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# Instruction Manual

Model PH20 & FU20  
pH/ORP Combination sensor

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## 1. GENERAL

### 1-1. INTRODUCTION

This instruction manual provides information for the installation and use of the FU20 and PH20, four-in-one wide body pH sensors. While both sensors can be used in a variety of applications, in general, the FU20 is the choice for the majority of typical wastewater and process applications. The PH20 with its patented "compensation panels", is selected when more aggressive chemicals (PVDF body) or varying process temperatures and pressures are present.

The Model **PH20** is patented design, provides continuous compensation for temperature and pressure changes in the process resulting in an extremely accurate and stable measurement. With this one sensor, pH, redox (ORP) and temperature can be measured simultaneously. The PH20 can be easily installed using a variety of adapters in Stainless Steel or PVDF. You can choose from a common 3/4" or 1" NPT threaded connection or select the optional (/SF4) stainless adapter that allows the use of Yokogawa's FF40, FS40 or FD40 sensor holders.

The Model **FU20** offers a simple and cost effective solution for a wide variety of wastewater and process applications. This all-in-one sensor provides simultaneous measurement of pH, redox (ORP) and temperature if desired. The rugged Ryton body is designed for easy installation into on-line and immersion applications via the 3/4" NPT threaded connections provided on both ends of the sensor. Optional quick-removal adapters in both stainless steel and titanium are available to make calibration and maintenance even easier.

Both the PH20 and FU20 include an integral cable of optional lengths designed to minimize the adverse affects of noise can have on the measurement. This cable is pre-finished to make connection to any industrial pH instrument as simple as possible.

### 1-2. Unpacking and Checking

Upon delivery, unpack the sensor carefully and inspect it to ensure it was not damaged during shipment. If damage is found, retain

the original packing materials (including outer box) and then immediately notify the carrier and the relevant Yokogawa sales office. Make sure the Model Code on the sensor is the same as on the packing list. Also, check any option(s) that were ordered are included and correct. The PH20 sensor has an identification number on the cable with the full Model Code and a Serial Number included

### 1-3. Warranty and Service

Yokogawa products and parts are guaranteed free from defects in workmanship and material under normal use and service for a period of (typically) 12 months from the date of shipment from the manufacturer. Individual sales organizations can deviate from the typical warranty period, and the conditions of sale relating to the original purchase order should be consulted. Damage caused by wear and tear, inadequate maintenance, corrosion, or by the effects of chemical processes are excluded from this warranty coverage. In the event of warranty claim, the defective goods should be sent (freight paid) to the Service Department of the relevant sales Organization for repair or replacement (at Yokogawa's discretion). The following information must be included in the letter accompanying the returned goods:

1. Part Number, Model Code and Serial Number.
2. Original Purchase Order and Date.
3. Length of time in service and description of the process.
4. Description of the fault and circumstances of the failure.
5. Process/environmental conditions that may be related to the failure of the sensor
6. Statement as to whether warranty or non-warranty service is requested.
7. Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person that can be reached for further information.

Returned goods that have been in contact with process fluids must be decontaminated and disinfected prior to shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material Safety Data sheets must be included for all components of the process to which the sensors/fittings have been exposed.

## 2. GENERAL SPECIFICATIONS PH20

<b>2-1. Measuring elements</b>	: pH glass electrode
	: Silver chloride reference
	: Solid platinum electrode
	: Pt1000 temperature sensor.

### 2-2. Construction materials

Body	: PVDF
Earthing pin	: Solid Platinum
O-ring	: Viton
Reference junction	: Porous PTFE
Cable	: Coaxial with 4 extra leads

### 2-3. Functional specifications (at 25°C)

Isothermal point	: pH 7
Glass impedance	: 200 M $\Omega$ (nominal)
Reference system	: Ag/AgCl with saturated KCl
Junction resistance	: 1 to 10 k $\Omega$
Temperature element	: Pt1000 to IEC 751
Asymmetry potential	: < 15 mV
Slope	: > 96 % (of theoretical value)

#### NOTE:

The temperature sensor included in the PH20 is intended to provide indication and cell compensation. The construction has not been tested to the pressure vessel standards required for plant temperature control.

### 2-4. Dynamic specifications

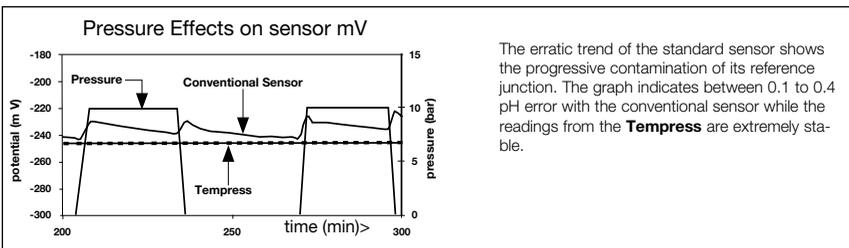
Response time pH step (7 to 4)	: < 10 sec for 90%
Response time temp step (10°C)	: < 3 min for 90 %
Stabilisation time (0.02 pH unit/ 10 s)	: < 1 minute

### 2-5. Operating range

pH	: 0 to 14
Temperature	: -10 to 100 °C (14 to 212 °F)
Pressure	: 0 to 10 bar ( 0 to 145 PSIG)
Conductivity	: > 50 $\mu$ S/cm
Storage temperature	: -30 to 50 °C (-22 to 122 °F)

#### NOTE:

Specifications should not be considered in isolation. For example the pH range can be 2-12 pH, where the measurement is at elevated temperatures. For advice about specific applications please contact your local sales office.



### 3. INSTALLATION OF PH20

For optimum measurement results, the PH20 should be installed in a location that offers an acceptable representation of the process composition and **DOES NOT** exceed the specifications of the sensor. The PH20 is designed with threads on either end of the body to allow installation via a selection of adapters, in a wide variety of applications.

#### 3-1. Typical Installation

The PH20 sensor is designed for in-line installation, via a bypass loop as an immersion assembly. For best results the PH20 should be mounted with the process coming towards the sensor (see Fig 1) and positioned at least 15° above the horizontal plane to eliminate air bubbles in the glass bulb.

#### 3-2. Preparing the Sensor for Use

Remove the sensor from its shipping box and slide off the "wet pocket" (the tube filled with solution to keep the measuring elements from drying out in storage or shipment).

Two sets of O-rings are provided with the sensor, a Viton set and an EPDM set. The wet pocket is sealed on the sensor with (2) Viton O-rings (K1511DP is 5 sets of 2 each Viton O-rings). An EPDM set is supplied in a plastic bag as an alternative (K1511DQ is 5 sets of 2 each EPDM O-rings).

#### IMPORTANT NOTICE

Before installing the sensor in the process it should be calibrated. The calibration procedure is normally described in the instrument Instruction Manual, but a general Guide is provided in Section 7.

#### 3-3. Mounting the Sensor

Apply Teflon (PTFE) tape to the threaded end of the appropriate adapter (step 2). Then install the selected adapter (/FN4, /FR4, /SNE, /SR3) in the process, tightening it by applying a suitable torque using a spanner on the adapter flats see Steps 1 & 3).

Next, screw the PH20 sensor into the adapter making sure that there are (2) O-rings mounted in the correct grooves (step 4). These O-rings form a seal on the straight section inside the adapter. This means that

the sensor needs only to be hand tightened, (until the O-rings are completely covered) for the seal to be completed (step 5).

#### NOTE 1:

DO NOT over tighten the sensor, as damage may result.

#### NOTE 2:

Installing the PH20, requires approximately seven turns. Take care, to leave enough slack so that the cable is not twisted and damaged.

If you are using one of the FF40, FS40 or FD40 holders, simply screw the adapter (/SF4) on the sensor body at the cable end ensuring the O-rings are correctly installed. See Section 6 for instructions to wire the sensor to the instrument.

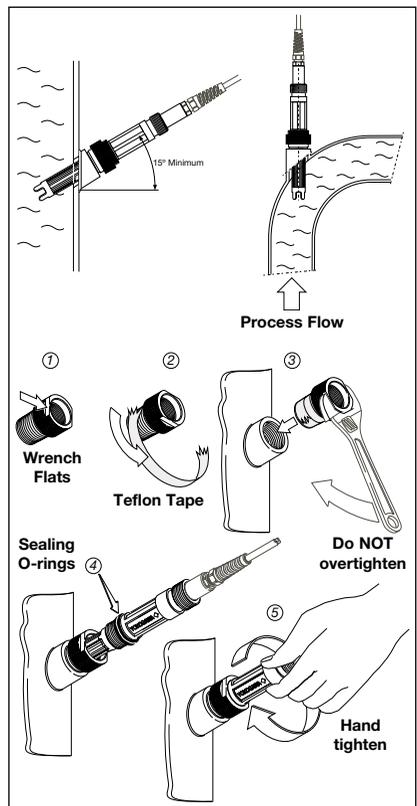
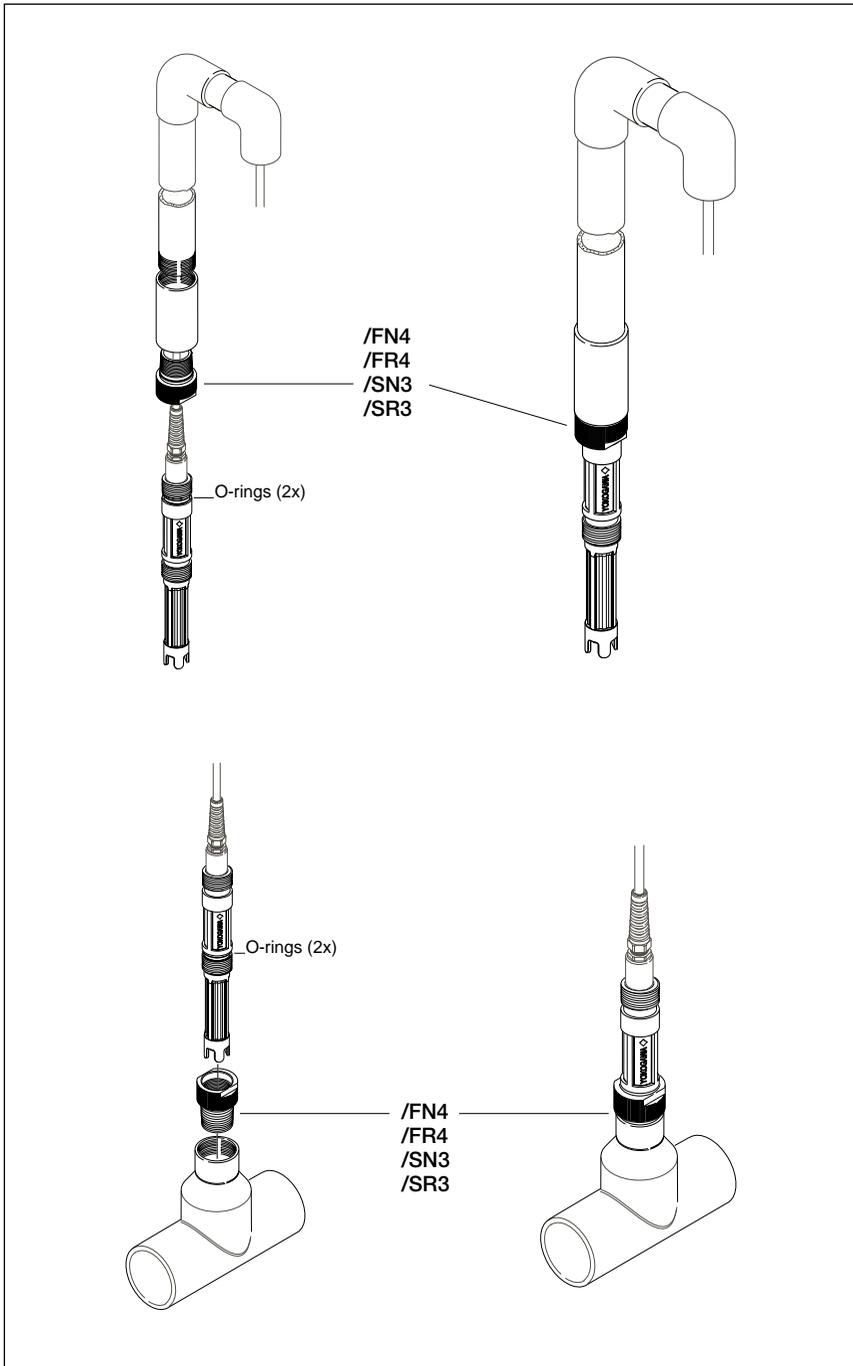


Figure 1. Sensor Installation



**Figure 2. Adapters for the PH20**

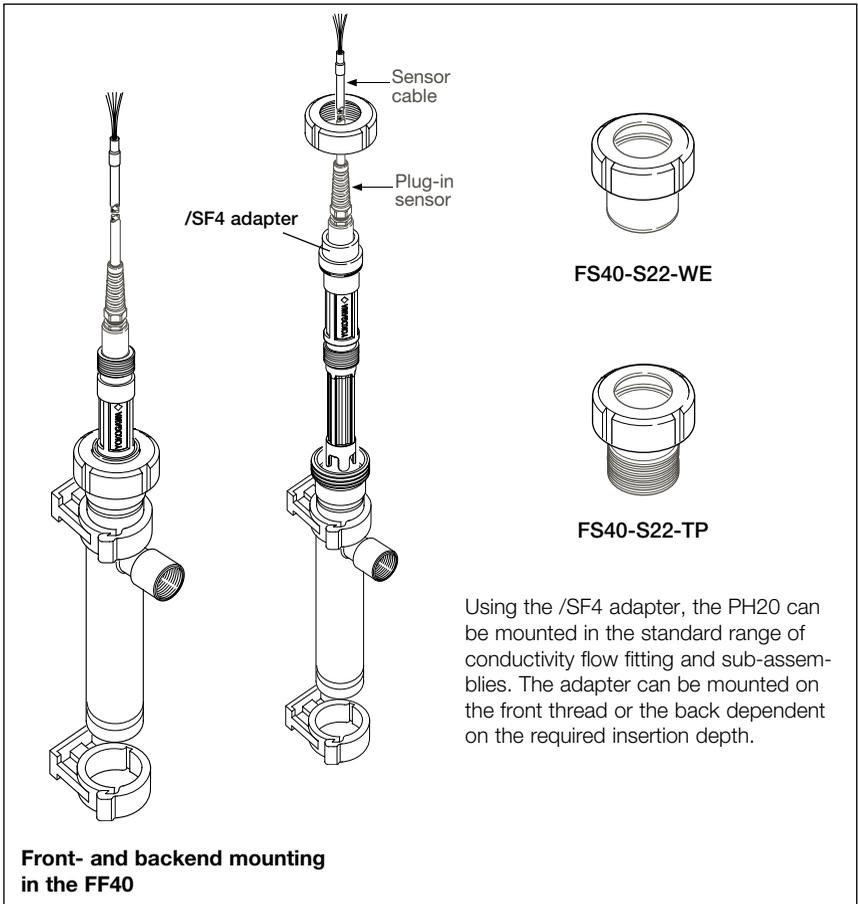


Figure 3. Installation Examples using the /SF4 adapter

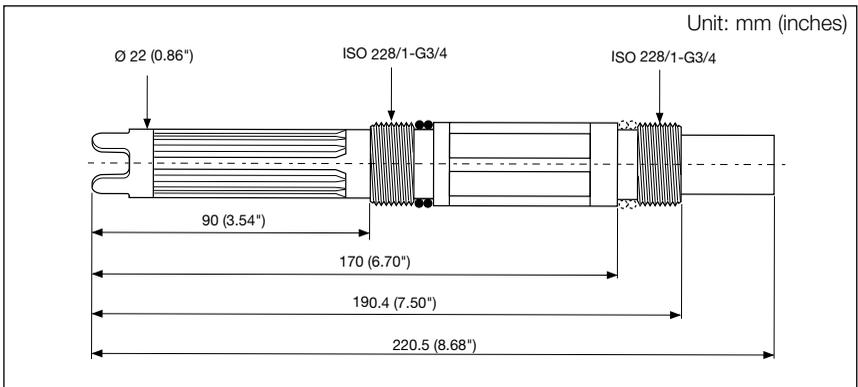
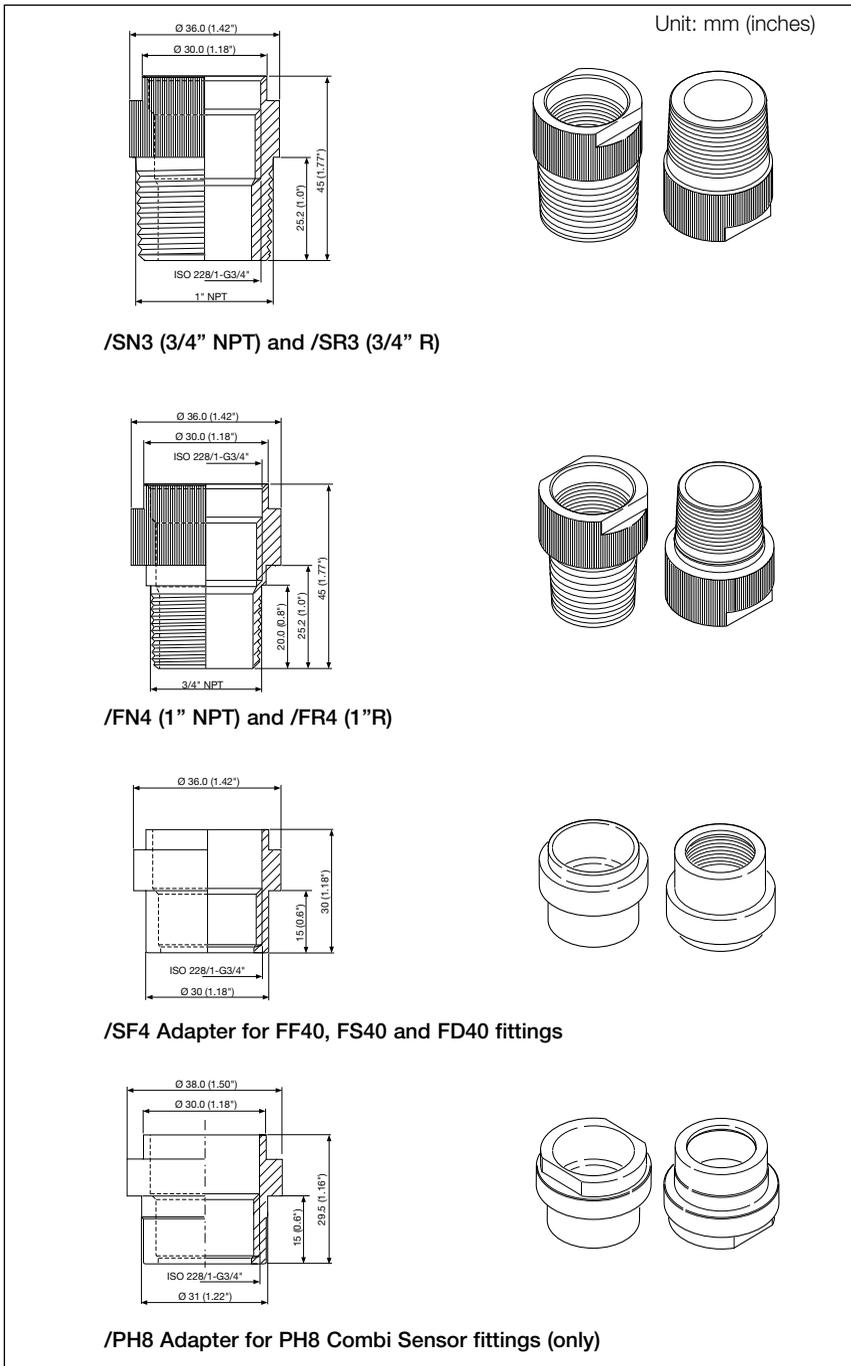


Figure 4. Dimensions of the sensor



**Figure 5. Dimensions of the adapters**

## 4. GENERAL SPECIFICATIONS FU20

<b>4-1. Measuring elements</b>	: pH glass electrode
	: Silver chloride reference
	: Solid platinum electrode
	: Pt1000 temperature sensor.
<b>4-2. Construction materials</b>	
Body	: PPS 40GF (Ryton) with glass filling
Earthing pin	: Solid Platinum
O-ring	: None
Reference junction	: Porous PTFE
Cable	: Coaxial with 4 extra leads
<b>4-3. Functional specifications (at 25°C)</b>	
Isothermal point	: pH 7
Glass impedance	
- Dome shape	: 250 to 500 M $\Omega$
- Flat Surface	: 400 to 1000 M $\Omega$
Reference system	: Ag/AgCl with saturated KCl
Junction resistance	: 0.5 to 5 k $\Omega$
Temperature element	: Pt1000 to IEC 751
Asymmetry potential	: < 15 mV
Slope	: > 96 % (of theoretical value)

### NOTE:

*The temperature sensor included in the FU20 is intended to provide indication and cell compensation. The construction has not been tested to the pressure vessel standards required for plant temperature control.*

### 4-4. Dynamic specifications

Response time pH step (7 to 4)	: < 15 sec for 90%
Response time temp step (10°C)	
- Dome shape	: < 3 min for 90%
- Flat Surface	: < 6 min for 90%
Stabilisation time (0.02 pH unit/ 10 s)	: < 2 minutes

### 4-5. Operating range

pH	: 0 to 14
Temperature	: -10 to 105 °C (14 to 221 °F)
Pressure	: 0 to 10 bar ( 0 to 145 PSIG)
Conductivity	: > 50 $\mu$ S/cm
Storage temperature	: -30 to 50 °C (-22 to 122 °F)

### NOTE:

*Specifications should not be considered in isolation. For example the pH range can be 2-12 pH, where the measurement is at elevated temperatures. For advice about specific applications please contact you local sales office.*

## 5. INSTALLATION OF FU20

For optimum measurement results, the FU20 should be installed in a location that offers an acceptable representation of the process composition and **DOES NOT** exceed the specifications of the sensor. The FU20 is designed with threads on either end of the body 3/4" NPT or ISO 7/1 -R 3/4) to allow installation in a wide variety of applications.

### 5-1. Typical Installation

The FU20 sensor is designed for in-line installation, via a bypass loop as an immersion assembly. For best results the FU20 should be mounted with the process coming towards the sensor (Fig 7) and positioned at least 15° above the horizontal plane to eliminate air bubbles in the glass bulb.

### 5-2. Preparing the Sensor for Use

Remove the sensor from its shipping box and slide off the "wet pocket" (the tube filled with solution to keep the measuring elements from drying out in storage or shipment).

### IMPORTANT NOTICE

Before mounting the sensor, it should be calibrated. The calibration procedure is normally described in the Instruction Manual of the pH transmitter, but a general calibration is given in section 7 of this manual.

### 5.3 Mounting the Sensor

The FU20 can be mounted using the threads on the body of the sensor (Fig. 6). Apply Teflon tape to the appropriate threaded end, then install in the process.

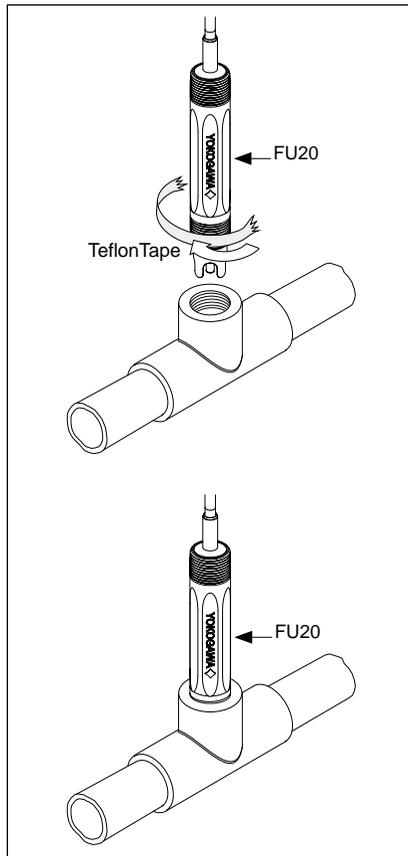
The FU20 can also be mounted using the threaded end of the quick release adapter. Apply Teflon (PTFE) tape to the threaded end of the quick release adapter (step 2). Then install the adapter (/NSS, /NTI, /BSP or /BTI) in the process, tightening it by applying a suitable torque using a spanner on the adapter flats, steps 1 & 3.

Next, slide the mating part of the adapter from the cable end of the FU20 (step 4) sensor and mount into the adapter making sure that the O-ring seats properly (step 5 & 6). Hand tightened the adapter nut (step 7).

### NOTE:

DO NOT over tighten the sensor, as damage may result.

See Section 6 for instructions to wire the sensor to the instrument.



**Figure 6. Sensor Installation**

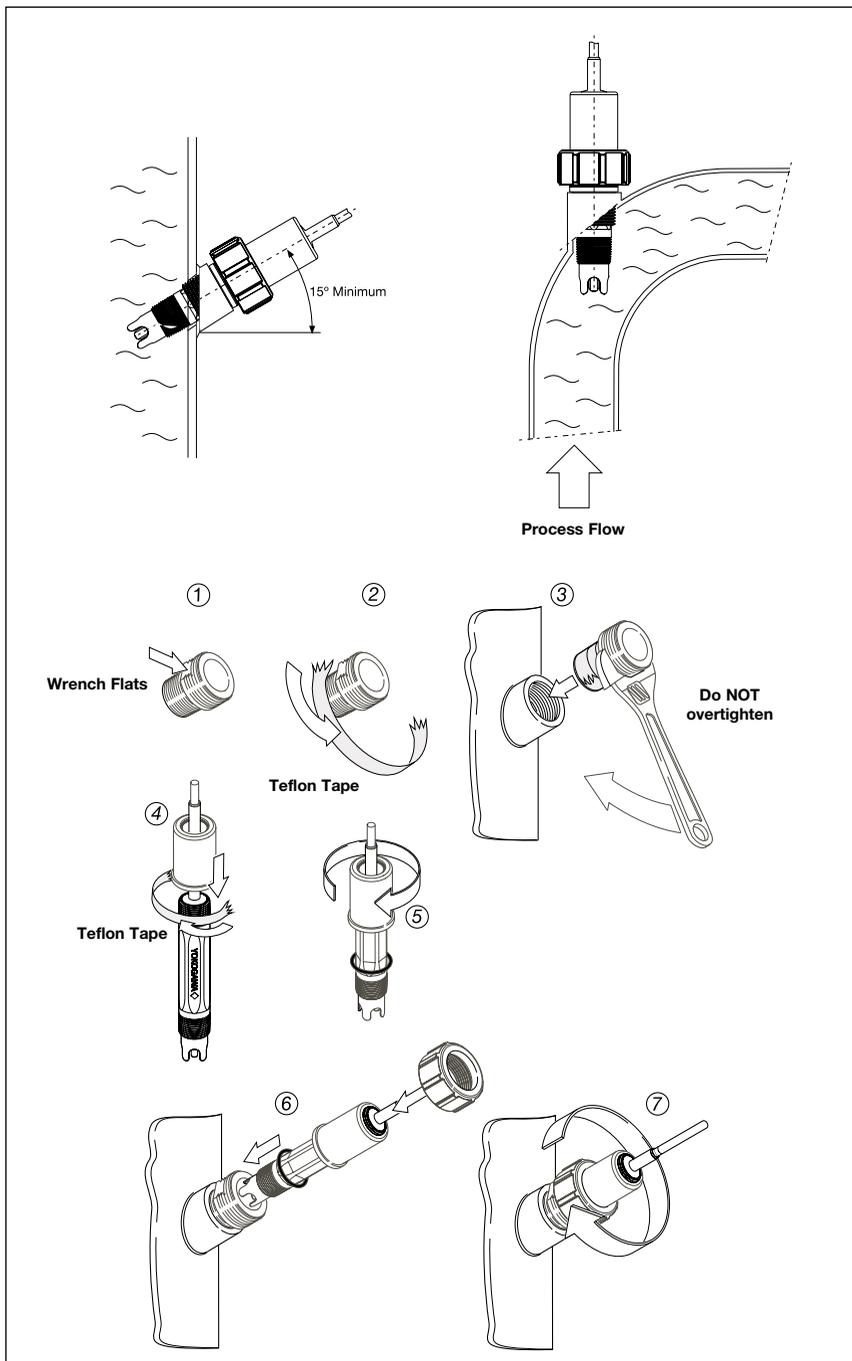


Figure 7. Sensor & adapter Installation

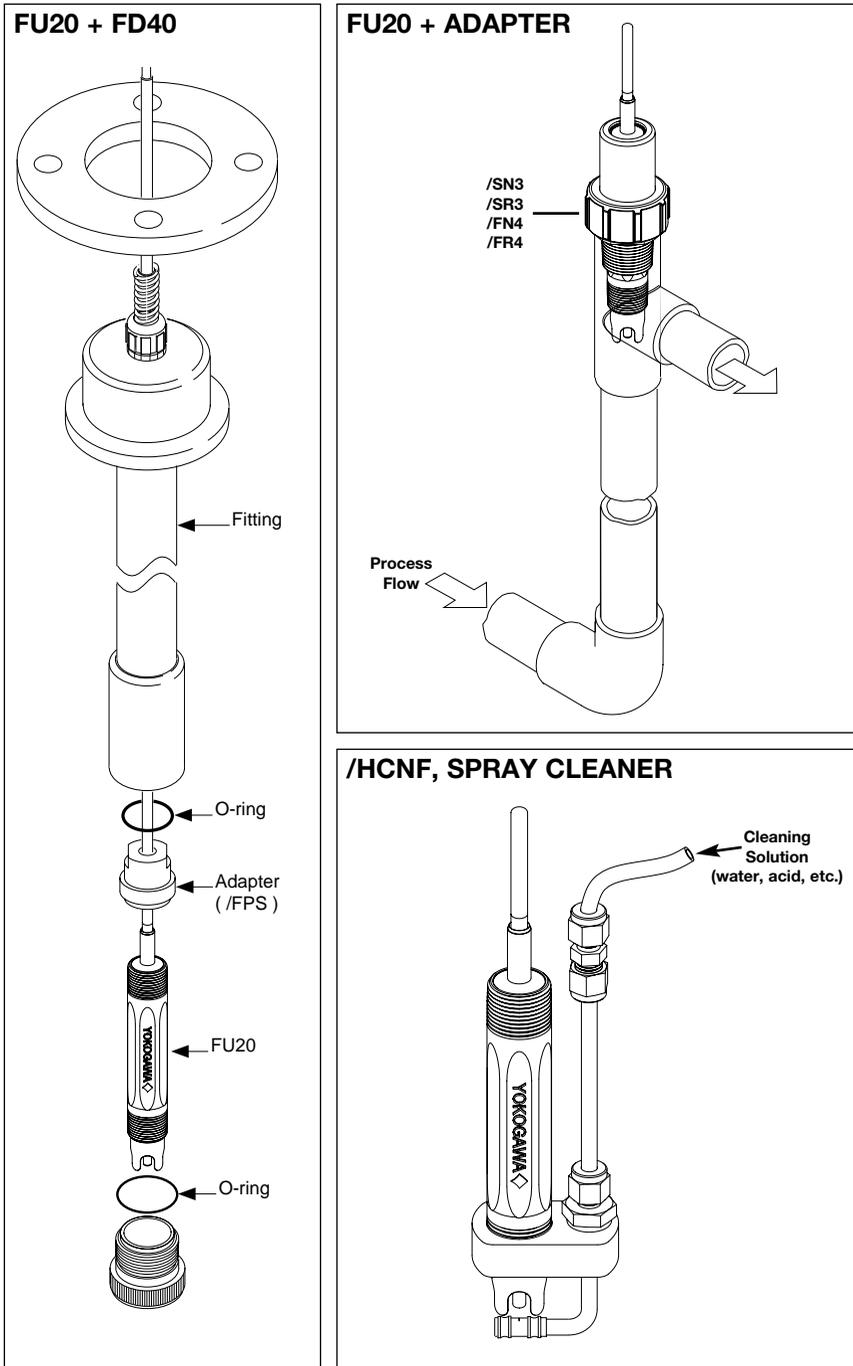


Figure 8. Installation examples for the FU20

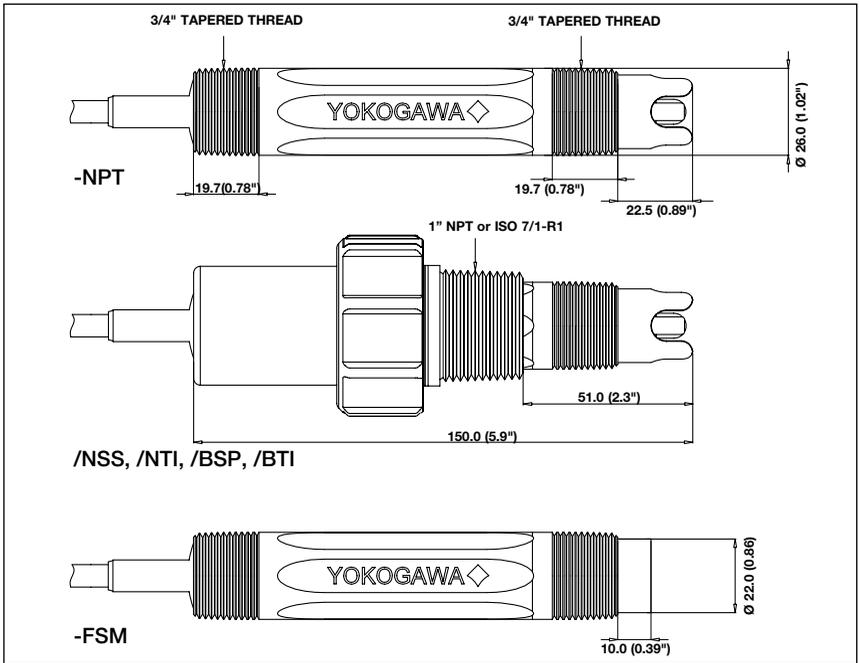


Figure 9. Dimensions FU20

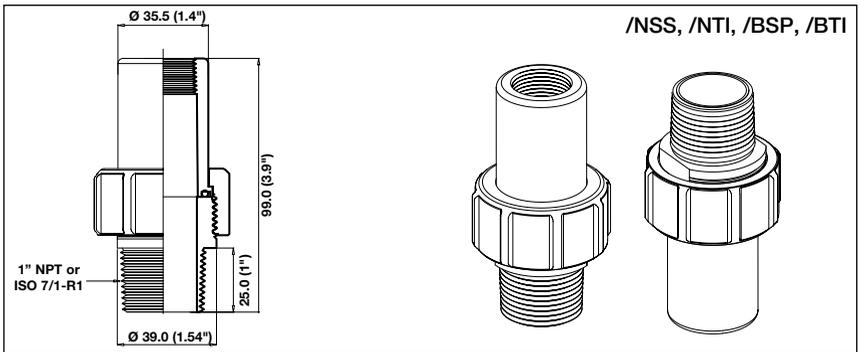


Figure 10. Dimensions 1" FU20 adapter Stainless Steel & Titanium

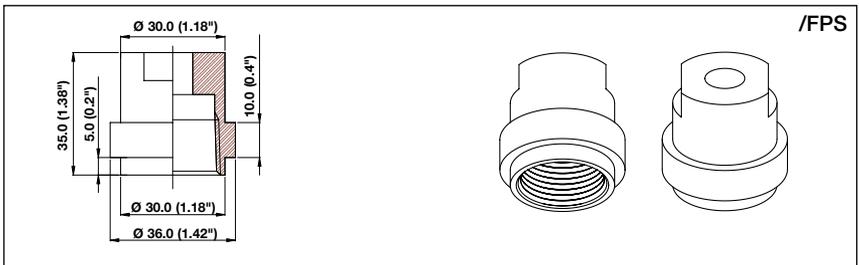


Figure 11. Dimensions FU20 adapter for FF40, FS40 and FD40 fittings

## 6. WIRING

### 6-1. Conventional pH (& ORP) Wiring

Connect the PH20 or FU20 to the EXA or EXAxt PH Analyzer as shown (Fig 12). With this configuration, it is possible to measure ORP (or rH) at the same time (Refer to the EXA or EXAxt Manual for appropriate impedance jumper and Service Code settings).

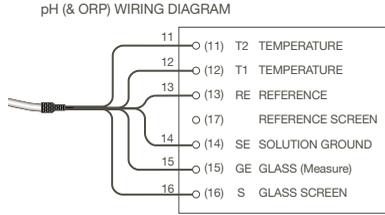


Figure 12.

### 6-2. Wiring for ORP measurement with normal reference

Connect the PH20 or FU20 to the EXA or EXAxt PH Analyzer as shown (Fig 13). Refer to the EXA or EXAxt Manual for appropriate impedance jumper and Service Code settings.

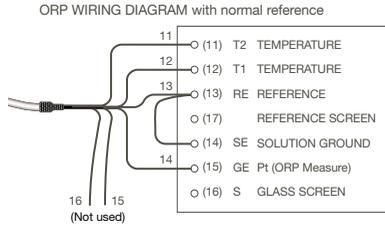


Figure 13.

### 6-3. Wiring for ORP measurement with pH reference

Connect the PH20 or FU20 to the EXA or EXAxt PH Analyzer as shown (Fig 14). Refer to the EXA or EXAxt Manual for appropriate impedance jumper and Service Code settings.

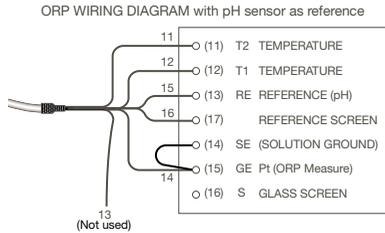


Figure 14.

## 7. GENERAL CALIBRATION & MAINTENANCE PROCEDURE

### 7-1. Calibration for pH measurement

To calibrate a pH sensor, two buffer solutions with known pH values are required. It is recommended that one buffer solution have a value near to pH 7.00. Depending on the process value to be measured, the second buffer solution should be either acidic (below 7.00) or alkaline (above 7.00) area. Normally, the IEC buffers (4.01, 6.87 and 9.18) are used.

The following is a very general 2-point calibration procedure.

1. Clean the sensor (deposits may be removed using a 5% (approximate) solution of HCL).
2. Rinse sensor thoroughly with clean water.
3. Immerse the sensor in the first buffer (6.87 pH is recommended).
4. Refer to appropriate Instrument Instruction Manual for Calibration procedures (Auto; Manual; Sample, etc.).
5. Rinse sensor thoroughly with clean water.
6. Immerse the sensor in the second buffer (4.01 or 9.18 recommended).
7. Repeat Step 4.

During calibration the temperature compensation should be active. The instrument automatically compensates for the sensitivity change of the pH sensor at different temperatures. After calibration is complete replace or re-install the sensor into the process.

### 7-2. Calibration for ORP measurement

For ORP calibrations the same procedure and buffer solutions pH 6.87 and pH 4.01 are to be used. When 1-20 grams ( $\pm 1$  teaspoon) quinhydrone is added to each buffer, it will produce a stable redox potential of 96 mV and 265 mV respectively. Mostly only 1-point calibrations are performed. Some analyzers also have the possibility to adjust the slope (2-point calibration).

### 7-3. Maintenance

All pH sensors require routine maintenance to keep the measuring elements clean and functioning. Depending on the process, different cleaning solutions may be required.

#### EXAMPLES:

1. Deposits of limes, hydroxides or carbonates can be removed by immersing the sensor in a solution containing dilute hydrochloric acid (5% is recommended). Afterwards rinse with water.
2. Deposits of oil and fat can be removed with hot water in conjunction with a detergent. When the results are unsatisfactory, a mild (carbonate based) abrasive can be used.
3. Protein deposits should be removed with a protein enzymatic solution. For instance a solution containing 8.5ml concentrated hydrochloric acid and 10 grams of pepsin in 1 liter of water will do.

After cleaning the probe is reinserted into the process by following the reverse procedure.

#### NOTE:

Avoid using non-polar solvent like tri-chloro ethylene, toluene or hexane. Cleaning with iso-propanol or methanol is acceptable.

The non-polar solvents will break up the gel-layer on the glass bulb and requires that the electrode to be soaked in water for at least 12 hours before functioning normally again.

The Teflon (PTFE) diaphragm of the sensor can sometimes be regenerated by putting it in hot (60 to 80°C) 3 molar Potassium Chlorine (KCL) solution and letting it cool to room temperature. This procedure clears the junction of process material and then "draws" the conductive (KCL) back into the junction.

## 8. MODEL CODES

Model Code	Suffix code	Option	Description
<b>PH20</b>			<b>4-in-1 pH/ORP sensor</b>
Material	-F		PVDF
Membrane	-G		Dome shaped
Cable length	-02 -05 -10 -20 -30		2 mtr 5 mtr 10 mtr 20 mtr 30 mtr
Temp. element	-T1		Pt1000
	-N -A		Always -N -A
Options		/SN3 /SR3 /FN4 /FR4 /PH8 /SF4  /HCNF	3/4" NPT adapter, SS (316L) 3/4" R adapter, SS (316L) 1" NPT adapter, PVDF 1" R adapter, PVDF Adapter for PH8 combi sensor fittings (only) Stainless steel adapter for FF40, FS40 and FD40 fittings Hastelloy cleaning system

Model Code	Suffix code	Option	Description
<b>FU20</b>			<b>Wide body sensor</b>
Cable length	-03 -05 -10 -20		3 mtr 5 mtr 10 mtr 20 mtr
Temp. element	-T1		Pt1000
Model	-NPT -FSM		Dome shape model Flat surface model
Options		/Q /HCNF /FPS /NSS /NTI /BSP /BTI	Quality Inspection Certificate Hastelloy cleaning system Adapter F*40 from noryl 1" NPT adapter, SS (316L) 1" NPT adapter, Titanium 1" BSP adapter, SS (316L) 1" BSP adapter, Titanium

## 9. SPARE PARTS

Spare part	Description
<b>FU20</b>	
K1523DC	/FPS Adapter for FF40, FS40 and FD40 fittings (PPO)
K1547PK	/NSS 1" NPT, Stainless Steel adapter (Viton O-ring)
K1547PL	/BSS ISO 7/1-R1, Stainless Steel adapter (Viton O-ring)
K1547PM	/NTI 1" NPT, Titanium adapter (Viton O-ring)
K1547PN	/BTI ISO 7/1-R1, Titanium adapter (Viton O-ring)
K1500 FR	Viton O-rings 29.82*2.62 (5 pcs) for 1" adapter
K1500FS	EPDM O-rings 29.82*2.62 (5 pcs) for 1" adapter
K1500FT	Silicone O-rings 29.82*2.62 (5 pcs) for 1" adapter
<b>PH20</b>	
K1547PC	/FN4 1" NPT adapter, PVDF
K1547PD	/FR4 1" R adapter, PVDF
K1547QA	/SN3 3/4" NPT adapter, SS (316L)
K1547QB	/SR3 3/4" R adapter, SS (316L)
K1547PE	/PH8 Adapter for Combi Sensor, PVDF
K1547QF	/SF4 Stainless steel adapter for FF40, FS40 and FD40 fittings
K1511DP	Viton O-rings 21.9*2.62 (5 set of 2 pcs)
K1511DQ	EPDM O-rings 21.9*2.62 (5 set of 2 pcs)
<b>Cleaning system for FU20 &amp; PH20</b>	
K1547PJ	Hastelloy cleaning system (HCNF)
K1547PG	Hastelloy nozzle and mounting set (HCNF)
K1547PH	Nylon tube (10 metre) and tube mounting set for chemical cleaning system
<b>Buffer powder</b>	
6C231	Buffer powder pH 1.68 ; IEC746-2
6C232	Buffer powder pH 4.01 ; IEC746-2
6C236	Buffer powder pH 9.18 ; IEC746-2
6C237	Buffer powder pH 6.87 ; IEC746-2
<b>Tester</b>	
QT20	pH/ORP input simulator with carrying case and cables
<b>Connection equipment</b>	
BA10	Junction box for pH extension cables
WF10-XXX-F	pH signal cable with terminated ends. Specify length in whole meters (e.g. XXX = 020)



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