

RBR *quartz*³ BPR | zero INSTRUMENT GUIDE



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1 RBRquartz³ BPR | zero

The RBRquartz³ BPR | zero is a special version of the robust RBRquartz³ BPR (Bottom Pressure Recorder) with the additional advantage of the AzeroA correction technique.

The instrument integrates one or two Paroscientific Digiquartz® pressure gauges, an internal quartz barometer, and a switching valve. It is the switching valve that provides *in situ* reference measurements to correct for the long term drift in the pressure gauge. The resulting drift is several hundred times lower than with uncompensated measurements.

The RBRquartz³ BPR | zero is intended for deep, long-term deployments where high stability and resolution of absolute pressure measurements are critical. Its applications include detection of natural disasters, such as avalanches, earthquakes, severe weather, tsunamis, and wake turbulence.

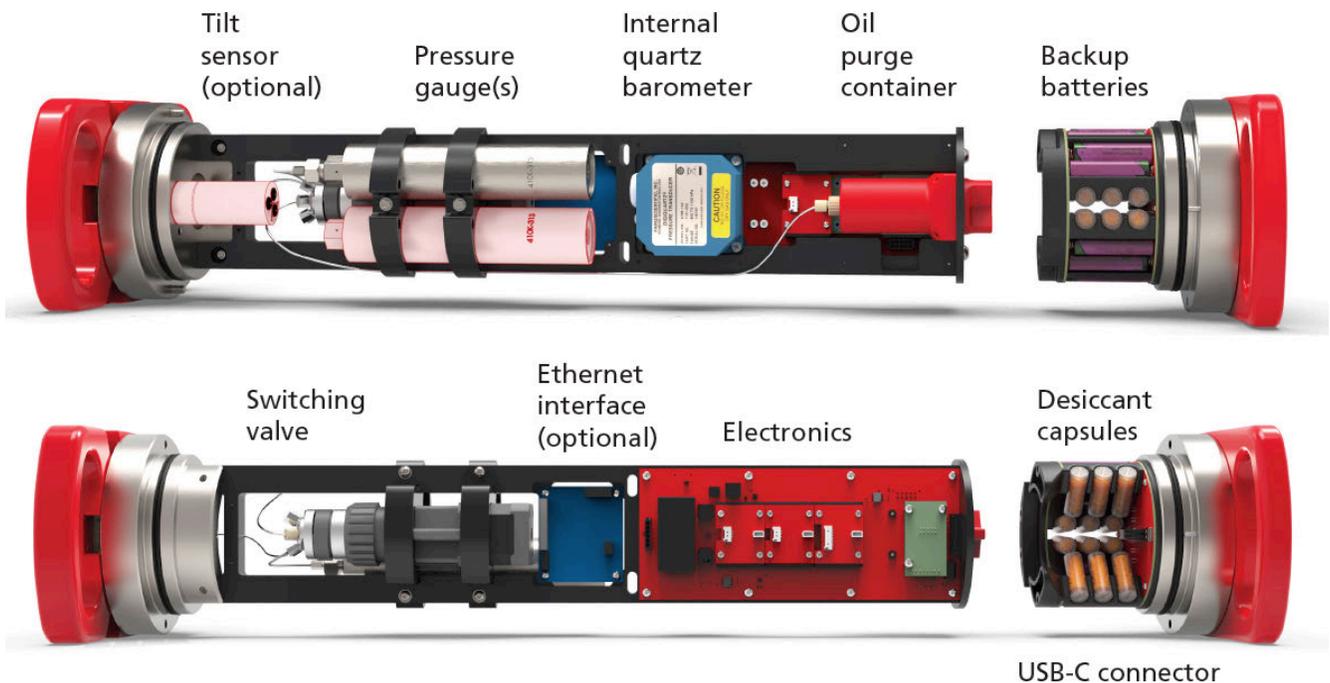
Key features of the RBRquartz³ BPR | zero are:

- AzeroA drift correction
- High accuracy
- Quartz stability
- Long deployments

Extend deployment times even further using external power supply from the RBRfermata (power) or the RBRcervata (power and memory) canisters. Alternatively, use an extension cable to connect the instrument to an observatory for external power and realtime data access.

The RBRquartz³ BPR | zero may include an optional built-in tilt sensor (accelerometer).

For a detailed description of bottom pressure recording using the RBRquartz³ BPR | zero, see [Ruskin User Guide: Standard Loggers³](#).



RBRquartz³ BPR | zero

2 Specifications

Instrument

Specification	Description
Maximum number of readings*	~240 million
Power	Internal: 8 AA cells (for backup power only) External: 9.5V to 30V
Communications	Internal: USB-C External: RS-232, RS-485, or Ethernet
Clock drift	±60 second/year
Depth rating	7000m
Housing	Titanium
Diameter	~140mm
Length	~788mm
Weight (single Paroscientific unit, with batteries)	30Kg in air, 18Kg in water

*Each sample can include multiple readings.

**Exceeding the absolute maximum pressure will damage the instrument.

Temperature sensor

Specification	Description
Range	-5 to 35°C*
Initial accuracy	±0.002°C
Resolution	0.00005°C
Typical stability	±0.002°C/year
Time constant	~3min

*A wider temperature range is available upon request. Contact [RBR](#) for more information.

Pressure sensor

Specification	Description
Range	1000 / 2000 / 4000 / 7000dbar
Initial accuracy	±0.01% full scale
Resolution	10ppb (at 1Hz sampling rate)

Power supply selection

If connected, an external power supply will be used preferentially over the internal batteries as long as the voltage remains 4.5V or greater. If it drops below 4.5V or complete disconnection occurs, the system automatically switches to the internal batteries. The internal batteries are sufficient to maintain sensor operation without the switching valve. The external power supply and cables shall support inrush currents of up to 5A for proper valve operation.

 External power with voltage of 9.5V or higher is required to operate the switching valve.

Clock

The instrument's clock is maintained during brief disconnections. This time is usually sufficient to change batteries or replace desiccants.

USB-C power

The USB-C cable provides power sufficient for configuration or data download. However, the instrument requires an internal or external power supply to perform sampling.

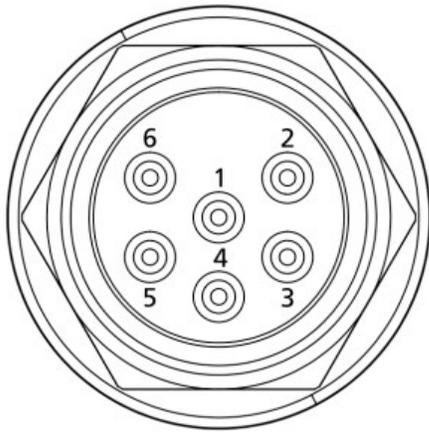
Deployment estimates

Deployment times are estimated for lithium thionyl chloride batteries based on both memory and internal battery capacity.

Speed	Internal LTC batteries only (no valve operation)		RBR <i>fermata</i> with LTC batteries (with the valve activated every 20 days)	
	Time (days)	Number of samples	Time (days)	Number of samples
8Hz	32	22M	75	45M
4Hz	32	11M	150	45M
2Hz	32	5.6M	300	45M
1Hz	32	2.8M	610	45M

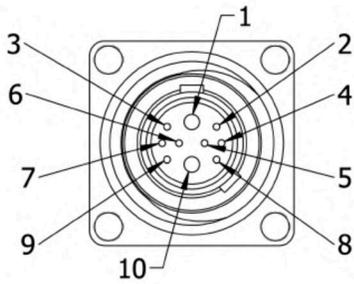
External MCBH-6-MP connector pinout

Pin No.	USB	RS-232	RS-485	Ethernet
1	Ground			
2	Power 9.5V to 30V			
3	N/C	Data output from the instrument (Tx)	TD (A)-	Data output from the instrument (Tx-)
4	VUSB +5V	Data input into the instrument (Rx)	RD (B)+	Data input into the instrument (Rx+)
5	D-	N/C	RD (A)-	Data input into the instrument (Rx-)
6	D+	N/C	TD (B)+	Data output from the instrument (Tx+)



External MINK connector pinout

Pin No.	RS-232	RS-485	Ethernet
1	Power 9.5V to 30V		
2	N/C	RD(A)	Data output from the instrument (Tx+)
3	N/C	N/C	Data input into the instrument (Rx+)
4	Data output from the instrument (Tx)	RD(B)+	Data output from the instrument (Tx-)
5	Ground		
6	Data input into the instrument (Rx)	TD(B)+	N/C
7	N/C	N/C	Data input into the instrument (Rx-)
8	N/C		
9	N/C	TD(A)-	N/C
10	Ground		



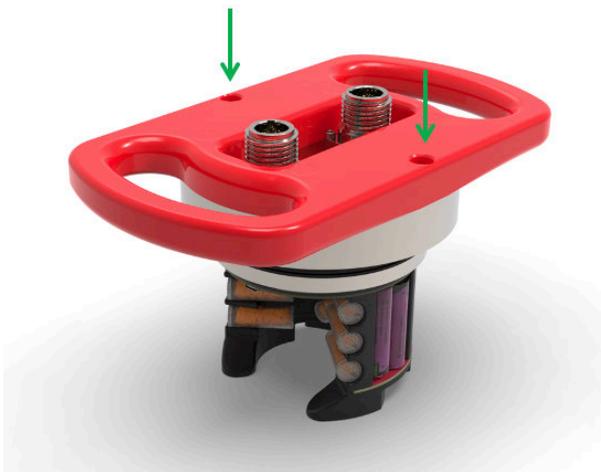
3 Hardware

3.1 Opening and closing the instrument

⚠ When opening the instrument, make sure to keep the O-rings clean and avoid scratching the O-ring mating surfaces.

Opening the instrument

1. Place the RBR*quartz*³ BPR | zero vertically with the battery end-cap up and the sensor end-cap down. Alternatively, you can lay it on the side.
2. Unscrew and remove the two cap screws using a 5mm hex key.
3. Rest the battery end-cap on the side of the instrument, as shown.



Locations of cap screws



Open instrument, with the end-cap resting on the side

Disconnecting the umbilical cable

1. Locate the small latch on the side of the connector.
2. Press the latch with your thumb and pull the connector down.
3. Set the battery end-cap aside..

 Do not pull on the wires attached to the connector!

Closing the instrument

1. If disconnected, insert the umbilical cable back in its socket.
2. Align the battery end-cap with the slot on the instrument housing and gently push down to ensure it fits in place.
3. Reinstall the two cap screws and tighten to 1/4 turn past tight (10Nm max).

3.2 RBR*quartz*³ BPR | zero interface

The RBR*quartz*³ BPR | zero instrument provides an internal USB-C port and several external communication options. Select from RS-232, RS-485, and Ethernet at the time of order, and RBR will wire the battery end-cap to support your preferred external connection.

 Patch cables and underwater extension cables are sold separately.

USB-C connection

The USB-C port is located under the battery end-cap.

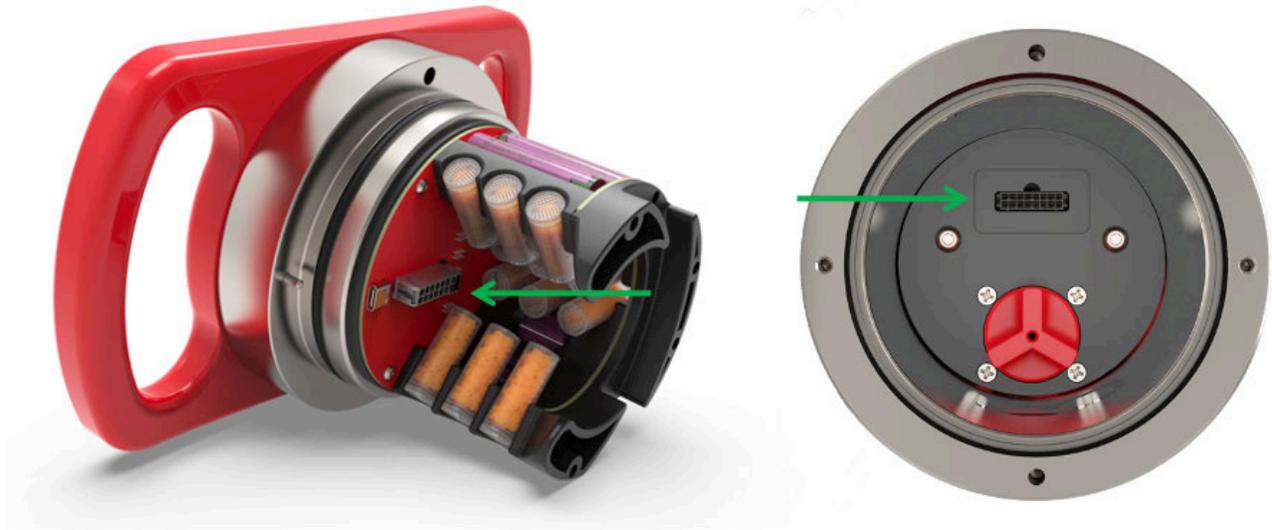


USB-C port

Refer to [Opening and closing the instrument](#) for details on accessing the internal USB-C port.

Umbilical connection

The umbilical cable connects the RBR*quartz*³ BPR | zero to the connectorised end-cap. There are two ports: one under the end-cap and one inside the instrument.



Umbilical ports

End-cap types

The RBR*quartz*³ BPR | zero battery end-caps may support a MINK-10-FCR connector, two MINK-10-FCR connectors, or two MCBH-6-MP connectors, depending on the type.



Dual MINK battery end-cap

MINK battery end-cap

Dual MCBH battery end-cap

Refer to [Specifications](#) for the external connector pinout diagrams.

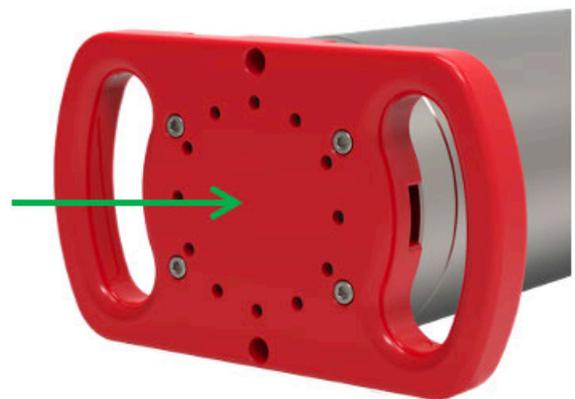
3.3 Orientation and datum location

The datum of the RBR*quartz*³ BPR | zero is located at the centre of the sensor end-cap. RBR performs an offset adjustment with the pressure sensor facing downwards, as shown in the first image below. It is recommended to deploy the instrument vertically with the battery end-cap up and the sensor end-cap down. It is acceptable to deploy horizontally if necessary.

⚠ Avoid deploying the instrument vertically with the sensor end-cap up! Such orientation will affect performance of the pressure sensor due to increased build-up of sediment.



Recommended orientation: sensor end-cap down



Datum location

3.4 Underwater battery canisters

RBR offers optional battery canisters which can extend deployment of instruments requiring a nominal 12V supply.

RBR*fermata*

The RBR*fermata* is a standard battery canister operating with lithium thionyl chloride and alkaline batteries. It prolongs deployment by providing 1kWh of power to any underwater instruments. For standard RBR instruments, this is approximately a 40x improvement to our extended battery carriage capacity.



RBR*fermata*



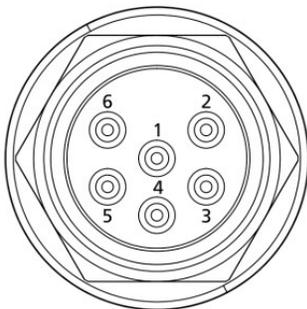
RBR*fermata* | deep

Specification	Description
Weight (with LTC batteries)	13kg in air, 2kg in water (plastic) 29kg in air, 17kg in water (Ti)
Batteries	56 D-type cell batteries
Connector	Three MCBH-6-FS
Diameter	140mm
Length	663mm
Depth rating	750m / 4000m / 10000m
Capacity*	1kWh (alkaline), 1.5kWh (LTC)

*temperature dependent

External MCBH-6-FS connector pinout

Pin No.	USB
1	Ground
2	Power
3	N/C
4	N/C
5	N/C
6	N/C

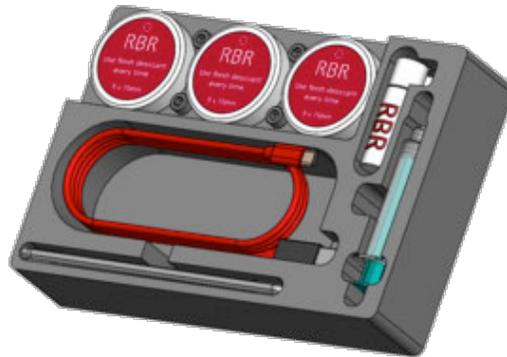


**RBR*fermata*
with the battery carriage pulled out**

4 General maintenance

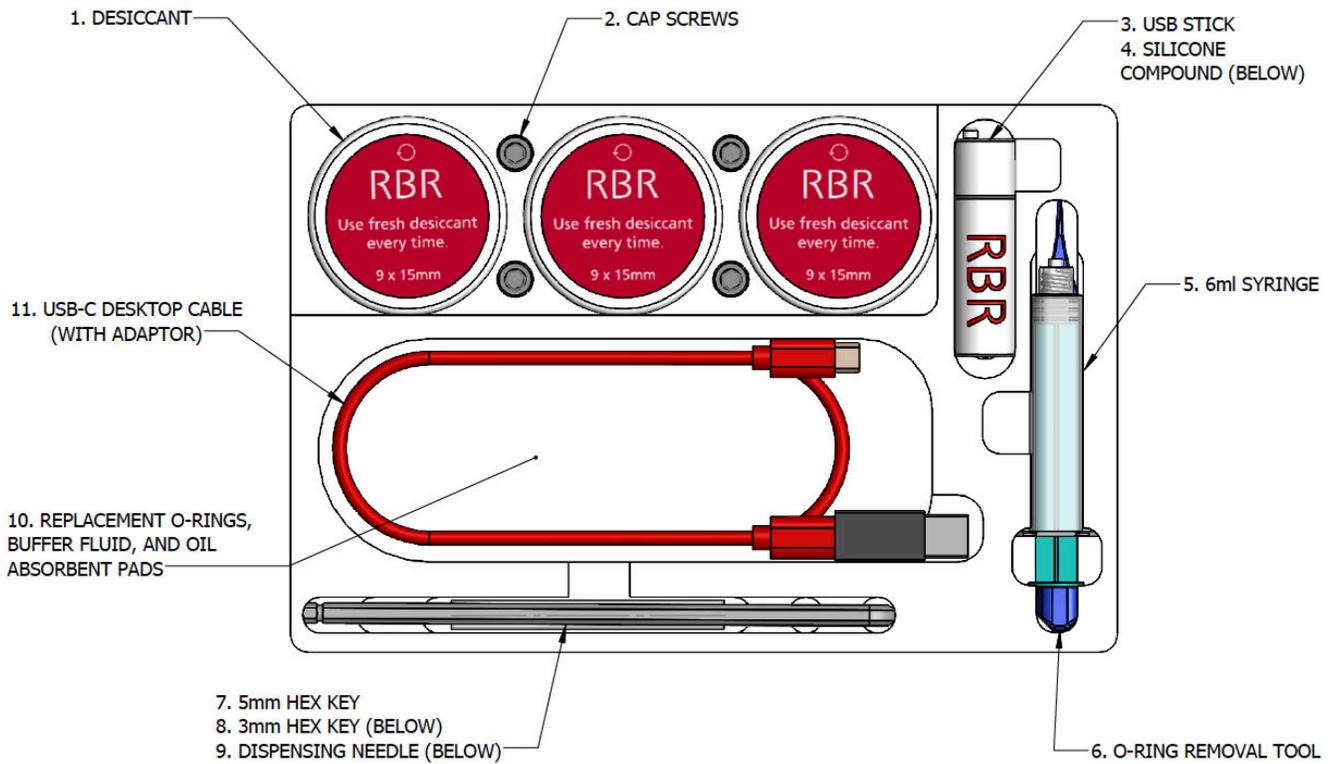
4.1 Support kit

RBR provides one support kit per every three instruments ordered. If you need more units, contact [RBR](#).



RBRquartz³ BPR | zero support kit

The RBR support kit contains an assortment of basic accessories and spare parts, as presented below.



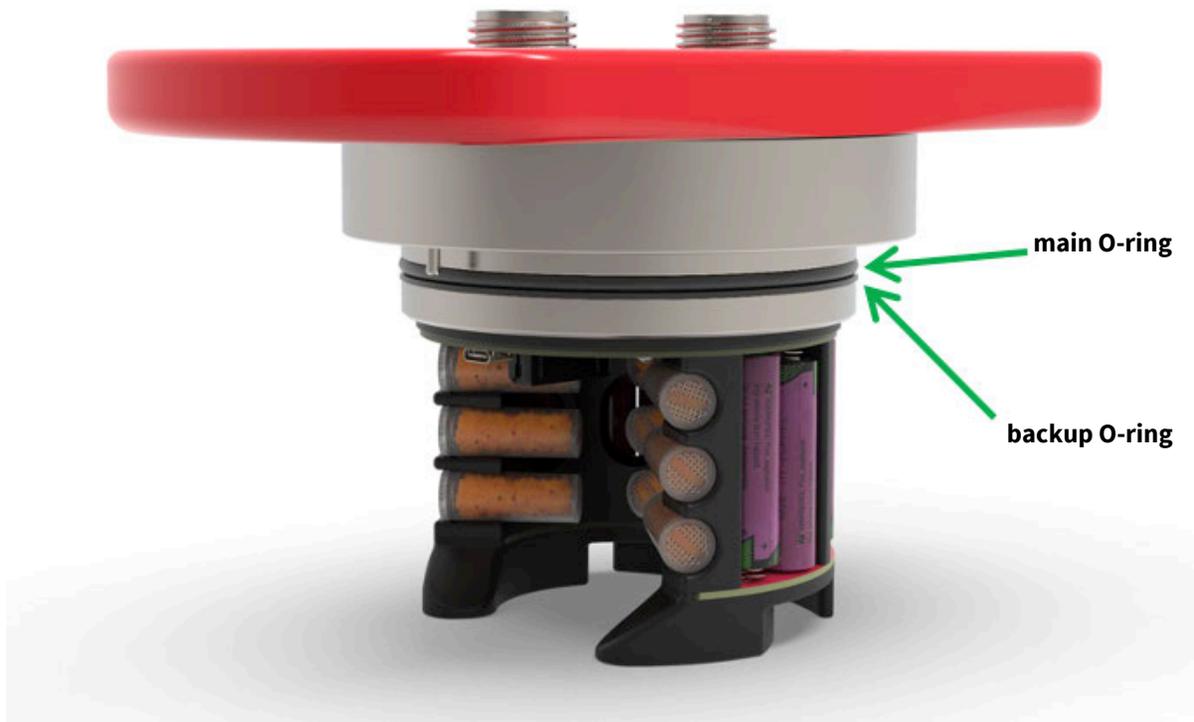
RBRquartz³ BPR | zero support kit diagram

4.2 Replacing the O-rings

Care for the O-rings is the single most important item of maintenance on any submersible RBR instrument. A water leak can damage the circuit board beyond repair and cause complete data loss. Every instrument's seal depends upon its O-rings, not the end-cap tightness. Therefore, proper O-ring maintenance is crucial.

i The O-rings may lose elasticity over time, even when the instrument is not deployed. RBR strongly recommends replacing the O-rings regularly.

The RBR^{quartz}3 BPR | zero uses two O-rings. One is the main O-ring, and the other is the backup. Both are required to protect the instrument from flooding. To access the O-rings, [open the instrument](#).



Location of the O-rings (main O-ring, backup O-ring)

Inspecting the O-rings and mating surfaces

Visually inspect the new O-ring for nicks and scratches before installing it. Pay attention to the following areas:

- The surface of the O-ring itself
- The mating surface on the inside of the case between the threads and the open end
- The groove in the end-cap where the O-ring sits

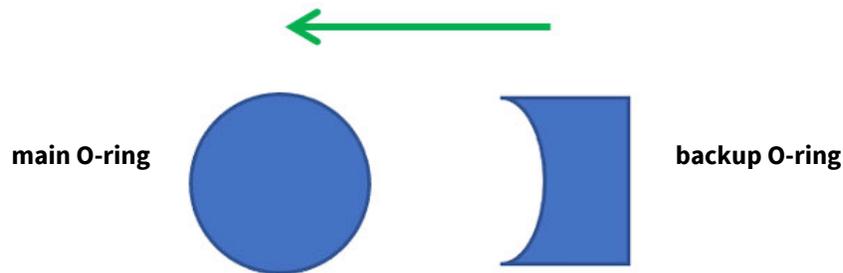
- ⚠** When handling O-rings:
- Avoid using any object that could scratch the O-ring or any of its mating surfaces.
 - If dirt is present in the O-ring groove, remove the O-ring as described below and thoroughly clean the groove.
 - Do not return this old O-ring to the instrument! If you remove the O-ring from the instrument for any reason, always replace it with a new one.
 - If the surfaces of the O-ring groove are scratched, pitted, or damaged, contact [RBR](#) for advice.

Replacing the O-rings

Correct placement and orientation of the two O-rings are critical to maintaining depth rating integrity.

The main O-ring has a round profile. It must be installed first.

The backup O-ring is flat on one side, and concave on the other. When installed, the concave side must face the main O-ring.



Orientation of the O-rings (main O-ring, backup O-ring)

- ⚠** Do not use metal screwdrivers or any other metal tool! They may scratch the O-ring groove and render the end-cap useless.

1. Use the plastic O-ring tool (included in the [support kit](#)) to remove the O-rings from the groove. The O-ring may need to stretch quite a bit as it is pushed off. This requires some effort, but can be done by hand.
2. Clean the groove thoroughly with a soft, lint-free cloth and compressed air, if necessary.
3. Select the proper O-rings and inspect it for damage.
4. Lubricate with a very light film of silicone compound (included in the [support kit](#)).
5. Install the main O-ring by pushing it into place and popping it into its groove.
6. Install the backup O-ring, ensuring that the concave side is facing toward the main O-ring.
7. Once in place, inspect the O-rings once more for scratches and debris, and wipe away any silicone compound deposited on the end-cap.
8. Once the inspection is complete, [close the instrument](#).

4.3 Replacing batteries

RBR ships new instruments with lithium thionyl chloride batteries included. Replace batteries before each deployment to maximise the operational time and prevent data loss.

Ruskin software allows users to estimate the remaining battery life during deployment (assuming fresh batteries) by tracking power consumption in mAh. See [Ruskin User Guide: Standard Loggers³](#) for more information on predicting battery life.

Replacing the batteries

1. Remove the battery end-cap. See [Opening the instrument](#).
2. Remove the eight old AA-type cell batteries.
3. Insert eight new AA-type cell batteries.
4. Check for correct battery polarity.
5. Return the end-cap back in its place. See [Closing the instrument](#).



Battery end-cap, with batteries

4.4 Replacing desiccant capsules

Replace desiccant capsules before each deployment.

Fresh desiccant will keep the instrument compartment dry and prevent malfunction. Water damage may occur if condensation forms inside the instrument.

As a preventative measure, RBR recommends servicing the instrument in a cool, dry place (when possible).

Replacing the desiccant capsules

1. Remove the battery end-cap. See [Opening the instrument](#).
2. Locate the desiccant holder inside the battery end-cap.
3. Remove the used desiccant capsules from their sockets.
4. Insert fresh desiccant capsules into their sockets.
5. Once all the capsules are secured, insert the battery end-cap back in its place. See [Closing the instrument](#).



Location of the desiccant capsules

All instruments ship with fresh reusable desiccant capsules. They use a cobalt-free colour changing indicator dye. Orange indicates fresh desiccant, while green indicates it is saturated (about 17% water by weight). Once exhausted, the capsules can be replaced with new ones (available from RBR), or refreshed.

Refreshing the desiccant

To refresh the desiccant, saturated silica beads must be removed from their capsule and heated to 120°C for about two hours. Once cool, refreshed beads can be returned to the capsule and reused.

⚠ Always remove the beads from their capsule before refreshing! The plastic capsule will deform if heated to 120°C.

4.5 Cables and connectors

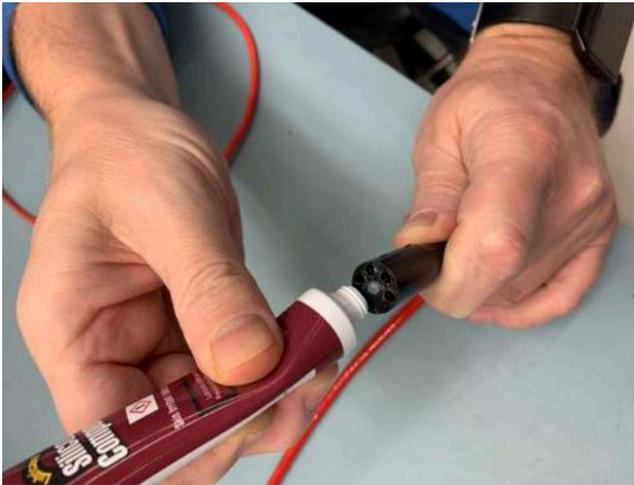
Cable bend radius

The smallest bend radius for RBR supplied cables is 15cm.

Lubricating the connectors

Lubrication improves watertight sealing, prevents corrosion, and reduces the force required to de-mate the connector. Use the silicone compound provided with your instrument.

- Apply the silicone compound to all female connectors before every mating
- Ensure each connector hole is filled with approximately 30% lubricant



Lubricating a connector

Reducing mechanical stress

- Do not pull on the cable
- Hold onto the connector to pull out the cable
- Disconnect by pulling straight out, not at an angle
- Avoid sharp bends at the point where the cable enters the connector
- Avoid angular loads on the connector

4.6 Cleaning the instrument

Clean the instrument after each extended deployment to remove deposits that may have accumulated.

Type	Procedure	Notes
General/biofouling	To clean the exterior, soak in a mild detergent, then scrub the instrument with a soft brush.	Avoid scratching the plastic (scratches make future cleaning more difficult).
Sensor antifouling mesh	Scrub the antifouling mesh with a soft brush. Replace the antifouling mesh if needed.	See instructions on removing the antifouling mesh for more information.
Calcification	Soak in vinegar for six hours, then scrub the surface using a soft brush.	Soaking in vinegar for more than 24 hours may damage the O-ring and increase the chances of a leak.

4.7 Calibrating the instrument

Factory calibration coefficients are calculated for each sensor, and the coefficients are stored on the instrument.

RBR calibration certificates contain calibration equations, coefficients, and residuals for each sensor. Hard copies are provided with each shipment. RBR can replace lost or misplaced calibration certificates upon request.

RBR recommends calibrating your instrument before any critical deployment, periodically once a year, or if you suspect the readings to be out of specifications.

Discuss your calibration requirements with RBR. In some cases, the instrument will need to be returned to RBR to have it checked and re-calibrated.

Please contact [RBR](#) for our current calibration fees.

5 Oil purge container maintenance

The RBRquartz³ BPR | zero uses one or two Paroscientific Digiquartz[®] sensors, with AzeroA drift correction.

A switching valve facilitates reference measurements of internal housing pressure. These data are monitored by an internal quartz barometer which corrects the drift of the sensors over time. Activation of the switching valve pushes a small amount of buffer oil out of the buffer tube into the housing, where it is captured in the oil purge container.

By cleaning the container and replacing the absorbent pad after each deployment you will maintain the pressure sensor accuracy and extend its life.

 All required materials for this procedure are provided in the [support kit](#).

Required materials

- 5mm hex key
- O-ring
- Silicone grease
- Replacement absorbent pads

Recommended handling materials

- Latex or nitrile gloves
- Eye protection
- Protective coat

 Buffer oil is not a hazardous substance, but it is recommended to practice good industrial hygiene and safety practices, and to use this material in a well-ventilated space.

Cleaning the oil purger container

Step	Description	Image
1	Unscrew the battery end-cap and remove the umbilical cord (see Opening and closing the instrument)	
2	Remove the container <ol style="list-style-type: none"> 1. Turn the red handle counterclockwise at least one full rotation 2. Pull the handle out, with the container 	

Step	Description	Image
3	<p>Remove the absorbent pad contaminated with buffer oil</p> <p> Dispose the contaminated pad in accordance with local regulations.</p>	
4	<p>Replace the O-ring on the oil purge container (see Replacing the O-rings for details on handling O-rings)</p>	
5	<p>Replace the absorbent pad</p> <ol style="list-style-type: none"> 1. Roll one side of a clean pad and insert it into the container's central compartment, letting the rest of the pad out through the slit on the side 2. Wrap the remaining pad around the container going clockwise once 3. If any length of the pad is left, loosen it so that there is only one full layer wrapped around the container (any additional layers will make it difficult to insert) 	
6	<p>Reinstall the container</p> <ol style="list-style-type: none"> 1. Hold the pad so that it does not unravel 2. Insert the container back into the instrument 3. Turn the red handle clockwise one full rotation 	
7	<p>Return the battery end-cap back onto the instrument (see Opening and closing the instrument)</p>	

6 Repairs

RBR supports all our products. Contact us immediately at support@rbr-global.com or via the [RBR website](#) if there are any issues with your instrument. Please have the model and the serial number of the unit ready. Our support team will work to resolve the issue remotely. In some cases, you may have to return your instrument to RBR for further servicing.

 There are no user-repairable parts of the instrument. Any attempt to repair without prior authorisation from RBR will void the warranty. Refer to the [RBR warranty statement](#).

To return a product to RBR for an upgrade, repair, or calibration, please contact our [support team](#) to obtain a return merchandise authorisation code (RMA) and review the detailed shipping information on the [RBR website](#).

7 Revision history

Revision No.	Release date	Notes
A	04-May-2020	Original
B	30-November-2021	Updated Specifications, Hardware, General maintenance, Pressure sensor maintenance, and Repair sections. Added information on the external pressure adaptor kit, removing the oil bladder, and servicing the valve. Removed the Warranty section (available on the RBR website) and Appendices. Minor updates throughout the document.

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