

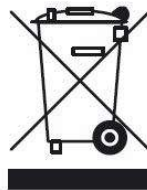


# USER MANUAL



3S-OIW

Fluorescence Sensor Refined Oil / PAH / BTEX



Electrical equipment marked with this symbol can not be disposed of through home or public waste disposal systems after 12 August 2005. In accordance with local and national European regulations (EU Directive 2002/96 / EC), users must return the equipment which is unsuccessful or can no longer be used to the manufacturer, which have to provide free of charge disposal.

Note: To return devices at the end of their useful life, accessories supplied by the manufacturer and all auxiliary items for recycling, contact the manufacturer or the vendor of the device to arrange proper disposal.

## INDEX

Sezione 1 - SAFETY INFORMATION	4
1.1 Warnings and safety information	4
Sezione 2 - GENERAL INFORMATION	5
2.1 Technical specifications	5
2.2 Instrument description	6
2.3 Applications	6
2.4 Method description	6
Sezione 3 - INSTALLATION	7
3.1 Opening the package	7
3.2 Product code	7
3.3 Wall mounting dimensions	7
3.4 Mounting the instrument (example with 3S-PC1000)	8
Sezione 4 - CALIBRATION	9
4.1 About the method	9
4.2 Calibration using oils	9
4.3 Calibration using a soluble standard	12
4.4 Process calibration	13

# 1 - SAFETY INFORMATION

## 1.1 Warnings and safety information

Before installing and operating the analyzer, read this manual thoroughly. Please pay particular attention to all the labels applied to the analyzer and to all the hazard information indicators in this manual.



This symbol indicates that you must refer to this manual for proper use of the equipment. Only qualified operators, properly trained on the use and maintenance of the analyzer can carry out service activities on the equipment.



This symbol indicates the existence of a risk of electric shock and/or electrocution. Only operators qualified for these activities can perform maintenance and control operations on the equipment bearing this label, always after unplugging it.

Parts involved:  
- input terminal block in the upper box



The instrument operates with low power UV radiation. Do not look directly at the light source and do not disassemble the light source enclosure.

Parts involved:  
- UV source

The manufacturer shall not be held responsible under any circumstances for improper use of the equipment.

The head of department and the machine operator must comply with the following rules and with the provisions of current legislation on the safety and health of workers.

The use, maintenance, and repair of the instrument are permitted only to persons authorised for such operations. These operators must be physically and mentally capable to perform such activities, which can not be performed under the influence of alcohol and drugs.

When the instrument is not being used it must be protected from voluntary or involuntary activation, after disconnecting the power supply.

Failure to follow the instructions given and/or failure to pay attention to the hazard indicators may cause serious risks of physical damage to operators and breaks or malfunctioning of the analyzer.

All the components of the instrument are placed within a panel closed by a door with a special key, supplied only to maintenance operators.

The instrument must then be used under operating conditions with the door closed.

## 2 - GENERAL INFORMATION

### 2.1 Technical specifications

Measured parameters	Oil-in-water, BTEX, aromatic hydrocarbons, PAH/PAC
Wavelength	Excitation: 280 nm Emission: 300 - 400 nm
Measuring principle	Fluorescence photometry
Measuring range	0 - 30 ppm as phenol equivalents 0 - 10 ppm as NDSA equivalents
Reproducibility	± 3 % of the full scale
Limit of detection	0.1 ppm (phenol equivalents)
Analysis Frequency	Continuous (aquisition time < 1 s)
Sample	Sample specifications for the optional probe reservoir: Temperature: 5 - 50 °C (41 - 122 °F) Flow Rate: 80 to 500 mL/min Connection: 6 mm (¼-in.) Drain: pressure-free, atmospheric drain
Body material	Stainless steel 316L or titanium
Dimensions	Ø 50 mm, L 175.8 mm
Weight	Approx. 1 Kg (2.2 lbs)
Power Supply	Sensor Voltage: 5 - 12 VDC (powered by the 3S-PC1000 controller)
Outputs	Digital interface with 3S-PC1000 controller
Installation	With probe holder reservoir, immersion pipe or appropriate brackets (optional accessories)
Protection Grade	IP68

## 2.2 Instrument description

The 3S-OIW is a sensor for water monitoring. The sensor works with the principle of UV fluorescence and can be used to detect many common pollutants such as hydrocarbons/oil-in-water, BTEX, PAH/PAC. The design is compact and robust, the stainless steel body offer great protection up to a depth of 60 m.

## 2.3 Applications

The instrument can be used to monitor the concentration of various parameters in aqueous samples and it finds application in civilian and industrial wastewater control, oil industry, hydrocarbons transport and storage and every other application that requires a fast and sensitive determination of possible pollutants.

## 2.4 Method description

Fluorescence spectroscopy, or fluorimetry, is a technique that measures the amount of light emitted by a fluorescent sample when excited with an incoming radiation of appropriate wavelength. Fluorescence is a property of some substances that are able to absorb energy from the incoming light and then release it as a radiation with a lower energy (longer wavelength) and partially as heat.

It's strictly related to absorption spectroscopy where a sample absorbs part of the incoming radiation and releases it exclusively as heat.

In fluorescence spectroscopy we can measure the intensity of the emitted radiation and correlate it to the concentration of the analyte.

Compared to the absorbance spectroscopy the technique presents a greater selectivity and sensitivity, since only fluorescent compounds are detected.

The light beam from an LED source in the UV region irradiate the sample. Some photons get absorbed by the substances in the sample and re-emitted as a polychromatic radiation (photons with different wavelengths). A second filter selects a target wavelength and its intensity is measured by a detector and correlated to the analyte concentration. The light emitted by the sample is diffused in every direction therefore the detector is placed at an angle to avoid interference with the incident light.

## 3 - INSTALLATION

### 3.1 Opening the package

For safety reasons, when removing the packaging of the equipment, please check for any visible defects and, if necessary, inform the supplier.

Parts inside the package apart from the user manual:

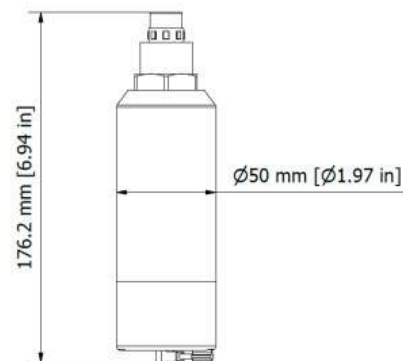
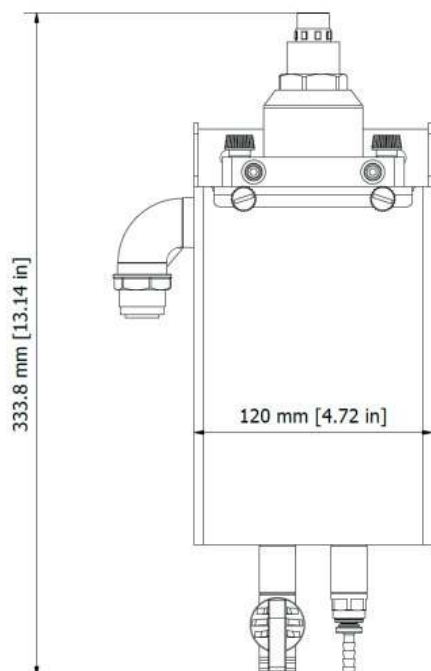
A	3S-OIW Fluorescence sensor refined oil / PAH / BTEX
B	Probe cable (6 m)

### 3.2 Product code

The product code is an alphanumeric code that identify your 3S Analyzers product and its configuration. For the 3S fluorescence sensor the code is the following:

3S-OIW

### 3.3 Wall mounting dimensions



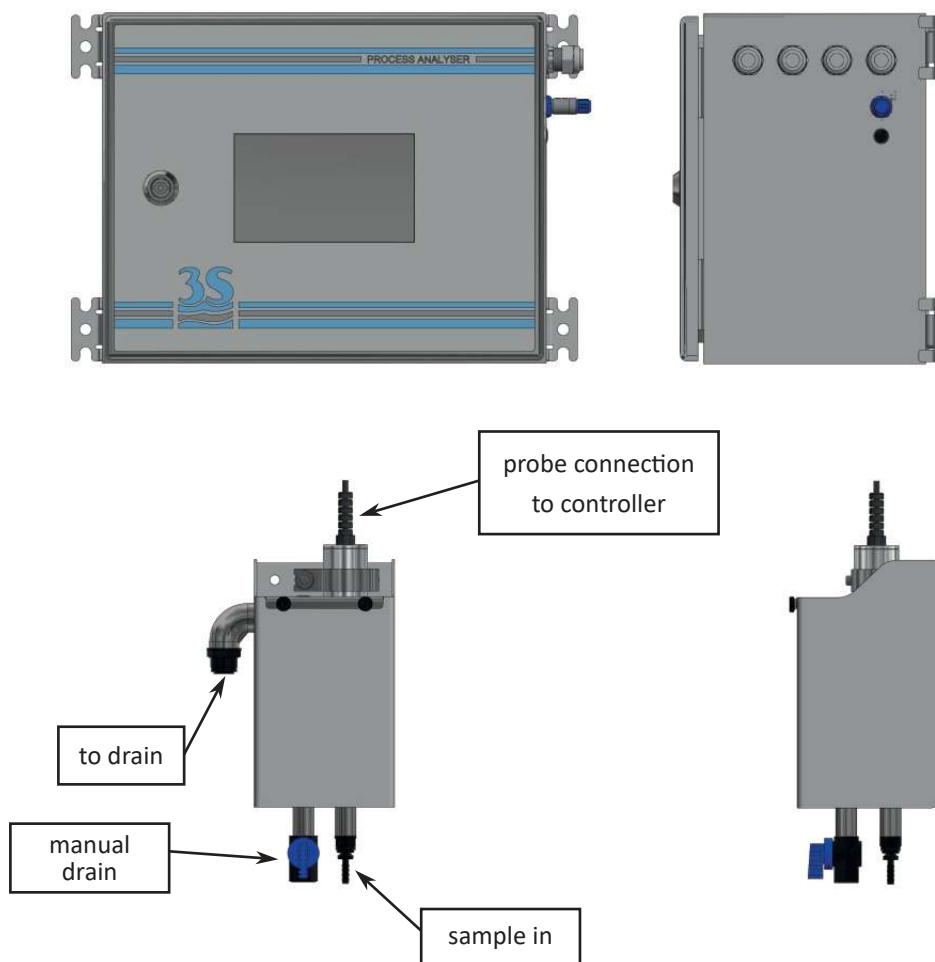
Recirculating sample reservoir cod. A46U10020 is included in the scheme as a reference, but should be purchased separately.

### 3.4 Mounting the instrument (example with 3S-PC1000)

The 3S-PC1000 controller and the sample reservoir must be mounted vertically on a wall or support suitable for their weight and not subject to vibrations. Use suitable screws (not included in the supply) and fasten them only on the side brackets (ear clips) of the instrument and in the holes of the tank metal plate. Mount them so as to get the display at eye height (160 cm, 63 in).

Since the probe connections and flow sensor connectors are on the right side of the analyzer, install sample reservoir underneath the analyzer, in a way that is reachable from the right side. Please, also consider that the surrounding space must allow easy opening of the analyzer door and easy access to the sample reservoir for cleaning or maintenance.

A minimum distance of 10 cm is required between the sides of the instrument and any other obstacle.



The sample reservoir (cod. A46U10020) should be mounted preferably under the controller. The sample line must be connected to the inlet below the container, optionally a flow sensor can be installed on the same line to detect the presence of the sample.

The reservoir has a side arm to drain the excess liquid and to maintain a constant sample flow. The side arm must be connected to the drain.

When the container is installed in a proper position the probe can be inserted into its slot and secured with the clamp.

Finally, attach the probe connector to the analyzer.



## 4 - CALIBRATION

### 4.1 About the method

The probe is calibrated using standard solutions which are analyzed in the same way as the sample.

In order to ensure correct measurement performance, the probe should be calibrated periodically, best results are obtained if it has been recently cleaned and serviced.

Due to the nature of some analytical methods the concentration/signal plot is not linear in the whole range of our interest. Therefore the analyzer uses a multi-point calibration curve. The first point is the blank (zero), which is usually done by analyzing demineralized water. A part from the blank, other points are needed for the calibration curve, covering the whole range of interest.

The 3S-PC1000 controller is able to manage two probes with independent calibration curves, up to five points each.

Please refer to the 3S-PC1000 user manual for detailed instructions to perform a multi-point calibration with the 3S-OIW probe.

### 4.2 Calibration using oils

The instructions shows a multi-point calibration. We need to make measurements at different concentrations to draw the calibration curve. If the probe response is linear only two points are necessary, the extra point can be extrapolated.

As an example the next paragraph describes a 5-point calibration of an oil-in-water probe using the oil of interest as standard.

Since different substances can have very different response, it is recommended to calibrate the analyzer using the specific oil we want to monitor. Also, to minimize matrix effects, it is important to dilute the oil in the same water present at the installation site.

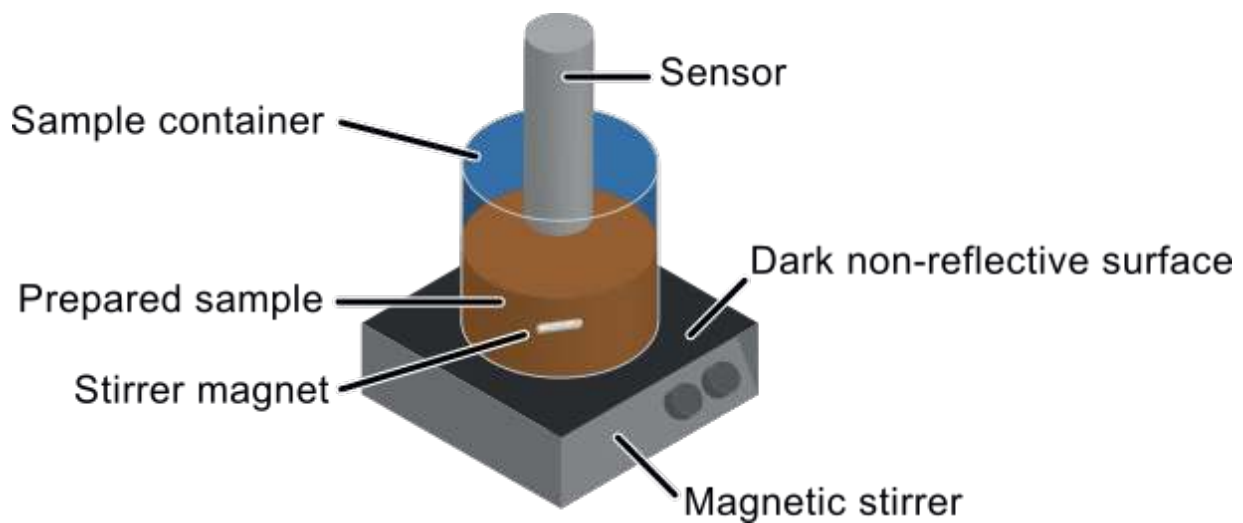
To perform a multi-point calibration, proceed as follow:

#### **Chemicals**

- Isopropanol
- A sample of oil we have to detect

#### **Instrumentation**

- A 1000 µl automatic pipette
- 2 l glass beacker
- 10 ml volumetric flask
- 1000 ml measuring cylinder
- Magnetic stirrer



### Stock solution

Prepare a stock solution (10000 ppm) of the oil. Take 100  $\mu\text{L}$  of oil using the pipette and insert it into the 10 mL volumetric flask, fill the flask with isopropanol up to the flask mark.

### Blank

The blank is measured using demineralized water. The blank is the first point of our calibration curve.

### Standard

We need four other points in addition to the blank. The four points should cover the range of interest, we will be using standard solutions equal to 25%, 50%, 75% and 100% of the full scale. The easiest procedure is to operate with the method of the standard additions, in this way you won't have to prepare all the calibration solution beforehand. We will start with a water sample and adding small aliquotes of analyte to it, increasing its concentration for each point measured.

### Procedure

The instrument can be easily calibrated using the method of the standard additions.

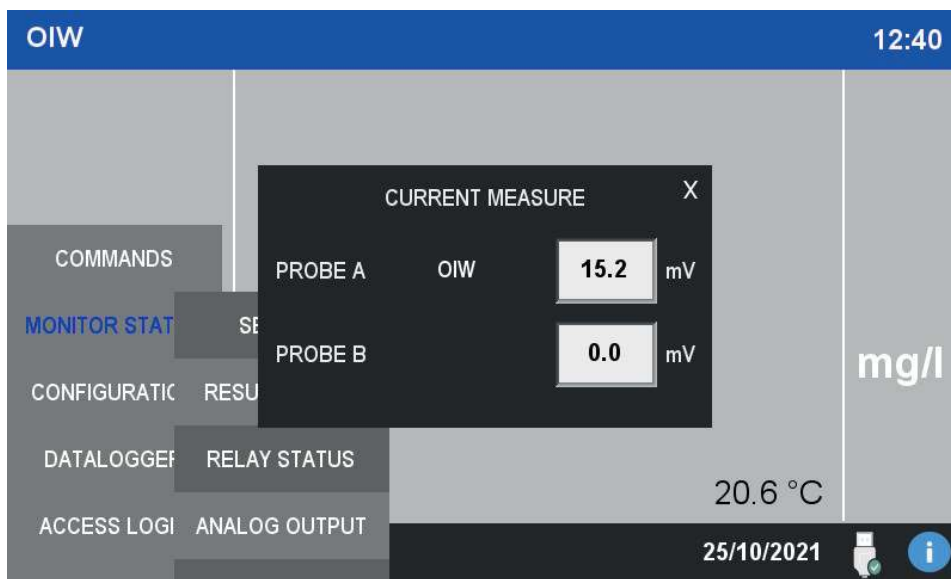
Fill the 2 l beaker with 800 ml of the blank water and place it on the magnetic stirrer, add the magnetic bar.

Clean the probe with a clean cloth and a drop of isopropanol. Place the probe into the beaker, immersed 2-3 cm into the solution and at least 5 cm from the container walls. You can use a stand to support the probe. Make sure no air bubbles are trapped below the sensor. Be also sure to place a dark, non reflective sheet on the stirrer plate, under the beaker.

Turn on the stirrer at 500 rpm and wait at least 90 seconds for the sensor to give a stable reading. Take note of the sensor reading, this is your blank.

Now, using the micropipette take the amount of stock solution that, diluted in 800 ml of water gives the concentration of the first point. For example, if you want to prepare a 5 ppm solution take 400 µl of stock solution and add it to the 800 ml of water you have in the beaker. After waiting at least 90 seconds, take note of the sensor response, this is your first point. For the other points, continue to add amount of stock solution to the same beaker, keeping it well stirred. For each point check the sensor voltage response and take note of it.

The sensor signal can be read from the MONITOR STATUS > SENSOR page.



The following table will give you an example of the points collected with this technique.

Total concentration (ppm)	Volume addition (ul)	Total volume (ml)
0	0	800
5	400	800
10	400	801
15	400	801
25	800	802

The total volume change after each addition is not significant, thus the volume variation can be omitted.

Now, insert your password in the ACCESS LOGIN page of the 3S-PC1000 controller, the calibration page is protected from unwanted access.

Go to CONFIGURATION > CALIBRATION DATA, fill the data collected during the calibration procedure in the table.

The result will look like this.



### 4.3 Calibration using a soluble standard

During the normal maintenance and calibration routine the user may find convenient to calibrate the probe using a soluble standard and correlate it to the process variable (see process calibration in the next paragraphs). This would be also the case if the analyte of interest is soluble in water.

In this case the user can replicate the calibration described in the previous section or use already prepared standard solutions.

In this example we will use phenol as our reference standard, a fluorescent substance.

#### **Stock solution**

Prepare a 1000 ppm phenol standard solution. The other solutions will be prepared by dilution of the stock solution.

## Blank

Even in this case we need to measure the blank using demineralized water.

## Standard

By dilution of the stock solution we prepare the following standards:

- 7.5 mg/l
- 15 mg/l
- 22.5 mg/l
- 30 mg/l

These solutions will cover well the range 0 - 30 mg/l, a very common range for phenol analysis.

## Procedure

Prepare a beaker or other suitable container with a volume of at least 1 liter. Since our standard substance is soluble we don't need to keep the solution stirred.

Fill the container with demineralized water and immerse the probe. Wait at least 90 seconds for the stabilization then take note of the signal value.

Replace the water in the container with the first standard solution, take note of the value.

Proceed with the analysis of the other standard solutions and collect all the signal values.

Eventually fill the calibration table with the data collected.

If the analyte of interest is phenol the calibration is completed at this point.

If we wanted to correlate the measure of phenol to another substance, please follow the process calibration described in the next section.

## 4.4 Process calibration

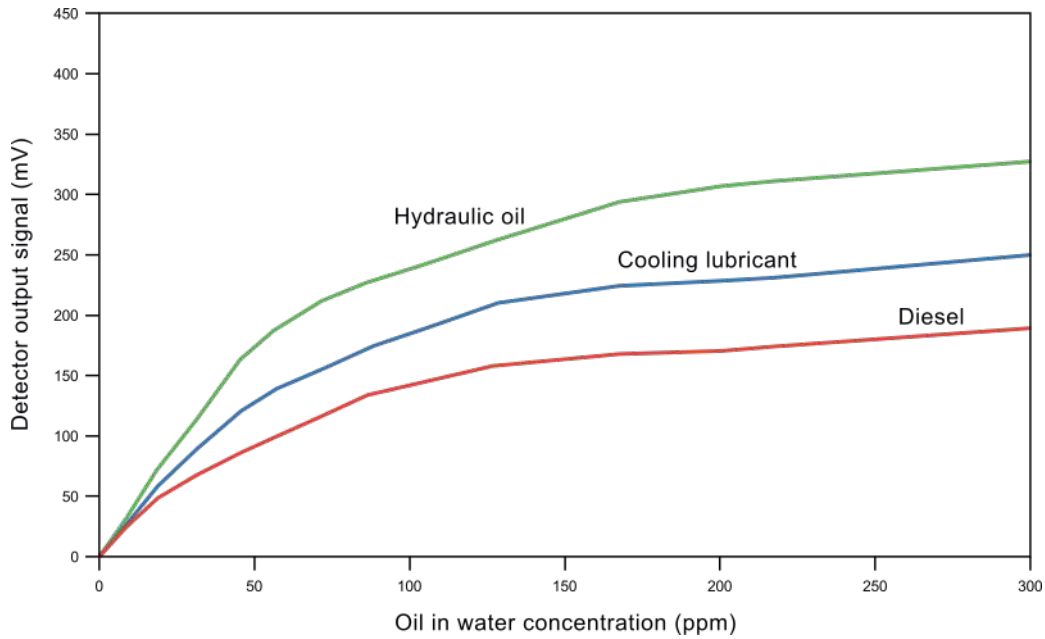
With the process calibration we can apply a correction factor to the measurement to align the measured value to the laboratory measurements. This is useful when the actual analyte is not available or it is not possible to make stable standard solutions with it. We can also use the process calibration to correct the measurement from matrix effects or other differences.

Different substances can have different response factors, therefore you should expect your calibration curves to be dependent on the substance used for the calibration.

For this reason it is recommended to choose a calibration standard which is as similar as possible to the compound of interest. Your target compound itself is of course the best standard choice.

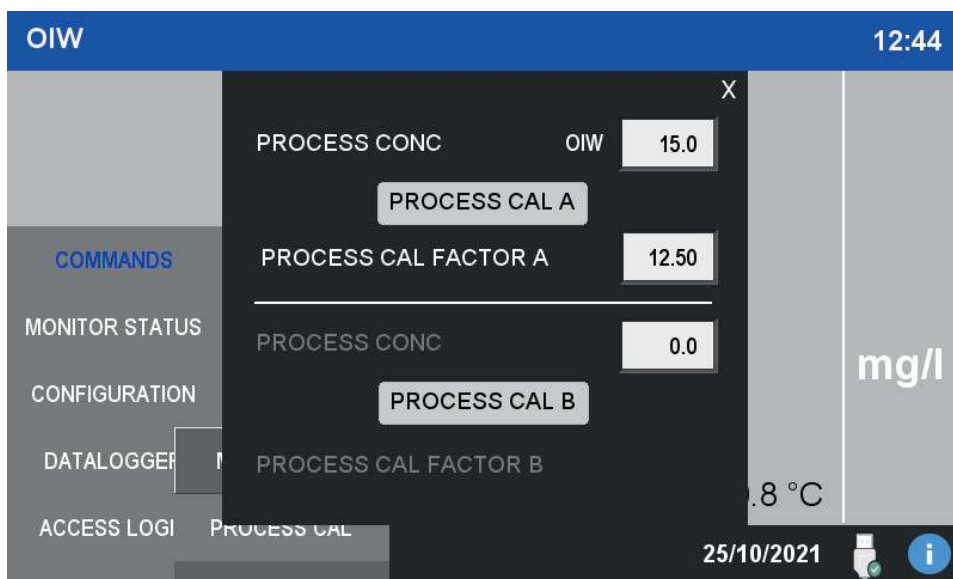
In many cases though, it is more convenient to use a common standard to calibrate the instrument on site and then align the results with laboratory data.

This can be done with process calibrations. The process calibration applies a scale factor to the measurement to align it to the value of the actual sample.



The process calibration can be performed through the following steps:

1. Take a sample representative of the water stream to be analyzed, at least 1 liter. Follow good sampling techniques to have reliable results.
2. Determine the concentration of the analyte of interest using a reference instrument or a laboratory analysis of the sample .
3. Immerge the probe in the sample and wait for a stable result.
4. Go to COMMANDS > PROCESS CAL



5. Press and hold PROCESS CAL A (or B depending on the probe you want to calibrate if more than one are present).
6. The process calibration is now completed, the new measurements will be corrected with the factor calculated in the procedure.

Note: is it possible to calculate the factor analyte/standard and put it directly in the process factor field on the same page.