

Wave Glider® SV3 Unpacking and Assembly Guide

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Wave Glider® SV3 Unpacking and Assembly Guide

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Patents and Inventions

The Wave Glider product is subject to the following patents: Chile (48.628), China (2011 101405179), Egypt (25194), Indonesia (P0027767), Israel (192828), Japan (2009533257), New Zealand (570562 and 592743), Singapore (144487), South Africa (200806769), U.S. (7,371,136, 7,641,524, 8,043,133, and 8,287,323). Additional U.S. and non-U.S. patent applications are pending. All aspects of the Wave Glider product have been developed at private expense by LRI, Inc.

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Revision History

Document Part Number	Revision	Publication Date	Changes
05813	A	February 2014	This is the initial release of this document.
05813	B	March 2014	Change Sub Wing attachment screw specification to M4x16mm. Change Sub Wing attachment screw torque specification to 1.7 Nm (15 in-lbs). Include Pacemaker warning about magnets in the thruster motor.

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Chapter 1. Before Starting

Please read through this manual in its entirety to familiarize yourself with the Wave Glider assembly process before unpacking the crates.

Take note of the following Health, Safety, Security, and Environmental (HSSE) considerations before unpacking the Wave Glider shipping crates.

Safety

HSSE Considerations: Ensure the Wave Glider crates and components are suitably positioned on a stable surface allowing free access for the unpacking and assembly process. Persons performing the unpacking and assembly procedure must use Personal Protective Equipment (PPE) including safety eye wear and barrier gloves to minimize risk.

Risk	Description	Mitigation
Loose debris from environment on Wave Glider surfaces.	Bio-fouling, loose paint.	Proper cleaning prior to servicing. Use of PPE (safety eyewear, apron, barrier gloves).
Contact with anti-fouling paint, if present.	Anti-fouling paints can contain harmful chemicals.	Use of PPE (safety eyewear, apron, barrier gloves). Refer to Material Safety Data Sheet (MSDS) information. Thorough cleansing of tools and equipment after servicing.
Hoisting and positioning.	Components of a Wave Glider are best handled by more than one person and or mechanical devices.	Components of a Wave Glider should be moved and positioned using team lifting and/or mechanical devices according to local safety procedures.



Warning

The thruster motor and rudder coupling in the Thrudder Module contain magnets. A magnetic field can be harmful to pacemaker wearers.

Requirements

People Required

Unpacking and assembly requires **at least** two people, but three people are recommended for lifting the Float.

Space Required

A minimum 5x5 meter (16'x16') area is required for unpacking and assembly.

Tools Required

The following tools are required to assemble the Wave Glider - most of them are included in the tool kit shipped in the parts container.

- Large flat-head screwdriver
- Torque screwdriver/socket driver, 4-Nm (35 in-lbs) capacity, with Phillips #2 screwdriver and 7mm socket wrench attachments (Not Included in Tool Kit)
- Huber + Suhner 8mm, 1Nm, SMA Torque wrench P/N 74Z-0-0-21 (Not Included in Tool Kit)
- Phillips #2 screwdriver
- 3mm T-handle hex wrench
- 4mm T-handle hex wrench
- 10-mm wrench or nut driver
- 1/2" box or open end wrench (for installing the AIS antenna)
- Needle nose pliers
- Diagonal wire cutters

Materials Required

- Loctite® 243
- Silicon-connector lubricant (for Umbilical) 3M Part Number 62-4678-4930-3

Unpack and Assembly Time

If assembling a Wave Glider for the first time, allow **at least** 3 hours for this task.

Assembly Location

Liquid Robotics Inc. (LRI) recommends that unpacking and assembly be done on shore to avoid instability caused by sea states.

Torque Values

Use a torque screwdriver for all fasteners. Torque values are as follows:

- M4x16 Phillips head cap screw: **1.7 Nm** (15 in-lbs). Used for attaching the Wings to the Sub frame.
- 5-mm screws: **4 Nm** (30 in-lbs). Used for attaching solar panels, all masts, and the Float skag.
- AIS antenna: **1Nm** (8.85 in-lbs).

Chapter 2. Wave Glider Shipping Crates

The Wave Glider is shipped in three crates. The crate type (Parts, Sub [Glider], or Float) is stenciled on the outside of each crate.

Figure 2.1. Parts Crate



Figure 2.2. Sub [Glider] Crate



Figure 2.3. Float Crate



The unpacking procedure calls for the crates to be opened in the following order:

1. Parts Crate
2. Sub [Glider] Crate
3. Float Crate

Chapter 3. Unpacking the Parts Crate

The Parts Crate lid is held on with metal clips. **Save** these clips for possible repacking later.

The following tools are required for this task:

- Large flat-head screwdriver or claw hammer

Removing the Crate Lid

1. Pry the clips off the top of the crate using a screwdriver or claw hammer.

Figure 3.1. Pry Clips off of Crate Using Screwdriver

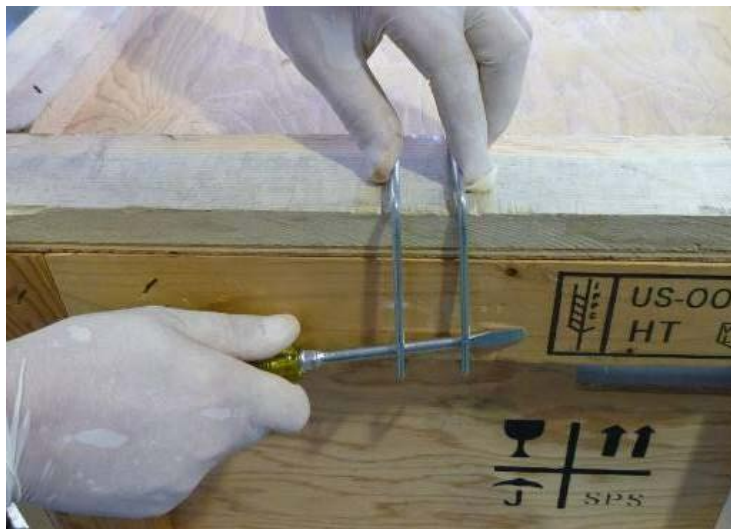


Figure 3.2. Pry Clips off of Crate Using Claw Hammer



2. Lift the lid and set it aside. At this point, the Parts Crate should look like [Figure 3.3](#)

The Parts Crate contains the following items:

- Wave Glider Documentation CD
- Orange Tool Box
- Launch Stand
- Launch Saddle
- Launch Straps
- Battery Charger
- Recovery Mechanism
- Two Boat Poles



Note

This is not a comprehensive list. Check the Packing List to make sure that **all** items that should be in the Packing Crate have been included.

Figure 3.3. Parts Crate with Lid Removed



Figure 3.4. Parts Crate - Small Items



3. Remove the following parts:

- Orange Tool Box
- Launch Stand

4. Use the black clasp on the side of the toolbox to open it ([Figure 3.5](#)).

Figure 3.5. Toolbox



5. Inventory the contents of the toolbox - it contains both spare parts and tools.

The spare parts bag is located on the top tray of the box ([Figure 3.6](#)). A list of the bag contents is contained inside the plastic bag. Check the contents against the list.

Lift out the top tray to access the tools and supplies in the bottom of the box. A separate list is provided for the tools. Check the contents against the list ([Figure 3.7](#)).

Figure 3.6. Spares Bag



Figure 3.7. Supplied Tools



Chapter 4. Unpacking the Sub [Glider] Crate

Next, unpack the Glider Crate. The Sub [Glider] Crate lid is held on with metal clips. **Save** these clips for possible repacking later.

The following tools are required for this task:

- Large flat-head screwdriver or claw hammer.

Removing the Crate Lid

1. Pry the clips off the top of the crate using a screwdriver or claw hammer.

Figure 4.1. Pry Clips off of Crate Using Screwdriver

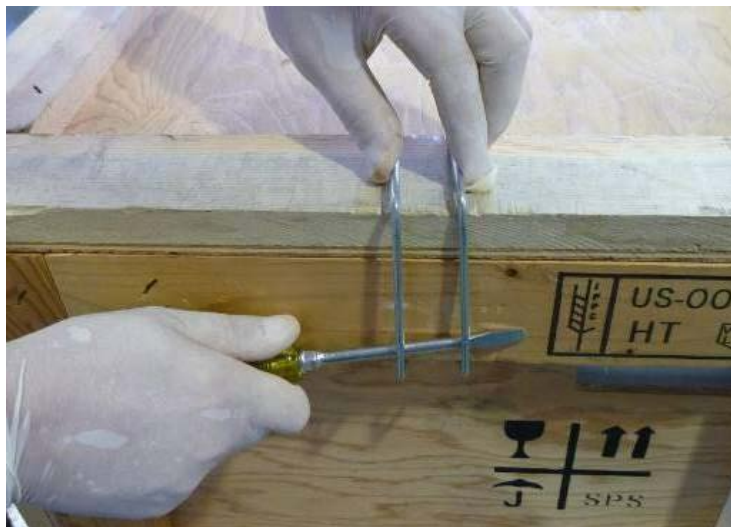


Figure 4.2. Pry Clips off of Crate Using Claw Hammer



2. Lift the lid and place it aside. The Sub [Glider] Crate should look like [\(Figure 4.4\)](#).

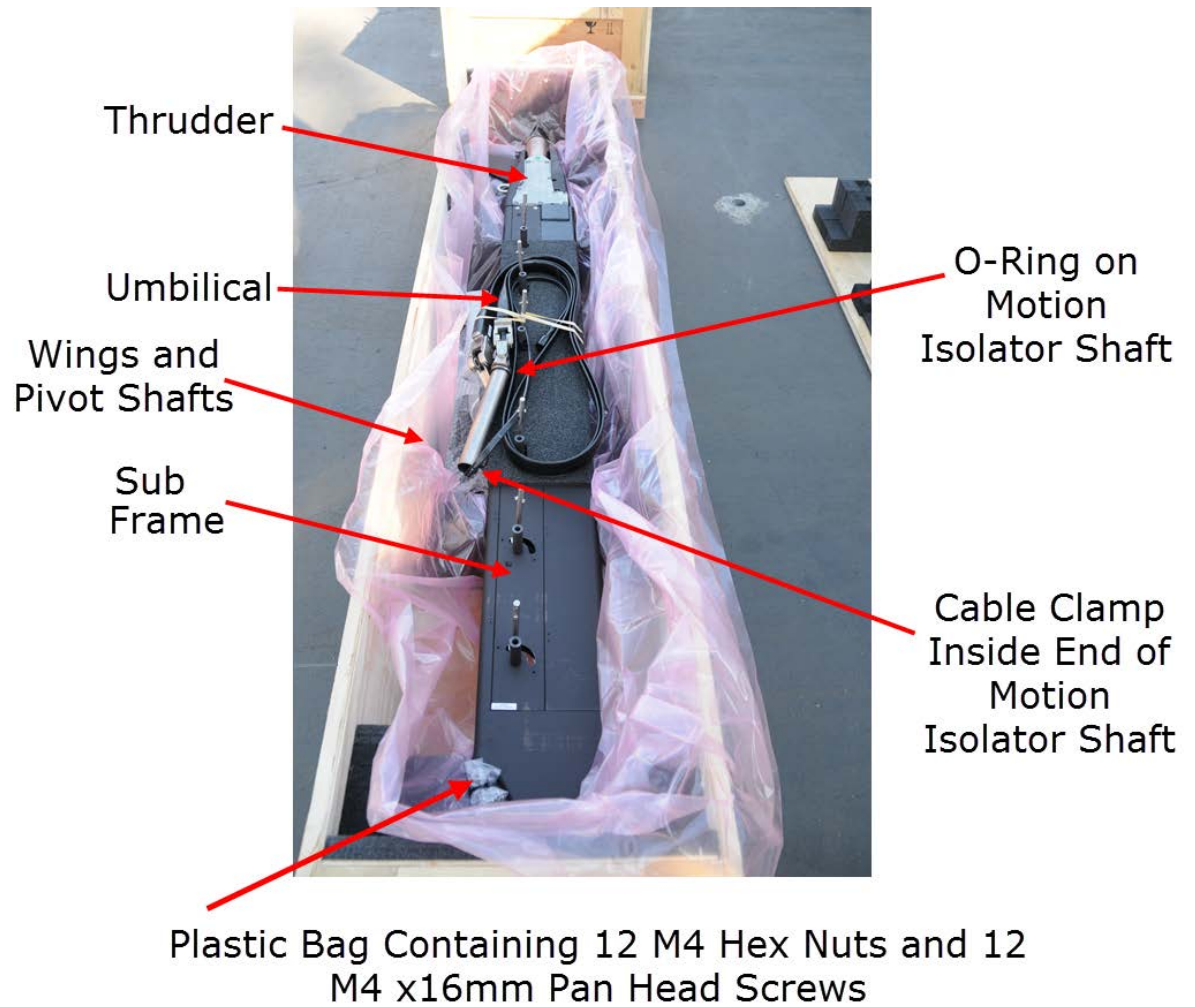
The Sub [Glider] Crate contains the following items:

- Sub Frame with Attached Thrudder
- Attached Umbilical
- 12 Sub Wings
- 6 Pivot Shafts

Figure 4.3. Remove Sub [Glider] Crate Cover



Figure 4.4. Opened Sub [Glider] Crate

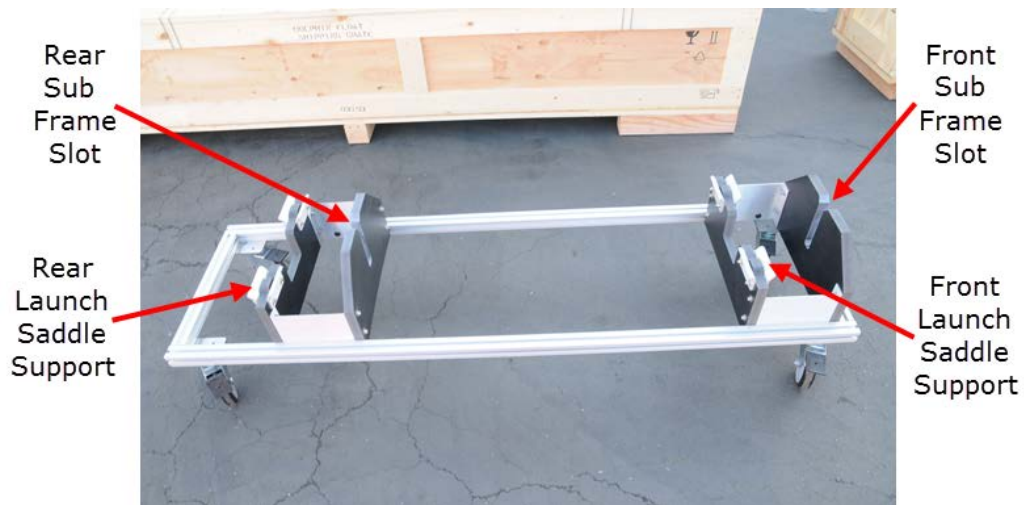


Chapter 5. Place Sub Frame on Launch Stand

Perform the following tasks to prepare the Sub Frame for installation of the Wings.

1. Move the Launch Stand adjacent to the Sub [Glider] Crate so the Thrudder (aft) end of the Sub Frame is closest to the Rear Sub Frame Slot, then lock the Launch Stand casters. The objective is to have the Launch Stand in a position where you can easily lift the Sub Frame from the crate and place it into the Launch Stand without having to reorient the Sub Frame.

Figure 5.1. Move Launch Stand Adjacent to Sub [Glider] Crate - Lock Casters



2. Uncoil the Umbilical and set it gently where it will not interfere with the transfer of the Sub Frame from the crate to the Launch Stand, then Lift the Sub Frame from the Sub [Glider] Crate.



Note

To avoid injury, lifting the Sub Frame requires three people, or mechanized lifting equipment.

Figure 5.2. Lift the Sub Frame from the Sub [Glider] Crate



3. Lower the Sub Frame in the upright position (Umbilical attach point on top) into the slots in the Launch Stand.

Figure 5.3. Gently Lower the Sub Frame into the Slots in the Launch Stand



4. To accommodate later steps in the Wave Glider assembly procedure (involving the Launch Saddle and folded Umbilical), the Umbilical should extend from the top of the Sub Frame to rest on the ground, or deck, entirely to the starboard side of the combined Sub Frame and Launch Stand. The Umbilical should not pass under the Sub Frame or the Launch Stand.

Figure 5.4. Relocate Umbilical If Necessary

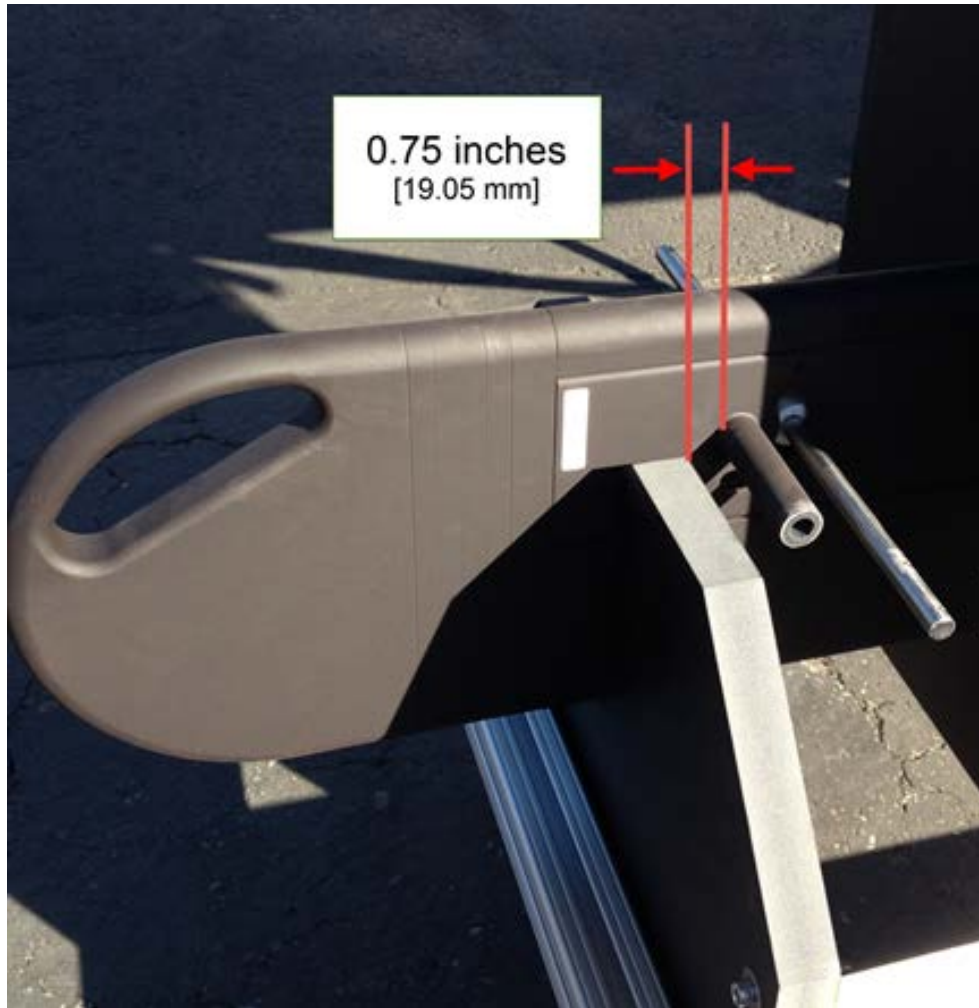


Figure 5.5. Sub Frame in Launch Stand with Umbilical Resting to Starboard Side



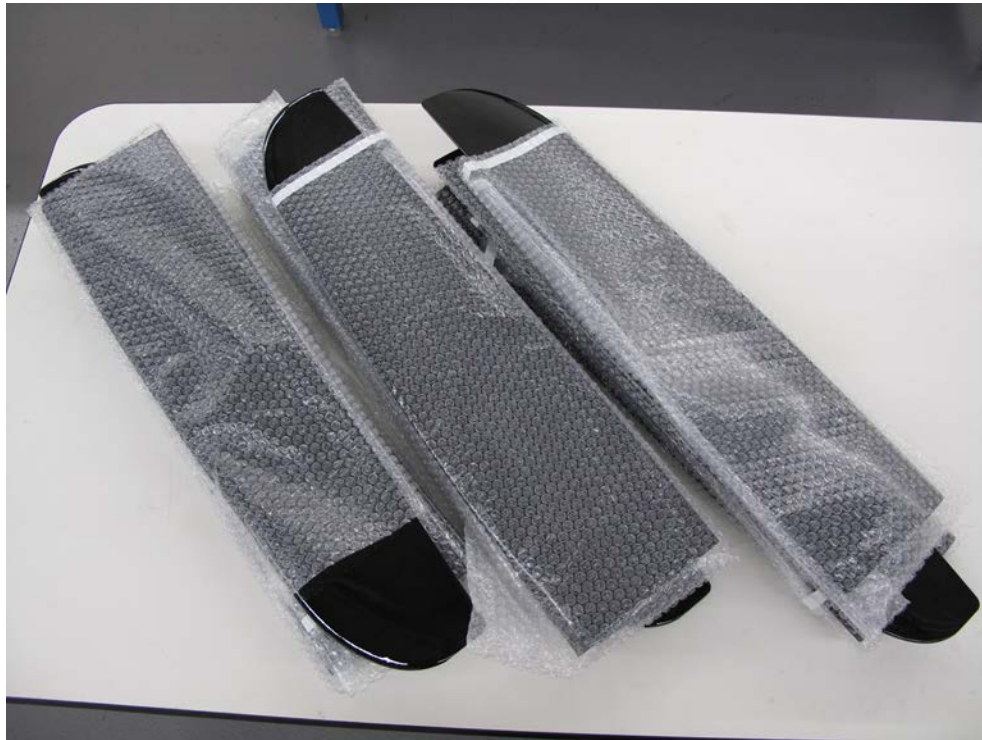
5. Position the Sub Frame in the Launch Stand so the Wings can be installed without interference from the Launch Stand. The front edge of the pivot for the first pair of Wings at the forward end of the Sub Frame should be 0.75 inches [19.05 mm] from the aft edge of the Sub Frame slot.

Figure 5.6. Proper Placement of Sub Frame for Wing Installation



6. Remove the Sub Wings from the Sub [Glider] Crate and set them aside.

Figure 5.7. Set the Sub Wings Aside



Chapter 6. Installing the Sub Wings

There are a total of six Pivot Shafts and six Spring Shafts. Each shaft projects to either side of the Sub Frame.

The six Pivot Shafts are not installed on the Sub Frame for shipment. You must locate them in the Float Crate and slide them through the Pivot Posts.

The six Spring Shafts are factory installed on the Sub Frame with an M4 x16mm pan head screw threaded into the bolt hole on each end of the shaft and secured with an M4 hex nut. You must remove a total of 12 M4 hex nuts and 12 M4 x16mm pan head screws from the Spring Shafts, before installing the Wings. To install the Wings, you will need these hex nuts and screws plus 12 additional M4 hex nuts and 12 additional M4 x16mm pan head screws that are in a plastic bag attached to the lifting handle on the forward end of the Sub Frame.

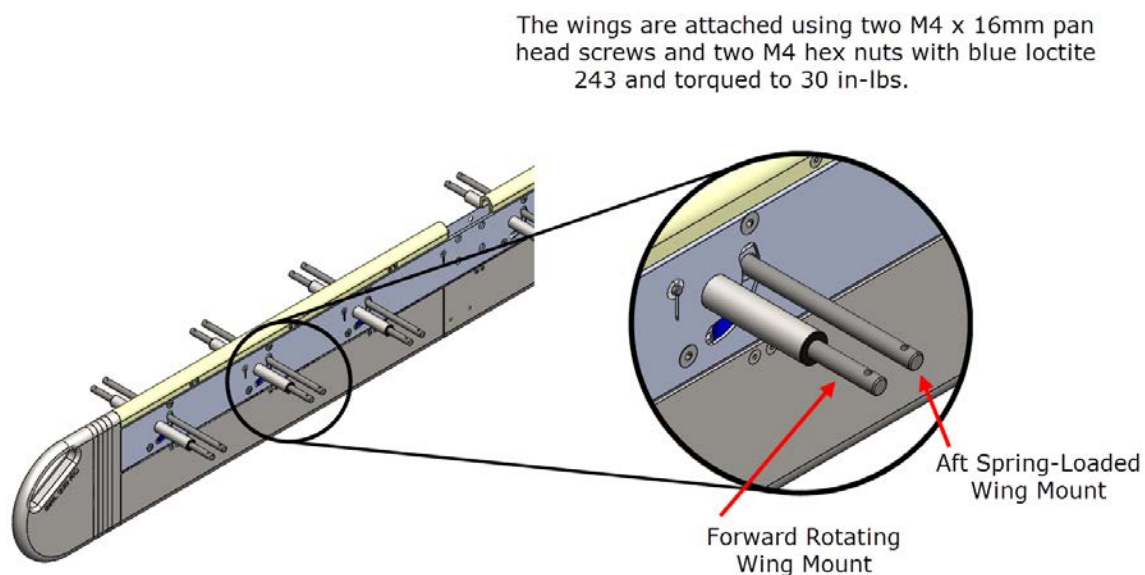


Caution

On some SV3 Wave Glider Subs each Pivot and Spring Shaft has two holes on each end. This design accommodated both SV2 and SV3 models, but was discontinued. If your Pivot and Spring Shafts have two holes on each end, the holes that are closest to the Sub Frame are the ones you must use when attaching SV3 Wings. Properly installed SV3 Wings will have approximately 1/16 inch clearance from the Sub Frame. Using the outer holes on the Pivot and Spring Shafts will result in a much greater (and incorrect) clearance between the Wings and the Sub Frame.

Note: [Figure 6.1](#) shows Pivot and Spring Shafts with one hole on each end.

Figure 6.1. Sub Wing Mounting



Before installing the Wings onto the Sub Frame, inspect the 12 wings removed from the Sub [Glider] Crate. Each Wing attaches to a pair of pivot and spring shafts. Each Wing has two

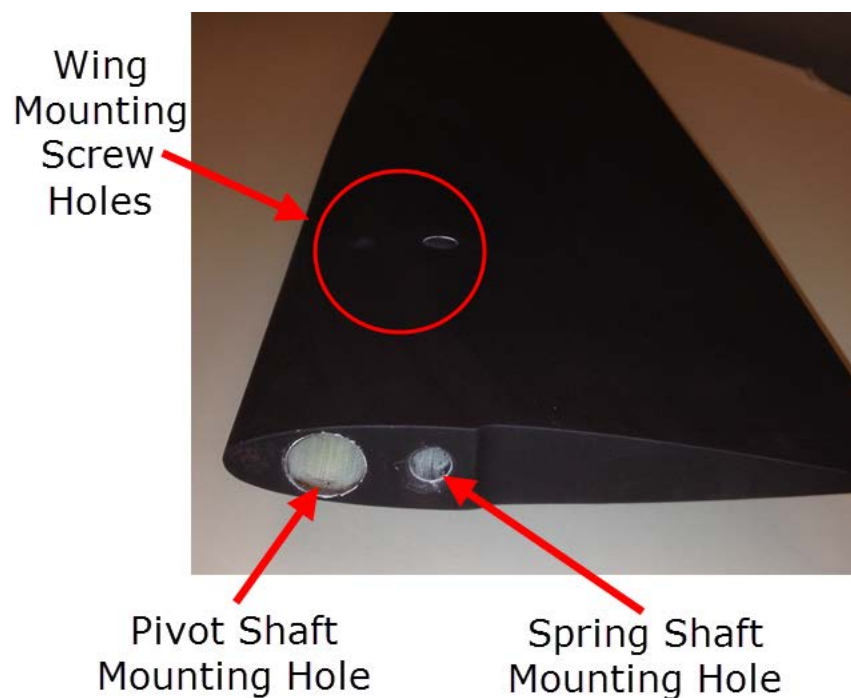
holes, one is for the screw that attaches the Wing to the Pivot Shaft, and the one is for the screw that attaches the Wing to the Spring Shaft.

Figure 6.2. Sub Wing Top View



Each Sub Wing slides onto a Pivot Shaft and a Spring Shaft and is secured with two M4 x16mm pan head screws coated with Loctite® 243. Each screw is inserted from the top of the Sub Wing and secured with an M4 hex nut from the bottom of the Sub Wing.

Figure 6.3. Sub Wing End View



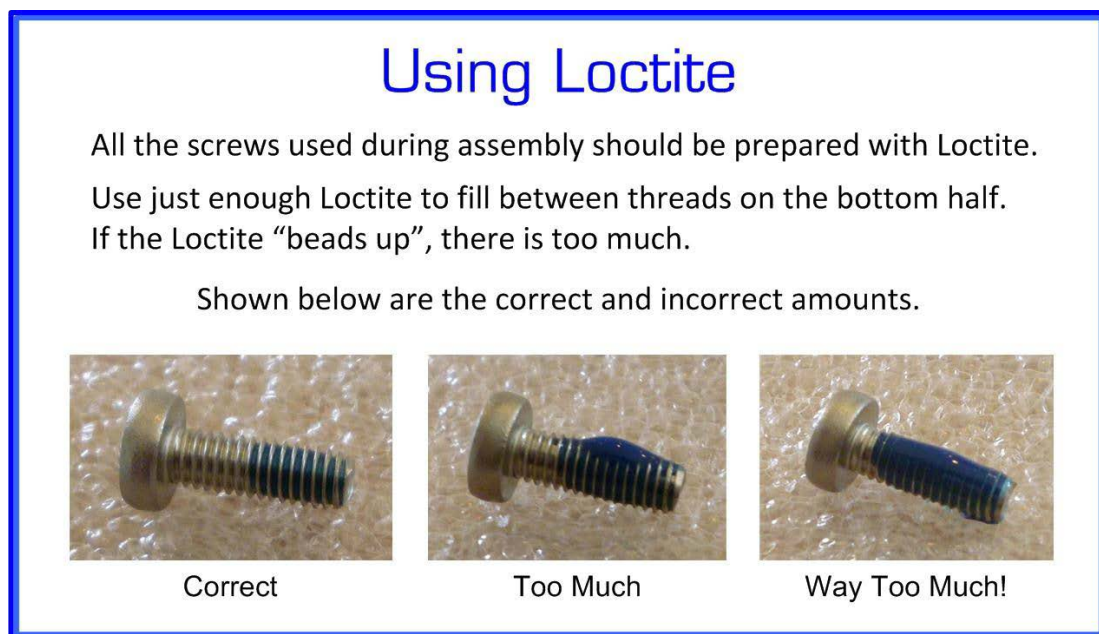
Wing Installation Procedure

The following tools and materials are required for Sub Wing installation:

- 24 M4 x16mm pan head screws
- 24 M4 hex nuts
- Phillips #2 screwdriver

- Torque screwdriver/socket driver, 4-Nm (35 in-lbs) capacity, with Phillips #2 screwdriver and 7mm socket wrench attachments (Not Included in Tool Kit)
- Loctite® 243 (Figure 6.4)

Figure 6.4. How to Use Loctite® 243



1. Remove a total of 12 M4 hex nuts and 12 M4 x16mm pan head screws from the Spring Shafts and save them. You will need these screws and nuts to install the Wings.

Figure 6.5. Removing Screws from Spring Shafts



2. Starting with the first pair of pivot and spring shafts at the forward end of the Sub Frame, hold both shafts on one side of the Sub Frame while sliding a Wing onto the shafts on the opposite side of the Sub Frame.

Figure 6.6. Sliding a Wing onto the Pivot and Spring Shafts



3. For leverage, thread an M4 x16mm pan head screw into the screw hole on the exposed end of the Pivot Shaft and rotate the shaft to align with the screw hole in the Wing. Repeat this procedure with the Spring Shaft.



Caution

Do not use pliers to rotate the Pivot Shaft and Spring Shaft. Use of pliers for this purpose may damage the shafts and void your warranty.

Figure 6.7. Rotate the Rod



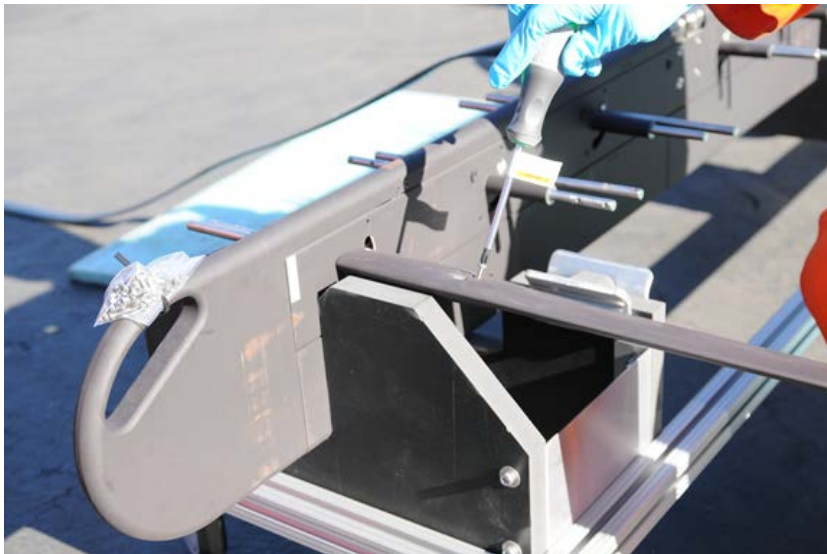
4. Place Loctite® 243 on two M4 x16mm pan head screws following the instructions in [Figure 6.4](#).
5. Use the torque screwdriver/socketdriver with a Phillips #2 screwdriver attachment to install the screws into the two holes in the Wing. Torque the screws to **1.7 Nm** (15 in-lbs).

Apply Loctite® 243 to the inside of two M4 nuts.

Thread the Loctite® 243-treated M4 nuts onto the screws from the under side of the Wing.

Use a Philips #2 screwdriver to hold the screws in place while using the torque screwdriver/socketdriver with a 7mm socket wrench attachment to tighten each nut to **1.7 Nm** (15 in-lbs).

Figure 6.8. Install the Wing Screws



6. While holding the installed Wing, slide another Wing onto the Pivot and Spring Shafts on the opposite side of the Sub Frame to complete the Wing pair.

Repeat steps 4 and 5 above to install two M4 x16mm pan head screws and two M4 nuts to secure the Wing to the Sub Frame.

Figure 6.9. Slide the Second Wing in the Wing Pair onto the Pivot and Spring Shafts



7. Fully rotate the first pair of Wings up and down to ensure that springs are functioning properly and that Wings do not bind. If the springs do not work in both directions, or if the Wings bind against the Sub Frame, contact the Liquid Robotics Support Organization.

Figure 6.10. Rotate Wing Pair Up to Ensure It Does Not Bind

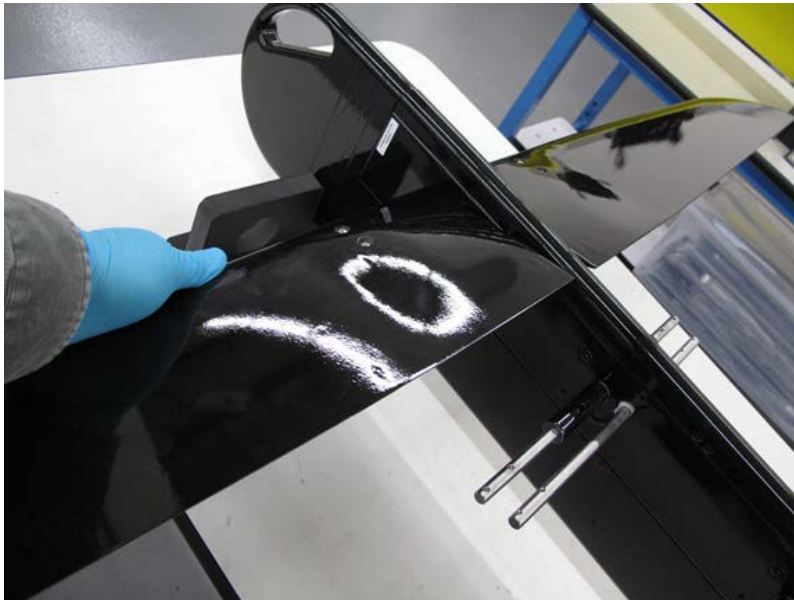
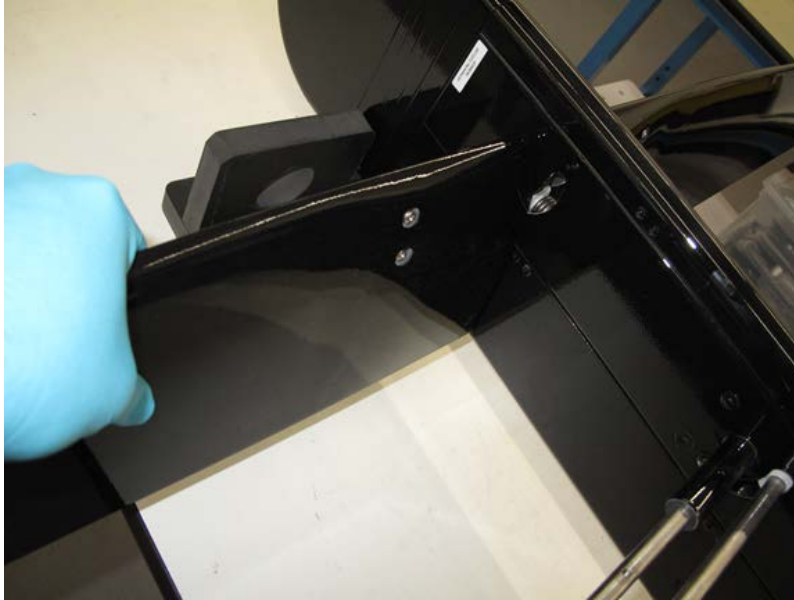


Figure 6.11. Rotate Wing Pair Down to Ensure It Does Not Bind



8. Repeat the steps outlined above to install the second Wing pair on the next pair of Pivot and Spring shafts moving aft along the Sub Frame.
9. Repeat the steps outlined above to install the third through sixth pairs of Wings, moving toward the aft end of the Sub Frame.

Figure 6.12. Sub Frame on Launch Stand with all Wings Installed



Chapter 7. Installing the Launch Saddle on the Sub Frame

The Launch Saddle (shipped in the Parts Crate) installs on top of the Sub Frame providing a secure resting place for the Wave Glider Float. Be sure to orient the Launch Saddle so the forward and aft ends correspond to the forward and aft ends of the Sub Frame.

Figure 7.1. Launch Saddle - Port Side View

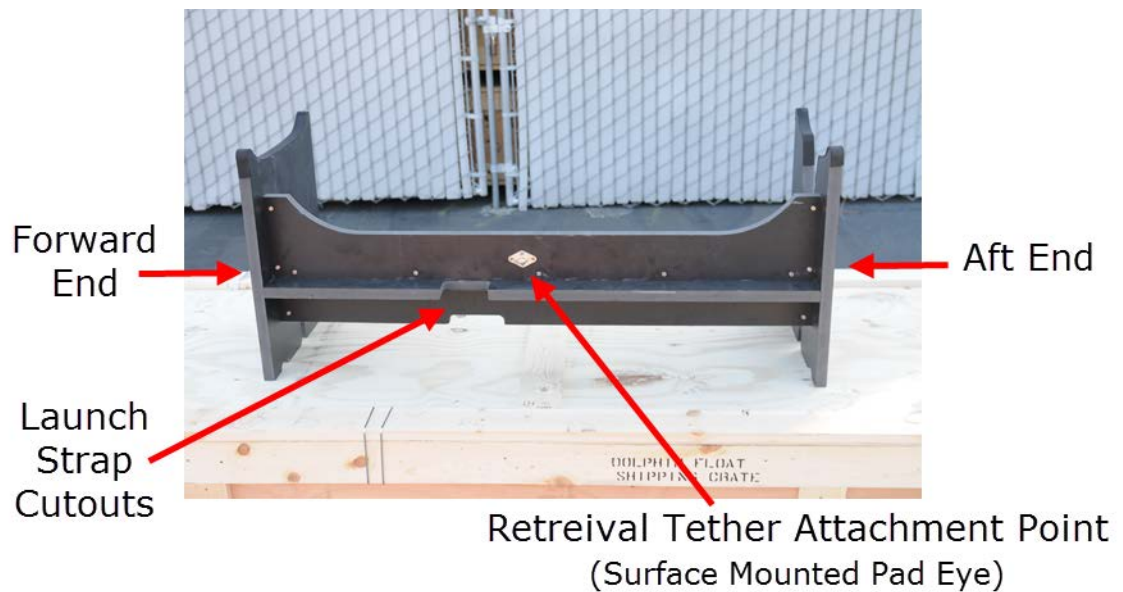
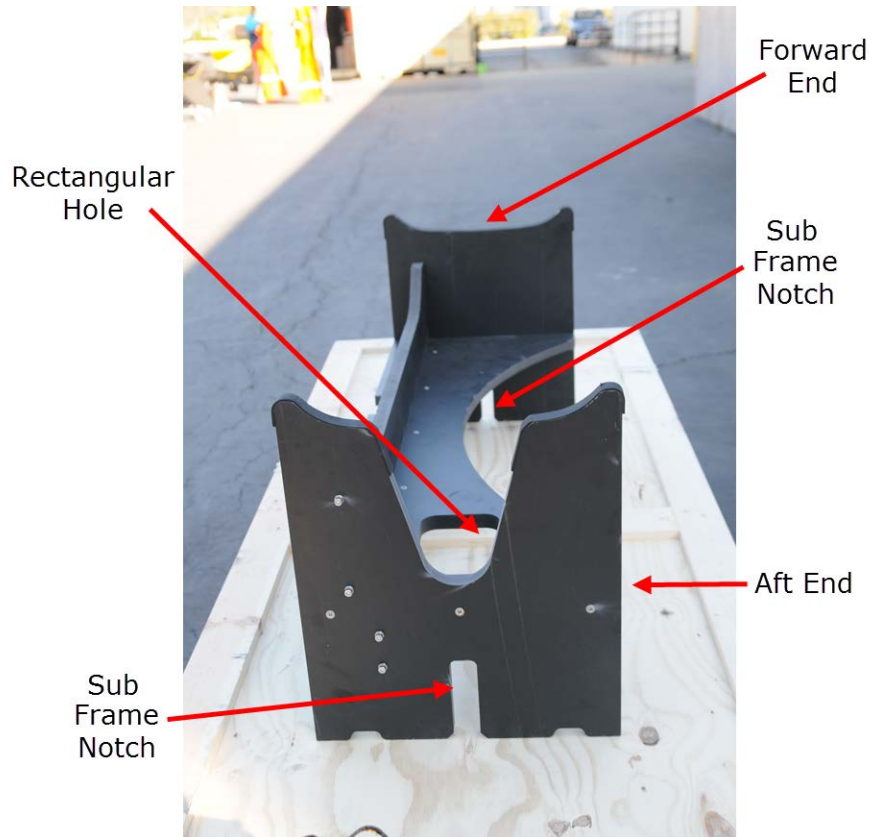


Figure 7.2. Launch Saddle Aft End View



1. Unpack the Launch Saddle from the Parts Crate.
2. Move the Umbilical to the starboard side of the Sub Frame.
3. Lower the Launch Saddle onto the Launch Stand orienting the Launch Saddle so its forward and aft ends rest on the forward and aft Launch Saddle receptacles on the Launch Stand - the Sub Frame Notches will accommodate the Sub Frame.

Figure 7.3. Lowering the Launch Saddle onto the Launch Stand

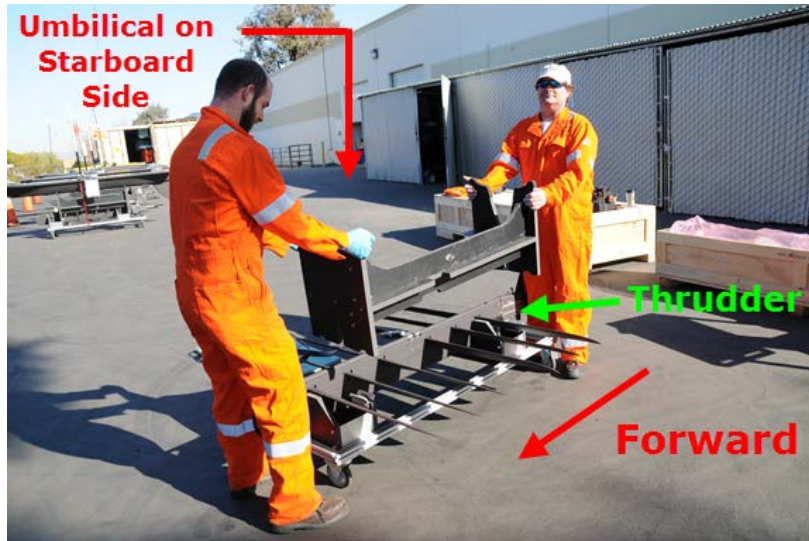


Figure 7.4. Launch Saddle Mounted on Launch Stand - Forward View

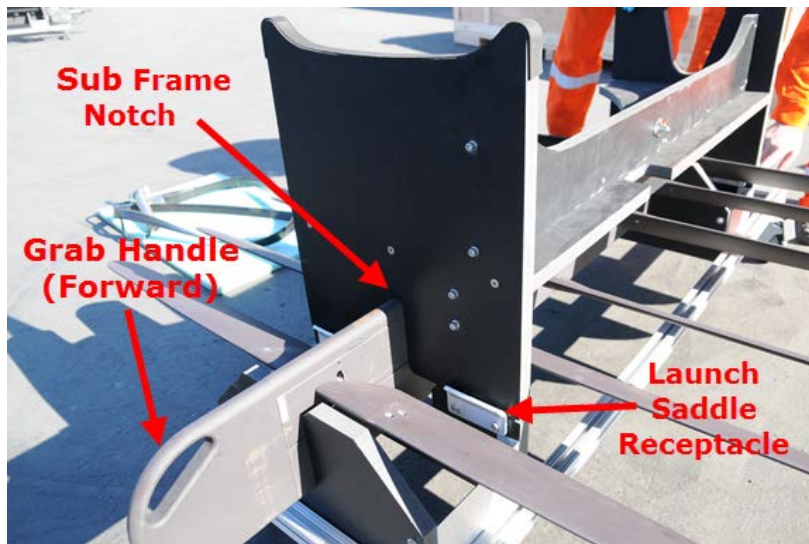
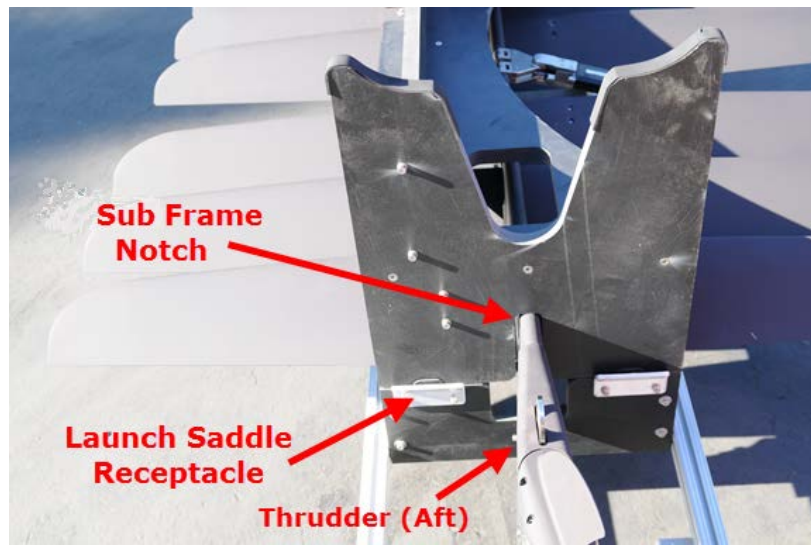


Figure 7.5. Launch Saddle Mounted on Launch Stand - Aft View



Chapter 8. Float Unpacking and Assembly

Next, unpack the Float Crate. The Float Crate lid is held on with metal clips. **Save** these clips for possible repacking later.

The following tools and materials are required for this task:

- Large flat-head screwdriver or claw hammer.
- 4-mm Hex T-handle hex wrench
- 8-mm Open-end wrench
- 1/2" wrench
- Loctite® 243

Removing the Crate Lid

1. Pry the clips off the top of the crate using a screwdriver or claw hammer.

Figure 8.1. Pry Clips off of Crate Using Screwdriver

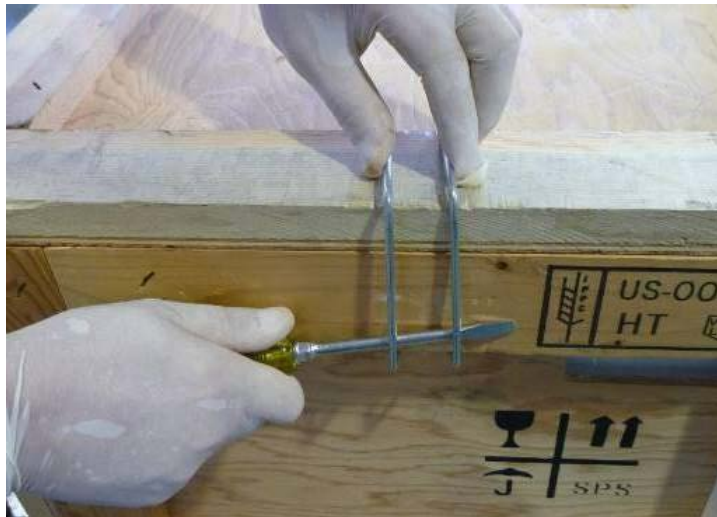


Figure 8.2. Pry Clips off of Crate Using Claw Hammer



2. Lift the lid and place it aside.

Figure 8.3. Opened Float Crate



The Float Crate contains the following items:

- Float with Solar Panels and Wave Glider Command & Control Unit (CCU)

- Skeg
- Recovery Buoy and attached Tether
- Weather Station Mast with Marker Light
- AIS Antenna Whip
- Cell Antenna Mast
- Radar Reflector Mast
- Motion Isolator Cap
- Central Lifting Ring
- Optional Mast-Equipped Instruments
- Optional Payloads Under Solar Panels

A Recovery Buoy with attached tether is packed in a corner of the Float Crate near the forward end of the Float. The other end of the Recovery Buoy tether is attached to a tether storage cavity at the aft end of the Float. Put the Recovery Buoy and the tether on top of the Float so it will not get in the way when you lift the Float onto the Launch Saddle.

A Weather Station Mast that is connected by a cable to the Wave Glider Command & Control Unit (CCU) is packed in the Float Crate along the starboard side of the Float. Put the Weather Station Mast on top of the Float so it will not get in the way when you lift the Float onto the Launch Saddle. Secure the Weather Station Mast with some tape to prevent it from rolling off of the Float during the lifting procedure.



Note

Be sure the Power Key located under the Power Key Cover on the CCU remains disengaged during Wave Glider assembly. Do not engage the Power Key until you are ready to power the Wave Glider electrical components.

Figure 8.4. Wave Glider Command & Control Unit (CCU)

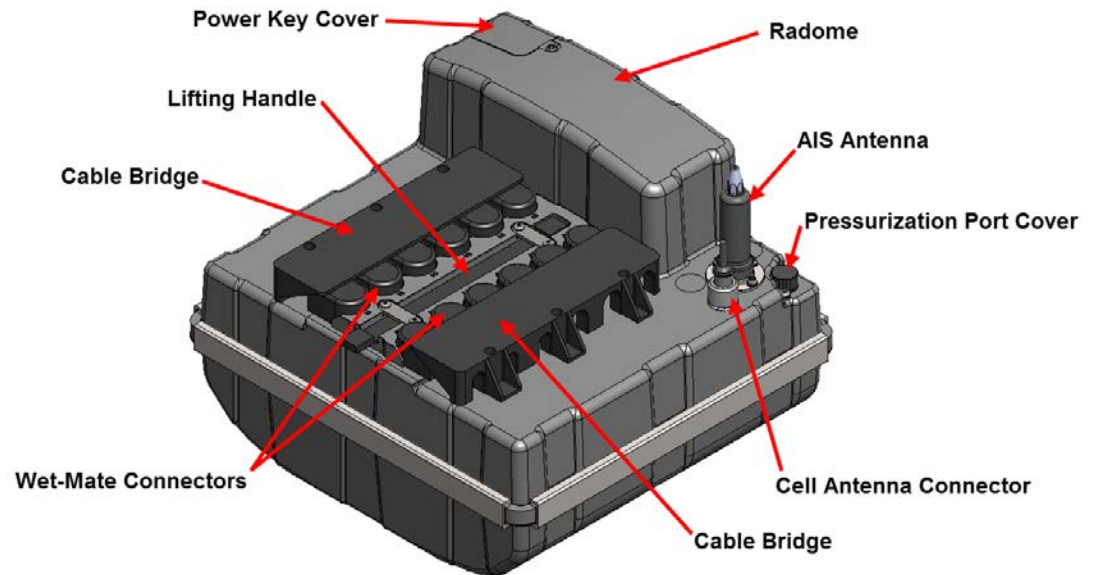


Figure 8.5. Recovery Buoy and Weather Station Mast Moved to Top of Float

**Wave
Glider
Command
& Control
Unit (CCU)**

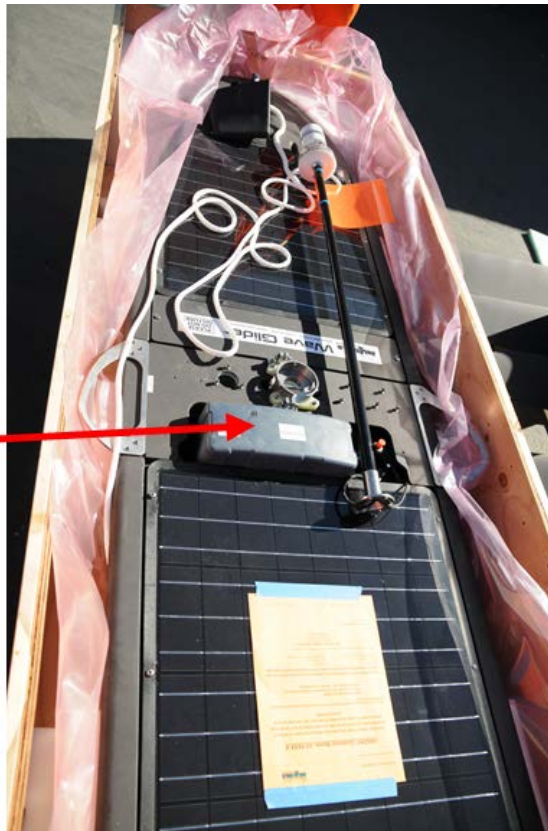


Figure 8.6. Recovery Buoy and Weather Station Mast Secured for Float Lifting



Placing the Float on the Launch Saddle

1. Move the Sub Frame with Saddle near the Float Crate and lock the casters.
2. Remove any items from the crate that are on top of the Float.
3. Lift the Float out using the forward and aft handles.



Note

Three people are required to lift the Float manually (without a hoist).

4. Place the Float onto the Launch Saddle with the same fore and aft orientation as the Sub.

Figure 8.7. Lift the Float from the Crate



Figure 8.8. Place the Float on the Launch Saddle

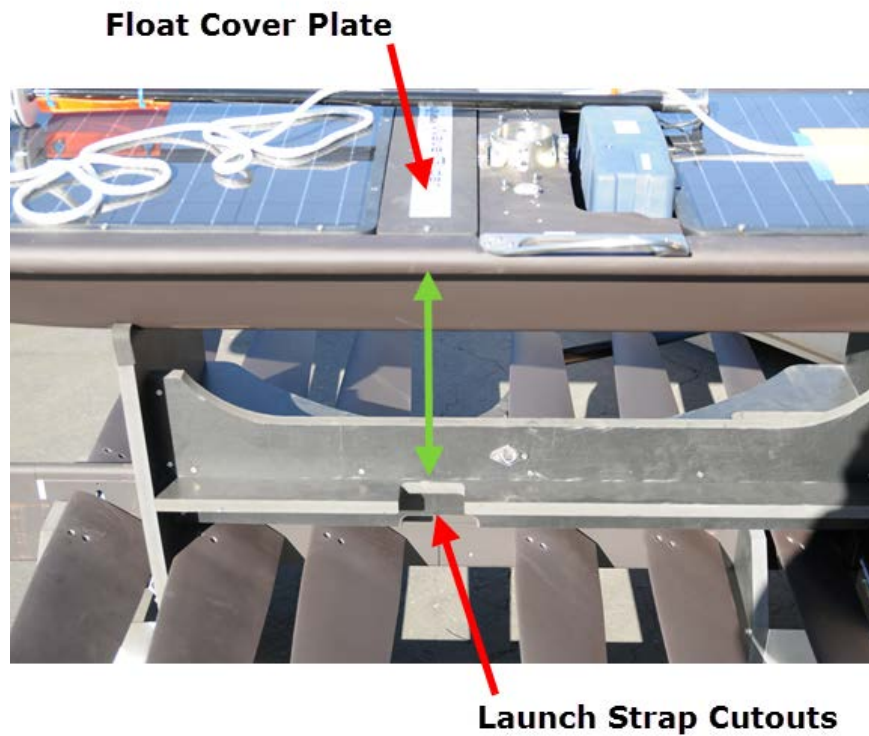


Figure 8.9. Align the Float on the Launch Saddle



5. The Cover Plate on the Float must be aligned with the Launch Strap cutouts on the Launch Saddle as illustrated in [Figure 8.10](#).

Figure 8.10. Correct Float Alignment on Launch Saddle



Installing the Recovery Buoy

The Recovery Buoy attaches to the aft end of the Float.

Note

The aft Solar Panel must be fastened to the Float before you start this procedure to avoid getting the Recovery Buoy tether pinched between the Float and the Solar Panel.

1. Feed the Recovery Buoy tether into the tether storage cavity at the aft end of the Float.

Figure 8.11. Feed the Recovery Buoy Tether into the Tether Cavity



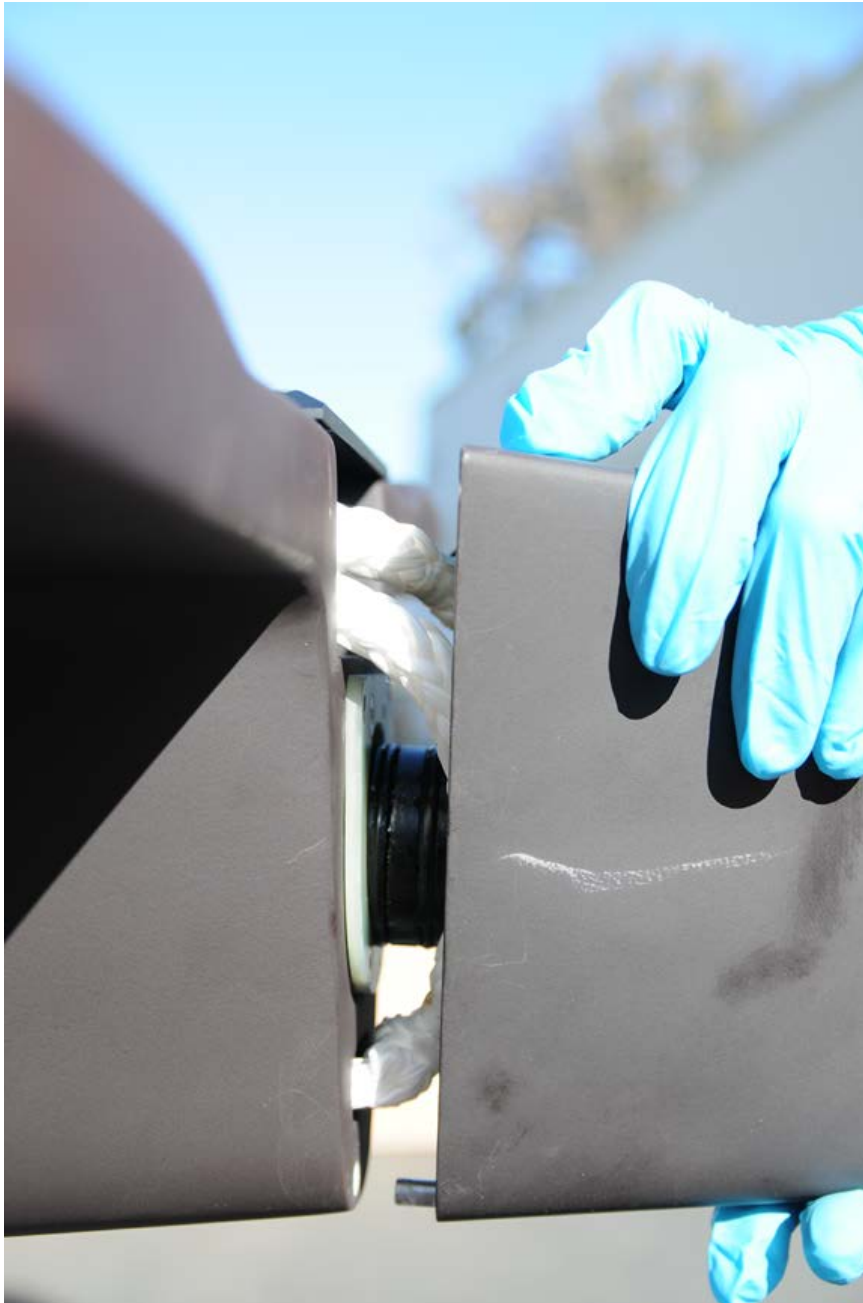
2. Insert the Recovery Buoy piston into the receptacle located just below the tether storage cavity. **Note: the O-rings on the Recovery Buoy piston are factory lubricated.**

Figure 8.12. Insert Recovery Buoy Piston into Receptacle



3. Press the Recovery Buoy into position so it is flush with the stern of the Float. There is a guide pin that ensures the Recovery Buoy is oriented properly when it is installed.

Figure 8.13. Pressing the Recovery Buoy Piston into the Receptacle



If the guide pin is not inserted into the small hole just below the Recovery Buoy receptacle, the Recovery Buoy is not properly installed.

Figure 8.14. Properly Installed Recovery Buoy



Installing the Skeg

The Skeg fits snugly into a slot under the aft end of the Float with its fin sweeping aft.

Figure 8.15. Correctly Installed Skeg



The Skeg is held in place with two M5 x 45mm titanium tapered head cap screws that are installed in the threaded inserts inside the Skeg slot for shipping.

1. Use a 4mm Allen wrench to remove the two Skeg screws from the Skeg slot.

2. Insert the Skeg into the slot.

Figure 8.16. Insert Skeg Into Slot Under the Aft End of the Float



3. Apply Loctite to the two Skeg screws and use them to attach the Skeg to the Float.
4. Tighten the Skeg screws to 30 in-lbs torque.

Figure 8.17. Secure Skeg with Two Screws



Chapter 9. Attaching the Umbilical to the Float

The Umbilical attaches mechanically to the Motion Isolator on the Float and it also has an electrical connection to the CCU.



Note

Do not skip ahead and install antennas on the Float before you install the Umbilical. Installed antennas will interfere with the Umbilical installation.

The following tools and materials are required for this task:

- Phillips #2 screwdriver
- Large flat-head screwdriver
- 4-mm Hex wrench
- 10-mm Hex wrench
- 2.5-mm Allen wrench
- Connector lubricant -- 3M silicone lubricant part Number 62-4678-4930-3

Umbilical Attachment Procedure

This procedure requires two people.

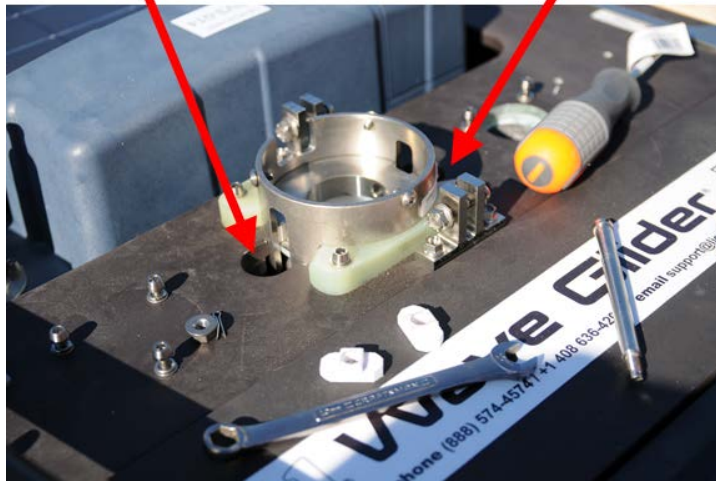


Caution

There are cutouts on either side of the Motion Isolator to accommodate the ends of the shoulder bolt when the Motion Isolator spring is compressed. Be careful not to let small parts fall into these cutouts - they will be very difficult to retrieve. Placing masking tape over the cut-outs during Wave Glider assembly and disassembly is strongly recommended.

Figure 9.1. Place Tape Over Motion Isolator Cut-Outs

Place Masking Tape Over Cut-Outs On Both Sides Of Motion Isolator



1. Remove the cotter pin from the shoulder bolt, then use a wrench and a screwdriver to remove the shoulder bolt and the white shoulder bolt slider bearings from the Motion Isolator assembly. Set these parts aside, they will be needed. The shoulder bolt is used to secure the Motion Isolator Shaft on the Umbilical assembly after it is inserted into the Motion Isolator on the Float.

Figure 9.2. Remove Cotter Pin

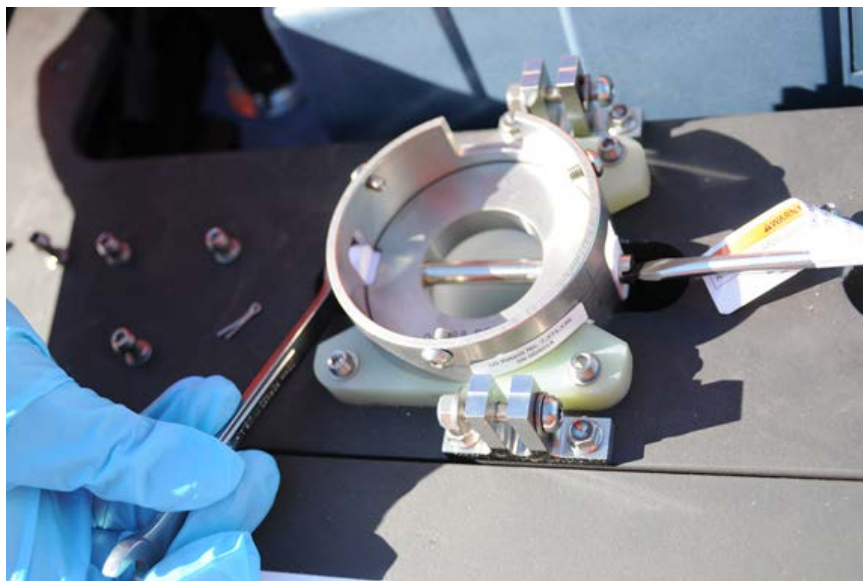


Figure 9.3. Remove Shoulder Bolt

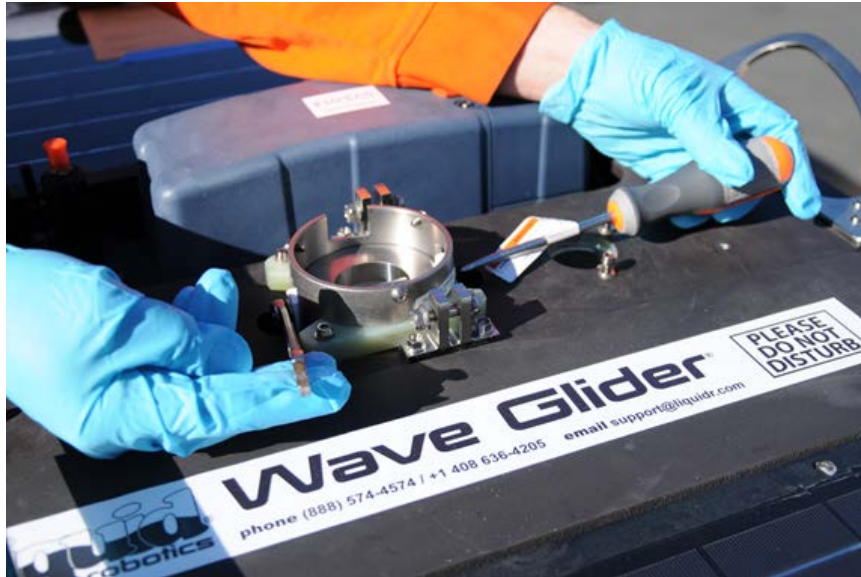
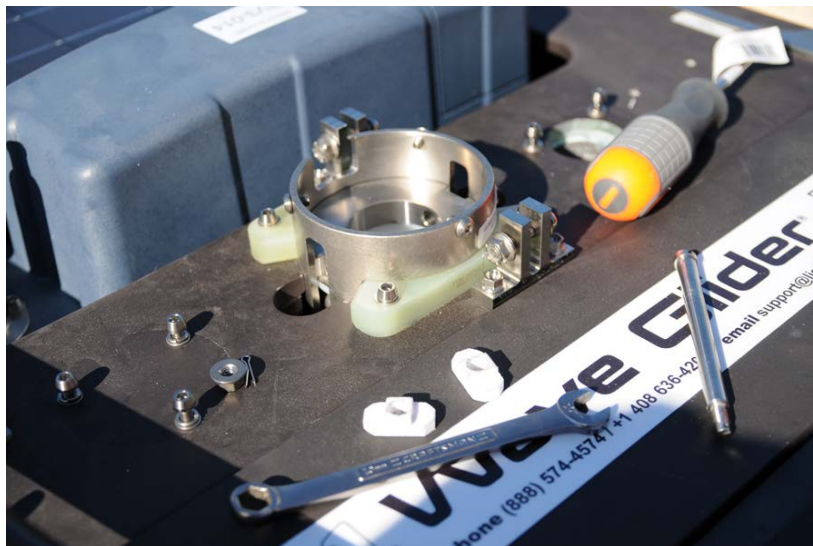


Figure 9.4. Set Parts Aside



2. Extend the Umbilical from where it attaches to the Sub Frame so it lays flat on the ground, then carry the Motion Isolator Shaft back toward the Float so the Umbilical folds over itself without any twists. Position the Motion Isolator Shaft under the Float so you can feed the Umbilical electrical whip up through the Motion Isolator to the topside of the Float.



Caution

It is critical that the leading (forward) edge of the Umbilical is facing forward when the Motion Isolator Shaft is inserted into the Motion Isolator. When the shoulder bolt is installed it will hold the Umbilical in this position.

Make sure the O-Ring is in place at the base of the Motion Isolator Shaft - see [Figure 9.8](#)

Figure 9.5. Position the Umbilical Motion Isolator Shaft for Insertion



3. Push the Umbilical Whip up through the Motion Isolator from below.

Figure 9.6. Pull the Umbilical Whip Through the Motion Isolator



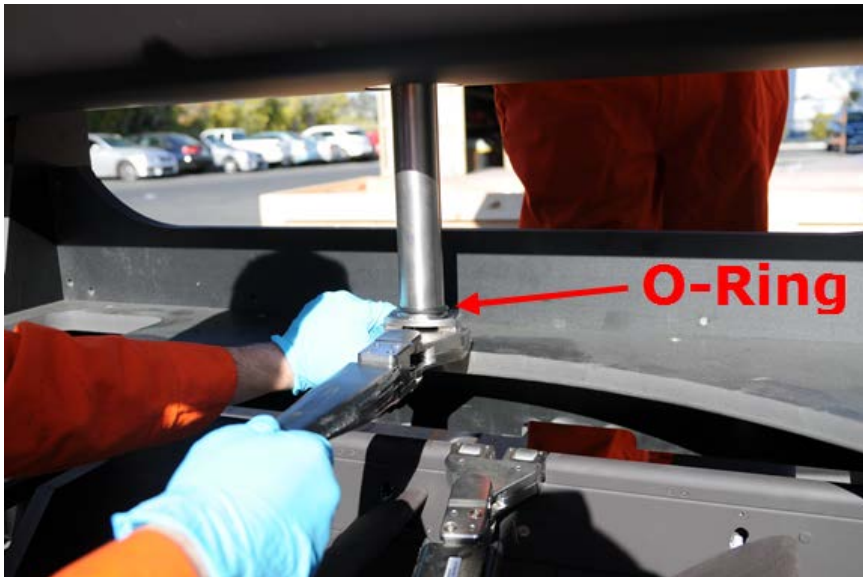
4. Gently pull the Umbilical Whip from above until there is no slack while the Umbilical Motion Isolator Shaft is inserted into the Motion Isolator.

Figure 9.7. Remove Slack from the Umbilical Whip



5. Lift the Motion Isolator Shaft into the Motion Isolator being careful to keep the leading edge of the Umbilical facing forward.

Figure 9.8. Lift the Umbilical Motion Isolator Shaft into the Motion Isolator



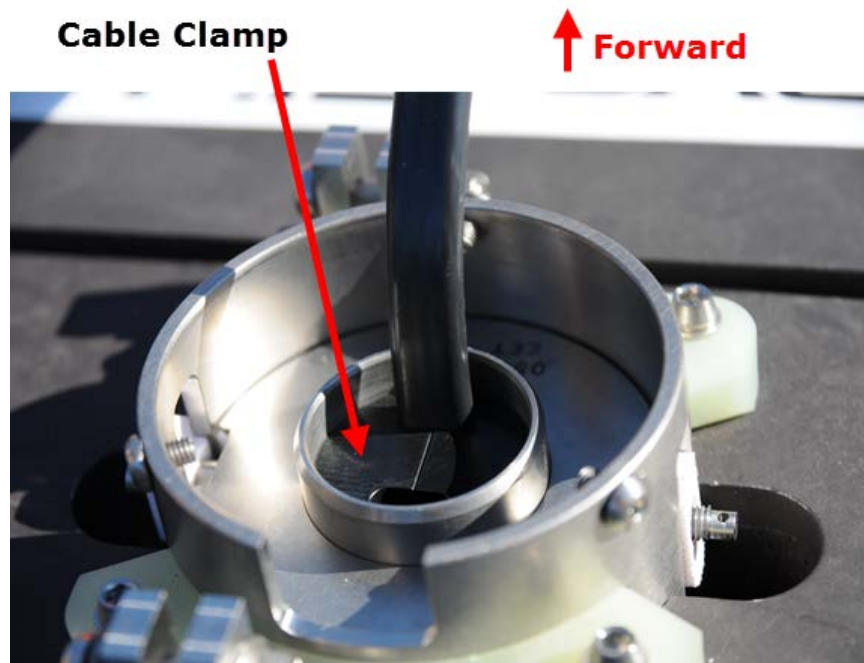
6. Hold the Umbilical Motion Isolator Shaft in position until an assistant inserts the shoulder bolt.

Figure 9.9. Hold the Umbilical Motion Isolator Shaft in Position



7. Before the shoulder bolt is installed, the black Cable Clamp assembly that surrounds the Umbilical Whip (ribbon cable) must be gently rotated a 1/4 turn so the ribbon cable is in a "port-to-starboard" position at the forward side of the Umbilical Motion Isolator Shaft, as illustrated in [Figure 9.10](#). This orientation allows for a larger radius when the ribbon cable is routed into the aft payload bay. The ribbon cable moves up and down as much as 1/2 an inch when the Umbilical U-Joint flexes.

Figure 9.10. Rotate the Umbilical Whip



8. Once the ribbon cable is properly rotated, hold it in position until the shoulder bolt is inserted.



Caution

When the Umbilical Motion Isolator Shaft is correctly inserted and the ribbon cable has been rotated a 1/4 turn as previously described, the ribbon cable will be in a "forward-to-aft" position as it passes through the Umbilical U-Joint - see [Figure 9.11](#).

Figure 9.11. Ribbon Cable Rotated 1/4 Turn at Top of the Motion Isolator Shaft



If the ribbon cable has been rotated more than 1/4 turn at the top of the Umbilical Motion Isolator Shaft, it will be twisted as it passes through the Umbilical U-Joint - see [Figure 9.12](#). **Rotating the ribbon cable more than 1/4 turn may lead to cable failure.**

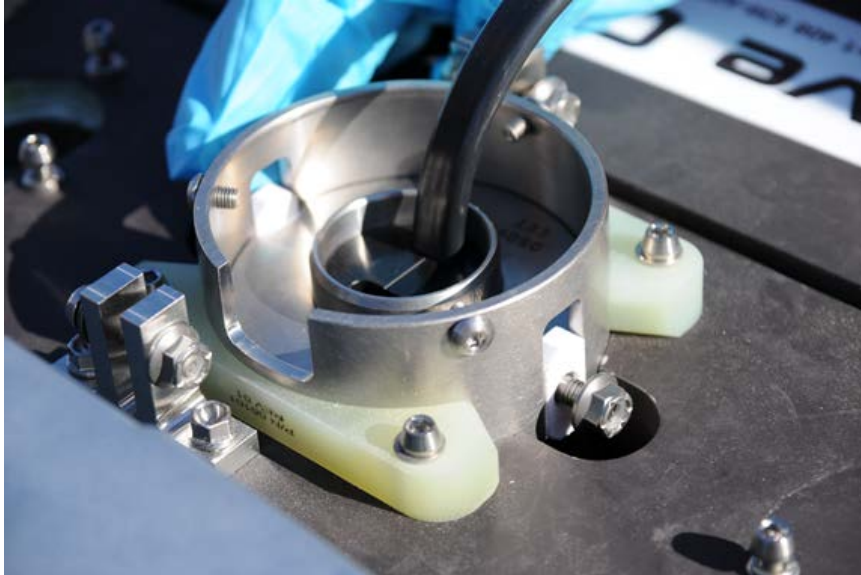
Figure 9.12. Ribbon Cable Rotated More Than 1/4 Turn at Top of Motion Isolator Shaft



9. Hold the white slider bearings in place while inserting the shoulder bolt through the Motion Isolator and the Motion Isolator Shaft until it projects out the other side. The shoulder bolt

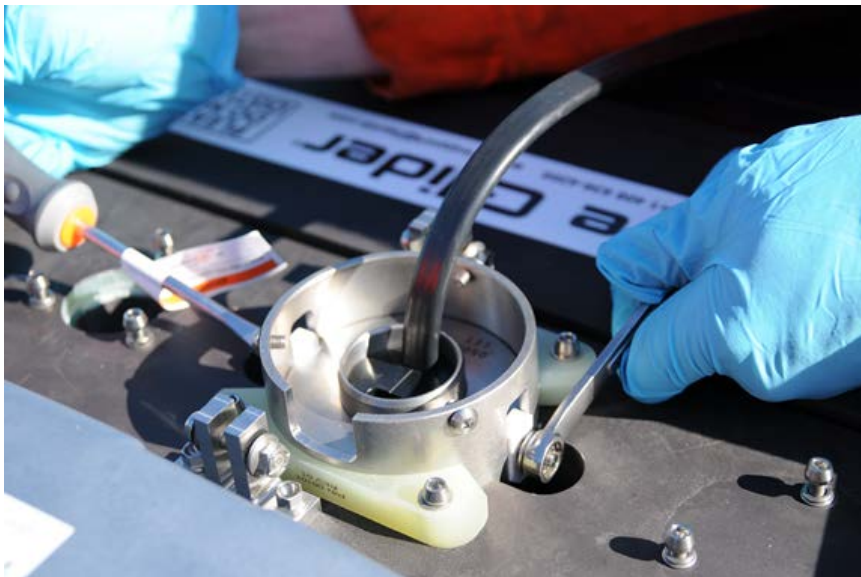
can be inserted from the port or starboard side. Once the shoulder bolt is inserted, it is no longer necessary to support the Motion Isolator Shaft from below.

Figure 9.13. Insert the Shoulder Bolt



10 Install the nut on the shoulder bolt.

Figure 9.14. Install the Nut



11 Install the cotter pin on the shoulder bolt using pliers to bend back the prongs.

Figure 9.15. Install the Cotter Pin



12 Remove the center solar panel.

Figure 9.16. Remove the Center Solar Panel



13 Remove the port side cable bridge from the CCU.

Figure 9.17. Remove the Cable Bridge



Figure 9.18. Cable Bridge Removed



14 Remove a block of blue foam from the forward side of the CCU.

Figure 9.19. Remove Foam



15 Gently slide the CCU forward a few inches into the space where the blue foam was removed. Be careful not to strain or bend cables.

Figure 9.20. Slide the CCU Forward



16 Run the Umbilical Whip under the Ribbon Cable Clamp on the payload bay bulkhead and around the port side of the CCU and connect it to the U1 (Umbilical) connector using 3M Silicone Connector Lubricant Part Number 62-4678-4930-3.

Figure 9.21. Run Umbilical Whip Under Cable Clamp

Ribbon Cable Clamp



Figure 9.22. Connect the Umbilical Whip to the CCU



17 Reinstall the Cable Bridge on the CCU.

Figure 9.23. Install the Cable Bridge



18 Slide the CCU aft to its original position.

Figure 9.24. Slide the CCU Back Into Place



19 Replace the block of blue foam.

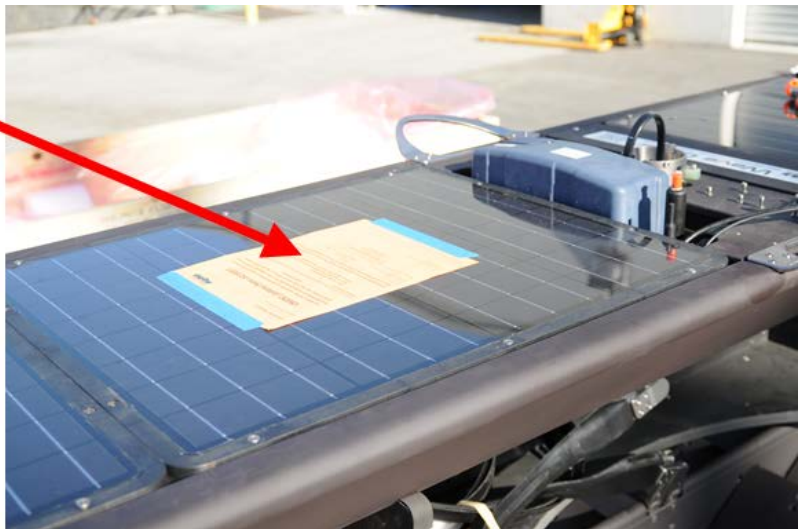
Figure 9.25. Replace the Foam



20 Replace the center solar panel. Do not remove the attached note containing important information about the Iridium Satellite Network.

Figure 9.26. Replace the Solar Panel

**Important
Note
About
Iridium
Satellite
Network**



21 Remove three screws from the top of the Motion Isolator - you will need these screws to install the Umbilical Whip Shroud.

Figure 9.27. Remove 3 Screws



22 Install the Umbilical Whip Shroud using three screws to hold it in place. Apply Loctite 243 to the screws.

Figure 9.28. Install Umbilical Whip Shroud



23 Figure 9.29. Install Screws



24 Figure 9.30. Properly Installed Umbilical Whip Shroud

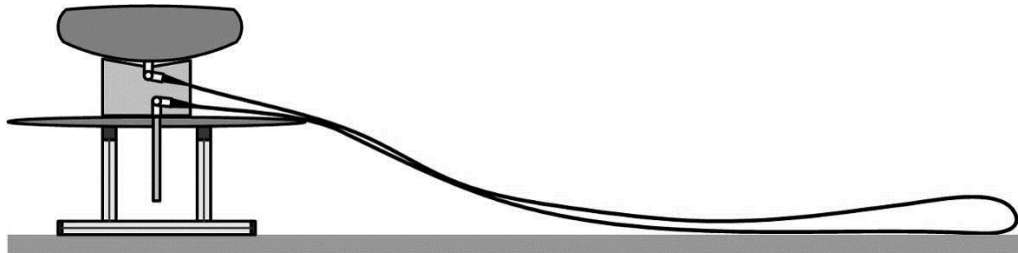


Chapter 10. Stowing the Umbilical

Perform the following to stow the Umbilical before launch.

1. Extend the Umbilical out to its full length and confirm that it is not twisted.

Figure 10.1. Confirm Umbilical Is Not Twisted



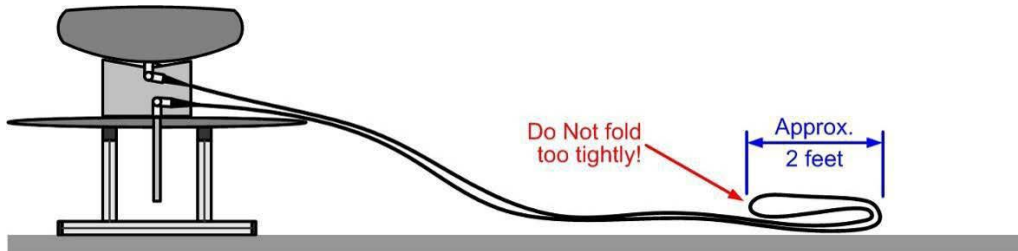
2. Begin carefully folding back the Umbilical from the farthest point in approximately 2-ft lengths as illustrated in [Figure 10.2](#). The diameter of the first fold should be approximately 3.5 to 4 inches, as illustrated in [Figure 10.3](#).



Caution

Never crease the Umbilical or force it to fold with less than a radius of 1.75 inches for each fold.

Figure 10.2. Begin Folding Umbilical



3. Continue folding until the Umbilical is at the Sub.

Figure 10.3. First Umbilical Fold



Figure 10.4. Second Umbilical Fold



Figure 10.5. Third Umbilical Fold



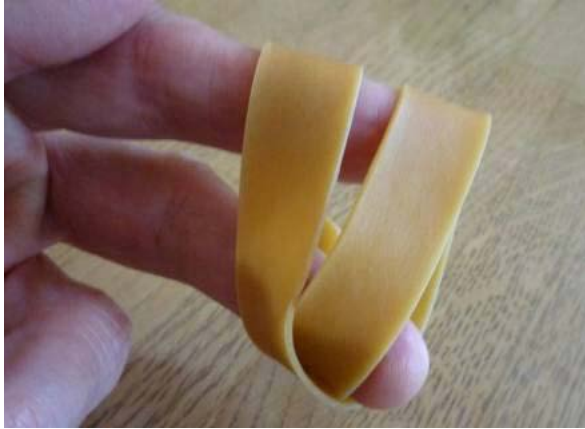
4. Remove the large rubber band from the Parts Crate.

Figure 10.6. Rubber Band from Parts Crate



5. Double-over the rubber band.

Figure 10.7. Double-over Rubber Band



6. Wrap the doubled-over rubber band around the folded Umbilical.



Note

The doubled over rubber band is sufficient to hold the folded Umbilical together during launch, but flexible enough to allow the Umbilical to unfold when the Launch Strap is released and the Sub descends.

Figure 10.8. Folded Umbilical Held Together with Large Rubber Band



7. Rest the banded Umbilical on the Launch Saddle frame.

Figure 10.9. Banded Umbilical Resting on Launch Saddle Frame



Chapter 11. Completing Assembly

To complete the assembly:

- Install the Lifting Ring
- Install Antennas and Masts
- Perform final checks

The following tool is required for these tasks:

- 12-mm box-end wrench
- 4-mm Allen wrench

Install the Center Lifting Ring

1. Remove the two screws, nuts, and lock washers from the Lifting Ring Mounts and set them aside.

Figure 11.1. Remove Screws from the Lifting Ring Mounts



2. Locate the Lifting Ring in the Float Crate.
3. Remove the screws from the two Lifting Ring Mounts and set them aside.
4. Insert the Lifting Ring into the Lifting Ring Mounts and secure it with the screws, nuts, and lock washers you set aside.



Note

Due to the location of the Umbilical Cable Shroud, the screw on the aft Lifting Ring Mount should be inserted from the Starboard side of the Float so you can retain it with a screw driver while tightening the nut.

Figure 11.2. Install Screws in Lifting Ring Mount



Install Antennas and Masts

The standard Wave Glider SV3 configuration includes the following Antennas and Masts:

- An AIS Antenna (attaches to CCU)
- A Cell Antenna Mast (attaches to Mast Deck)
- A Radar Reflector Mast (attaches to Mast Deck)
- A Weather Station and Marker Light Mast (attaches to Mast Deck)

The antennas and masts are shipped in the Float Crate:

- The Weather Station/Marker Light mast ships connected to the CCU, but not mounted to the Mast Deck.
- The Radar Reflector mast ships disconnected from the CCU.
- The Cell Antenna Mast ships disconnected from the CCU.
- The AIS Antenna ships disconnected from the CCU.

Installing the Masts

The Radar Reflector, Cell Antenna, and Weather Station/Marker Light masts all have the same mounting hardware and all attach to the Mast Deck on the Float.

Each mast is secured by three titanium tapered head cap screws with flat washers and lock washers. Loctite 243 is applied to each screw.

The Weather Station/Marker Light Mast and the Radar Reflector Mast are already connected to the CCU and need only to be mounted to the Mast Deck.

The Cell Antenna Mast must be connected to the CCU after it has been mounted to the Mast Deck. For more information see [“Connecting the Cell Antenna to the CCU”](#) (page 68).



Note

The AIS Antenna is connected directly to the CCU. For more information see [“Installing the AIS Antenna”](#) (page 70).

Figure 11.3. Locations of Antennas and Masts Port Side View

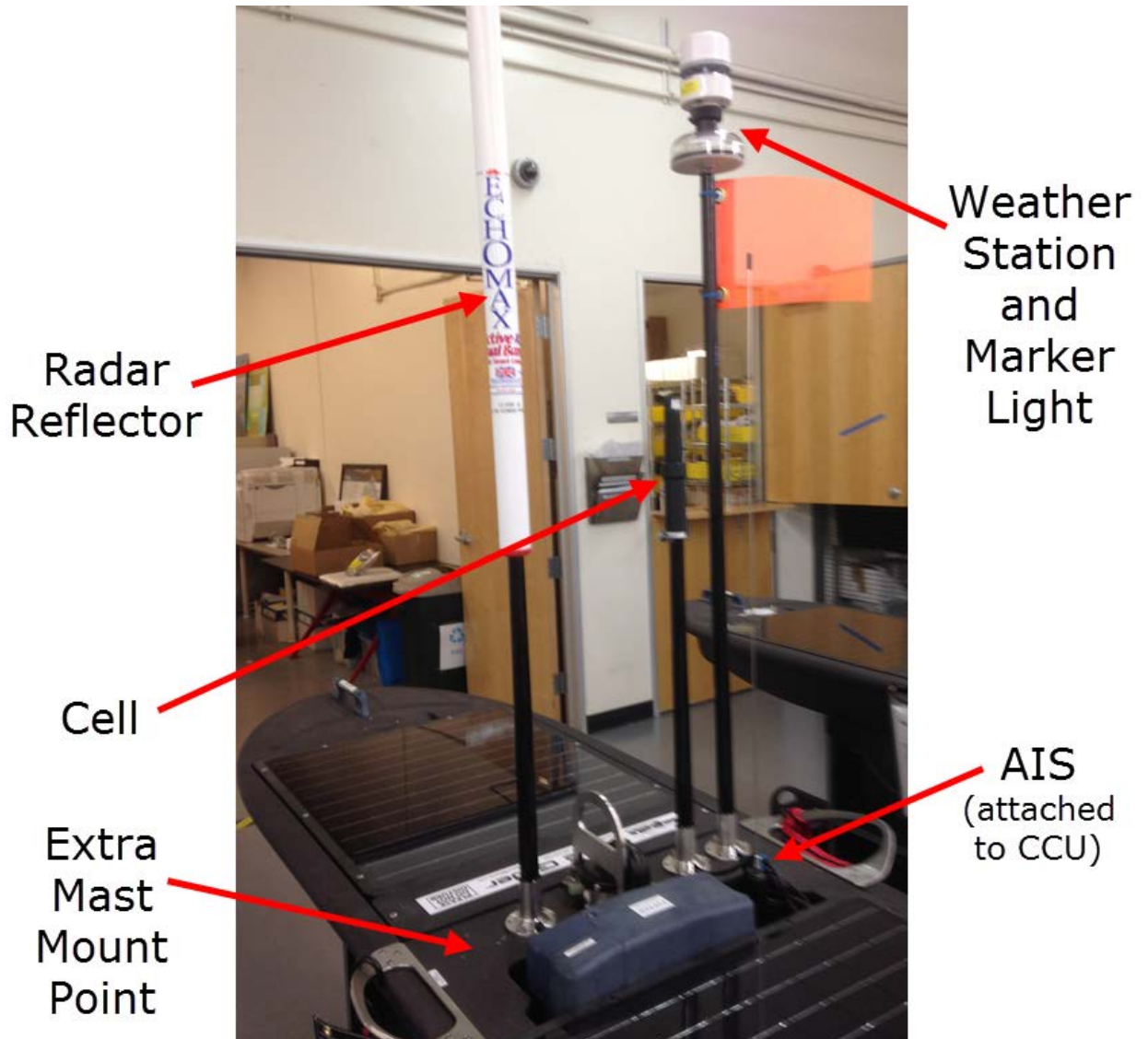
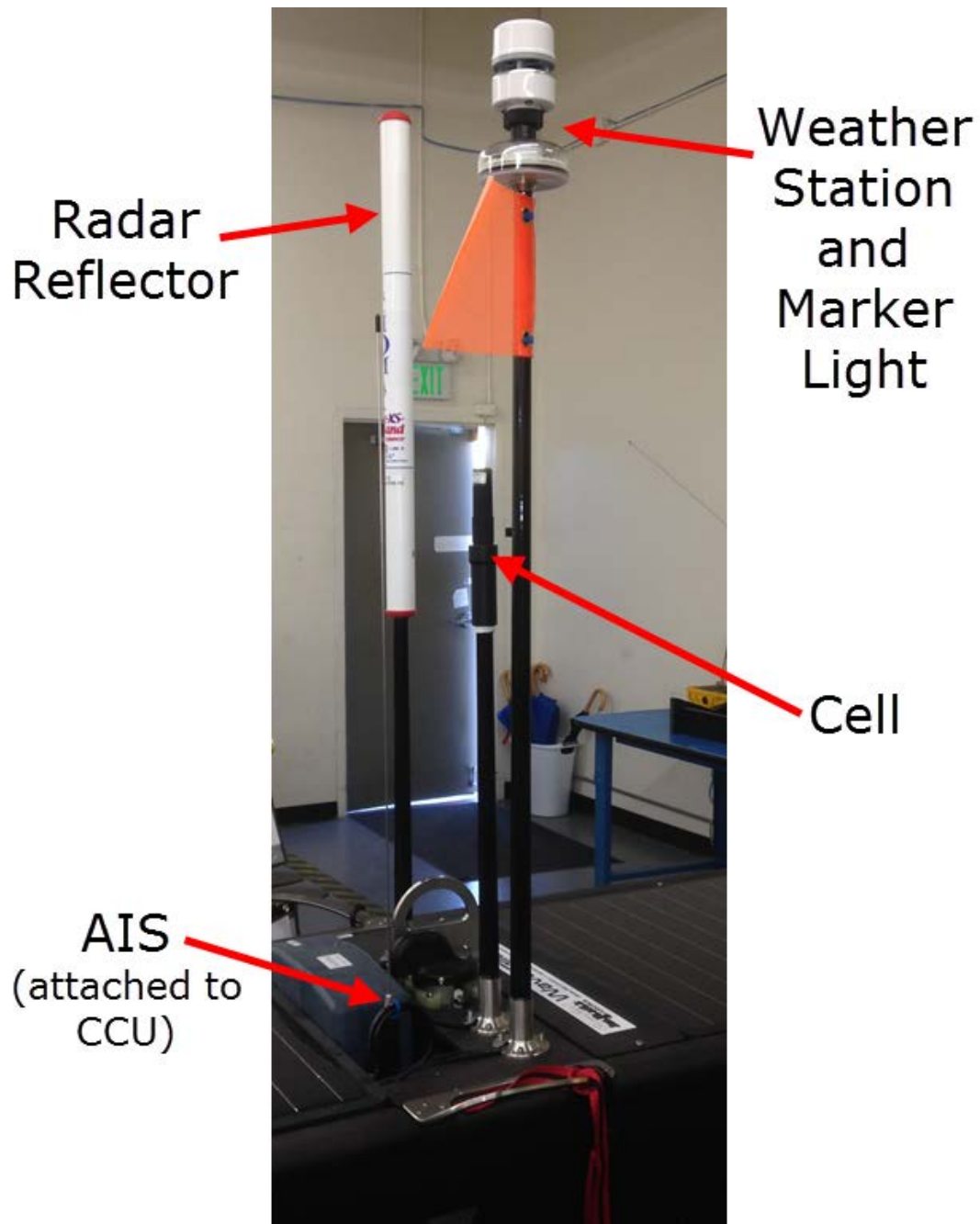


Figure 11.4. Locations of Antennas and Masts Starboard Side View



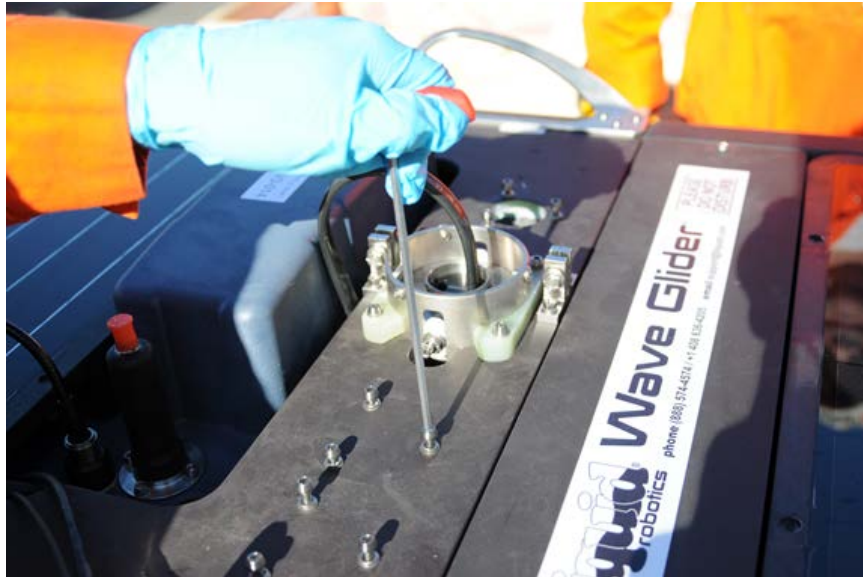
There are four mast mounting points on the Float Mast Deck. Each mast mounting point has 3 titanium inserts to accommodate the hex head screws that secure the masts.

The Float is shipped with hex head screws threaded into 3 of the 4 mast mounting points (there is one spare mast mounting point available for optional equipment).

To install the masts:

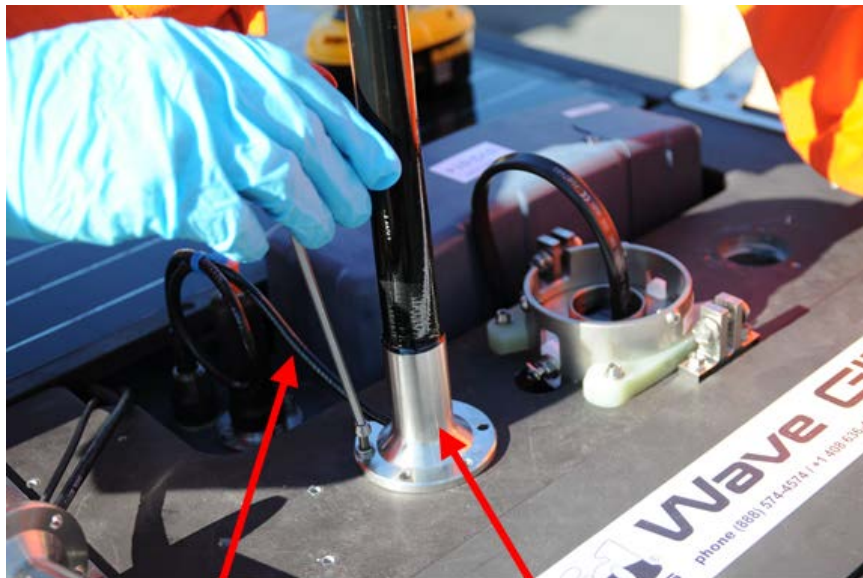
1. Remove the hex head screws and lock washers from the Mast Mounting Points and set them aside.

Figure 11.5. Remove Mast Mounting Screws



2. Use 3 hex head screws with flat washers and lock washers to install each mast. Apply Loctite 243 to each screw. The masts should be located as shown in [Figure 11.3](#) and [Figure 11.4](#) with the cable running out the aft end of the mast mounting base.

Figure 11.6. Install Masts



Cable Exits
to Aft

Mast
Mounting
Base

Connecting the Cell Antenna to the CCU

1. The CCU ships with a rubber "dummy" plug installed in the Cell antenna connector. Unscrew the black retainer ring and remove the dummy plug (retain the dummy plug for future use).

Figure 11.7. Remove Dummy Plug



Figure 11.8. Dummy Plug Removed



2. Slide the Cell Antenna connector through the retainer. The O-rings on the Cell Antenna connector are pre-lubricated. Inspect the O-rings for dirt/hair/etc. Clean and re-lubricate if necessary.

Figure 11.9. Slide Cell Antenna Connector Through the Retainer



3. Plug in the Cell Antenna connector and use an SMA 8-mm, 1Nm torque wrench to tighten the Cell Antenna connector nut.

Figure 11.10. Connect the Cell Antenna Cable



4. Slide the retainer over the Cell Antenna connector and hand-tighten the black retainer ring.

Figure 11.11. Slide the Retainer Over the Cell Antenna Connector



5. Figure 11.12. Hand-Tighten the Black Retainer Ring



Installing the AIS Antenna

1. Remove the AIS antenna from the Float Crate.



Note

The AIS antenna ships with STUF Dielectric Water Proofing Filler applied to the attachment threads. You should re-apply STUF (or a comparable product) whenever you detach and reattach the AIS antenna.

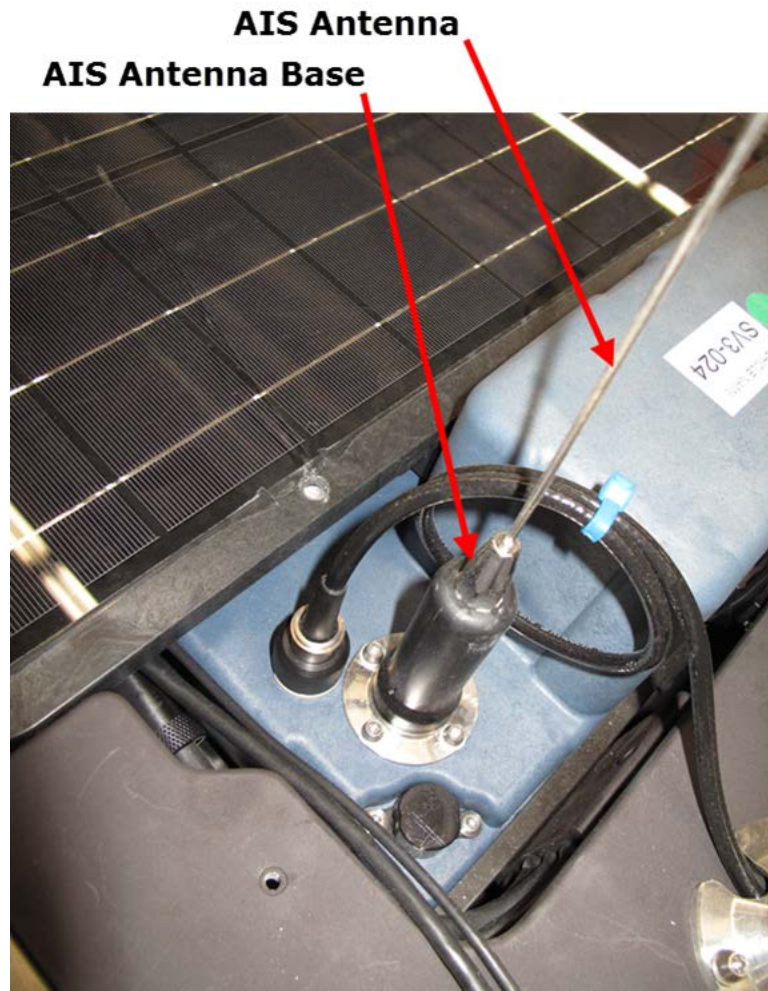
2. Screw on the AIS antenna by hand.



Note

Be careful not to damage the threads when attaching the antenna.

Figure 11.13. Screw on the AIS Antenna



3. Place the box-end wrench over the antenna from the top and bring it down to the antenna base. Tighten the antenna until it bottoms out, then tighten an extra 1/8 turn (45 degrees). **Do not over-tighten.**

Figure 11.14. Tighten AIS Antenna



Final Checks

1. Confirm that the Umbilical connector and all other connectors to the CCU are fully inserted - tight to their mating connectors on the CCU.
2. Confirm that the solar panel cables are connected.
3. Ensure there are no loose screws, tools, and so forth in or on the Float.
4. Engage the Power Key on the CCU to provide power to the Wave Glider electrical system.

Deck Options for Mounting Additional Equipment

For information on optional Masts and other Deck Options, contact Liquid Robotics Customer Support.



Important

Before contacting LRI support, please have available the serial number of the vehicle(s) or part(s) that you are contacting LRI Customer Support about.

The Liquid Robotics Customer Support organization is available 24/7.

Telephone:

(US) 888-574-4574

(International) 1-408-636-4205

Email:

support@liquidr.com