



Battery Charging Manual.

For Boxfish vehicles: ROV, Alpha, Luna



BOXFISH[®]
R E S E A R C H

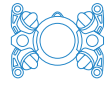




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1 About this document

This document aims to cover all topics relating to the batteries used in Boxfish vehicles. These topics are included but not limited to: safety, usage, charging, handling, storage, shipping, travelling and disposal.

Information is common to all Boxfish vehicle models, including Boxfish Luna, Boxfish ROV, Boxfish Alpha and autonomous-capable vehicles.

1.1 Definition of terms used in this document

For simplicity:

- All Boxfish vehicles are referred to as **ROVs**.
- All procedures using Boxfish charging equipment are referred to as **charging**, including “Storage” tasks on the charger and testing internal resistance of battery packs.

1.2 This document supersedes ALL battery-related information in Boxfish vehicle manuals

The information in this document **replaces ALL battery-related information contained in any vehicle or accessory manual released before 10 June 2022**, specifically:

- Boxfish ROV Owner’s Manual
- Boxfish Luna Owner’s Manual
- Boxfish Luna Camera Operations Manual
- Boxfish Alpha Owner’s Manual
- Boxfish High-Speed Charger Manual

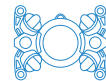
It also replaces **ALL other Boxfish User Guides related to battery charging, removing batteries from battery packs and reinstalling them in battery packs**.

1.3 Latest version of this document

The most up to date version of this document will be available online at <https://www.boxfish.nz/downloads/>.

1.4 Who should read this document

All Boxfish operators must read and understand this manual before charging or using the ROV.



2 About the Boxfish ROV battery pack



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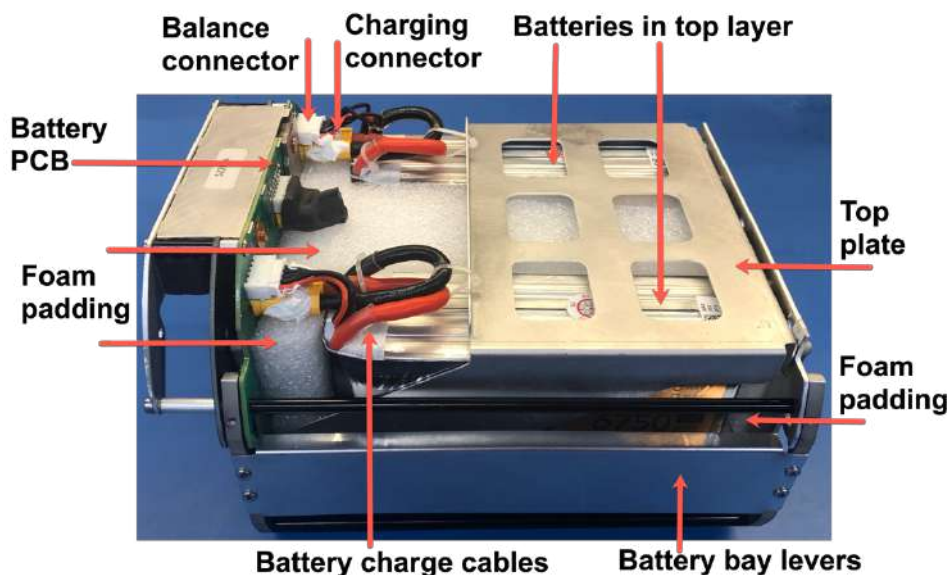
The Boxfish battery pack uses Lithium Polymer (LiPo) batteries. When used according to the instructions in this manual, these batteries are safe to use.

Failure to follow instructions could result in fire or explosion which could cause injury, death or property loss.

If you have any questions or concerns about your batteries, contact us immediately: support@boxfish.nz or +64 9 600 1910.

2.1 About the ROV battery pack

The ROV is powered by a battery pack assembly comprised of individual lithium polymer (LiPo) batteries. Battery packs for Boxfish ROV and Boxfish Luna contain six batteries. Battery packs for Boxfish Alpha and autonomous-capable vehicles contain five batteries.



Battery pack for Boxfish Alpha

The ROV battery pack consists of the following:

- **Batteries:** Two or three batteries on the top layer, and three batteries on the bottom layer. **Note:** Batteries in newer packs will have a date sticker indicating manufacture of battery pack, and a heat-sensitive label which will be triggered if the battery gets too hot.



- **Battery charge leads** are connected to the battery pack PCB. Charge connectors (yellow XT60 connectors) **must be held together with silicone sealant** to prevent them from disconnecting with vibrations of the ROV during operations.
- **Foam:** Foam padding is used to position batteries within the pack.
- **Battery bay levers:** Rotate outwards to disengage contacts and allow battery pack to be removed from the ROV tray.

2.2 About the batteries used inside the pack

The capacity of each battery is 99.9 Watt-hours (Wh). Each battery has four cells. The battery has two charge leads: positive/negative cable with a yellow XT60 connector, and a balance cable with white JST connector (used to keep all four cells within the battery at an equal voltage).

A typical battery used in the Boxfish battery pack is shown below.



Battery and charge leads



Side view showing four cells inside battery

2.3 Recommended voltages

State of the ROV	Voltage	Cell Voltage
Freight/shipping/travelling with the ROV. Use this when the ROV batteries will be in transit.	15.0V	3.75V
Storage. For when ROV is not in active use (won't be used in the next 24 hours). The LiPo batteries in your ROV will be safest, most stable, and have the best chance of a long life if they are stored at this voltage.	15.6V	3.90V
Preparing for a dive. Use maximum charge.	16.8V	4.20V

Note: Minimum charge is 3.0V for each cell (12.0V total). If any cell is allowed to discharge below 3.0V, the battery will become unable to charge using the Boxfish charging equipment, and should therefore be disposed of.



2.4 Safety instructions for your ROV battery pack

General safety rules for LiPo batteries apply:

- Do not drop, pierce, strike, stand on or subject the batteries or battery pack to strong impacts or shocks.
- Do not heat batteries or battery pack or place into fire.
- Do not allow the batteries or battery pack to get wet.
- Do not modify of the batteries or battery pack. Batteries may be removed from the battery pack for the purposes of air travel with your ROV, yearly safety inspections and replacing batteries at their end of life. Safe procedures for removing and replacing batteries in the Boxfish battery packs are covered in this manual.
- Dispose of batteries in accordance with local regulations. We encourage customers to recycle batteries with an approved provider.
- Do not put LiPo batteries directly into household or business waste, as fires or explosions can be caused when charged batteries are crushed by the compacting equipment.

2.4.1 Multiple battery packs

Some customers have one or more additional battery packs that they can slot into the ROV to provide immediate power without having to re-charge their existing battery pack.

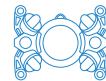
If you have a spare battery pack, ensure it is protected from physical damage while it is not inside the ROV, and keep up with the same maintenance procedures applicable for internal battery packs.

2.5 Care and maintenance of your Boxfish battery pack

- **Receiving your ROV for the first time.** For safety during shipping, the voltage of your ROV batteries will be around 15.0V (3.75V per cell). As this is too low for long-term storage, the battery pack must be charged up to storage voltage (optimum voltage) of 15.6V as soon as is practical.
- **Monthly maintenance - power on your ROV for six hours once per month and then charge back up to storage voltage to avoid total battery drain.** LiPo batteries slowly self-discharge over long periods of time. Cameras in the ROVs contain internal batteries that store camera settings including time, date etc. The ROV batteries must have enough charge to keep those settings.
- **Keep batteries at storage voltage most of the time.**



- **Test internal resistance:** before every charge.
- **Yearly check/maintenance:** Take out your battery pack and inspect for:
 - Silicone sealant – this should be in place on XT60 connectors to ensure they remain connected at all times.
 - Swollen/puffy battery cells: Do not use batteries if any sign of puffiness is present.
 - Heat labels activated: If the labels have turned black, do not use your batteries.
- **Look out for any unusual behaviour of your ROV battery:** for example, significantly reduced dive times, as this indicates a problem. Contact us for advice.



3 Using Boxfish charging equipment

Only use charging equipment supplied by Boxfish.

3.1 Boxfish ROV charging equipment

Three products may be used to charge the ROV battery pack:

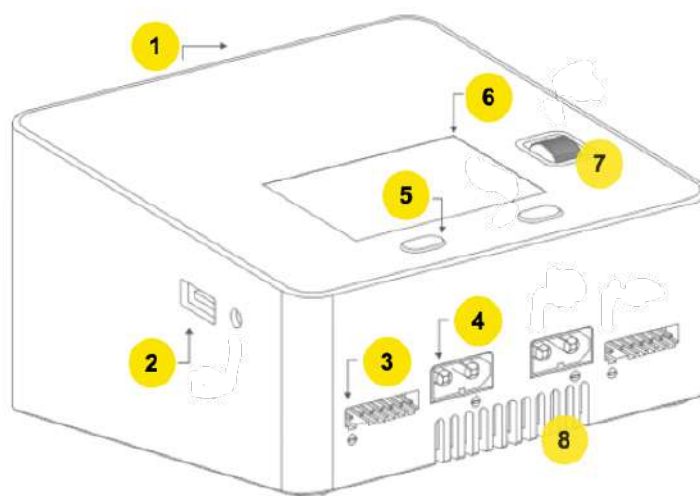
1. **Boxfish standard 12A battery charger** (usage explained in this section)
2. **Boxfish high-speed battery charger** (usage explained in Section 10)
3. **Boxfish Power Pack** (see separate manual).

3.2 Boxfish standard battery charger

All customers have our standard charger, shown below.

Before use, check that the charger has not been damaged from heat, water or humidity, that the charging ports are free of dust or foreign material, and that the air intake and fan vents are not obstructed.

When charging, you will use the numbered items shown.

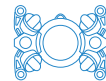


- | | |
|-------------------------------|-------------------------------|
| 1. AC power input | 2. USB port for balance cable |
| 3. JST port for balance cable | 4. XT port for charge cable |
| 5. Channel 1 selection button | 6. 2.4" display screen |
| 7. Selection dial | 8. Air intake vent |

3.2.1 How to use charger controls

When the charger is connected to AC power and the display lights up:

- Press the Channel 1 selection button. Then, you can press the selection dial down to see the Task settings for Channel 1.
- Scroll the dial on the selection dial to move through options in the menu.



- Press down on the selection dial to select the item from the menu and access a list of options.
- Press down on the selection dial to select an option from the list.
- To return to a previous menu, press the selection dial to the left.

3.3 About ROV charge cables

Well insulated charge cables clearly labelled with red/positive and black/negative connectors to the ROV charge ports. The XT-60 end connects to the battery charger.



3.4 ROV balance cable

Cable to facilitate balancing of cells in each battery while charging is in progress.

Charger connection consists of a white JST-XH balance connector and a USB Type A connector to provide power for balancing.



3.5 ROV charge ports

Ports are clearly labelled positive (red, +), negative (black, -) and balance (blue) to help users connect cables to the correct port.



Caps for the charge ports have an interconnected cover to easily keep them together when removed for charging.



3.6 How to connect charging equipment

1. First, connect the cell balancing connector to the charger Channel 1 ports. Note: align the white JST connector to the left of the JST port.
2. Next, connect the positive and negative XT60 connector to the charger.





3. Remove the interconnected plugs from the three battery charging ports on the rear of the ROV. Keep the plugs in a safe place.
4. Connect the POSITIVE/RED/+ cable to the port labelled POSITIVE/RED/+ on the ROV.
5. Connect the NEGATIVE/BLACK/- cable to the port labelled NEGATIVE/BLACK/- on the ROV.
6. Connect the BLUE/BALANCING cable to the BLUE port. There are pins in this connector. To help you connect the cable, line up the notch on the balance port with the groove on the cable.



Boxfish ROV charge cables and charger connected in preparation for charging



4 Check internal resistance of ROV battery pack

Follow the procedure in this section to verify that the internal resistance of cells in your battery pack's batteries are within our acceptable limit.

Perform this check **every time** before charging your battery pack (including before charging spare battery packs).

4.1 Why check internal resistance?

A measure of internal resistance gives us a good indication of the condition of your batteries.

The internal resistance of LiPo batteries may increase with age or misuse. If the internal resistance is higher than specified in the below procedure, contact Boxfish Research and do not charge your batteries. Charging batteries with high internal resistance may result in fire or explosion.

4.2 Items required

You will need:

- ROV
- Boxfish ROV positive and negative charging cable
- Boxfish ROV balancing cable
- Boxfish battery charger.

4.3 Procedure

1. Before you start, ensure ROV is powered off.
2. Connect charge cables and balance cable to the ROV using the procedure in Section 3.
3. Press the CH1 button to select Channel 1 and press the selection dial down to access the **CH1 Task settings** menu.
4. Use the selection dial to set the charger to the following settings:
 - Task: Charge
 - Battery type: LiPo
 - Cell Voltage: 4.20 (**Note:** we are not going to charge to this voltage; we are just going to briefly charge the battery to do the test)
 - Cell count: 4S
 - Current setting: 11.5A





5. Select **Start task** to begin the charging process. The screen will appear with a red colour to indicate charging is in progress.
6. Wait for about 30 seconds, press Channel 1 button again and then use the scroll dial to scroll down. Instead of displaying the voltages of each cell, the screen will display the resistance of each cell in $m\Omega$, as shown.
7. If the resistance of cells in each of the positions is **less than $3.3m\Omega$** , the battery pack is OK to charge. If the resistance of any cell is more than $3.3m\Omega$ DO NOT charge this battery pack and contact us for advice.





5 Charging procedures

5.1 Safe charging environment

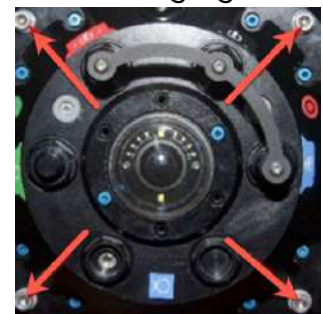
To prepare the safest possible charging environment:

- **Charge the battery in an open and well-ventilated space.** This allows heat generated by the charging equipment to dissipate.
- **Remove all clutter from charging area, especially flammable or explosive substances:** Do not charge the ROV near material that may cause any fire or explosion to become worse.
- **Charge battery on a non-flammable surface:** Suitable surfaces are concrete, steel, ceramic or stone. Do not charge or discharge on flammable surfaces such as carpet, wooden tables, paper, plastic, vinyl, leather or wood.
- **Do not leave charging equipment unattended:** Stay with the Power Pack and ROV during charging so that you can react quickly and evacuate if necessary.

5.2 Prerequisite checks

Complete the following checks and procedures.

1. **Silicone present on battery pack connectors:** This check is applicable if you have removed and then reconnected the batteries from your battery pack since your last charge. Check that the silicone is present on all yellow XT connectors.
2. **Internal ROV temperature between 0-40°C:** Briefly power the ROV on and connect it to the Control Station to check the Temperature value on the telemetry screen. Then power the ROV off in preparation for charging.
3. **Loosen rear bolts holding tray to ROV:** Loosen all four bolts shown, leaving the threads engaged by a few turns so the tray will be held in place. If any explosion occurs during battery charging, pressure should be released through the tray and not cause the dome to shatter.
4. **Check internal resistance:** Before every dive, ensure the internal resistance each of the battery pack cells are within our acceptable limit.





5.3 How to charge ROV battery pack before a dive

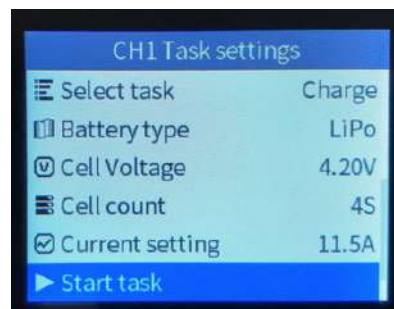
The maximum capacity of your ROV battery pack is 16.8V (4.20V per cell). **Note:** charge to maximum capacity only before a dive. Do not leave batteries fully charged for long periods of time (more than 24 hours).

1. Power off ROV and loosen four rear bolts in preparation for charging.
2. Connect the charger to power.
3. When the charger screen lights up, press the CH1 button to select Channel 1.
4. Set the Task to **Charge**, and the Cell Voltage to **4.20V**. Other settings should NOT be changed:

Battery type: LiPo

Cell count: 4S

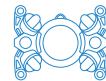
Current setting: 11.5A.



WARNING!

Battery Type and Cell Count must be set to EXACTLY the settings above, otherwise battery fire and/or explosion could occur.

5. Select **Start task** by pressing the selection dial down.
6. If the charger displays a warning message saying “Charge without balancing” DO NOT proceed. Check that the balance cable is connected and contact us if the charger continues to display this message.
7. If you see any other warning messages on the charger, DO NOT CHARGE your battery pack. Contact us for assistance.
8. While charging, the screen will display in orange colour.
9. When charging is complete, the screen will turn GREEN. However it is best to wait until the screen turns BLUE to ensure the cells are evenly balanced.
10. Power down the charger.
11. Disconnect the charge cables from the ROV ports and replace charge caps.
12. Disconnect the cables from the charger and store all charging equipment safely in your ROV Accessory Box.
13. Tighten bolts at rear of ROV.



5.4 How to prepare battery pack for storage

It is best and safest to keep your ROV battery pack at storage voltage, which is 3.90V per cell (15.6V per battery).

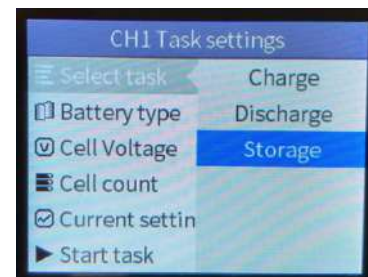
1. Power off ROV and loosen four rear bolts in preparation for charging.
2. Connect the charger to power.
3. When the charger screen lights up, press the CH1 button to select Channel 1.
4. Set the Task to **Storage**, and the Cell Voltage to **3.90V** (so that the total for four cells is 15.6V).

Other settings should not be changed:

Battery type: LiPo,

Cell count: 4S,

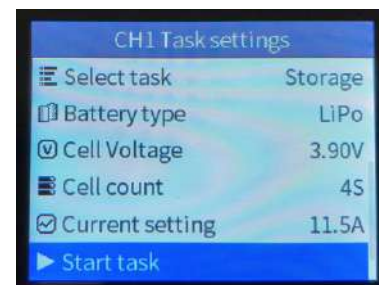
Current setting: 11.5A.



WARNING!

Battery Type and Cell Count must be set to EXACTLY the settings above, otherwise battery fire and/or explosion could occur.

5. Double-check that the settings are exactly as displayed on the image to the right.
6. Select **Start task** by pressing the selection dial down.



7. If you see a warning message saying “Charge without balancing” DO NOT proceed. Check that the balance cable is connected and contact us if the charger continues to display this message.
8. If you see any other warning messages on the charger, DO NOT CHARGE your batteries. Contact us for assistance.
9. Wait until task is complete and cells are balanced.
10. Power down the charger.
11. Disconnect the charge cables from the ROV ports and replace charge caps.
12. Disconnect the cables from the charger and put store all charging equipment safely in your ROV Accessory Box.
13. Tighten bolts at rear of ROV.

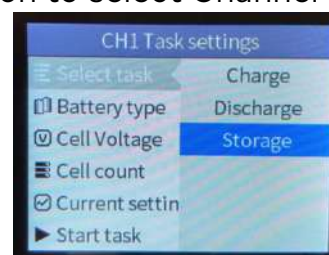


5.6 How to prepare battery pack for travel or shipping

Your battery pack should be at about 33% (15.0V total; 3.75V per cell) for safety during travel or shipping. As soon as the ROV is at its destination, the battery pack should be charged to storage voltage.

Note: If the ROV batteries are close to fully charged, discharging them to shipping voltage can take a long time (8+ hours). It's faster and easier to run the ROV in the water with lights at 100% until the batteries are closer to 33% (15.0V).

1. Power off ROV and loosen four rear bolts in preparation for charging.
2. Connect the charger to power.
3. When the charger screen lights up, press the CH1 button to select Channel 1.
4. Set the Task to **Storage**, and the Cell Voltage to **3.75V**.



5. Other settings MUST NOT be changed:

Battery type: LiPo

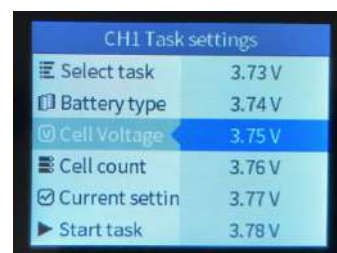
Cell count: 4S

Current setting: 11.5A.



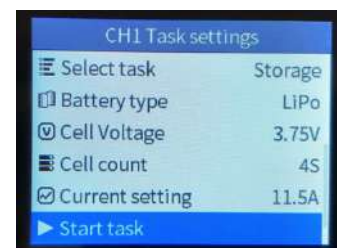
WARNING!

Battery Type and Cell Count must be set to EXACTLY the settings above, otherwise battery fire and/or explosion could occur.



6. Double-check that the settings are exactly as displayed on the image to the right.

7. Select **Start task** by pressing the selection dial down.



8. If the charger displays a "Charge without balancing" warning message DO NOT proceed. Check that the balance cable is connected and contact us if the charger continues to display this message.
9. If you see any other warning messages on the charger, DO NOT CHARGE your batteries. Contact us for assistance.
10. Wait until the screen turns BLUE to indicate charging is complete.
11. Power down the charger.
12. Disconnect the charge cables from the ROV ports and replace charge caps.



13. Disconnect the cables from the charger and put store all charging equipment safely in your ROV Accessory Box.
14. Tighten bolts at rear of ROV.



5.7 Monthly maintenance charging

IMPORTANT!

To avoid damaging the internal battery inside your vehicle's camera, power on your ROV for six hours per month while charging it to storage voltage.

The cameras inside all Boxfish vehicles contain an [internal battery](#) that saves time/date settings on the camera. It is recharged with the camera is in use.

If your vehicle is left for more than about a month without being powered on, the camera's internal battery can drain to the point where you will be prompted to set the time and date on the camera before you can use the ROV.

If the camera is left for longer without being powered on, this battery can become permanently damaged.

It is therefore important to power on the ROV for six hours every month.

While the ROV is powered on, the ROV can be simultaneously charged to bring it to storage voltage.

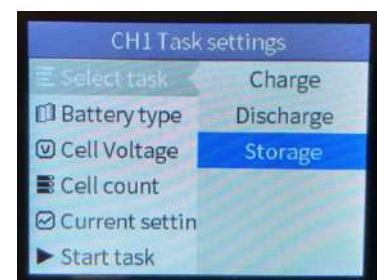
1. With ROV powered off, loosen the four rear bolts in preparation for charging.
- 2. Power on the ROV with the magnetic key.**
3. Connect the charger to power.
4. When the charger screen lights up, press the CH1 button to select Channel 1.
5. Set the Task to **Storage**, and the Cell Voltage to **3.90V** (so that the total for four cells is 15.6V).

Other settings should not be changed:

Battery type: LiPo,

Cell count: 4S,

Current setting: 11.5A.

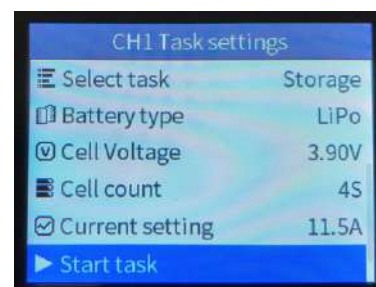


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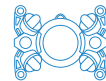
Battery Type and Cell Count must be set to EXACTLY the settings above, otherwise battery fire and/or explosion could occur.



6. Double-check that the settings are exactly as displayed on the image to the right.
7. Select **Start task** by pressing the selection dial down.



8. If you see a warning message saying “Charge without balancing” DO NOT proceed. Check that the balance cable is connected and contact us if the charger continues to display this message.
9. If you see any other warning messages on the charger, DO NOT CHARGE your batteries. Contact us for assistance.
- 10. Wait until task is complete, battery is charged to 15.6V and cells are balanced. The task will likely be complete before the six hours is up.**
11. Power down the charger.
12. Disconnect the charge cables from the ROV ports and replace charge caps.
13. Disconnect the cables from the charger and put store all charging equipment safely in your ROV Accessory Box.
- 14. Power off ROV after six hours.**
15. Tighten bolts at rear of ROV and return to storage case.



6 How to take battery pack out of the ROV

To access the battery pack (along with other internal components), you must first take the internal tray out of the ROV. The tray is accessible from the rear of the ROV.

6.1 Items required

- 6mm Allen Key
- (Optional) Tray-removal levers from your accessories box (levers were included in ROVs shipped from 2022 onwards).

6.2 How to take out ROV internal tray

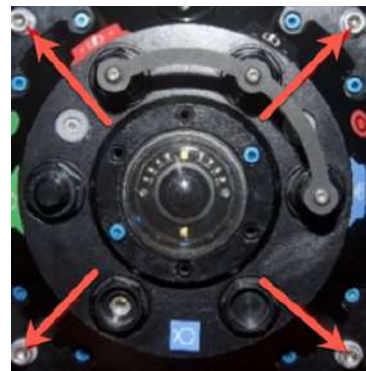
- ROV must be powered off
- Vacuum must be from the ROV: take off the vacuum port cap, pull valve to release, and replace the cap (for details see your vehicle's Owner's Manual).



WARNING!

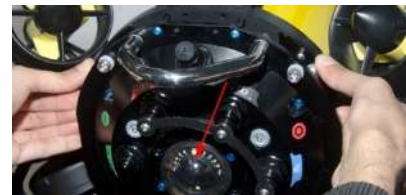
Make sure ROV is powered off before removing the ROV tray.

1. Power off ROV and remove vacuum.
2. If using tray-removal levers, use an Allen key to take out the four hex head bolts on the rear of the ROV that hold the tray to the ROV body.
3. If you have the levers, insert the end of the short side into the gap between the tray and the Luna body. Rotate the levers to prise apart the tray from the Luna body.





4. If not using levers, loosen bolts most of the way until there are just a few threads gripping the ROV body. Start to loosen the seal. Be gentle but firm while you loosen the seal. Use your thumbs to push on the rear of the ROV and your fingers to grip the bottom edge of the tray. Then alternate hand positions: move your hands to the side and pull, bottom and pull, and back to the side.
5. Repeat the pulling process until the tray moves towards you and the O-ring seal is no longer in contact with the body of the ROV. Any further movement outwards will be stopped by the bolts which are still in place. You can now take the bolts out.



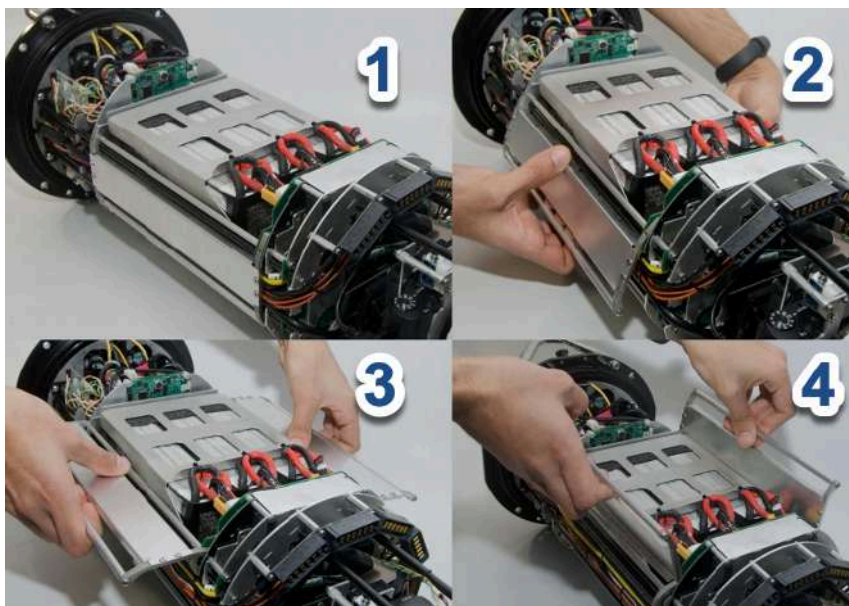
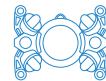
6. Use the rear stainless steel bumper to begin pulling the tray out. Make sure the tray is level and aligned with the ROV body.
7. When the tray is around 15cm out, support the weight of the tray with one hand while pulling out the tray with the other hand.
8. When the tray is completely out of the ROV body, place it on a clean, dry surface, ideally on some foam for support.

IMPORTANT!

Keep the ROV tray on a safe surface, away from the risk of being bumped, knocked or dropped.

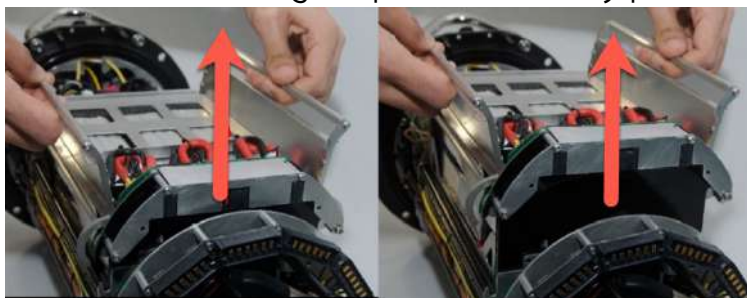
6.3 How to take battery pack out of ROV tray

1. Using both hands, grip the removal handles on both sides of the battery pack (see pictures below).
2. Gently rotate both removal handles up and out at the same time. As you do this the terminals in the battery pack will move inwards to disconnect from the terminals on the tray. Continue rotating both handles up until they are almost vertical and stop at the top of their travel. Take care not to over-rotate and bend the handles.



Rotating the handles outward and upwards to disconnect battery pack from terminals

3. Gently lift the battery pack vertically out of the tray using both handles. Take care to lift straight up so the battery pack does not catch on the tray.



Lifting battery pack straight upwards to remove from tray



7 How to reinsert battery pack into ROV



WARNING!

Check that the XT60 connectors are held together with non-corrosive silicone sealant so that they do not come undone during ROV operation. Charging the ROV with these disconnected will cause fire and/or explosion!

7.1 Prerequisites

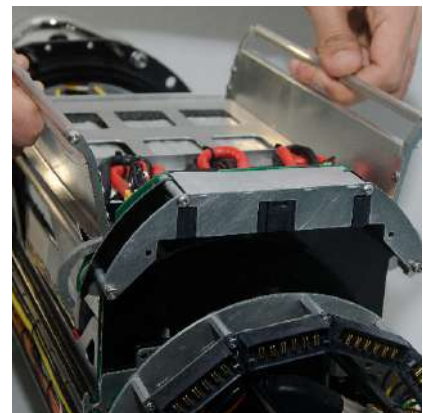
- Silicone the XT60 connectors together if they are not already.
- Check that the battery pack and the compartment in the ROV tray are clean and dry and there is nothing in the contacts.

7.2 Put battery pack into ROV tray

First put the battery pack back into the ROV tray.

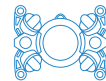
1. Rotate both removal handles on the battery pack to the upward position. This will move the terminals inwards.

2. With the handles in the upward position, position the battery pack directly over the ROV tray. Lower battery assembly into tray, making sure that the battery pack terminals are in line with the terminals in the ROV tray.

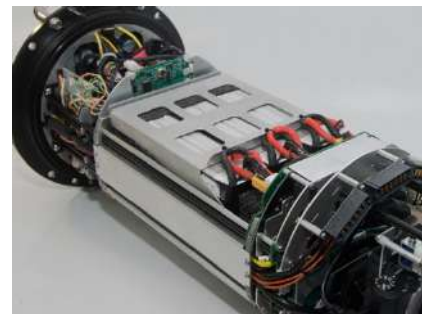


3. When the battery pack is in position, gently rotate handles downwards to connect the terminals. As you rotate both handles down, the fingers on the battery pack will pull it into position. Make sure the fingers on the handles engage the rails on the ROV tray. **Don't use excessive force to lower the handles** – they are easily damaged. If the handles do not move freely, rotate them up again and remove. Look for the source of the obstruction, then realign battery pack and try again.

Note: When battery contacts are engaged when the battery is put back into the battery tray, the ROV will power on. You can power off the ROV with its magnetic key.



4. When fully inserted the battery pack handles should be completely down and flush with the sides of the ROV tray, as shown.



7.3 How to put tray back into the ROV

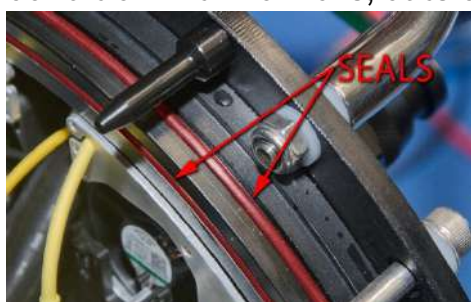
Once the battery pack is in place, re-insert the tray into the ROV.

IMPORTANT!

When re-installing the tray, check O-ring seals are in good condition and fitted well, and ROV can hold a vacuum once installed to avoid potential for water ingress and damage to ROV.

Before installation, ensure:

- Ensure sure battery assembly is correctly installed, and the aluminium levers are completely flush with the sides of the tray.
- The two O-ring seals on the tray (axial seal and face seal) are correctly in place, especially the face seal as it can easily come free when the tray is taken out.
- The two O-rings have been lubricated with silicone grease and are in good condition with no nicks, cuts or flat areas. Replace them if necessary.

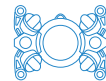


The two O-ring seals of the ROV tray

1. To install the tray, hold the top bar with one hand and support the tray with one hand underneath the tray.
2. Align the tray with the ROV. You will see two internal rails that the tray will grip onto.
3. Slide the tray forward until it grips the internal rails. Keep the tray aligned with the ROV body to prevent bending.



4. When the tray is inserted far enough for the bolts to almost engage the threads, stop, and check O-ring seals are correctly positioned.
5. Ensure alignment pins in the ROV tray are aligned with the holes in the ROV body, and push the ROV forward until you feel resistance from the O-ring seals.
6. Use your fingers to tighten bolts into the threaded holes on the ROV body. Alternate the bolts so they are evenly tightened.
7. Once bolts are finger tight use the Allen Key to tighten bolts a small amount at a time using the pattern Top Right, Bottom Left, Top Left, Bottom Right until the tray is firmly sealed and the bolts are tight.
8. Power on ROV and check operation.
9. Check ROV can hold a vacuum.



8 How to take batteries out of battery pack

Follow the procedures in this section:

- For airline travel, if your airline requires batteries to be removed from the battery pack before the ROV can be checked into the hold.
- If your batteries are dead and you need to replace them.



WARNING!

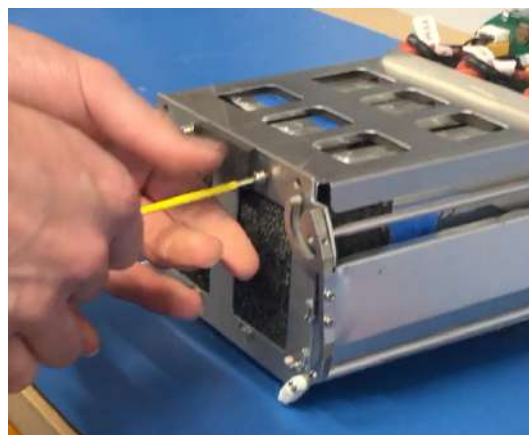
While the batteries are outside the battery tray, cover the positive and negative contacts (yellow XT60 connector) with tape for protection and to avoid a short circuit.

8.1 Items required

- Allen key set
- Snips to cut cable ties
- Tape to cover connectors to avoid short circuit.

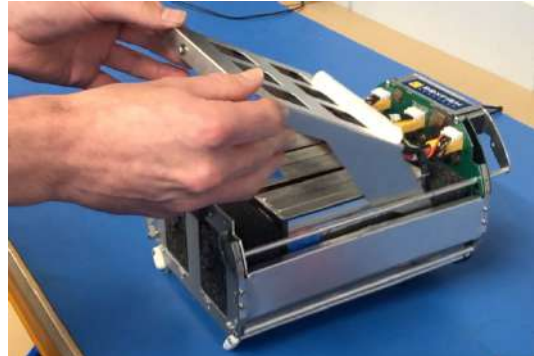
8.2 Procedure

1. Cut the cable ties around the cables and remove the cable ties. Take care not to damage the cables.
2. Unscrew the fasteners on the end of the battery pack that hold the top plate in place.

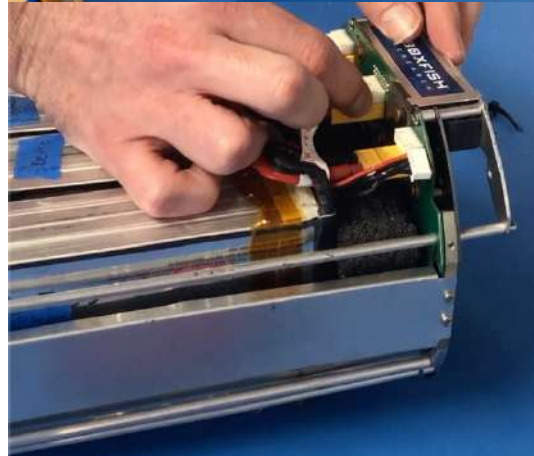




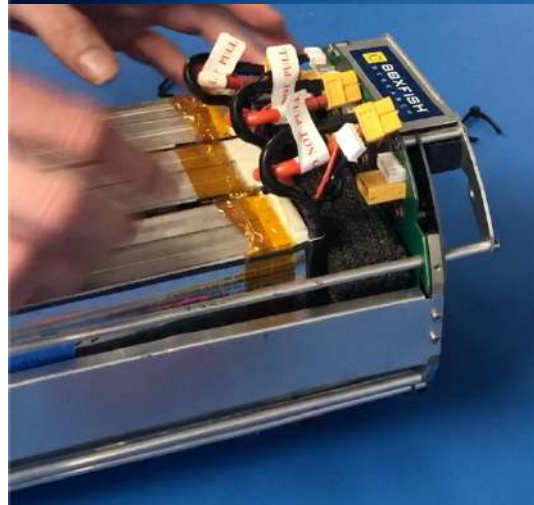
3. Lift the top plate as shown and take it out. Place to the side.



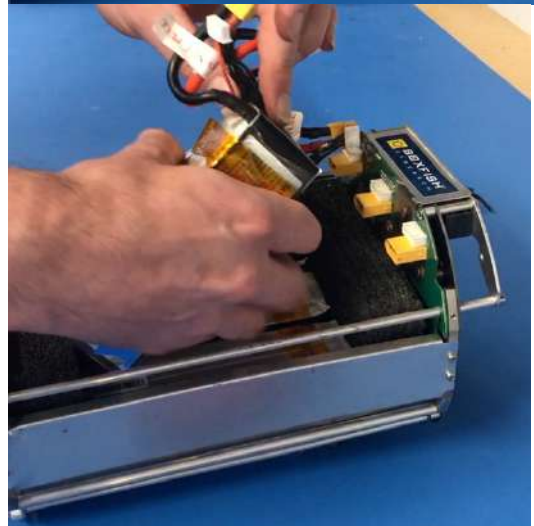
4. Disconnect the white JST connectors from the top three batteries by squeezing in the sides of the connector while gently pulling out.



5. Peel off the silicone on the XT60 connectors and gently pull apart.



6. Lift the top three batteries out and place to the side.

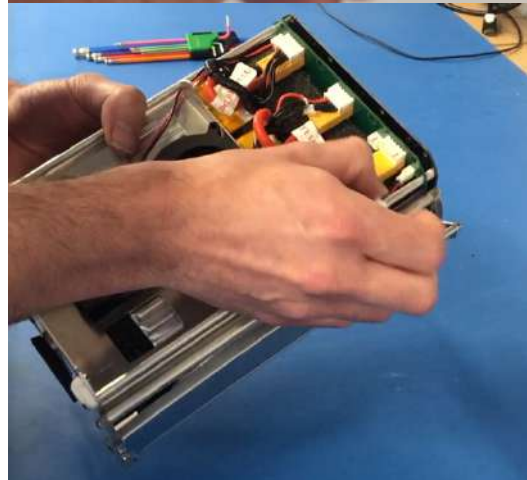




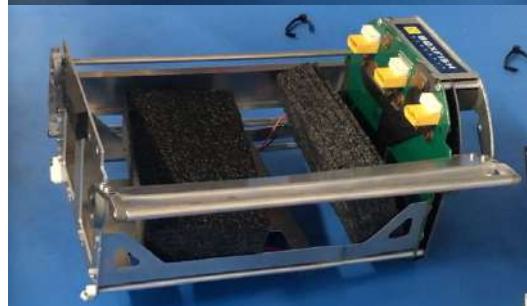
7. Tape the ends of the XT60 connectors for safety and protection while the batteries are out of the tray.



8. Turn over the tray. Now disconnect and remove the bottom three batteries. Tape over the ends of the connectors.



9. Turn the empty pack the right side up again. Keep the foam inserts inside the pack for later.

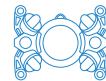


10. Replace the plate onto the top of the pack. First hook the ends under at the point shown. Then you will be able to lower the plate into position.

11. Fasten the plate into position with the fasteners.



Replace the empty battery pack into the ROV tray, and put the ROV tray back into the ROV.



9 How to install batteries into battery pack

Follow the procedures in this section:

- If you have removed batteries from a battery pack for the purposes of travel or shipping and need to put them back in
- For new batteries, before putting them into the battery pack for the first time.

9.1 Items required

- **Batteries:** six individual 99.9Wh batteries (must be supplied by Boxfish)
- **Charger:** (from your Accessory Box)
- **Battery pack case:** must include padding foam to keep batteries in place
- **Cable ties:** small ties from your Accessory Box
- **Silicone sealant, non-corrosive:** Not supplied. Must be non-corrosive. Ask us for a recommended brand if unsure.

If your batteries are new (shipped directly from our supplier), you will also need:

- **Foam squares:** to pad middle battery in top/bottom layer in pack to stop batteries from moving around within the pack. Not supplied, ask us for a recommendation if unsure.
- **Battery heat indication stickers:** if we have supplied these to you.

9.2 Procedures

9.2.1 Inspect batteries for damage



WARNING!

Inspect batteries carefully. DO NOT use damaged batteries.

Before using the batteries in your Boxfish battery pack, verify that the batteries are in good condition:

- **Cables:** insulation must be intact on all cables and no internal metal wires exposed.
- **Cells:** the four cells in each battery are not swelled or puffed up as this indicates the battery has degraded and it must not be used.
- **Physical damage:** there are no tears or punctures in the plastic. If you suspect they have been dropped from more than 50cm or sustained a similarly hard knock or bump, do not use them. Contact us for advice.

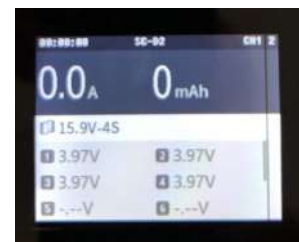


9.2.2 Verify that all batteries have same the same total voltage

Before reconnecting the batteries to the pack, please make sure that:

- Each battery has the same total voltage AND
- The four cells within the battery are balanced to the same voltage.

1. Power on the charger
2. Connect the white JST connector to the charger.
Connect this to the left-hand side, and left-align the connector.
3. Remove tape (if present) from the XT60 connector of the first battery and connect it to the charger.
4. The charger will display summary information about this battery on the left hand side (Channel 1 side). **Example:** For the battery measured on the screen on the right, it is at 15.9V and cells are between 3.97~3.97V.
5. To see specific cell values, press the CH1 button, then scroll the dial up to see individual voltages for each cell.
6. Write down these values in the chart below.
7. Repeat steps 2-6 for the other five batteries. Record cell and total voltage in a chart like the below (Battery 1 row filled in as per above example).



Battery #	Cell 1 (V)	Cell 2 (V)	Cell 3 (V)	Cell 4 (V)	Total Voltage
1	3.97	3.97	3.97	3.97	15.9
2					
3					
4					
5					
6					
Max-min difference	Should be < 0.05V	Should be < 0.05V	Should be < 0.05V	Should be < 0.05V	Should be no difference

8. Compare the values of the cells in each of the positions. In the chart above, each cell position corresponds to a column. The maximum difference between the highest and lowest cell values in each position should be less than 0.05V. Additionally, there should be no variation in battery voltage



between the six batteries. If there is a variation in batteries or cells that is larger than this, contact us for assistance.

9.2.3 Put batteries into battery pack

Note: We can send you videos of each step.



WARNING!

DO NOT connect batteries to battery pack until you have verified they are at the same voltage and cells are balanced within 0.05V.

1. Place padding foam into front and back of battery tray.
2. Insert batteries into the bottom layer of the pack so that the cables are facing downwards. Insert a small piece of foam between the middle battery in the bottom layer so that the batteries cannot move around within the pack.
3. Repeat for the top layer, with the cables facing upwards.
4. Replace the plate back onto the top of the pack and secure with 2x fasteners.
5. Connect all six yellow XT60 connectors. As there is no clip to keep them in place, secure with some silicone on the sides and top of the connector, as shown.
6. Wait for 24 hours for the silicone to cure, to be sure that it is holding the connectors firmly in place so they won't detach.
7. Secure the cables to the battery pack using cable ties. Take care not to pull on the cables using the cable tie – they are to hold the cables to the battery pack and should not be pulling the connectors otherwise they could come out.
8. Snip off the end of the cable tie and ensure the cables are as flat as possible against the battery pack.
9. Affix a heat label to each battery, as close to the middle of each battery as possible but still visible from the outside of the pack.
10. Follow the instructions in Section 8 to put the battery pack back into the ROV tray.



10 How to charge ROV battery pack using Boxfish high-speed battery charger

The Boxfish high-speed battery charger allows fast-charging of the ROV batteries, and is useful for field operations where repeated charging is required.

Note: Use this charger for charging the ROV batteries to full capacity for a dive (16.8V). For charging to storage and shipping voltages, please use the Boxfish charger in your Accessory Box (see Section 5.4 and 5.5 in this manual).

10.1 About the high-speed charger

The high-speed charger is contained in a Nanuk 925 case (same size as a Control Station).

Items in the case are as follows:

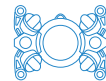
- 1200Wh Power Supply and AC cable
- Battery charger
- Cable to connect battery charger to 1200W Power Supply
- Cable to connect battery charger to ROV positive/negative charge cables.

Note: To use the charger, you will need the ROV charge cables and balance cable from your Accessory Box.

To use the charger:

- Press the CH-1 (channel 1) button to go forward/back through the menus, and to start or stop charging
- Rotate the dial clockwise and anti-clockwise to scroll through options within each menu
- Press the centre of the dial to select an item from the menu





10.2 Charging procedure

10.2.1 Prerequisite safety checks

Note: Before charging, ensure you have completed the same safety checks as our standard charger:

- Safe charging environment (see Section 5.1)
- Prerequisite checks (See Section 5.2).

10.2.2 Connect cables

1. Connect cables according to the image below, taking care to connect positive to positive (red to red) and negative to negative (black to black)



2. Align the balance cable's JST connector to the right of the BALANCE PORT-1 connector on the charger, as shown below.



3. Connect charger to power and switch on using the button on its left side.
4. Connect charge cables to ROV.
5. Power on the charger.

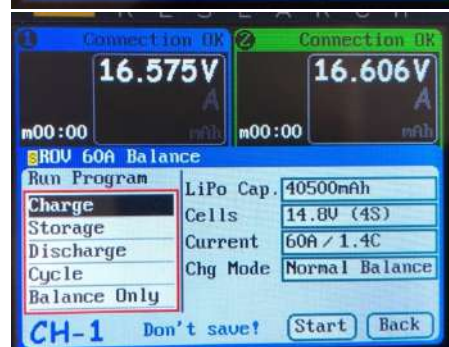


10.2.3 Use fast charger to begin charging ROV battery

Note: We have configured the battery charger with the exact settings required. DO NOT adjust any settings on the battery charger.

1. Power on the Power Supply and charger.
2. From the initial screen, press the CH-1 button. The screen on the right will appear. Here you can select the current to be used for charging. The higher the current, the less time it will take to charge. Use 60A, 40A or 20A Balance charging options only. **Do not use 20A No Balance.**
3. When you have selected the charging current, you will see the screen on the right.

Make sure 'Charge' is highlighted and press the dial to select.



7. Confirm by pressing the centre dial to select 'Yes'.

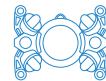


8. When charging, the screen on the right will be displayed.

You can monitor each cell's progress towards a full charge in the region highlighted. 4.200V is a full charge for a cell.



9. Wait until the battery charger shows the cells are at full voltage. Note that as each cell approaches 4.200V the charger will take more time as each cell reaches a full charge and then discharges to balance the other cells.
10. Press the CH-1 / Stop button to stop the charging process. You can stop the



charger early if the job demands quick turnaround.

11. Turn off the red switch on the 1200W Power Supply.

12. Disconnect the charging cables and cell balancing cable from the ROV.

Replace the port covers on the ROV and screw them in so they are finger tight.

13. Disconnect the remaining cables.

14. Tighten bolts at rear of ROV.

Note: When practical, or at least every 4-5 charges, we recommend letting the battery charger run for its maximum duration (4 hours) to balance the cells as much as possible.

10.2.4 Guide to battery charging duration

Current selection	Charging time (approx)	Usage
60A Balanced	40 mins	Use when fast charging is needed.
40A Balanced	1 hour	Best speed for maintaining battery life.
20A Balanced	2 hours	Use this when you are unsure of your power supply.
20A Unbalanced	DO NOT use unbalanced charging.	



11 Document history

Date / Release	Description of changes	Signed off by
R2 16/8/22	Added Monthly Maintenance Charging procedure to ensure camera internal batteries are protected from draining and damage.	Craig Anderson
R1 28/7/22	Initial release for this manual. Replaces all battery-related safety information, charging procedures, instructions for accessing battery packs inside ROVs, and instructions for replacing batteries within the packs in the following manuals (links are now provided to this manual instead): ■ Boxfish ROV Owner's Manual ■ Boxfish Luna Owner's Manual ■ Boxfish Luna Camera Operations Manual ■ Boxfish Alpha Owner's Manual ■ Boxfish High-Speed Battery Charger Manual	Craig Anderson





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