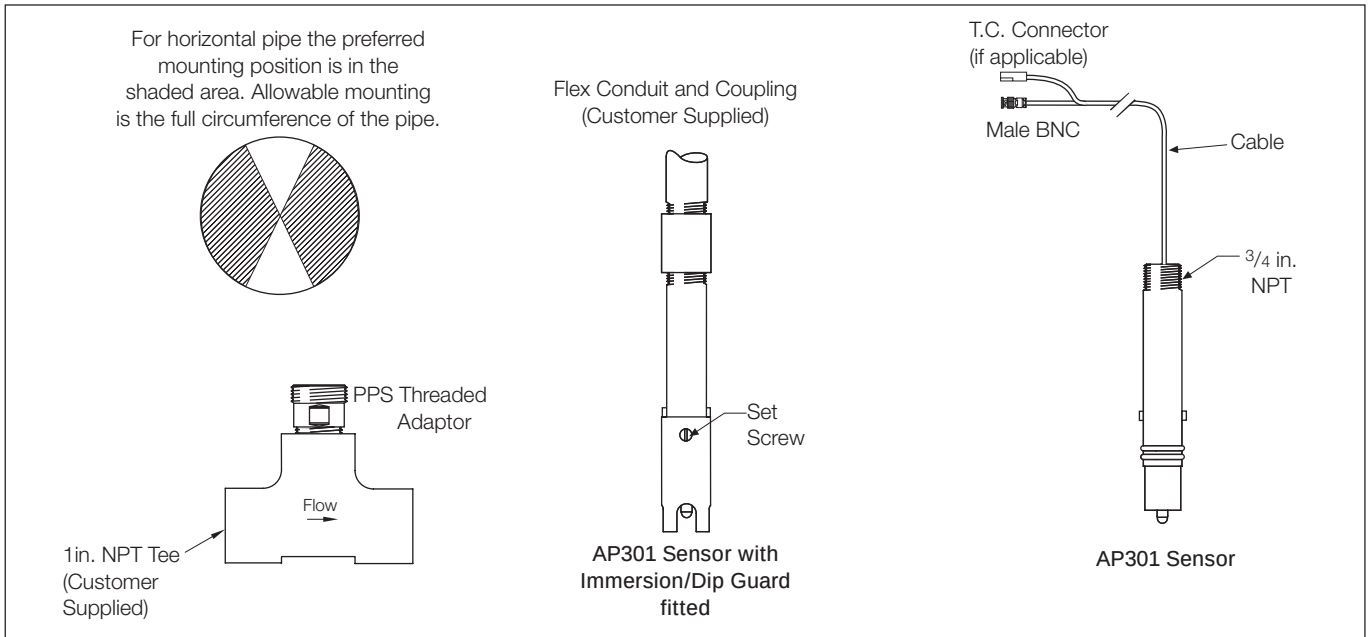


Fig. 2.1 Installing the AP301

2.1.2 AP302/3 Sensors – Fig. 2.2

Insertion/Flow Type

1) Process lines must be shut down and depressurized before inserting or removing sensors.
2) Teflon tape or other sealing compounds must be applied to the sensor threads to prevent leakage. Overtightening the sensor threads may cause internal damage to the sensor.
3) Some plastic 3/4 inch tees have a very narrow internal diameter and will not permit insertion of these sensors. These tees must be bored out to a minimum 0.89 in. inside diameter.
4) Sensors are sometimes mounted upright into a tee in a line that is not full. The sensor can then be suspended above the liquid or may become air-locked. Both occurrences will cause erratic and erroneous measurement. Most of the time this can prevented by rotating the sensor to ensure that it is fully immersed in sample.

Immersion/Dip Type

1) Levels in many tanks, sumps and channels vary. The sensor must be immersed to the lowest representative level, to ensure it is always immersed in sample.
2) Sensor cables on immersion sensors should be of adequate length for the BNC to be attached to an extension cable outside the immersion area.

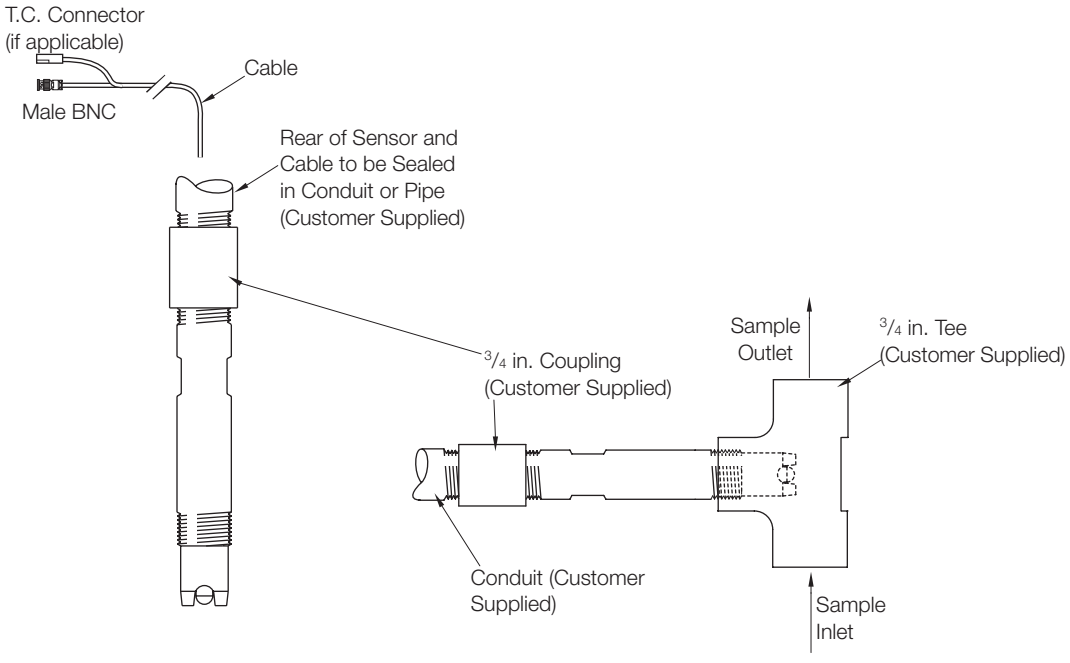
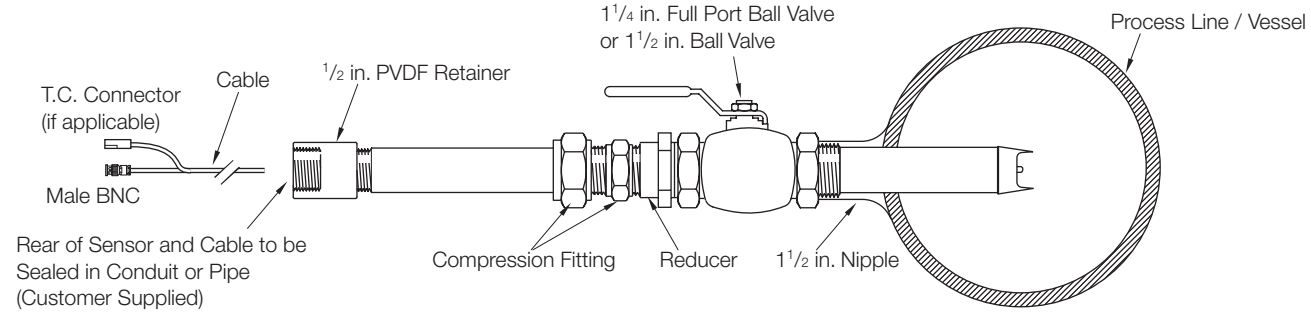
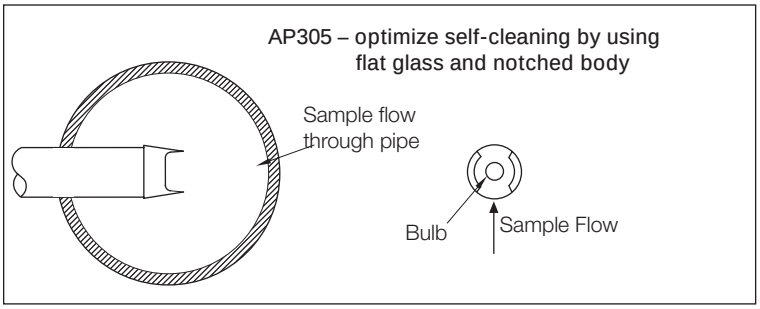


Fig. 2.2 Installing the AP302/3

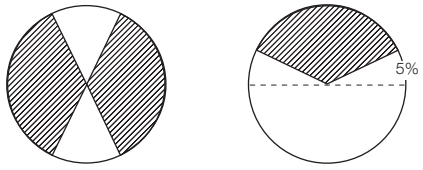
2.1.3 AP304/5 Sensors – Fig. 2.3

1) Process pressure must not exceed 6.9 bar (100 lb in^{-2}) continuous, or 10 bar (150 lb in^{-2}) infrequent pulses. Sensors should be retracted during process start-up to prevent damage due to pressure surges or water hammer.
2) Insert the sensor only as far as necessary to achieve representative flow. Over-insertion may damage the sensor and/or cause slow response.
3) Fully retract the sensor before closing the valve and fully open the valve before inserting the sensor.





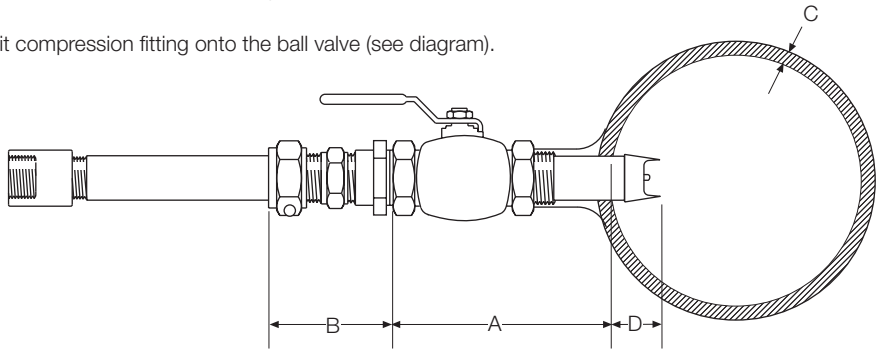
For horizontal pipe, the preferred mounting position is within the shaded area. Allowable mounting is anywhere within the full circumference of the pipe.



Bulb Glass Flat Glass

(1) Fit choice of ball valve into the process line or vessel.

(2) Fit compression fitting onto the ball valve (see diagram).



(3) Measure and record the following distances:
A = outside of pipe/vessel to the reducer at the back end of the valve.
B = length of compression fitting after insertion into the reducer.
C = pipe/vessel wall thickness.
D = sensor insertion depth.

(4) Add together measurements A, B, C and D and, measuring from the tip of the sensor, mark off total onto the shaft of the sensor.

(5) Insert the sensor into the ball valve. Tighten onto the ball valve on reducer.

(6) Open the ball valve fully and gently push the sensor into the valve until the mark made at (4) reaches the compression fitting.

(7) Tighten the outer compression joint (manually or using wrench depending on type of fitting chosen).

Fig. 2.3 Installing the AP302/3

3 ELECTRICAL CONNECTIONS

3.1 Sensor Connections – Fig. 3.1

All sensors are supplied with either an integral cable in the following lengths:

3 m (10 ft)
6 m (20 ft)
9 m (30 ft)

or with a detachable cable and fitted junction box.

Terminations are shown in Fig. 3.1.

Each version allows for tagged sensor terminations enabling connection to a wide variety of process pH/redox (ORP) instruments. Alternatively, the sensor can be supplied with detachable BNC and Molex connectors for pH/redox (ORP) and temperature compensation (if applicable).

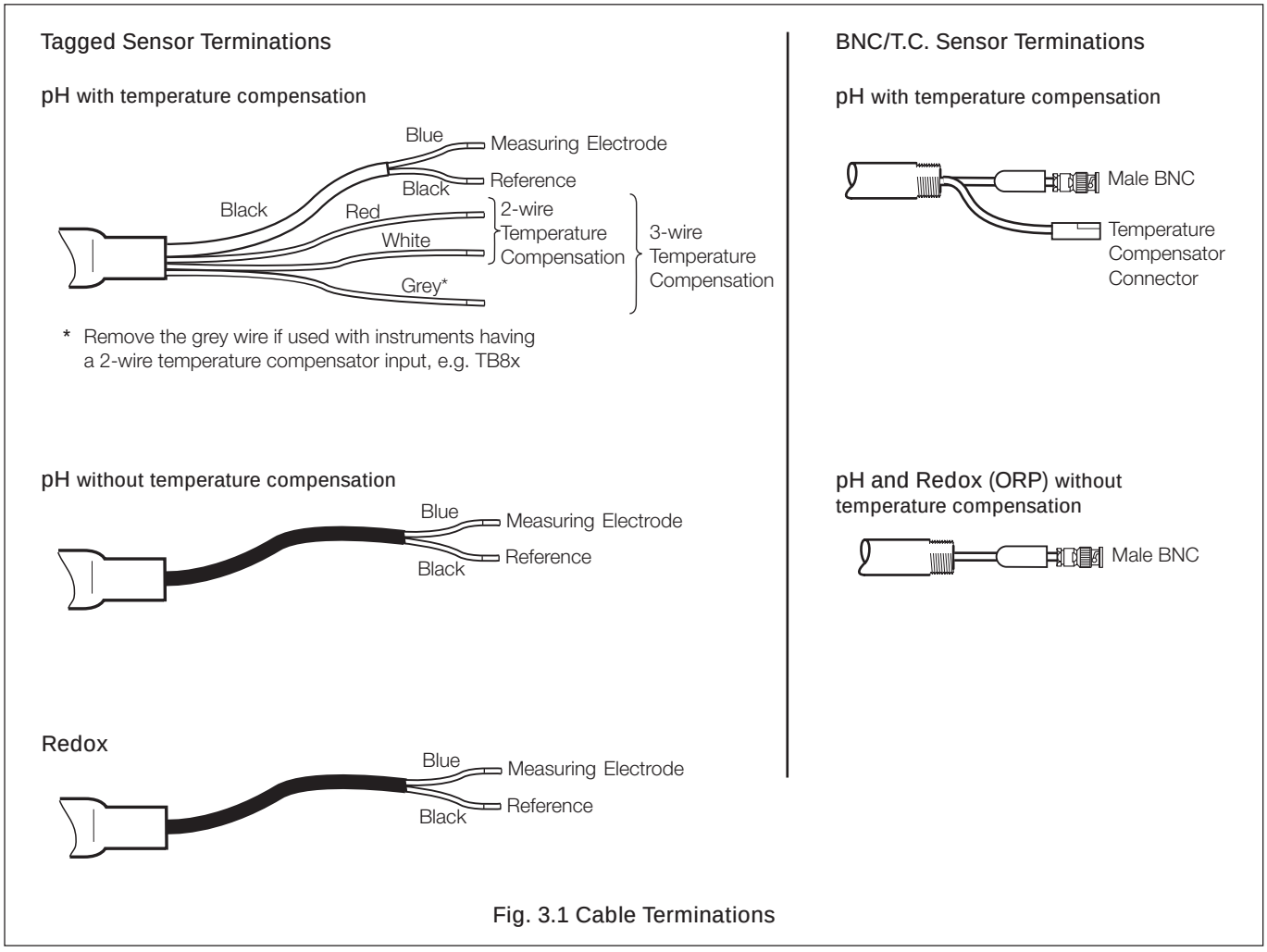
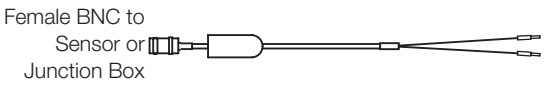


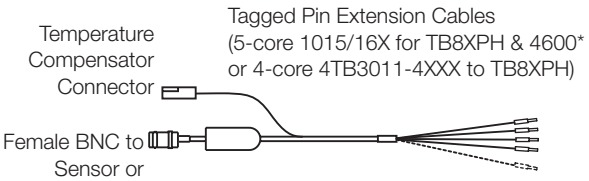
Fig. 3.1 Cable Terminations

3.2 Extension Cables – Figs 3.2 and 3.3

pH without temperature compensation or Redox (ORP)



pH with temperature compensation



*Note. Automatic pt100 lead resistance compensation with Model 4630 instruments or similar.

Part number: 4TB3011-3xxx (where xxx is the cable length in feet – maximum is 100 feet) or type 9170/300 (length by request)

Part numbers:

5 m	1015 160
10 m	1015 161
20 m	1015 162
30 m	1015 163
Special length (by request)	1015 169

Fig. 3.2 Extension Cables

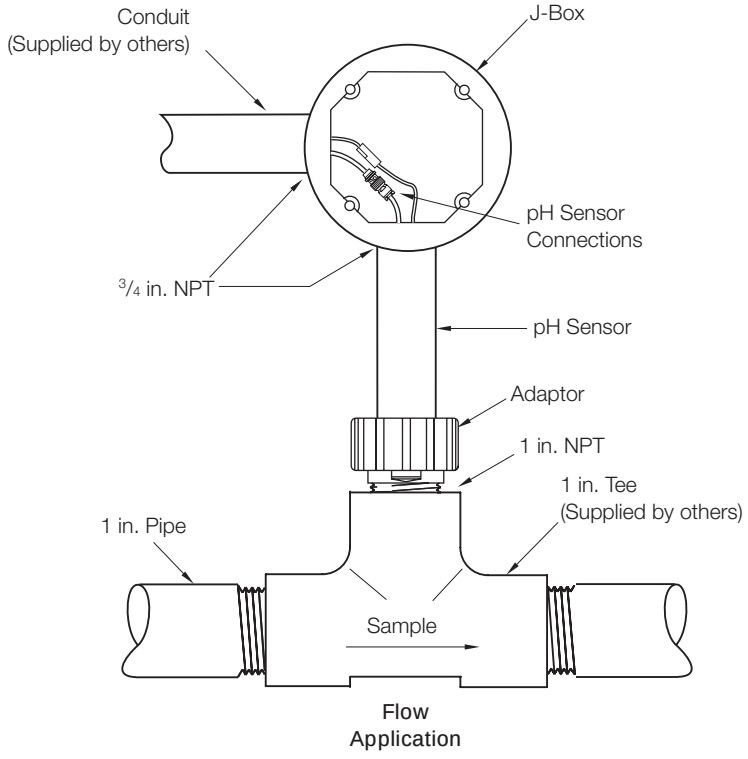


Fig. 3.3 Extension Cables – Typical Installations

4 CALIBRATION

4.1 pH Sensor

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

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

or

b) in two separate calibration solutions of known pH values for a two point calibration.

For sensors already in use:

1) Remove the electrode from the process or sample.
2) Wash the visible electrode surface with demineralised water.
3) Proceed as described in the paragraph above.

To have agreement with a measured sample, there may be times when a process calibrarion is necessary.

1) Perform a buffer calibration.
2) Ensure that the sensor is returned to the process for at least 10 minutes before performing a process calibration.
3) To mimimise solution temperature effects, measure the sample at the same temperature as the process.

Refer to the instruction manual for the pH transmitter for full details of the calibration procedures.

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

Caution. It is important when buffering to ensure that the visible surface of the electrodes has been cleaned using demineralised water. Also ensure when moving from one buffer solution to the next to wash the electrodes and dry them carefully using a soft tissue.

4.2 Redox (ORP Sensor)

When the sensor has been correctly connected and all electrical connections have been made to the associated Redox (ORP) transmitter, it is ready for calibrating. Follow the calibration procedure in the transmitter instruction manual.

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

1) Prepare standard 4 and 7 pH buffer solutions. Add one gramme (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.

The values obtained should be within ±15 mV of the values below:

pH Buffer	mV
4	+259
7	+82

5 MAINTENANCE

5.1 General Cleaning

Warning. Before removing a sensor from a flow line, ensure that any 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 deposit are detailed below. Replace the sensor if its performance does not improve after cleaning.

5.1.1 General Sludge and Loosely Adhering Matter

Rinse off the excess matter and wipe the sensor with a soft cloth or tissue before calibrating.

5.1.2 Heavy, Non-Greasy Deposits

For example: lime, salts, etc. Immerse the sensor in 1 to 2 M hydrochloric acid until the deposit has dissolved. Rinse the sensor with water before calibrating.

5.1.3 Greasy or Organic Deposits

Wipe the glass membrane with a detergent or acetone-based solvent. Rinse with water before calibrating.

5.2 Fault Finding

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

Short scaling (Low Slope) or sluggish response

1) Glass sensor membrane dirty or coated – refer to Section 5.1 for cleaning.
2) Poor insulation on cable connectors, possibly due to moisture – dry connectors with warm air.

   Replace the sensor if no improvement is seen. It may also be necessary to replace the extension cable if used.

No response to pH buffer or sample

1) Check the sensor has been correctly wired to the transmitter as detailed in Section 3.1 and the relevant transmitter instruction manual.
2) Check the glass sensor membrane is not broken or cracked.

Unstable readings or drift

1) Check the sensor has been correctly wired to the transmitter as detailed in Section 3.1 and the relevant transmitter instruction manual.
2) Dry or dirty reference junction – clean the junction as detailed in Section 5.1. Leave to soak in a buffer solution for several hours.

   Replace the sensor if no improvement is seen.

Stable but incorrect readings

1) Recalibrate using fresh buffer solutions.
2) Check temperature compensation settings are correct – manual temperature is correct, or automatic temperature compensation is reading correctly.
3) If the sensor responds correctly to pH changes, but there is an offset of <1.0 pH to >0.2 pH, perform a one-point process calibration (see Section 4.1).

Note. All the above symptoms could be caused by a faulty extension cable. Check and replace it, if necessary.

5.3 Storage of the Electrode

Caution. Failure to ensure that the glass membrane and reference junction do not dry out may irreversibly affect the response of the electrode.

If it is necessary to remove the electrode from the sample line, fill the retained protective cap with buffer solution and cotton wool, or equivalent, and fit it to the sensor.

6 SPARES

6.1 General Spares – Ordering Information

pH/Redox (ORP) Sensor/Assembly	AP30	X	/	X	X	0	X	X	XX	X
Gel-filled, disposable sensor with dirt-repellent PTFE junction										
Body style										
Twist-lock insertion/immersion (TB551 style)										
Standard insertion – no sensor guard (flush)		1								
3/4 in.threaded insertion/immersion (TB556 style)										
Insertion depth 1.1 in. – no sensor guard (flush)		2								
Insertion depth 1.5 in. – notched sensor guard		3								
Hot-tap ball valve insertion (TB557 style)										
No sensor guard (flush)		4								
Notched sensor guard		5								
Measuring Electrode										
Flat glass pH for in-line, fouling applications (5 to 100°C, 0 to 14pH)				1						
Standard glass, pH (0 to 105°C, 0 to 14pH)				2						
Platinum, Redox (ORP)				5						
Integral Temperature Sensor										
None – only for Redox (ORP) sensors					0					
Pt100 – only for pH sensors					1					
3kΩ – only for pH sensors					2					
Reserved										
Junction Box or Integral Cable Length										
Short length cable – supplied **without** junction box							0			
3m (10 ft)							1			
6m (20 ft)							2			
9m (30 ft)							3			
Integral junction box supplied with short length cable							8			
Sensor Connectors										
Tagged Pin Leads – all tagged terminations								0		
Connectors – BNC on pH/Redox (ORP) + TC connector (if used)								1		
Also select for electrodes used with junction box										
Accessory Hardware										
No accessory supplied									00	
For AP301										
1 in. NPT, locknut adapter – Ryton (PPS)									12	
PVC immersion (dip) guard									13	
For AP304 & AP305										
16 in. stainless steel sheath									20	
16 in. stainless steel sheath & 316 stainless steel wrench-tight fitting									21	
16 in. stainless steel sheath & 316 stainless steel hand-tight fitting									22	
20 in. stainless steel sheath									23	
20 in. stainless steel sheath & 316 stainless steel wrench-tight fitting									24	
20 in. stainless steel sheath & 316 stainless steel hand-tight fitting									25	
Instruction Manual										
No manual supplied – for replacement sensors only										0
English										1
French										2
German										3
Spanish										4

6.2 Additional Spares – Ordering Information

Threaded Lock-nut Adaptor, PPS (Ryton) (1 inch NPT)	4TB 9515-0120
PVC Immersion/Dip Guard	4TB 5205-0120
Junction Box (Requires cable gland)	4TB 5023-0162
Cable Gland	4TB 9515-0244

6.3 Extension Cables – Ordering Information

Redox (ORP) and non-temperature compensated pH	4TB 3011-3xxx* or 9170/300**

Temperature compensated pH

Tagged Pin Extension Cables (5-core1015/16X for TB8XPH & 4630*** or 4-core 4TB3011-4XXX to TB8XPH)

5 m	1015 160
10 m	1015 161
20 m	1015 162
30 m	1015 163
Special length	1015 169

* xxx is the cable length in feet. Maximum is 100 feet.

** Length by request.

*** Automatic pt100 lead resistance compensation with Model 4630 instruments or similar.

7 SPECIFICATION

pH measuring range: 0 to 14 pH

Redox (ORP) measuring range: –2000 mV to +2000 mV

Temperature range:

Body	0°C to 105°C (32°F to 221°F)
Standard glass	0°C to 105°C (32°F to 221°F)
Flat glass	0°C to 100°C (32°F to 212°F)
Redox (ORP)	0°C to 105°C (32°F to 221°F)

Maximum operating pressure: 6 bar (90 lb in^{-2})

Temperature compensator (pH sensors only) Integral Pt 100 or Balco 3k

Wetted materials:

Glass:	pH electrode
Platinum:	Redox (ORP)
PTFE:	Junction
PPS (Ryton):	Body AP301
PVDF (Kynar):	AP302/3 & AP304/5
Stainless steel:	AP 304/5 shaft

pH glass types:

Bulb:	general duties
Flat:	in-line, self-cleaning

Reference system:

Ag/AgCl-3.5M KCl in gel matrix

Reference junction:

Porous PTFE

NOTES

PRODUCTS & CUSTOMER SUPPORT

Products

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- *for the following industries:*
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- *ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.*
- *Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.*

Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom

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Fax: +44 (0)1453 827856

United States of America

ABB Inc.
Tel: +1 (0) 755 883 4366
Fax: +1 (0) 755 883 4373

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.

In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of operating and maintenance records relating to the alleged faulty unit.

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The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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