AP200 series

Rugged pH/Redox (ORP) sensor systems with rapid temperature response for critical processes

Measurement made easy

AP200 series
Rugged pH/Redox
(ORP) sensor systems

Introduction

The pH / redox (ORP) sensor AP200 provides high reliability and withstands the toughest environments for process monitoring and control. The rugged assembly is built to bear the rigors of weather and process. Parts in contact with the process comprise chemically-resistant PPS Ryton™ and stainless steel, or PPS Ryton™ and Hastelloy C. Flow-through holders are available in polypropylene, while the PPS Ryton™ insertion adapter enables installation in alternative material pipelines. Insertion and Flow-through systems tolerate temperatures up to 130 °C (266 °F) and pressures up to 6 bar (90 psi). The inner electrode connections are ingress-protected to IP 67 / NEMA 6P (exceeds NEMA 4X).

For more information

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AP200 Rugged pH/Redox (ORP) sensor systems with rapid temperature response for critical processes Data Sheet	DS/AP200-EN
AAO100 Dosing pump User Guide	IM/DOSPMP

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.

Contents

Note. The candidate list according to Article 59 of the Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of chemicals (REACH) continues to expand. Article 33 places a legal obligation on an article producer to inform recipients of the information requirements when a candidate list substance is contained within an article at percentage of greater than 0.1% W/W.

The candidate list substance, acrylamide, a substance of very high concern, (CAS 79-06-1) is totally enclosed within the gel component of the product and should pose no risk to the user during installation, use and decommissioning providing the probe is handled in accordance with the instructions defined in the user manual.

1 Description

1.1 Introduction

This manual describes the installation and maintenance of the AP200 Series Process pH and Redox (ORP) Electrode Holder Systems.

1.2 Systems

1.2.1 Typical Systems

- AP201 Insertion system
- AP202 In-line, flow-through system
- AP203 Dip (immersion) system

1.2.2 AP120 Series Electrodes Used with Holders

AP121/11000 General process	0 to 14 pH, 0 to 100°C
AP121/21000 High temperature	0 to 14 pH, 0 to 130°C
AP121/31000 Low temperature	0 to 10 pH, –5 to +50°C
AP121/60000 Redox (ORP) platinum	0 to 100°C

See Section 6, page 15 for full details.

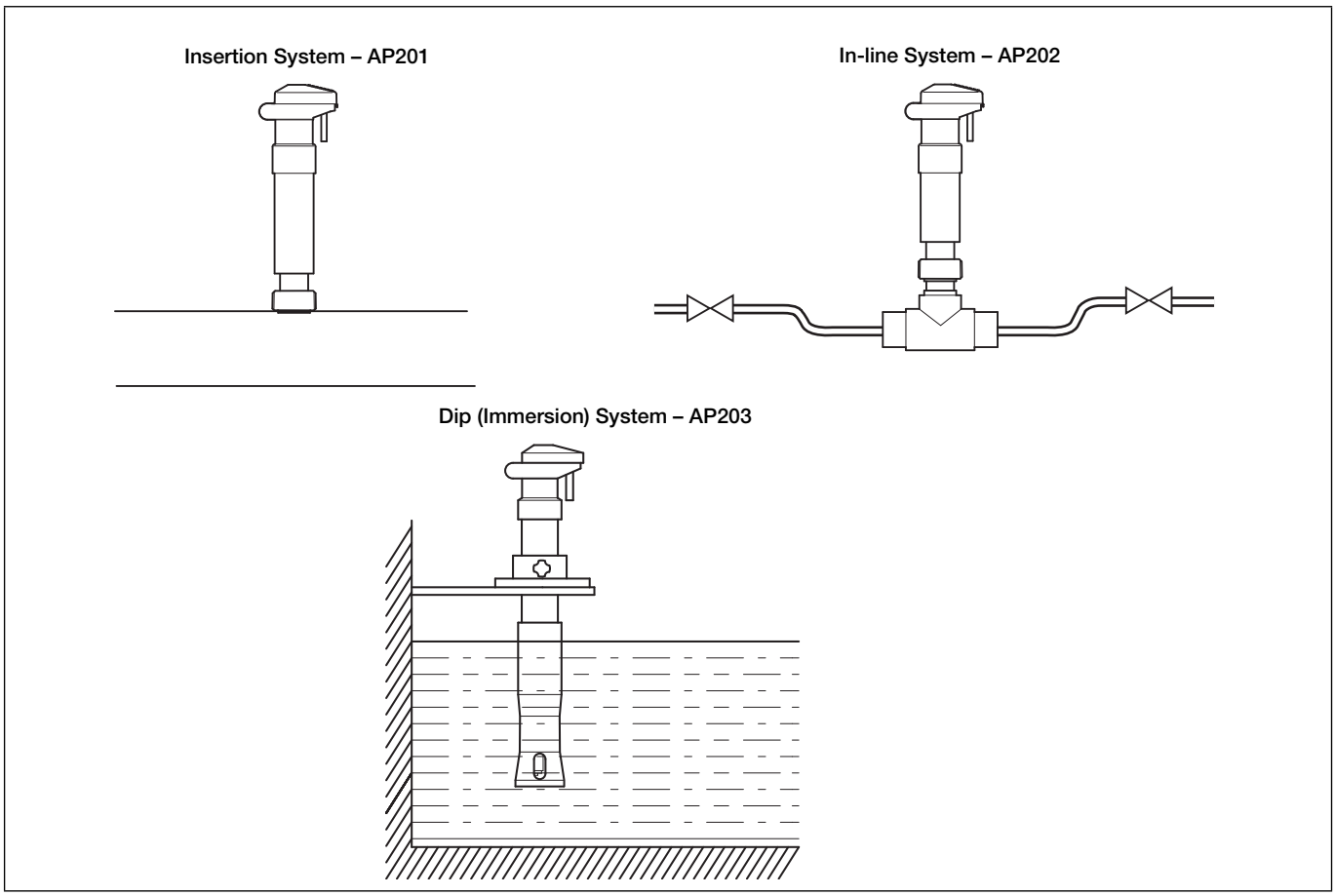


Fig. 1.1 System Schematics

2 Mechanical Installation

2.1 Installing the Systems

2.1.1 Model AP201 Insertion System

This system is designed to mount directly into a pipeline or tank. Mounting adaptors are available:

7690 130	PPS Ryton™ R 1¼ in. adaptor	7690 128	R 1in. Stainless Steel adaptor
7690 134	Polypropylene 1¼ in. NPT adaptor	7690 132	DN25 Straight-weld socket
7690 129	Polypropylene R 1¼ in. adaptor	7690 133	DN25 Angled-weld socket
7690 131	1in. NPT Stainless steel adaptor		

Dimensions in mm (in.)

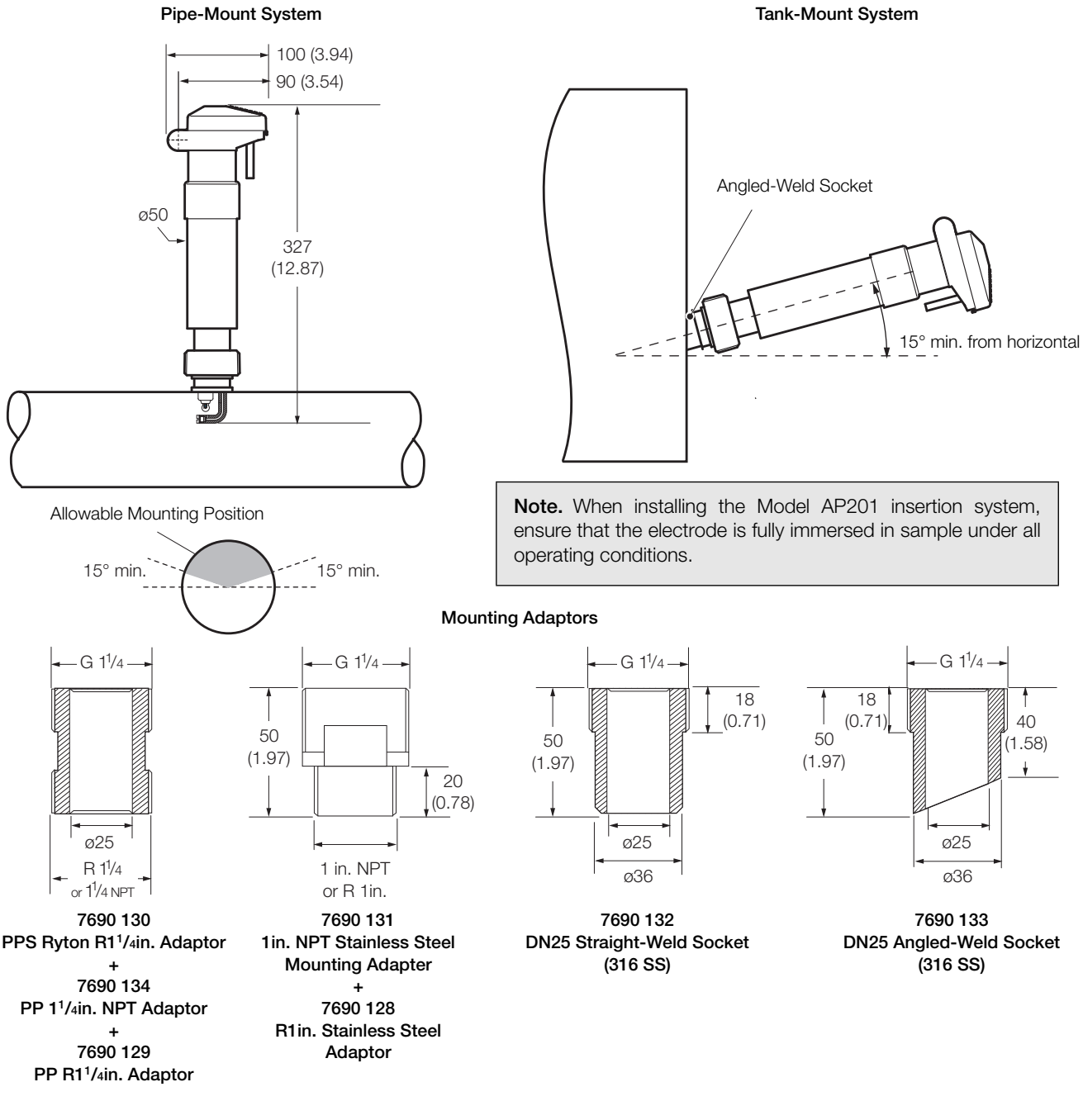
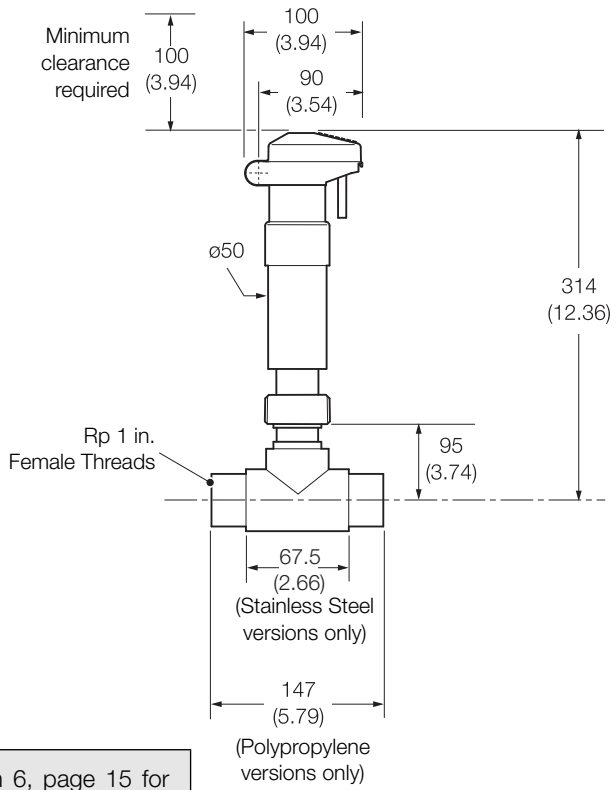


Fig. 2.1 Model AP201 Insertion System

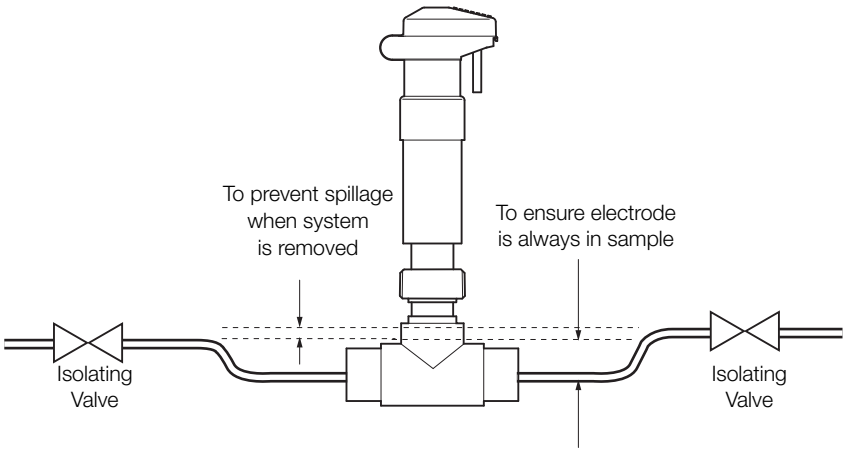
2.1.2 Model AP202 Inline System

This system is supplied with an inline tee-piece for mounting the system directly into a pipeline. Allow sufficient height above the system to enable the sensor to be withdrawn from the tee-piece.

Dimensions in mm (in.)



Note. Refer to Section 6, page 15 for information about the different versions.



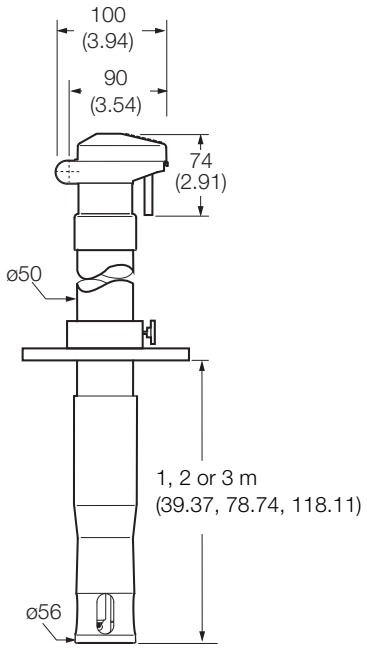
Typical Installation

Fig. 2.2 Model AP202 Inline System

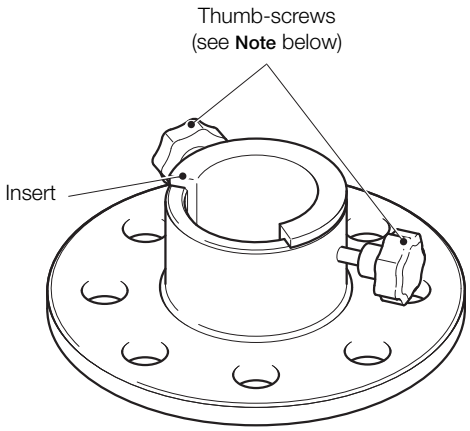
2.1.3 Model AP203 Flanged Dip (Immersion) System

This system is designed to be installed over an unpressurized tank or channel. A sliding flange is supplied to enable adjustment of the immersion depth. A suitable mounting bracket or support must be supplied by the user.

Dimensions in mm (in.)

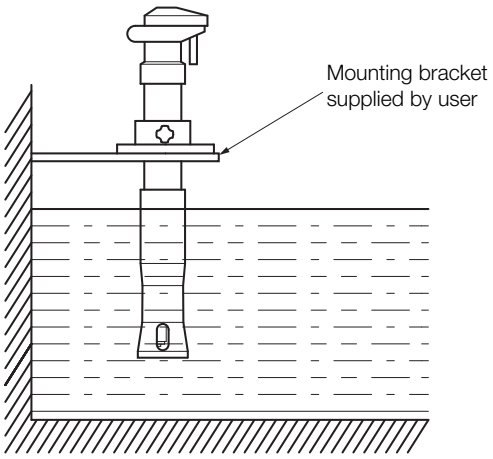


Dimensions



Mounting Flange

Note. Ensure the thumb-screws compress the insert when clamping the flange to the dip tube.



Typical Installation

Fig. 2.3 Model AP203 Flanged Dip (Immersion) System

2.2 Removing the Sensor Holder

2.2.1 Models AP201 Insertion and AP202 Inline Systems

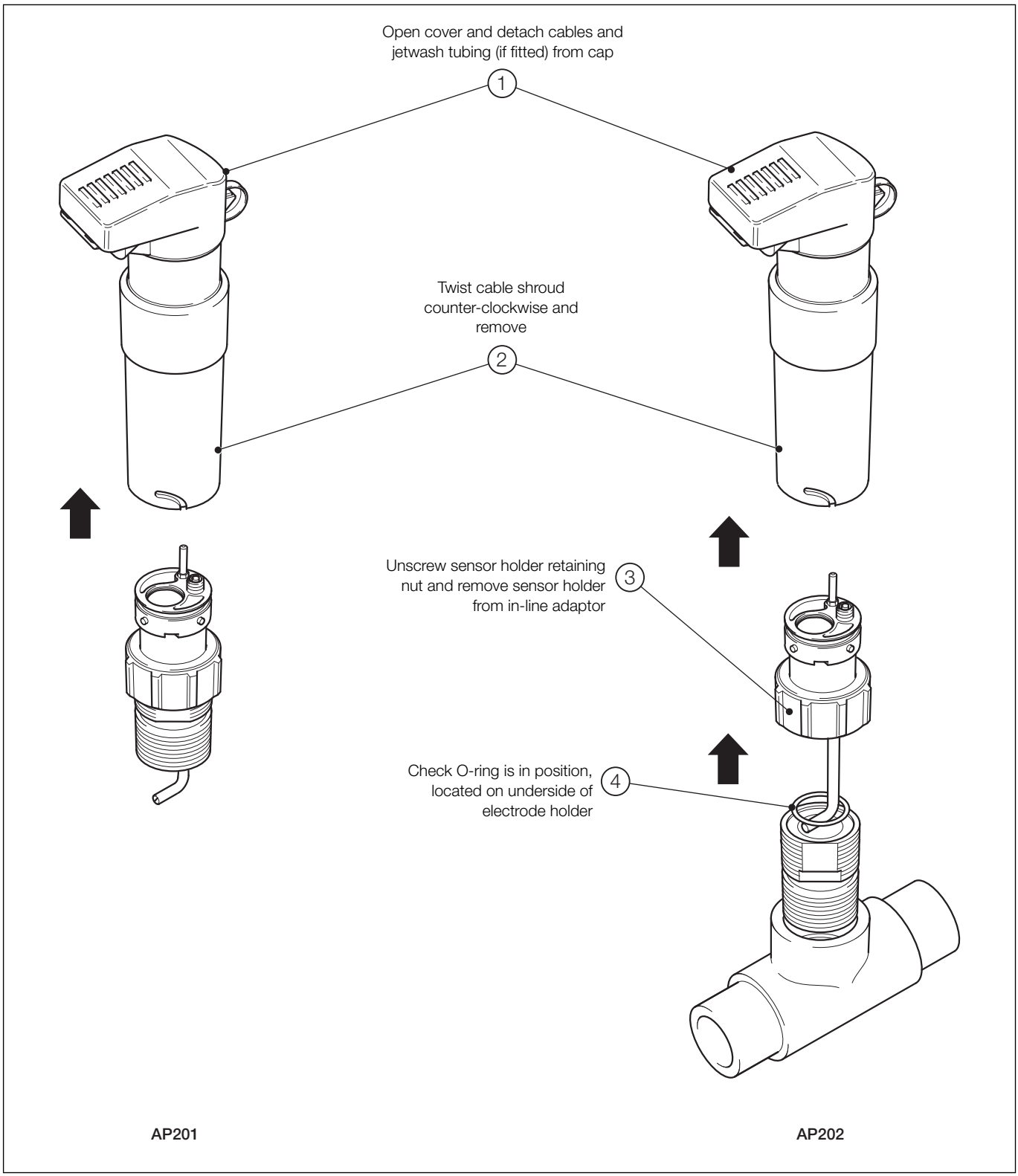


Fig. 2.4 Models AP201 and AP202 – Removing the Sensor Holder

2.2.2 Model AP203 Flanged DIp (Immersion) System

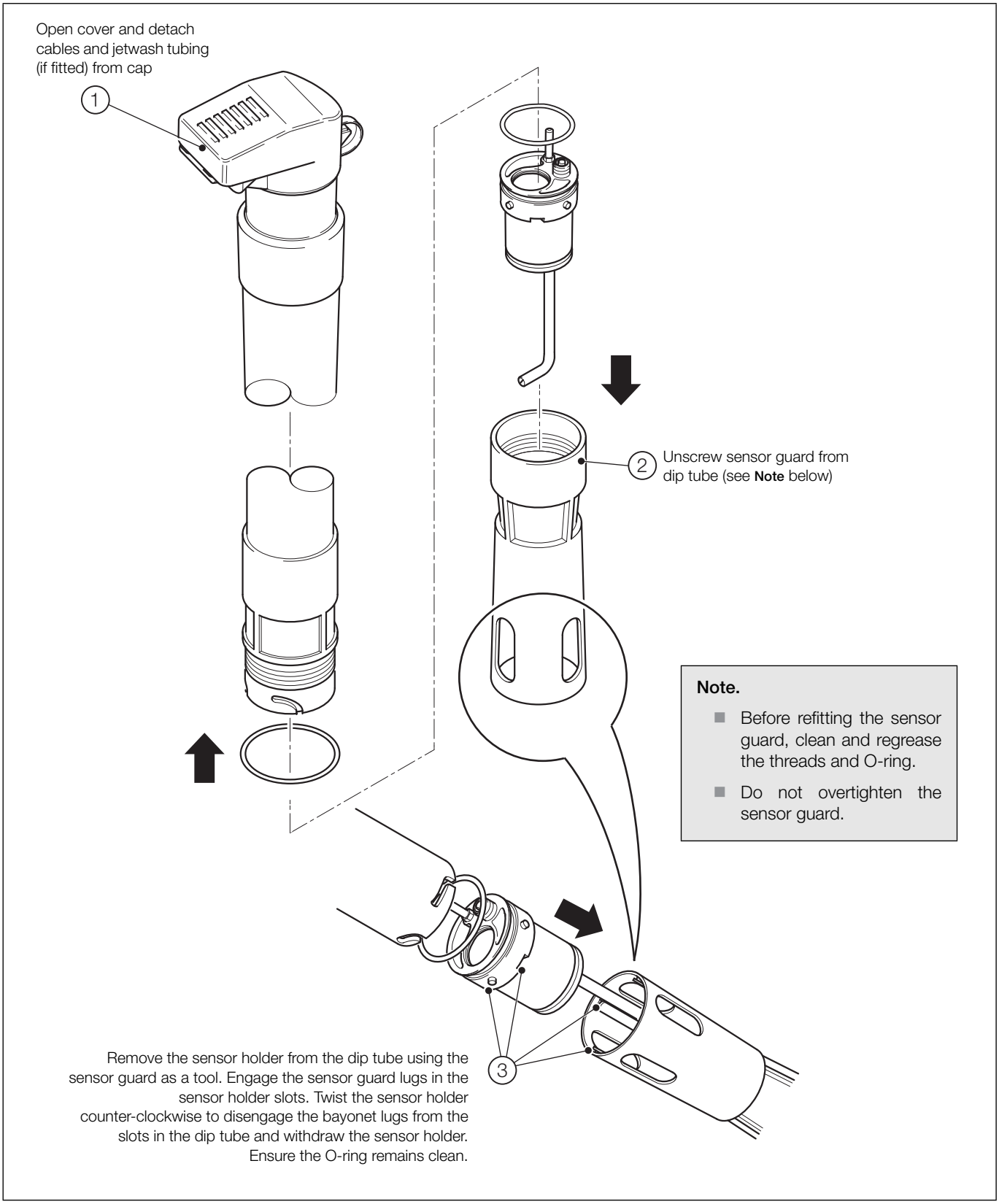


Fig. 2.5 Model AP203 – Removing the Sensor Holder

2.3 System Assembly

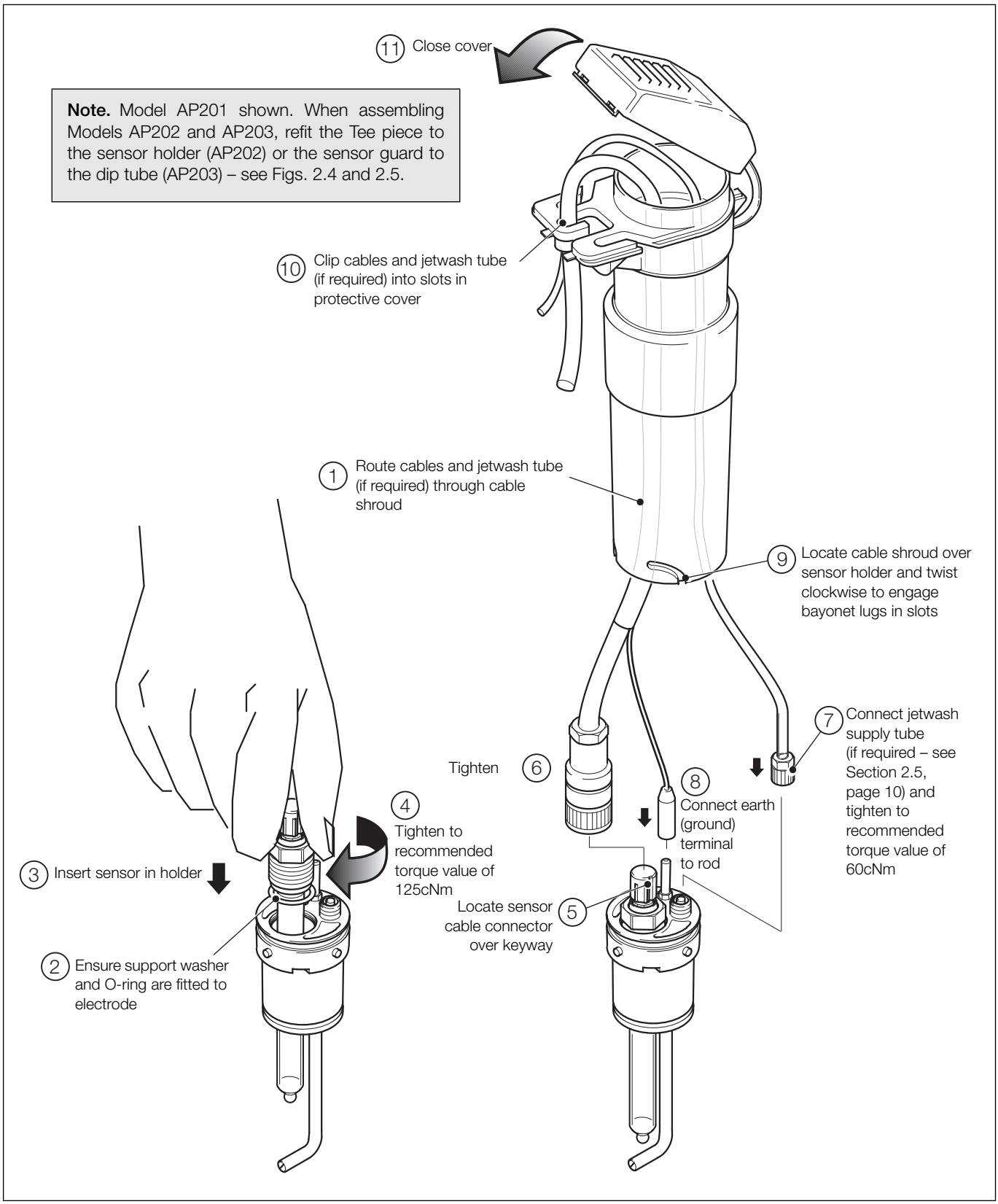


Fig. 2.6 System Assembly

2.4 Jetwash System

Note. Installation must be carried out in accordance with local water company and council bylaws.

The jetwash system enables automatic cleaning of both the measuring element and the reference junction by spraying either water or a cleaning solution at them in situ, thus reducing system maintenance requirements.

An external pump or solenoid valve is required, controlled by a pH analyzer with auto-cleaning control functions.

Note. For optimal performance, the pressure of the jetwash system should be 2 to 3 bar (30 to 45 psi) greater than the process pressure.

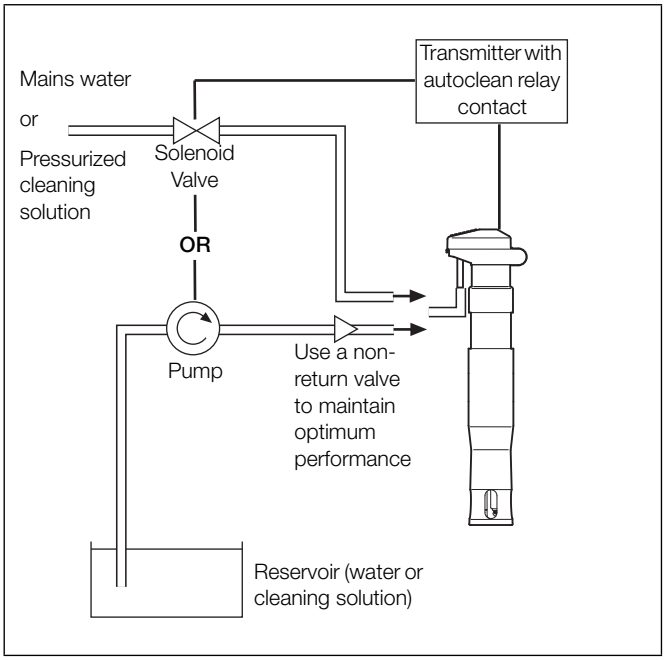


Fig. 2.7 Typical Jetwash Installation

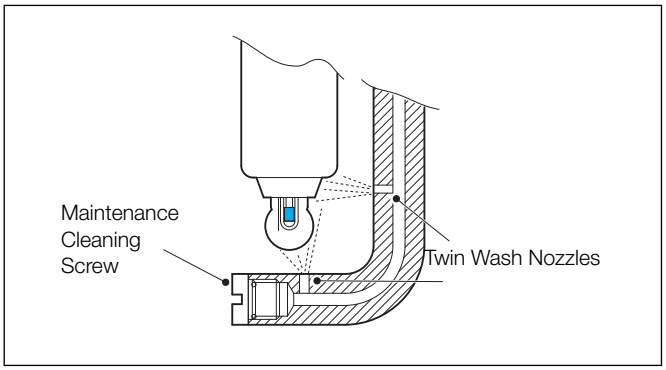


Fig. 2.8 Location of Jetwash Nozzle

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	1M nitric acid
Metal hydroxides	1M sulphuric or nitric acid
Cyanides	
Heavy biological	
Proteins	Mixture of 1M sulphuric or nitric acid and pepsin (saturated)
Fibres	Pressurized water with or without wetting agents
Light biological	Pressurized water
Latex (see **Note** below)	Pressurized cold water

Note. If removed from the process the latex must be completely removed quickly before it hardens.

2.5 Jetwash System Assembly

The system is supplied with a blanking plug fitted to the jetwash tubing connector. If the jetwash system is to be used, remove the plug and fit the jetwash supply tube as shown in Fig. 2.9.

Note. Recommended tubing is 6mm OD semi-rigid polyethylene tube (part no. 0212035).

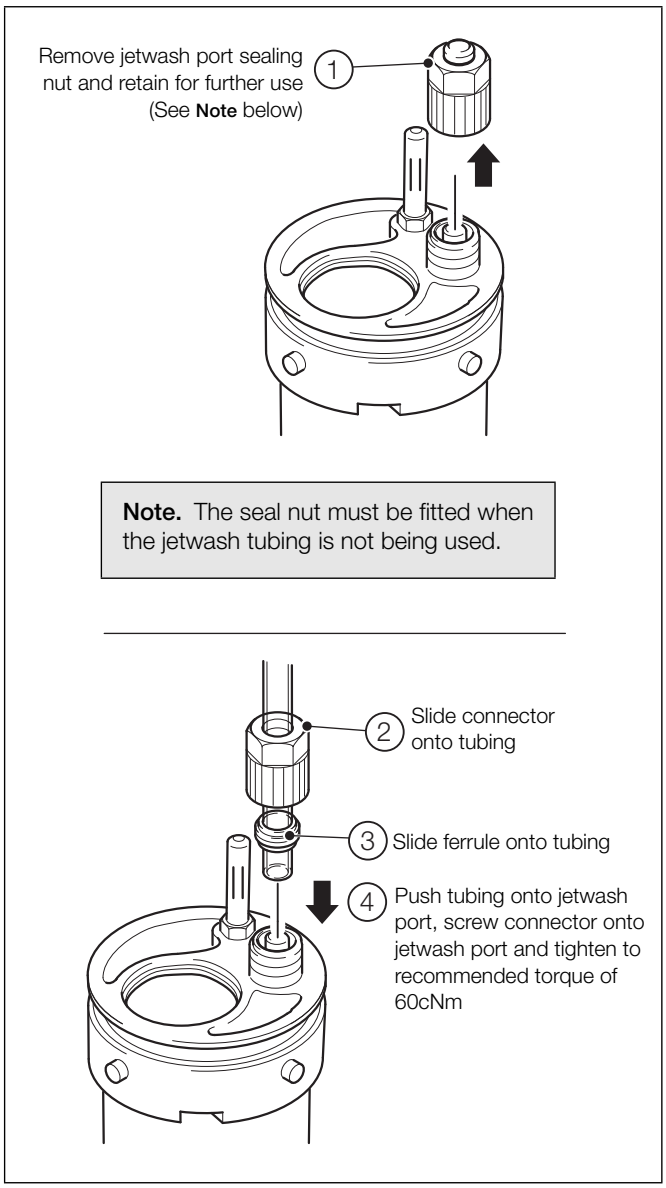


Fig. 2.9 Fitting Jetwash Supply Tubing

3 Electrical Installation

3.1 Analyzer Connections

System cable connections are identified in Fig. 3.1 to enable connection to the appropriate terminal on the analyzer.

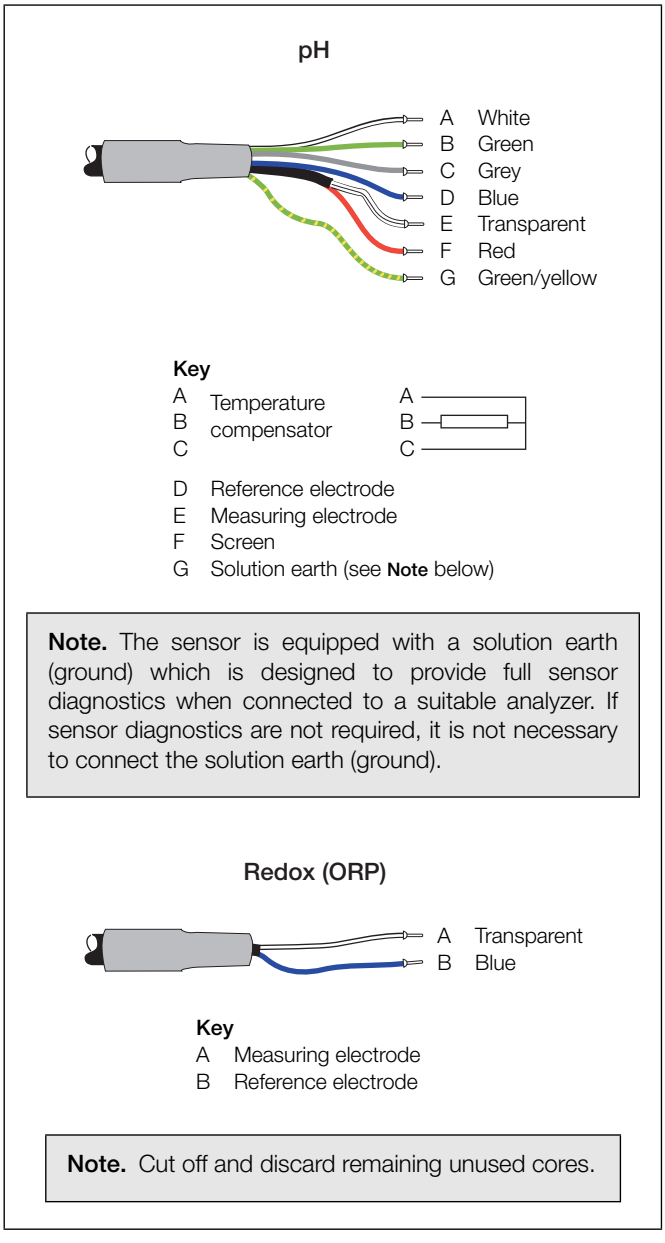


Fig. 3.1 Cable Termination

3.2 Shortening the Connection Cable

The connection cable is supplied in various standard lengths. If it is necessary to shorten the cable, prepare the cable ends as shown in Fig. 3.2.

The cable comprises:

1. an outer insulating layer
2. an inner braided shield
3. a shielded coaxial core
4. four insulated wires

Note. Do not allow the shielding to contact any other bare wires.

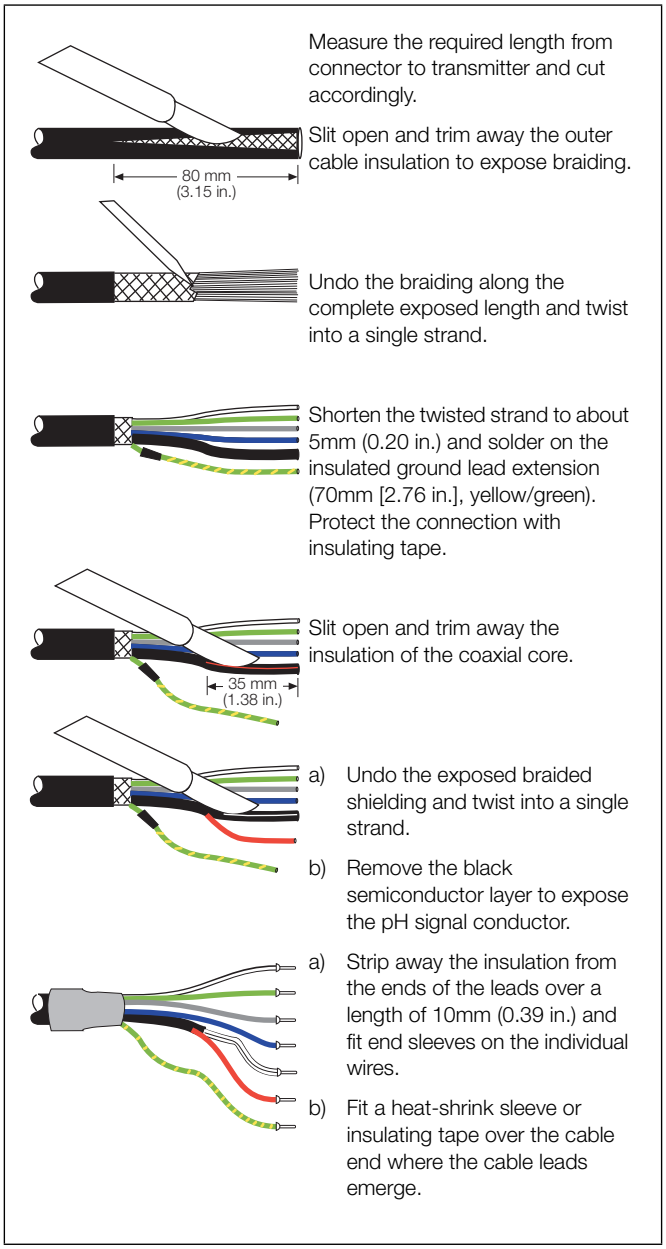


Fig. 3.2 Shortening the Connection Cable

3.3 Extending the Connection Cable

If it is necessary to extend the cable, a suitable junction box and the correct length of 6-core cable are required. Connect the junction box as shown in Fig. 3.3.

Note.

- Junction box (part no. 7690/049) is recommended.
- 6-core cable, part no, 7690054/XX (where XX is the cable length, from 5 to 50 meters, in 5 meter increments) is recommended.
- Cable 7690054 is identical to that fitted to the sensor. See Fig. 3.2 for cable end preparation instructions.

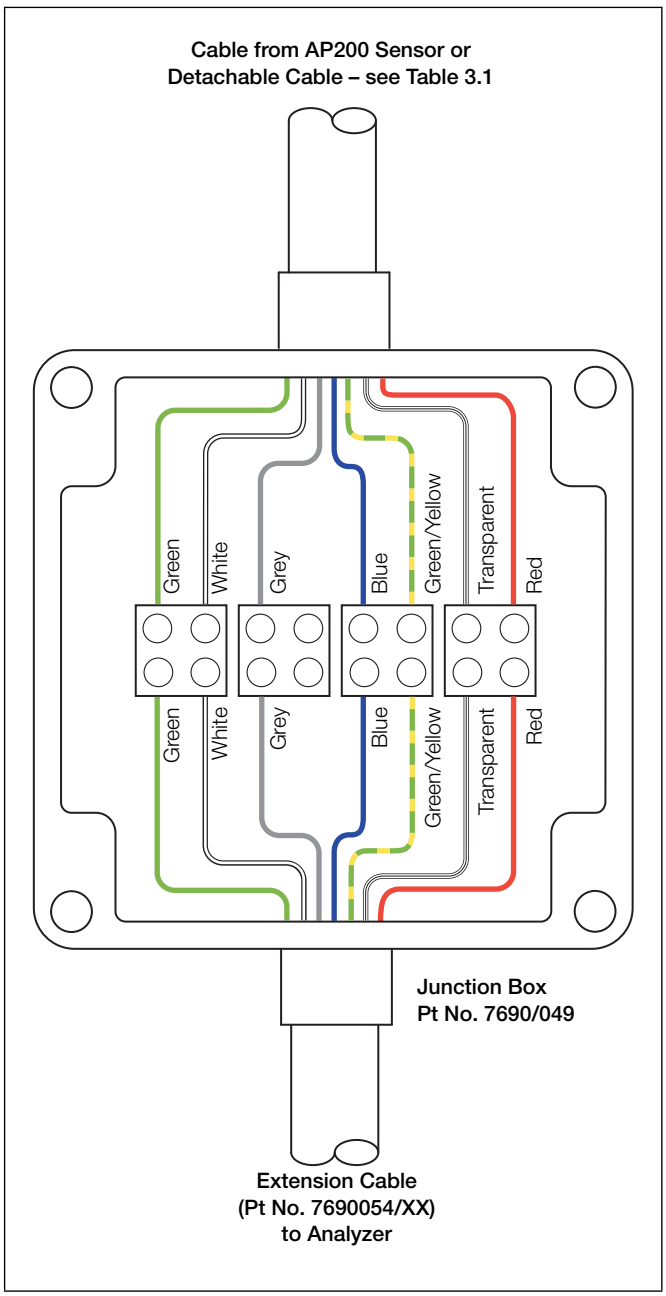


Fig. 3.3 Extending the Connection Cable

Cable Length	Part Number
5 m (16 ft)	7690050
10 m (33 ft)	7690051
15 m (49 ft)	7690052
20 m (60 ft)	7690053

Table 3.1 Detachable Cables

3.4 Jetwash System Connections

The electrical supply to the jetwash system pump or solenoid valve is connected to the analyzer relay used for automatic cleaning – see Fig. 3.4. The analyzer controls the frequency of the wash sequence and the duration for which the cleaning solution flows.

The analyzer outputs are held during a cleaning sequence.

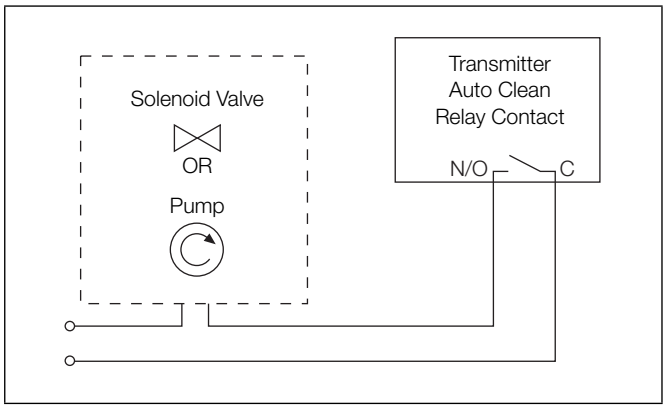


Fig. 3.4 Electrical Connections for Jetwash Systems

4 Calibration

4.1 Method

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

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

   or

2. 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 demineralized water.
3. Proceed as described in the paragraph above.

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

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

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

Warning. Close all isolating valves before removing an electrode from a flow line.

4.2 Buffer Solutions

Recommended buffer solutions are shown in Table 4.1.

Buffer Solution	Part No.
4pH 0.05M potassium hydrogen phthalate	0400 110
7pH Disodium hydrogen phosphate/monopotassium dihydrogen phosphate mix	0400 120
9pH 0.05M borax	0400 130

Table 4.1 Recommended Buffer Solutions

Note.

- Ensure that the visible surface of the electrode has been cleaned using demineralized water.
- When moving from one buffer solution to the next, wash the electrode using demineralized water and dry it carefully using a soft tissue.

Table 4.2 shows the change in pH value that occurs with a change in the temperature of the recommended 4, 7, and 9 pH buffer solutions.

°C / pH	0	10	20	25	30	40	50	60	70	80	90
4	4.00	4.00	4.00	4.01	4.01	4.03	4.05	4.08	4.12	4.16	4.21
7	7.11	7.06	7.01	7.00	6.98	6.97	6.97	6.97	6.99	7.03	7.08
9	9.48	9.35	9.23	9.18	9.13	9.05	8.98	8.93	8.90	8.88	8.84

Table 4.2 Buffer pH Value / Temperature (°C)

4.3 Redox (ORP Sensor)

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

For sensors that are connected to analyzers 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 gram (heaped spatula) of analar quinhydrone to 100 ml (3.5 Flu oz.) 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 following:

pH Buffer	mV
4	+259
7	+82

5 Maintenance

5.1 General Cleaning

Warning. Close all isolating valves before removing an electrode from a flow line.

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

Automatic cleaning using the optional jetwash system and controlling the cleaning solution using a suitable controller or analyzer, will reduce the amount of manual cleaning.

Methods of removing various types of deposit are detailed below. Replace the sensor if the performance of the sensor 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 with demineralized water before calibrating.

5.1.3 Greasy or Organic Deposits

Wipe the glass membrane with a detergent or acetone-based solvent. Rinse with demineralized 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 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. Sensor incorrectly connected – see Section 3.1, page 11 and the analyzer user guide for connection details.
2. Glass sensor membrane broken or cracked – replace sensor.

Unstable readings or drift

1. Sensor incorrectly connected – see Section 3.1, page 11 and the analyzer user guide for connection details.
2. Dry or dirty reference junction – clean junction as detailed in Section 5.1. Leave to soak in a buffer solution for several hours.

Replace sensor if no improvement is seen.

Stable but incorrect readings

1. Incorrect calibration – recalibrate using fresh buffer solutions.
2. Incorrect temperature compensation settings – enter correct manual temperature or check that automatic temperature compensation is reading correctly.
3. Sensor responds correctly to pH changes, but there is an offset of <1.0 pH and >0.2 pH – perform a one-point process calibration – see Section 4.1, page 13.

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

5.3 Storing the Electrode

Note. Allowing the glass membrane and reference junction to dry out irreversibly affects 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 Specification

All Systems

Materials

Shaft and cap	Polypropylene
Sensor body	Ryton™ PPS
Ground rod/Spray tube	316 Stainless steel

Jet-wash facility

Non-return function	Integral one-way valve
Spray tube connection	6mm compression fitting
Recommended operating pressure	Min. 1 bar (15 psi) over process pressure

Certification

The systems comply with SEP (Safe Engineering Practice) level Pressure Equipment Directive 97123/EC

AP201 Insertion System

Maximum Temperature

130 °C (266 °F)	PPS and steel adapters
90 °C (194 °F)	Polypropylene adapter

Maximum Pressure

6 bar (90 psi) @ 25ºC (77ºF)

Process Connections

Union nutG	1¼ in. (BSP)
PPS process adapter	R1¼ in. (tapered BSP male)
PP process adapters	R1¼ in. 1¼ in. NPT
Stainless steel adapters	R1 in. (tapered BSP male) 1 in. NPT
Stainless steel sockets	Angled DN25 Straight DN25

AP202 Flow-through System

Materials

Flow-cells	Polypropylene Stainless steel

Maximum Temperature

90 °C (194 °F)	Polypropylene flow cell
130 °C (266 °F)	Stainless steel flow cell

Maximum Pressure

6 bar (90 psi) @ 25ºC (77ºF)

Process Connections

Union nut	G1¼ in. (BSP)
Flow-cell inlet & outlet	Rp1 in. (BSP female) or 1 in. NPT

AP203 Immersion (Dip) System

Materials

Guard, shaft and cap	Polypropylene

Maximum Temperature

90 °C (194 °F)

Maximum Pressure

Not applicable

Process Connections

Sliding flange	Composite DIN & ANSI DN50 / ANSI 2 in.
Immersion lengths	1 m (3.3 ft) 2 m (6.6 ft) 3 m (10 ft)

AP120 Combination Sensor

Measuring Ranges

AP121/0 General Process 0 to 14 pH 0 to +100 °C (32 to 212 °F)
AP121/1 High Temp/Alkali 0 to 14 pH 10 to 130 °C (50 to 266 °F)
AP121/2 Low Resistance 0 to 10 pH –5 to 50 °C (23 to 122 °F)
AP121/6 Pt Redox (ORP) ± 2000mV 0 to 130 °C (32 to 266 °F)

Reference Electrode System

Primary Electrolyte	Solid, Ag-free Gel with KCl charge
Inner reference system	Ag/AgCl
JunctionAnnular	PTFE, sterilizable
Nominal zero point, E_0	7 pH
Minimum Conductivity	> 50 µS/cm

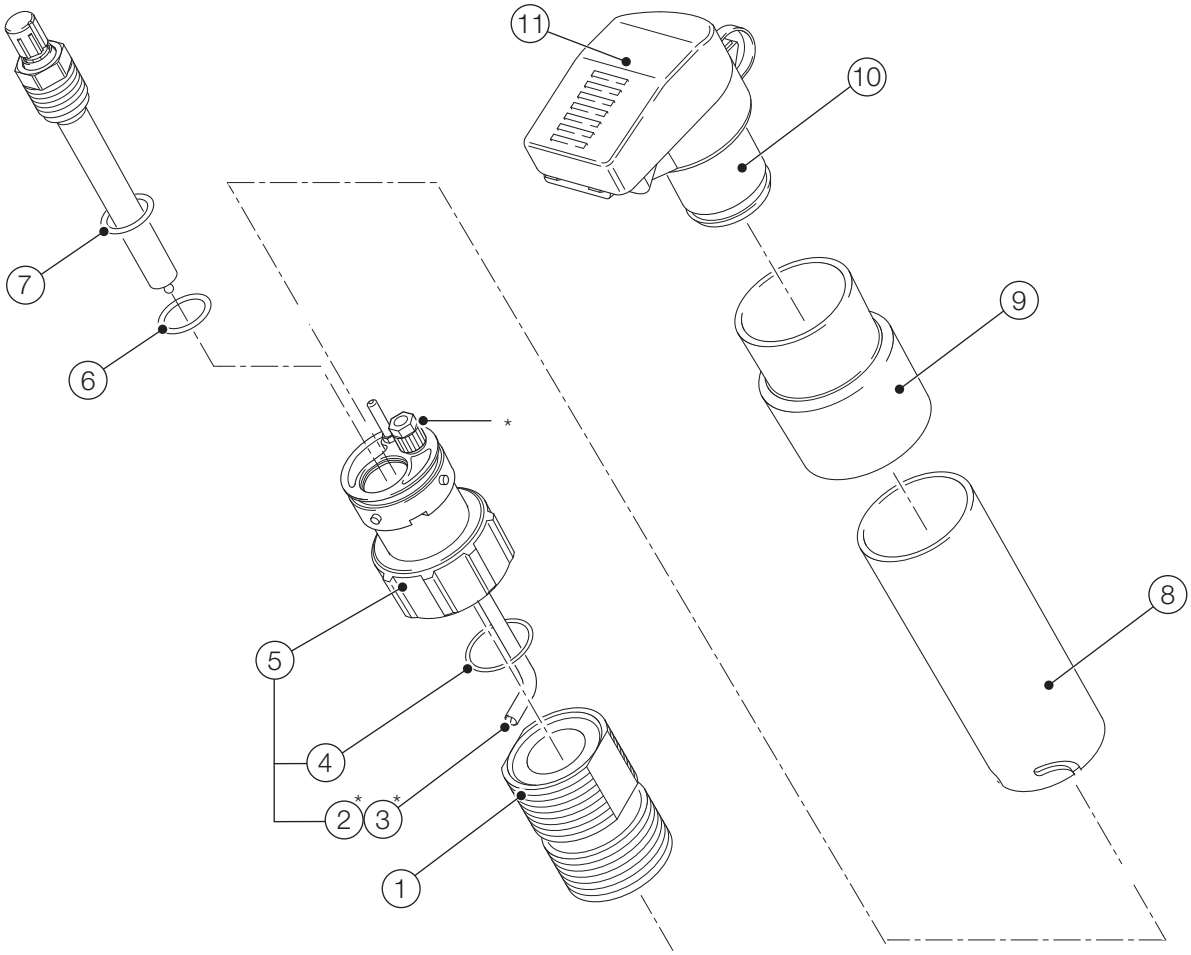
General Data

Temperature Sensor	(pH only) Integral Pt100
Temperature response	T_{90} <70s
Electrode Shaft Length	120 mm
Max. Pressure	6 bar (90 psi)
Ingress Protection	IP67/NEMA 6P (exceeds NEMA4X)
Connection head	Sterilizable VP (VarioPin) connector with PG13.5 thread

DS/AP200–EN Rev. I

7 Spares

7.1 Model AP201 Insertion System



* Fitted on water wash option only

Fig. 7.1 Model AP201 Insertion System Spares

Item	Part No.	Description	Qty
①	7690130	$1^{1}/_{4}$ in. BSP Adaptor	1
⑤**	7690043	Sensor Holder (non water wash only)	1
	or	or	
	7690041	Sensor Holder (water wash only)	
⑧	7690160	Cable Shroud	1
⑨	7690218	Protective Cover Adaptor Sleeve	1
⑩	7690140	Protective Cover	1
⑪	7690145	Protective Lid	1

** Comprises items ②, ③ and ④

Item	Part No.	Description	Qty
—	7690040	Service Pack Comprising:	
②*		Cleaning Screw (water wash only)	1
③*		O-Ring 3 mm ID x 1.5 mm CH Viton (water wash only)	2
			2
④		O-Ring $1^{1}/_{16}$ in. ID x 0.103 in. CH Viton	2
⑥		O-Ring 11.6 mm ID x 2.4 mm CH Viton	2
⑦		O-Ring Support Washer	
The following are also supplied in the Service Pack but not used on the AP201 Insertion System:			
		O-Ring 37.77 mm ID x 2.62 mm CH Viton	2
		O-Ring 46 mm ID x 2 mm CH Viton	2

* Fitted on water wash option only

7.2 Model AP202 Inline System

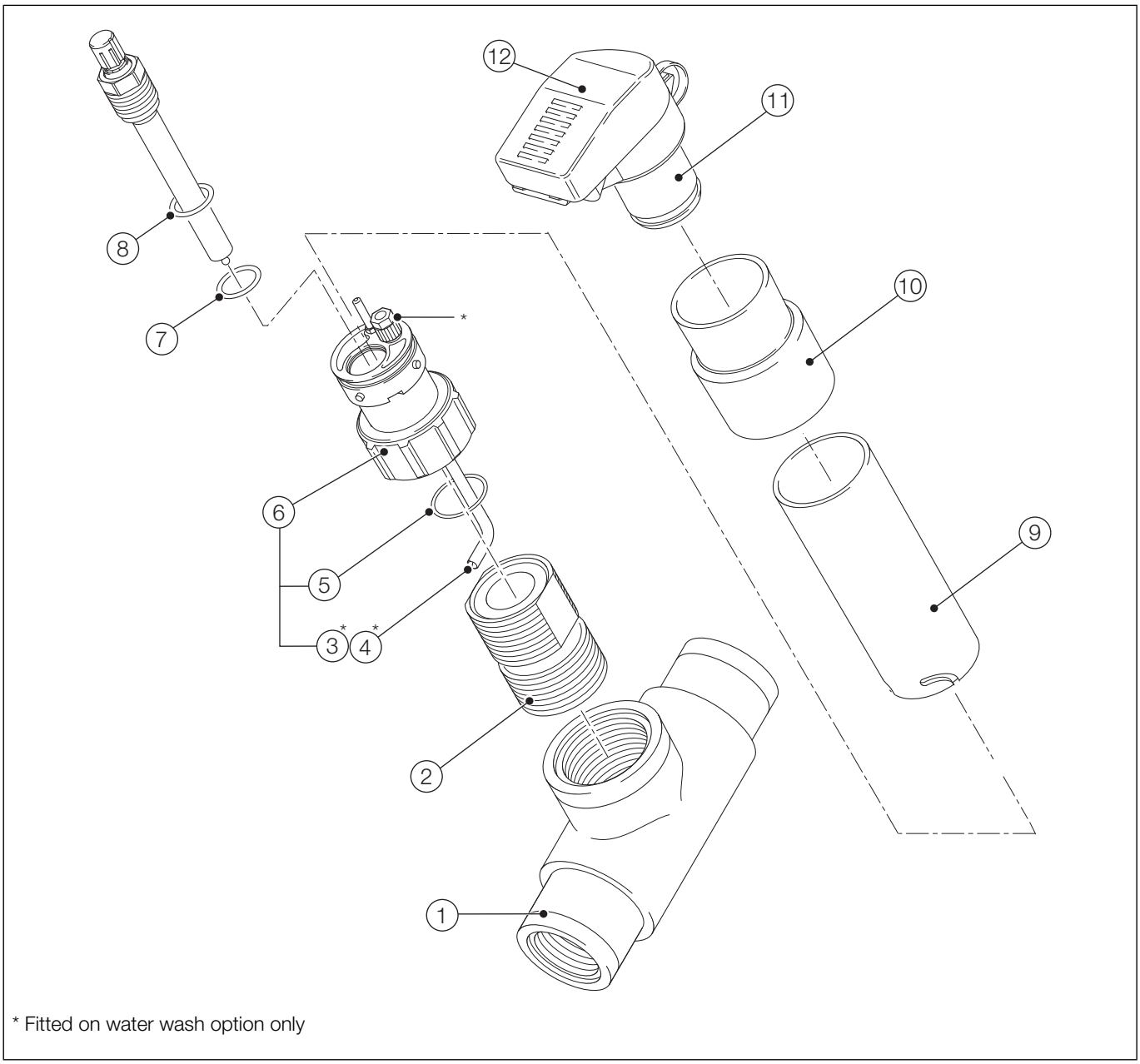


Fig. 7.2 Model AP202 Inline System Spares

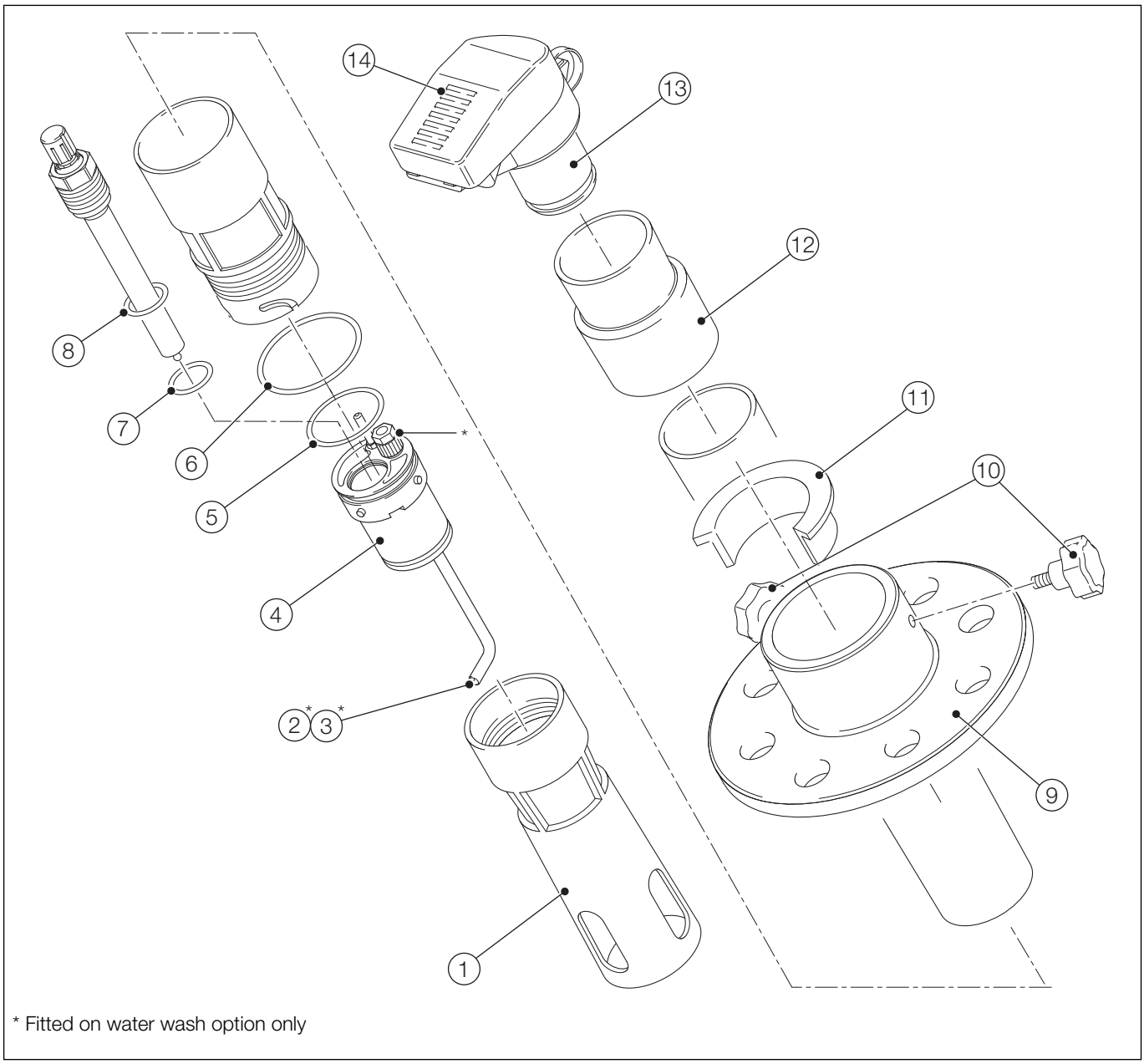
Item	Part No.	Description	Qty
①	7690150	Tee-piece	1
②	7690130	$1^{1}/_{4}$ in. BSP Adaptor	1
⑥**	7690043	Sensor Holder (non water wash only)	1
	or	or	
	7690041	Sensor Holder (water wash only)	
⑨	7690160	Cable Shroud	1
⑩	7690218	Protective Cover Adaptor Sleeve	1
⑪	7690140	Protective Cover	1
⑫	7690145	Protective Lid	1

** Comprises items ③, ④ and ⑤

Item	Part No.	Description	Qty
—	7690040	Service Pack Comprising:	
③*		Cleaning Screw (water wash only)	1
④*		O-Ring 3 mm ID x 1.5 mm CH Viton (water wash only)	2
⑤		O-Ring $1^{1}/_{16}$ in. ID x 0.103 in. CH Viton	2
⑦		O-Ring 11.6 mm ID x 2.4 mm CH Viton	2
⑧		O-Ring Support Washer	2
The following are also supplied in the Service Pack but not used on the AP202 Inline System:			
		O-Ring 37.77 mm ID x 2.62 mm CH Viton	2
		O-Ring 46 mm ID x 2 mm CH Viton	2

* Fitted on water wash option only

7.3 Model AP203 Flanged Dip (Immersion) System



* Fitted on water wash option only

Fig. 7.3 Model AP203 Flanged Immersion (Dip) System Spares

Item	Part No.	Description	Qty
①	7690210	Protective Skirt	1
④	7690042	Sensor Holder	1
⑨	7690212	Non-Seal Flange	1
⑩	7690044	Scalloped Knob spare M5 x 15 mm (pack of 2)	1
⑪	7690213	Ind Dip Flange Insert	1
⑫	7690218	Protective Cover Adaptor Sleeve	1
⑬	7690140	Protective Cover	1
⑭	7690145	Protective Lid	1

Item	Part No.	Description	Qty
—	7690040	Service Pack Comprising:	
②*		Cleaning Screw (water wash only)	1
③*		O-Ring 3 mm ID x 1.5 mm CH Viton (water wash only)	2
⑤		O-Ring 37.77 mm ID x 2.62 mm CH Viton	2
⑥		O-Ring 46 mm ID x 2 mm CH Viton	2
⑦		O-Ring 11.6 mm ID x 2.4 mm CH Viton	2
⑧		O-Ring Support Washer	2
The following is also supplied in the Service Pack but not used on the AP203 Flanged Immersion (Dip) System:			
		O-Ring $1^{1}/_{16}$ in. ID x 0.103 in. CH Viton	2

* Fitted on water wash option only

Notes

Notes

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:

- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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Service

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