Unisense
In Situ UniAmp
Connector System
Shallow water and Deep sea

IN SITU UNIAMP CONNECTOR SYSTEM MANUAL

Version 3.4, October 2020

Contents

1 Overview

The Unisense In Situ UniAmp Connector system is designed for easy replacement of sensors.

Unisense In Situ UniAmp Connector system is a dedicated system for mounting microsensors:

- Simple and safe mounting
- Prevent seawater from entering the sensor and connections
- Enables pressure compensation for deep-sea use
- Shielding the sensor signal from electrical noise making the sensor signal very stable also in a laboratory setting

The connector system is used on Unisense in situ instruments with the in situ amplifiers.

Support, ordering, and contact information

To order products or if you encounter any problems and need scientific/technical assistance, please do not hesitate to contact our sales and support team. We will respond to your inquiry within one working day.

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For further documentation and support, go to: www.unisense.com

Notice to purchaser: The In Situ UniAmp Connector System is for research-use only!

2 General description of the In Situ UniAmp connector system

The In Situ UniAmp system is available in two versions, the Shallow version for water depths down to 300 m, and the Deep Sea version for water depths down to 6000 m.

Microsensors for in situ use must be mounted in an In Situ Connector before use which is described in this manual. Mounting of the sensor in the In Situ Connector is the same for the Shallow and Deep Sea versions. Sensors for use at >50 m water depth must have the pressure compensation wire (paragraph 3).

Make sure to test the sensor no later than two weeks after receipt (see the specific sensor manual and paragraph 8).

2.1 Shallow version: 0 - 300 m

Figure 1: Shallow water In situ UniAmp amplifier.

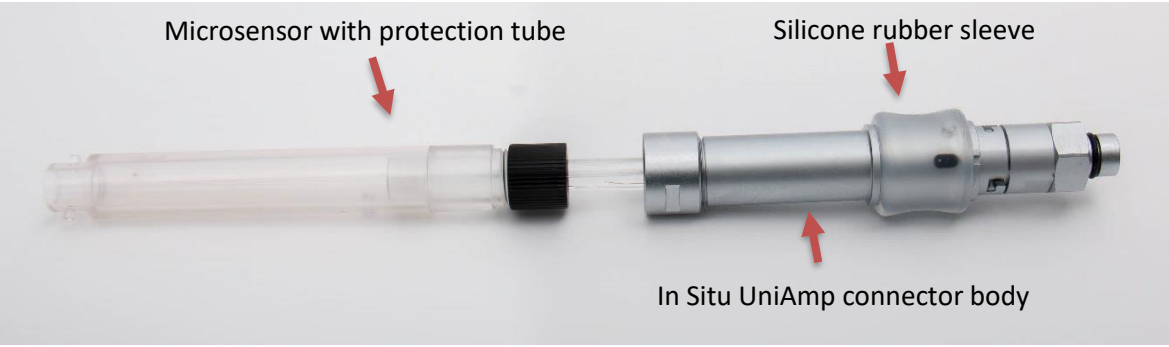

Figure 2: In situ microsensor with protection tube mounted in the In Situ connector - Shallow version.

The procedures for mounting the microsensors in the In Situ Connectors are different for the 0 - 50 m and the 0 - 300 m depth ratings:

A. Depth rating 0 - 50 m: The connector body and the silicone rubber sleeve must be filled with oil before deployment (see paragraph 9).
B. Depth rating 0 - 300 m: Sensors for more than 50 m depth contain a pressure compensation wire (see Figure 5 & Figure 8) which must be removed before mounting in the In Situ UniAmp Connector. The UniAmp connector body and the silicone rubber sleeve must be filled with oil before deployment (see paragraph 9).

2.2 Deep sea version: 0 - 6000 m

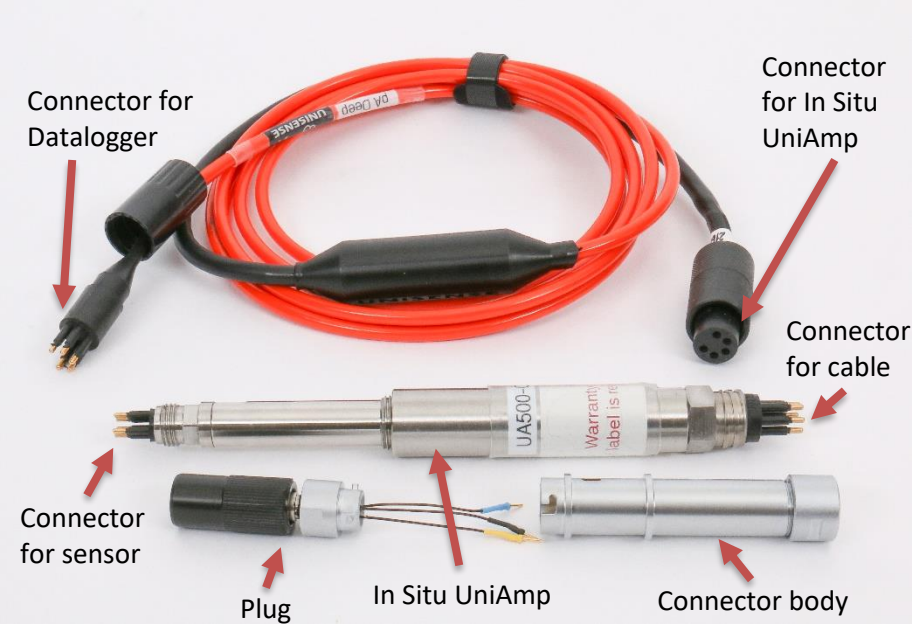

Figure 3: Deep-Sea In Situ UniAmp system

Figure 4: In situ microsensor with protection tube, mounted in the In Situ connector - Deep-Sea version.

The Deep Sea version is rated for water depths from 0 to 6000 m. The sensors for use at > 50 m water depth have a pressure compensation wire (see Figure 10) that must be removed before the sensor is mounted in the In Situ UniAmp Connector. The connector body and silicone rubber sleeve must be filled with oil before deployment.

3 Pressure compensation

Pressure compensation is needed for sensors deployed to more than 50 m water depth. The purpose of the pressure compensation is to maintain the same pressure inside and outside the microsensor. By removing the pressure compensation wire (Figure 5 & Figure 10), a channel is created that connects the interior of the sensor with the oil in the UniAmp connector body (Figure 6). The ambient pressure is transmitted from the outside through the silicone rubber sleeve and the paraffin oil into the sensor as pressure changes during deployment.

After removal of the pressure compensation wire, it is possible for the electrolyte to evaporate from the sensor. To avoid this, the sensor must be mounted in the in situ connecter and this must be filled with oil. This should first be done close to deployment. After removing the wire and filling the connector with oil, the sensor-connector assembly should be placed upright to avoid mixing of oil and electrolyte, and to avoid that electrolyte enters the in situ connector with the signal conducting wires.

For testing the sensor, it is not necessary to mount it in the in situ connector. Simply connect it to the In Situ UniAmp using only the plug or connect it to a Unisense lab amplifier as described in paragraph 8.

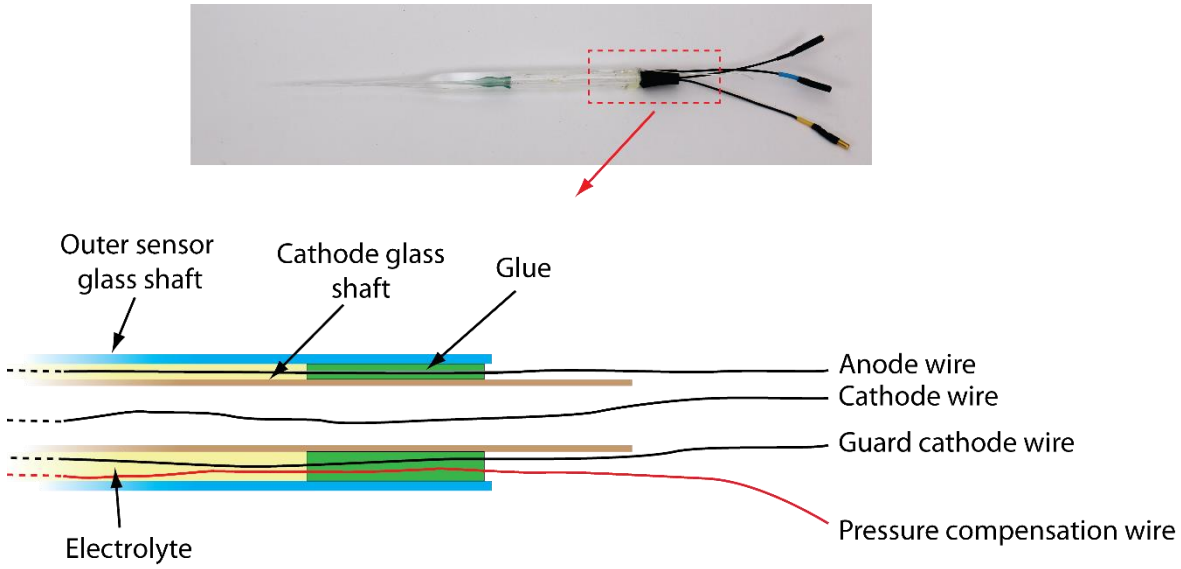

Figure 5: In Situ sensor with pressure compensation wire in place (silver wire in photo, red line in drawing).

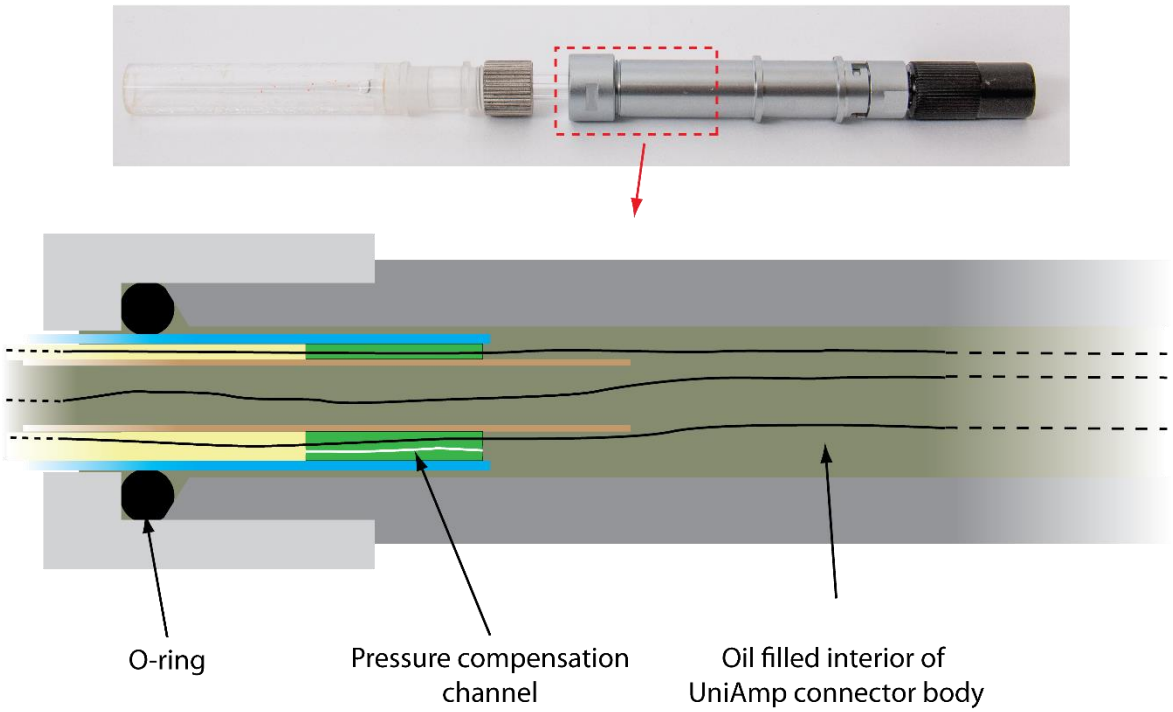

Figure 6: In situ sensor mounted in the In Situ UniAmp connector. Drawing shows details of the part indicated on the photo. The pressure compensation wire has been removed and there is now an open channel in the glue (green), connecting the electrolyte compartment (yellow) in the sensor with the oil in the connector (olive). See Figure 5 for details on the sensor.

4 The In Situ UniAmp Connector

The In Situ Connectors for the Shallow and Deep Sea versions are identical, except for the plug (Figure 7 & Figure 9). The In Situ Connector consist of the connector body, the plug, the silicone rubber sleeve, a locking nut, and an O-ring.

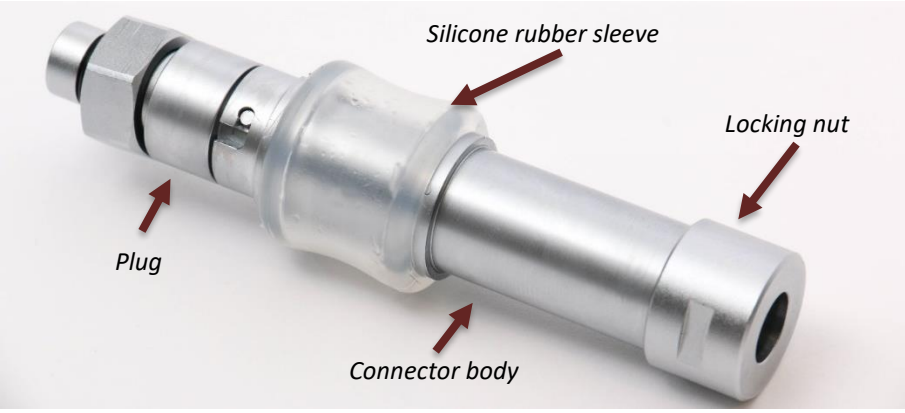

Figure 7: In Situ UniAmp Connector.

The plug and body can be assembled by first placing the O-ring inside the sensor holder and then inserting the plug into the sensor holder. The plug must be twisted relative to the sensor holder until it clicks into place.

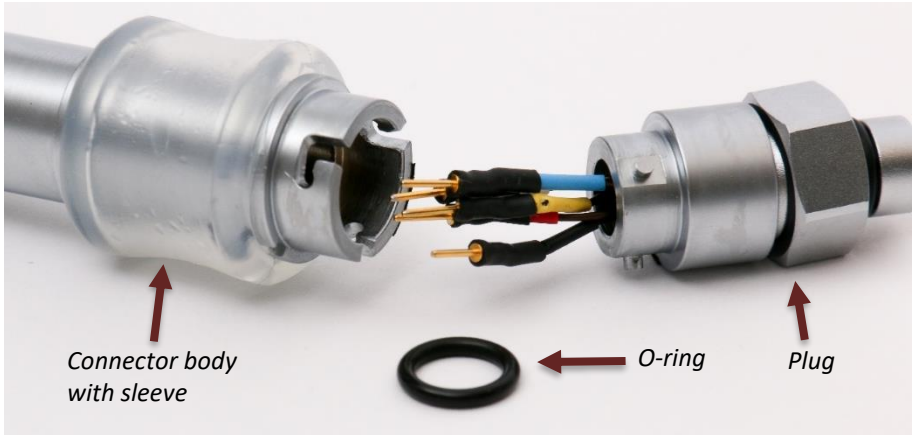

Figure 8: Shallow version In Situ UniAmp Connector disassembled. The plug is for STOX sensors, hence the five cables, most sensors have three cables.

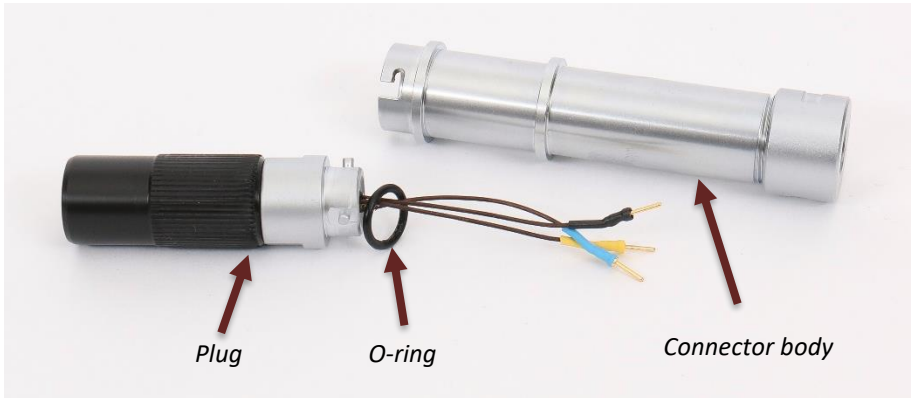

Figure 9: Deep Sea version In Situ UniAmp connector disassembled. Plug is for standard amperometric sensors with three cables (e.g. O_2).

5 The In Situ Microsensor

The sensors for use with the In Situ UniAmp system are delivered with cables for connection to the pins on the plug (Figure 10). All cables on sensor and plug are colour coded and colours must be matched when connected. The number of cables depends on the specific sensor type.

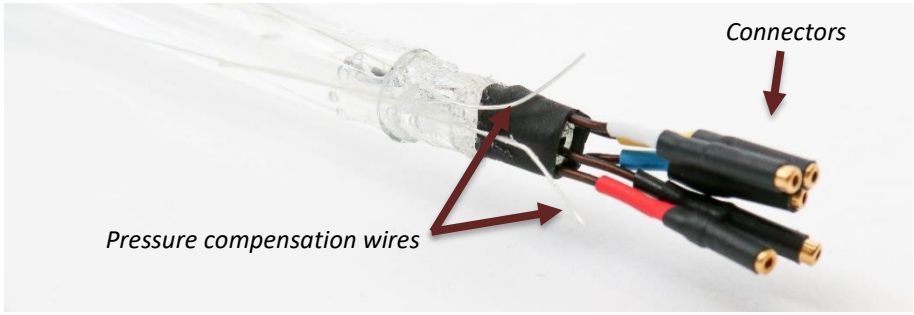

Figure 10: In Situ STOX Sensor with connectors and cables. The silver wires are for pressure compensation and must be removed before mounting in the In Situ UniAmp connector. Most sensors have only three cables and connectors and one pressure compensation wire.

6 Mounting a microsensor in the In Situ UniAmp Connector

For sensor rated for >50 m water depth, remove the pressure compensation wires from the sensor by pulling gently (tweezers or pliers may be needed). This leave a channel in the sensor that will allow oil from the sensor body to enter the sensor (Figure 6). This will allow pressure change outside the sensor to propagate to the inside. The number of pressure compensation wires depends on the sensor type.

Place the O-ring inside the connector body as shown in Figure 11.

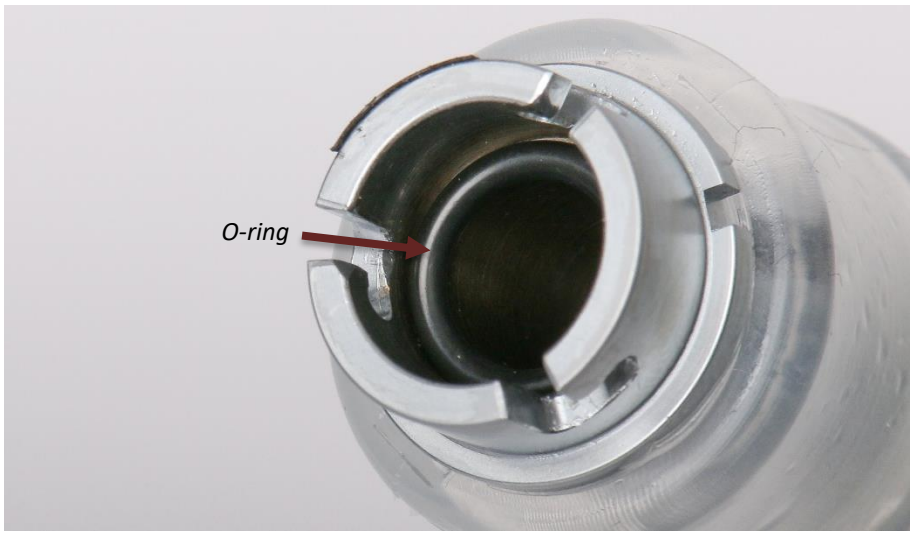

Figure 11: Connector body with O-ring in place.

Loosen the locking nut on the connector body and insert the shaft and cables of the microsensor into the connector body. The sensor should be inserted until the locking nut on the sensor protection tube touches the locking nut on the connector body to make the cables reach out of the connector body as much as possible. (Figure 12). It may be necessary to loosen the locking nut on the sensor protection tube and slide the sensor a bit further out of this, so that the wires will reach far enough out of the connector body to comfortably make the connections.

Figure 12: Microsensor inserted in the connector body with the cables and connectors extending.

Connect the cables on the sensor with the cables on the plug, connecting cables with the same colour (Figure 13). Make sure that the colours on the two cables for each connection are identical. Wrong connection may destroy the sensor.

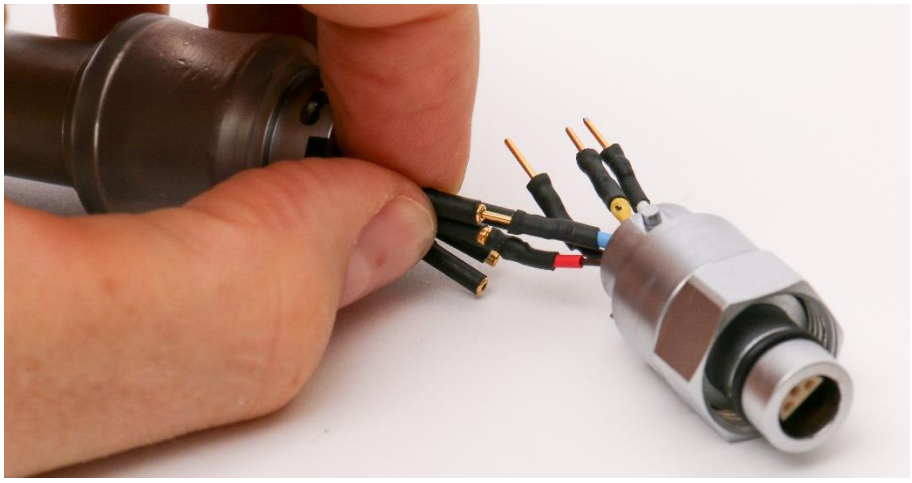

Figure 13: Connect the connectors on the sensor cables with the pins on the plug cables. Observe the colour coding.

Once all the connections have been made (doublecheck that the colour coding is correct) pull the sensor gently away from the connector body while simultaneously gently pushing the connected wires into the connector body (Figure 14). Match the three notches on the plug to the guides in the connector body. Once the plug is fully inserted, twist this counter-clockwise until it clicks into place. This may require a reasonable amount of force.

Figure 14: All connections have been made and the sensor must be gently pulled away from the connector body and the cables and the plug must be pushed into the body.

The sensor may now be pushed gently a little into the connector body. Take care not to crush the wires and connections inside. Tighten the locking nut by hand when the sensor is in the correct position. If the sensor can move too much sideward relative to the connector then loosen the locking nut slightly and push the sensor further in and tighten the locking nut again.

Figure 15: Microsensor with In Situ UniAmp Connector mounted

7 General advice on handling and storage of sensors

As soon as the pressure compensation wire has been removed from the sensor, the sensor must be mounted in the In Situ UniAmp Connector and this must be filled with oil. The electrolyte will evaporate through the pressure compensation channels if left open. Mounting and filling with oil will prevent this. Hereafter the sensors should be stored upright with the connector pointing upwards to minimize mixing of oil and electrolyte.

7.1 Suggested storing, transport and handling of sensors:

1. Test the sensor upon receipt without removing the pressure compensation wires (see paragraph 8)
2. Store and transport the sensor in the membrane box in which it was shipped
3. Remove the pressure compensation wires, mount the sensor in the In Situ UniAmp Connector, and fill with oil first when the sensor will be used
4. After mounting and filling with oil, store and transport the sensor upright (connector pointing upwards).

8 Testing a sensor upon arrival

All Unisense microsensors must be tested within two weeks after receipt. You can do this using a Unisense lab amplifier or the In Situ UniAmp amplifier and this may be done without mounting the sensor in the in situ connector.

If you want to test a sensor on a lab amplifier you will need a cable with a standard lab connector at one end and open golden pins at the other. Just connect the pins of this cable to the connectors on the sensor and plug it into the lab amplifier. Make sure that the colours on the pins and the connectors are identical. Wrong connections may destroy the sensor. Contact Unisense if you need such a cable.

You can also test the sensor on the In Situ UniAmp amplifier without mounting it in the In Situ Connector, just using the Connector Plug (Figure 16). Connect the cables on the sensor with the cables on the plug, connecting cables with the same colour (Figure 13). Make sure that the colours on the two cables for each connection are identical. Wrong connection may destroy the sensor. Mount the connector plug in the In Situ UniAmp amplifier and test the sensor.

The signal from the sensor mounted in one of these ways will show more noise than when mounted fully in the UniAmp Connector because the electrical shielding provided by the connector body is missing here. However, the performance of the sensor can easily be tested this way.

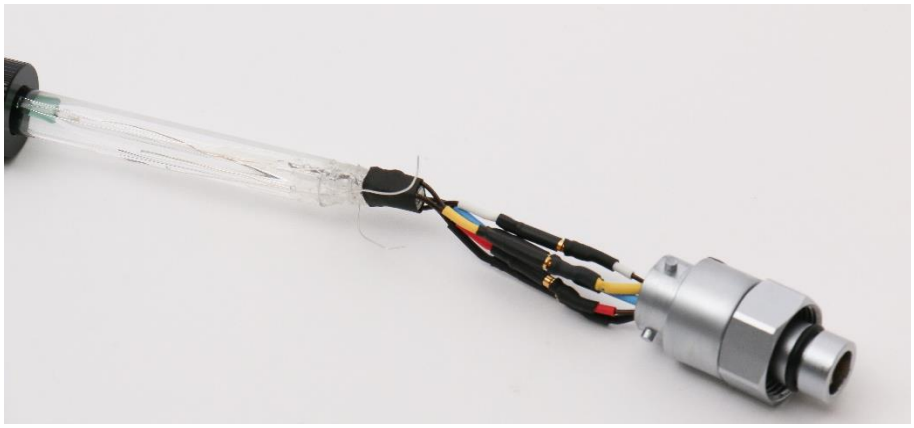

Figure 16: Sensor mounted with the connector plug for testing.

9 Filling connector and sleeve with oil

The In Situ UniAmp connectors must be filled with high purity paraffin oil e.g. Sigma-Aldrich prod. no: 18512-1L. Pure paraffin oil has a very low electrical conductivity. If it gets contaminated, the conductivity is higher, and it may allow a current to run between the cables which will give a falsely high signal. If this happens, clean the cables, the top of the sensor, and the inside of the connector and replace the oil.

For filling with oil, you will need: paraffin oil, a syringe with cut off needle, gloves, and paper towel

Figure 17: Ready for filling with oil.

9.1 Filling the connector body with oil

1. Remove the pressure compensation wire (Figure 10) by pulling gently using pliers or tweezers. This will leave a channel between the connector and sensor interior.
2. Push the silicone rubber sleeve to the side and inject oil through the hole in the side of the connector body (Figure 18). Tilt the connector and sensor back and forth to allow the interior of the body to become completely filled with oil and let all the air escape.

3. Slide the sleeve into the closed position between the two protruding rings on the connector body (Figure 19) completely covering the hole in the connector body.

Figure 18: Injecting oil into the UniAmp connector body.

Figure 19: UniAmp connector body with the sleeve in the closed position.

9.2 Filling the sleeve with oil

Before filling the sleeve with paraffin oil make sure that the sleeve is positioned between the two ridges on the connector body, covering the hole in the UniAmp connector body as shown in Figure 19.

Filling the sleeve with oil:

1. Place the connector and sensor flat on the table with the oil filling hole facing upwards.
2. Insert the cut off needle under the sleeve as shown in Figure 20.
3. Inject oil slowly, letting it fill the space under the sleeve from below and letting the air out along the needle.
4. When only a small air bubble is left, pick up the connector and sensor so that the air moves to where the needle is inserted (Figure 21). Inject oil slowly, letting the last air escape along the needle. Pull out the needle when only a small air bubble is left. The sleeve is now filled with oil and only a small air bubble is left as shown in Figure 22.

Figure 20: Filling the cavity under the sleeve with oil

Figure 21: Filling the sleeve with oil and letting the last air escape

Figure 22: Sleeve appropriately filled with oil with a small air bubble left

10 Mounting the UniAmp connector on the bulkhead

10.1 Shallow version

The UniAmp connector is mounted on a bulkhead connector on an in situ amplifier (as shown in Figure 23).

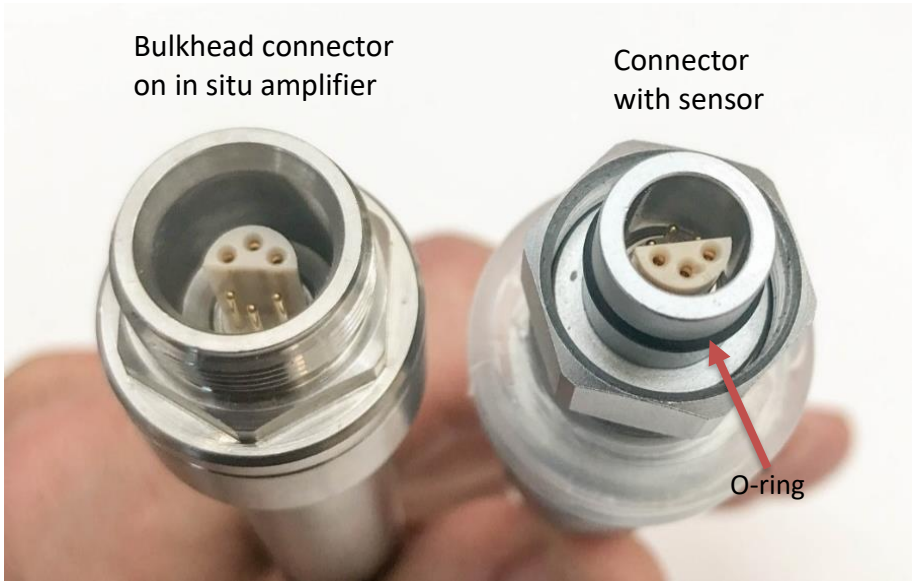

Figure 23: Shallow version bulkhead connector on an in situ amplifier (left) and UniAmp connector with sensor (right).

Figure 24: In Situ UniAmp with connector and sensor. Shallow version.

Mounting the connector on the bulkhead:

1. Make sure that the bulkhead connector and the UniAmp in situ connector are clean.

2. Check that the O-ring is in sitting correctly, is lubricated, and intact. Regarding lubrication of the O-ring: after cleaning (if necessary) apply O-ring grease so that the O-ring and groove is covered. Remove excess grease with a dry clean cloth until the O-ring only has a thin shiny layer of grease.
3. Insert the UniAmp connector into the bulkhead, oriented so that the two half-moon shaped parts can pass by each other.

Make the hexagonal nut engage with the thread on the bulkhead and hand-tighten this. Do not use tools for this

10.2 Deep Sea version

The UniAmp connector is connected to the narrow end of the In Situ UniAmp (Figure 3). Align the pins and holes and insert the pins into the holes. Tighten the plastic cap by hand. It may be necessary to push the pins in and tighten a few times, to get the pins fully inserted.

Make sure both parts of the connector are clean. Apply a slight amount of silicone grease now and then to keep the connector pins shiny.

Figure 25: Deep Sea version In Situ UniAmp (right) and UniAmp connector (left).

Figure 26: In Situ UniAmp with connector and sensor. Deep sea version.

11 Transport and storage of sensor-connector assembly

11.1 Sensors for < 50 m water depth

For transport, the sensors mounted in the In Situ Connector should be packed in the membrane box in which they are delivered. For correct packing, place the sensor so that it is squeezed in between the two membranes (Figure 27). For storage see the relevant sensor manual which can be found here: http://www.unisense.com/manuals/

11.2 Sensors for > 50 m water depth

Sensors that have the pressure compensation wire in place should be shipped and stored in the membrane box in which they were delivered.

When the pressure compensation wire has been removed and the sensor has been mounted in the In Situ Connector, the sensor-connector assembly should be shipped and stored upright with the tip pointing down. This is to prevent electrolyte from entering the connector body. Inside the connector body there are un-insulated cables connecting the sensor to the connector and electrolyte around these may short the sensor. The best way to ship oil filled sensors is to place them upright in boxes with other equipment, e.g. in a heavy aluminium box. Such boxes are generally not turned upside down during transport.

Figure 27: Membrane box with sensors placed between membranes.

12 Electrolyte for in situ sensors

Important for deep sea in situ sensors:
To enable pressure compensation in the electrolyte reservoir, the in situ sensors for depths > 50 m are equipped with a channel through the glue that binds the inner and outer glass tubes together at the top of the sensor (closed with a silver wire when shipped, see Figure 5 & Figure 6). Furthermore, part of the space between inner and outer glass tubes is sealed with silicone. Over time electrolyte in the sensor can evaporate or leak through the channel and the silicone. Sufficient levels of electrolyte in the sensor are required for connection between the anodes and the cathodes of Unisense amperometric gas sensors, and for connection between the internal reference of redox and pH electrodes. Furthermore, sufficient electrolyte volume shields against electrical noise. Therefore, it is **critical to maintain appropriate electrolyte volume** in the sensor.

The sensor has appropriate electrolyte volume when only a small air bubble (<0.1 mL) is present in the electrolyte reservoir.

A minor leak of electrolyte (<10%) can be restored by injecting distilled water into the sensor. In case more than 10 % is missing, the electrolyte should be refilled with the specific electrolyte described in the recipes below.

Electrolyte for in situ sensors:
pH/redox electrodes:
1 M KCl

Oxygen sensors:
Add to 1 L of distilled water:
1.25 g $KHCO_3$
25.90 g K_2CO_3
39.00 g KCl

H_2S-type sulfide sensors:
Mix 50 mL 0.5 M $KHCO_3$ + 50 mL 0.5 M K_2CO_3. Then add and dissolve 1.64 g $K_3Fe(CN)_6$.

Use double distilled water for mixing the electrolyte. The solution must be absolutely clean and kept absolutely dark.

13 Procedure for refilling electrolyte on in situ sensors

CAUTION: The cavity in the centre glass tube of the sensor/electrode with the blank wire is also pressure compensated with a channel, therefore be careful not accidentally to fill electrolyte into this cavity, as this may destroy the sensor.

Unmounted sensors can directly be refilled with electrolyte as described below. Sensors mounted in the In Situ UniAmp Connector first needs to be removed from the connector. Twist the connector Plug to loosen it (see Figure 7) and pull it gently out of the Connector body. Pour the oil from the Connector body into a container. Loosen the Locking nut on the Connector body and push the sensor into the Connector body as far as possible (Figure 12). Now disconnect the sensor cables from the pins on the Plug (see Figure 13). Pull the sensor gently out of the Connector body.

Refilling of electrolyte or water (see paragraph 12 above) is done by injecting it with syringe and needle through the silicone part of the seal between the inner and outer glass tubes at the top of the sensor (Figure 28). The largest part of this seal consists of glue and a small part consists of silicone rubber. The silicone rubber part is slightly more opaque than the glue and is soft and can be penetrated with a hypodermic needle. The glue is hard and cannot be penetrated by the needle.

Use a clean syringe with a needle of 0.4 mm and fill electrolyte or water into the syringe. Remove any air bubbles from the syringe. Locate the silicone part of the seal and insert the needle through this, while keeping the sensor vertical (tip down). Insert a second open needle through the silicone (Figure 28). The tip of the open needle must be just below the silicone seal and will act as a vent to

let out air. The tip of the needle, that is mounted on the syringe, must be just at the surface of the electrolyte inside the sensor.

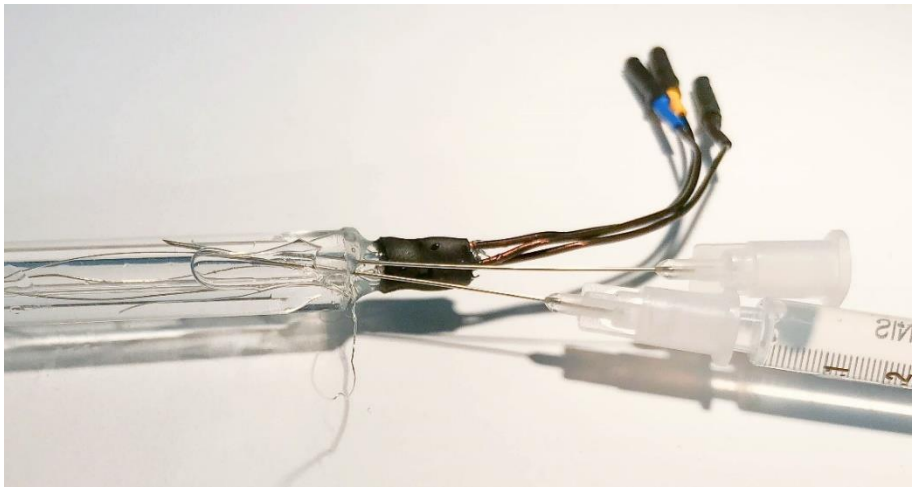

Figure 28: Injection of electrolyte into in situ sensor

With the needles in place, inject slowly. The electrolyte levels should now increase, with the air escaping through the open needle in the top seal of the microsensor. If electrolyte escapes instead of air try tilt the sensor so the air is on the side of the sensor where the open needle is, reposition needles, inject faster/slower etc. Keep a piece of paper tissue around the top of the sensor to catch spills.

The sensor is now ready for mounting in the In Situ UniAmp Connector again (see paragraph 6).

NOTE: Sensors for use at more than 50 m water depth are pressure compensated. If the pressure compensation wire (Figure 10) has been removed there is an opening into the electrolyte. If this is left open to the atmosphere, the electrolyte will evaporate. Therefore, sensors where the pressure compensation wire has been removed must be mounted in the In Situ UniAmp Connector and this must be oil filled. This will prevent the electrolyte from evaporating.

14 Testing the in situ amplifier

The in situ amplifier can be tested by mounting a Test Sensor on the amplifier and recording the signal from the amplifier. The expected signal depends on the amplifier type. To test the in situ amplifier, simply connect the test sensor wires to an In Situ Connector plug, observing the colour coding as shown for a real sensor in Figure 13, and connect it to the in situ amplifier. If the amplifier works correctly, the resulting signal will be stable and close to the expected value.

The test sensor for amperometric amplifiers (O_2, H_2, H_2S, N_2O, NO) is an electrical resistor mounted in a glass tube with two wires for connecting to an In Situ Connector plug (Figure 29). This will simulate a microsensor and give a constant signal. For a Test Sensor with a 1 GΩ resistor the signal will be 1 pA for -1 mV polarization. Normally, 1 pA is converted to 1 mV in the Field Datalogger (except for Eddy Covariance amplifiers, see below), Underwater Meter, and Field Datalogger Mini. See Table 1 for the expected signal for each In Situ UniAmp type.

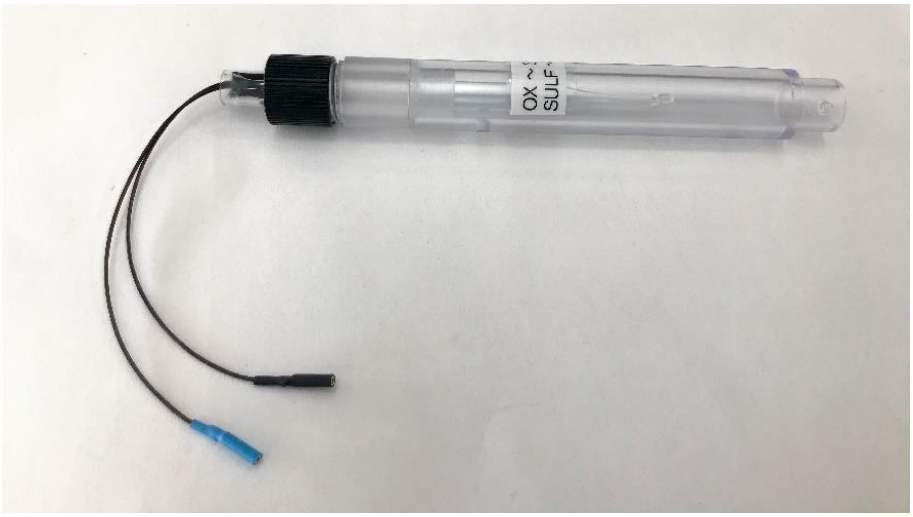

Figure 29: Test sensor for amperometric in situ amplifiers. The two wires must be connected to pins of the same colour on an In Situ Connector plug.

Table 1: Expected test values for the different amplifier types when mounting a 1 GΩ resistor. Up to 10% deviation from the expected signal is fine.

Sensor	Amplifier type	Expected signal (mV)
O_2	OX	800
H_2S (SULF-type)	SULF	200
H_2S (H2S-type)	H2S	85
N_2O	N2O	800
H_2 (Version 1, → Oct. 2020)	H2 version 1	1000
H_2 (Version 2, Oct. 2020 →)	H2 version 2	100
NO	NO	1250

The oxygen amplifier for Eddy Covariation system is different from the standard oxygen amplifier. The signal is amplified by a factor of 10 and the zero reading is -2500 mV. Therefore, to keep the signal within the working range of the amplifier, a different resistor is used. For example: A test sensor with a 2 GΩ resistor will generate a signal of 400 pA. The amplifier will multiply this by 10 giving a signal of 4000 pA, but because the baseline of the amplifier is -2500 pA the reading will be 4000 pA - 2500 pA = 1500 pA. In the Field Datalogger, 1 pA is converted to 1 mV and the signal will thus be 1500 mV. Up to 10% deviation from the expected value is fine.

The Test Sensor for pH and mV amplifiers is a battery box with two wires attached. This will generate a signal in mV as indicated on the Test Sensor.

15 Warranty and liability

15.1 In Situ Amplifier

The in situ amplifier is covered by a one year warranty.

The warranty does not include repair or replacement necessitated by accident, neglect, misuse, unauthorized repair, or modification of the product. In no event will Unisense be liable for any direct, indirect, consequential or incidental damages, including lost profits, or for any claim by any third party, arising out of the use, the results of use, or the inability to use this product.

Equipment that is not covered by the warranty will, if possible, be repaired by Unisense with appropriate charges paid by the customer. In case of return of equipment please contact us for return authorization.

For further information please see the documents Conditions for Sale and Delivery for Unisense and Warranty and Shipping Information as well as the manuals for the respective products.

15.2 Microsensors

The microsensors are covered by a limited warranty as indicating in the manual for each type of sensor. This warranty requires that the sensors are tested within 2 weeks of receipt. See *8 Testing a sensor upon arrival* for how to test the sensor. Unisense should be notified of any malfunction shortly hereafter.

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