KONGSBERG

Seaglider Refurbishment

Maintenance Guide

Part Number: 4311043

Rev. C

End User License Agreement Governing

Commercial Computer Software and Commercial Technical Data

Delivered With Seaglider Autonomous Underwater Vehicle

Introductory Note. The Seaglider Autonomous Underwater Vehicle ("AUV") is a "commercial item" and is offered for sale and sold by Kongsberg Underwater Technology, Inc. (Kongsberg) under license from University of Washington. The computer software and technical data pertaining to, and delivered with Kongsberg's Seaglider AUV is commercial computer software, commercial computer software documentation, and commercial technical data and is licensed to end users of Kongsberg's Seaglider AUV under commercial terms and conditions.

IMPORTANT - READ BEFORE COPYING, INSTALLING OR USING.

BY DOWNLOADING, INSTALLING, OR USING THE SOFTWARE OR THE SEAGLIDER, YOU ARE BINDING YOURSELF AND THE BUSINESS ENTITY THAT YOU REPRESENT (COLLECTIVELY, "CUSTOMER") TO THE AGREEMENT. IF YOU DO NOT AGREE TO ALL OF THE TERMS OF THE AGREEMENT, THEN KONGSBERG IS UNWILLING TO LICENSE THE MATERIAL TO YOU AND YOU MAY NOT DOWNLOAD, INSTALL OR USE THE SOFTWARE OR KONGSBERG SEAGLIDER, AND YOU MAY RETURN THE ENTIRE PRODUCT FOR A FULL REFUND. CUSTOMER'S RIGHT TO RETURN AND REFUND EXPIRES 30 CALENDAR DAYS AFTER PURCHASE, AND APPLIES ONLY IF YOU ARE THE ORIGINAL END USER PURCHASER.

Copyright and Liability Information

Limits of Liability

By attending Seaglider refurbishment training, Kongsberg Underwater Technologies, Inc. will certify you to conduct basic refurbishment of a Seaglider. This certification will allow you to procure the necessary parts through Kongsberg to perform such basic refurbishment. Kongsberg, by providing this basic refurbishment training to you, provides no warranty on any work performed by you, or your personnel, on your Seaglider, or the Seaglider of any third parties, and Kongsberg expressly disclaims all warranties, express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. In addition, Kongsberg shall not be responsible for any damage to, or loss of, a Seaglider resulting from any refurbishment or repairs performed by you or your personnel.

While every precaution has been taken in the preparation of this documentation, Kongsberg Underwater Technologies, Inc. assumes no responsibility whatsoever for errors, omissions, or for damages resulting from the use of the information contained herein.

To the maximum extent permitted by applicable law, Kongsberg Underwater Technologies, Inc., its officers, employees and contractors, and their suppliers disclaim all warranties, either expressed or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose, with regard to the hardware, software, and all accompanying or subsequently supplied written materials and documentation.

To the maximum extent permitted by applicable law, in no event shall Kongsberg Underwater Technologies, Inc., its officers, employees or contractors, or their suppliers, be liable for any damages whatsoever, including without limitation, special, incidental, consequential, or in-direct damages for personal injury, loss of business profits, or business interruption.

Trademarks

Kongsberg and Seaglider are registered trademarks of Kongsberg Underwater Technologies, Inc.

Other product and company names mentioned may be trademarks or registered trademarks of their respective companies. Mention of third-party products is for informational purposes only and constitutes neither a recommendation nor an endorsement.

Support Information

For Kongsberg Seaglider Support contact km.support.seaglider@kongsberg.com or +1 425 712-1107.

1 Introduction

The Kongsberg Seaglider is a deep-diving, autonomous, underwater vehicle (AUV) designed for long-term data-gathering missions. It measures water temperature, salinity and other oceanographic characteristics over a wide mission area, and sends collected data to a base station via global satellite telemetry.

This manual provides instruction to perform a basic refurbishment of a functional glider, including external condition inspection, software checkouts of the glider's navigation, communications and control systems, replacement of the batteries, recalibration of the compass and the procedure for returning to Kongsberg a glider for refurbishment/repair or science sensors for OEM recalibration. The training will also include instruction on updating a glider's trim sheet and calculating new ballasting solutions. The procedures in this manual apply to Seagliders containing an Electrochem lithium sulfuryl chloride battery mass shifter assembly. A refurbishment should not be attempted prior to attending Seaglider refurbishment training, conducted by Kongsberg.

By attending Seaglider refurbishment training, Kongsberg Underwater Technologies, Inc. will certify you to conduct basic refurbishment of a Seaglider. This certification will allow you to procure the necessary parts through Kongsberg to perform such basic refurbishment. Kongsberg, by providing this refurbishment training to you, provides no warranty on any work performed by you, or your personnel, on your Seaglider, or the Seaglider of any third parties, and Kongsberg disclaims all warranties, express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. In addition, Kongsberg shall not be responsible for any damage to, or loss of, a Seaglider resulting from any refurbishment or repairs performed by you or your personnel nor for any bodily injury to you or your personnel resulting from the refurbishment process.

2 Organization of This Guide

This guide is arranged in the following manner:

- *System Overview*: This section contains short descriptions of each major subassembly involved in the refurbishment process. It also lists the support equipment and consumable items that are required in order to perform a full Seaglider refurbishment.

- *Safety Considerations*: This section provides explanations of Warning and Caution symbols used throughout the manual. The Warning/Caution information is intended to alert the maintainer to a potential hazard related to the step that follows the alert. Each alert contains a directed action and the possible consequence, if that instruction is not complied with.

- *Refurbishment process*: This section contains the following information:

    - *Process Flow Chart* - Abroad outline of the sequence of events are provided for a typical basic full Seaglider refurbishment

    - *Seaglider refurbishment checklist and detailed process* – This section provides step-by-step guidance to perform the refurbishment, beginning with an inventory check of the Seaglider case, and ending with a post-refurbishment system test. Verifying the case contents is an optional step, but if new or repaired wings and/or rudders will be installed, their weights should be recorded on the checklist, to be later transferred to the glider trim sheet. All other steps in the process should be performed in sequence.

- *Appendix A: Refurbishment Check List* - example on page 17 of this document, a printable version in this appendix.

- *Appendix B: Equipment Return for Repair Procedure* – This flow chart outlines Kongsberg's procedure for processing glider equipment returned to them for repair/refurbishment/OEM calibration.

- *Appendix D: Technical Service Bulletin* - This bulletin describes the procedure to add a pad to the SIM card to prevent poor contact with the modem.

- *Appendix E: Material Safety Data Sheets* – This document provides proper handling, storage and disposal methods for the Seaglider's Electrochem lithium battery packs, Tef-Gel, Loctite 243, Hi-Slip Grease, Blue-Moly grease, Dow Corning 4 Silicone grease, 3M spray Silicone lubricant, Dow Corning Xiameter PMX-200 oil and Brightside Polyurethane Single Part Enamel.

- *Appendix F*: Warranty – This document specifies the warranty provided with each Seaglider.

3 Seaglider and Accessory Serial and Part Numbers

3.1 Serial Numbers

Each Seaglider is assigned a unique 3-digit serial number, which should be marked on the exterior surface of the aft fairing, near the base of the antenna. All subassemblies in a glider should also be marked with the same 3-digit serial number to ensure the weight/trim parameters are accurate for ballasting purposes. Parts from multiple Seagliders should not be intermixed. Mixing of parts between gliders can lead to inaccuracies on the trim sheet which will cause errors in the ballasting and potential loss of the glider.

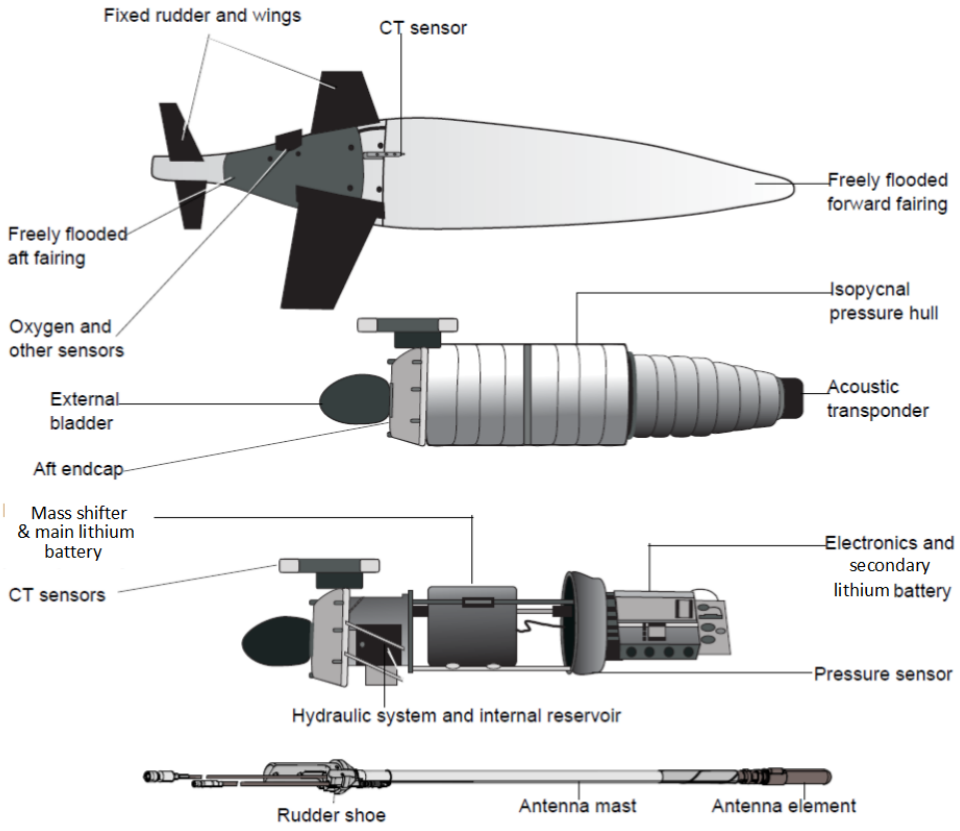
4 System Overview

The Autonomous Underwater Vehicle (AUV) is the base component, acting as a chassis upon which various sensor payloads are installed. The chassis also houses the batteries, navigation and control system and communications interface with the Basestation. Refer to figure 1.

Supporting Publications:

- Seaglider User's Guide, PN 4220126

Figure 1: Seaglider Components



4.1 Seaglider Components

The Seaglider consists of a hollow composite outer shell (fairing) which allows water to enter. Under the fairing is the pressure hull, which is a sealed assembly that houses the vehicle navigation, communications and control

electronics. The antenna is mounted to the aft fairing. The temperature/conductivity sensor (CT sail) protrudes from the top center of the aft fairing, and optional sensors can be mounted to the aft fairing hatches. **Note:** Gliders with a serial number of 160 or higher have aft fairing hatches. Gliders with a serial number lower than 160 were manufactured without hatch covers, however hatches may have been added at a later date. If the aft fairing is not equipped with removable hatch covers, the sensors are mounted directly to the aft fairing.

The Seaglider has the following main components:

4.1.1 Fairing

The fairing consists of a forward and an aft piece. The aft fairing may be equipped with two removable hatches, which provide access to the connectors on the aft endcap, without removing the entire aft fairing. The removable hatches also allow various optional sensors to be easily removed and installed.

4.1.2 Antenna

The antenna assembly is a combination GPS/Iridium antenna installed at the distal end of a one meter long fiberglass mast. An antenna shoe at the base of the antenna mast secures the antenna assembly to the glider. The antenna assembly provides a means to transmit telemetry and data, and receive piloting commands, when the Seaglider surfaces.

4.1.3 Wings and Rudder

These stabilizing and lifting surfaces are attached to the fairing.

4.1.4 Pressure Hull (or *Pupa*)

The pressure hull is a sealed, pressure rated capsule containing the batteries, electronics and communications system. The pressure hull is separated into four sections (three flanges) for refurbishment maintenance: forward hull, bulkhead with mass shifter, main pressure hull and aft endcap.

4.1.5 Forward Electronics Assembly

The electronics assembly houses the main board, Iridium modem, navigation and communications PCBs and secondary battery pack. Note that the secondary battery pack can be either 10 or 15 VDC based on electronics and main battery pack voltage. The customer should verify which secondary battery pack is used in their glider before performing refurbishment. The forward hull shrouds the electronics assembly and houses the compass and transponder.

4.1.6 Mass Shifter Assembly

The mass shifter controls the pitch and roll of the glider. The assembly is comprised of the main battery pack sitting inside a frame with a brass weight affixed to the underside of the frame. Note that the main battery

pack can be either 24 or 15 VDC. The customer should verify which main battery pack is used in their glider before performing refurbishment.

Pitch change is accomplished by sliding the main battery axially forward or aft along a center rod.

Roll movement is accomplished by positioning the brass weight circumferentially.

4.1.7 Aft Endcap

The aft endcap assembly contains the buoyancy engine, electrical connector receptacles for external sensors and direct communication, the pressure relief valve and the CT Sail.

5 Maintenance Support Equipment

Table 1 lists the support equipment desired when a full Seaglider refurbishment is performed. Diagrams of glider specific refurbishment equipment are shown after the table.

Table 1. Support Equipment and Consumables

Part Number	Description
4199416	Magnetic Wand or Shorting Plug Power ON/OFF – Fig. 2
Commercially Available	Pressure Relief Valve Vacuum Adapter (DeepSea Power & Light tool 701-00004) – Fig. 3
Commercially Available	Pressure Relief Valve Installation Tool (DeepSea Power & Light) – Fig. 4
4303135	Pressure Hull Maintenance Fixture (Whirligig), Table Mounted Clamp - Figure 5
4236215	CT Sail Calibration Housing – Fig. 6

Part Number	Description
4275669	Aft Endcap Assembly Holder – Fig. 7
Commercially Available	Laptop Computer for Seaglider Communications
Commercially Available	Compact Flash Card Reader
Commercially Available	Tera Term Software
4230233	Compass Calibration Software (optional)
4196985	Non-powered Communications Cable (50 ft.)
4196986	Powered Communications Cable (10 ft., optional)
Commercially Available	Power Supplies for Use with Powered Communications Cable (optional), 0-30V variable input,0-3A variable input
4255737	Kit, Refurbishment, Battery Packs, Electrochem
Sartorius GP100K, or equivalent	Scale – Large Capacity, Resolution to ±1 gram, 65 kg minimum capacity
Sartorius GE7101, or equivalent	Scale – Small Capacity, Resolution to 0.1 gram
4339426	Vacuum Pump Kit, or equivalent commercially available pump (i.e. Gast DOA-P704-AA)
Commercially Available	Soldering Iron and Desoldering Tool (solder sucker or wick)

Part Number	Description
Commercially Available	Heat Gun, variable temperature
Commercially Available	SMA Torque Wrench, 5/16”, Preset to 8 in-lbs.
Commercially Available	Allen Driver, T-Handle, 7/64 Inch (Long Handle)
Commercially Available	Screwdriver, #1 Phillips
Commercially Available	Screwdriver, #2 Phillips
Commercially Available	Screwdriver, Flat-Head, medium blade
Commercially Available	Allen Wrenches, 3/32”, 7/64”, 9/64”, English (Standard)
Commercially Available	¾ Inch Standard Open Wrench (for CT Sail mounting nut)
Commercially Available	Knife (to cut tape)
Commercially Available	Tape Measure
Commercially Available	Electrical Tape, ¾”, (3M Scotch Super 88)
Commercially Available	Electrical Tape, 1.5”, 3M Scotch Super 88
Commercially Available	Duct Tape, 3M or Gorilla Tape
Commercially Available	Carpet Tape
Commercially Available	Lubricant, Tef-Gel – Anti-Corrosion, Anti-Seize

Part Number	Description
Commercially Available	Adhesive, Threadlocker, Loctite® 243 Blue
Commercially Available	Lubricant, Anti-Seize (ex. Blue Moly Never-Seez)
Sentry Solutions PN 91050	Grease, Sentry Hi-Slip
Commercially Available	Lubricant, Grease – Electrical Insulating for O-rings, (Dow Corning 4)
Commercially Available	Spray, 3M Silicone Lubricant (for servicing IE55 connectors)
Commercially Available	Fluid, Dow Corning XIAMETER PMX-200, any viscosity
Commercially Available	Sealant, Dow Corning 748, Non-Corrosive
Commercially Available	Isopropyl Alcohol
Commercially Available	Plastic Syringe (for drawing and filling Paine sensor oil, 10 cc)

Figure 2: Magnetic Wand or Shorting Plug: powers the Seaglider ON and OFF.

Note: Kongsberg offers a shorting plug ON/OFF option as an alternative to the standard reed switches controlled by the magnetic wand. If present, the shorting plug is located on the back end of the aft fairing near the base of the antenna mast.

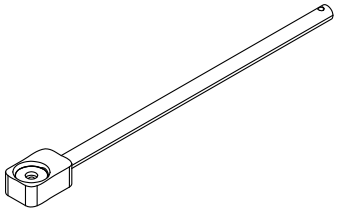


Figure 3: Pressure Relief Valve Vacuum Adapter: used to apply vacuum to the pressure hull

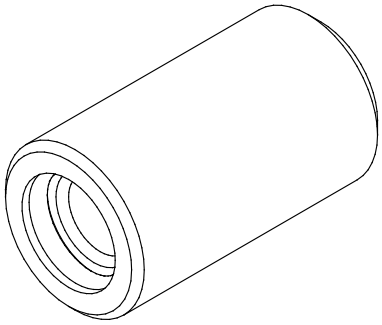


Figure 4: Pressure Relief Valve Installation Tool: used to release vacuum from the pressure hull

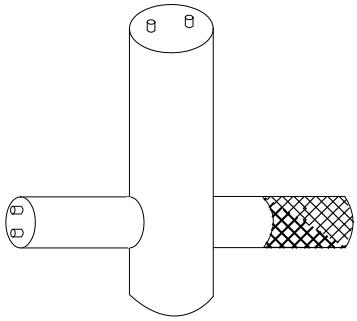


Figure 5: Whirligig Clamp-Mounted Maintenance Fixture: attaches to a workbench, and allows 360° rotation of the pressure hull.

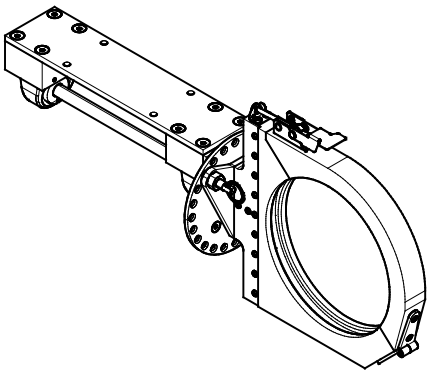


Figure 6: CT Sensor Calibration Fixture: The CT Sail, along with the temperature and conductivity printed circuit boards are installed into this fixture, when being sent out for calibration.

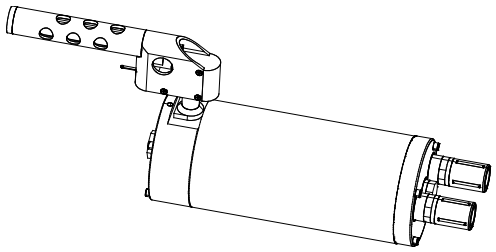
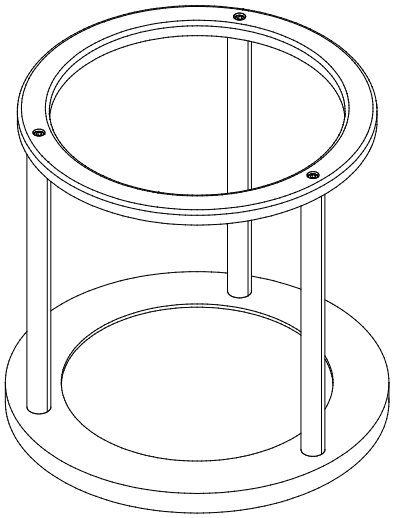


Figure 7: Aft Endcap Assembly Holder: The endcap is placed bladder-down into the fixture, to allow maintenance access.



6 Safety Considerations

To ensure safety when performing maintenance on the Seaglider, carefully read the **Warning** and **Caution** statements. **Warning** statements indicate possible danger to personnel; **Caution** statements indicate possible damage to equipment or other objects.

6.1 Safety Symbols


Warning: Indicates possible danger to the operator or others


Warning: Indicates the risk of electric shock

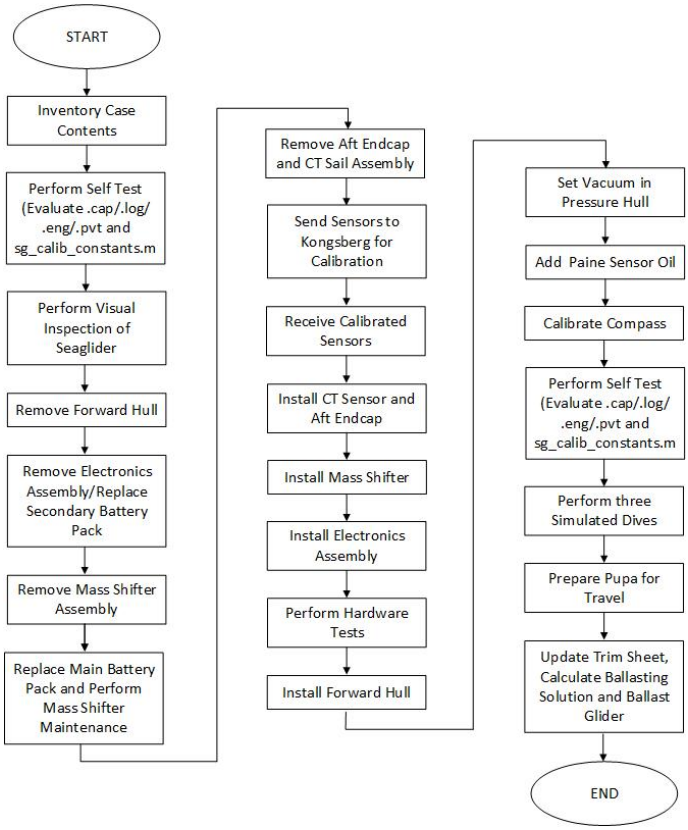

Caution: Indicates the possible damage to Seaglider or other objects


Caution: Indicates possible damage to electronics due to electrostatic discharge

7 Refurbishment Process

The Seaglider refurbishment is performed after a mission, to restore the vehicle to nominal operating condition, in preparation for subsequent missions. During refurbishment, the main, secondary and coin batteries are replaced, the sensors and compass are re-calibrated and any surface damage is evaluated and if necessary, repaired. Figure 8 shows an overview of the full refurbishment process flow.

Figure 8: Refurbishment Process Flow



Caution: Use only silicon spray lubricant to treat sensor cable IE55 connectors. The use of other lubricants, such as WD-40 or CorrosionX, will result in damage to the connector and subsequent failure of the sensor.

7.1 Seaglider Refurbishment Checklist and Detailed Process

Seaglider Serial Number SG_____

Owner _____

Refurbishment Start Date: _____ End Date: _____

7.1.1 Case Contents and Condition

Item Description	Present
Forward Fairing Condition:	Y / N
Aft Fairing Condition:	Y / N
Port Wing Condition:	Y / N
Starboard Wing Condition:	Y / N
Rudder Condition:	Y / N
Antenna Mast Condition:	Y / N
(2x) Power ON/OFF Magnetic Wands or /shorting plugs (1) On, (1) Off (circle appropriate option)	Y / N

Item Description	Present
Laptop Computer for Communications (optional)	Y / N
50 Ft. Non-Powered Communications Cable (optional)	Y / N
10 Ft. Powered Communications Cable (optional)	Y / N
WET Labs Calibration Cap (optional)	Y / N
Collapsible Launch Cradle: (Optional) ____ (2x) End Plates ____ (4x) Rails ____ (8x) Screw, Hex Head - 1/2-13 X 1.500, 18-8 SS ____ mesh ____ (4x) Eye Screws (size) ____(4X) light weight line to connect eye screws to mesh	Y / N
Sensors *CT Sail Serial Number:* Condition of Conductivity Cell: Condition of Thermistor: Condition of Stand-off:	Y / N

Item Description	Present
Port B Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port C*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port D*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor:	

Item Description	Present
Port E: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port F*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor:	
Pressure Hull Condition:	Y / N
Notes:	Y / N

7.1.2 Serial Numbers, Weights and Voltages of Refurbishment Components

Serial Numbers, Weights and Voltages
Main Battery Pack S/N: Weight: Voltage (no load):
Secondary Battery Pack S/N: Weight: Voltage (no load):
Coin Cell Battery Voltage (no load):
Electronics Assembly w/ New Secondary Battery Weight:
Mass Shifter Assembly w/ New Main Battery Weight:
Pressure Hull with Vacuum Pulled Weight:
Fully Assembled Glider including wings, rudder and antenna Weight:
Internal Pressure Target value: Starting value (before vacuum pulled): Ending Value (after vacuum pulled):
Internal Humidity Before vacuum pulled: After vacuum pulled:

7.1.3 Run a self test on battery power. Refer to the Seaglider User's Guide for Autonomous Self Test Instructions.

7.1.4 Before powering OFF the glider:

7.1.4.1 Put the glider into Travel Mode:

a. From Main Menu, select option 2 [hw] Hardware tests and monitoring
b. From Hardware Menu, select Miscellaneous
c. From Miscellaneous Menu, select Travel Mode
d. Press <enter> twice to return to the Hardware tests and monitoring

7.1.4.2 Set the mass shifter to the ¾ aft position: 3000 A/D counts, following the steps below:

a. From Hardware Menu, select option 1 [pitch] Pitch Control
b. From Pitch Menu, select option 2 [ad] and input "3000" to move the mass shifter ¾ aft

7.1.5 Power OFF the glider and disconnect the laptop and communications cable.

7.1.6 Transfer the glider to a horizontal surface, such as the glider's transport cradle.

7.1.7 If the wings are installed, remove them following the procedure below.

7.2 Wing Removal

7.2.1 Equipment Needed

- #2 Phillips Screwdriver

7.2.2 Procedure

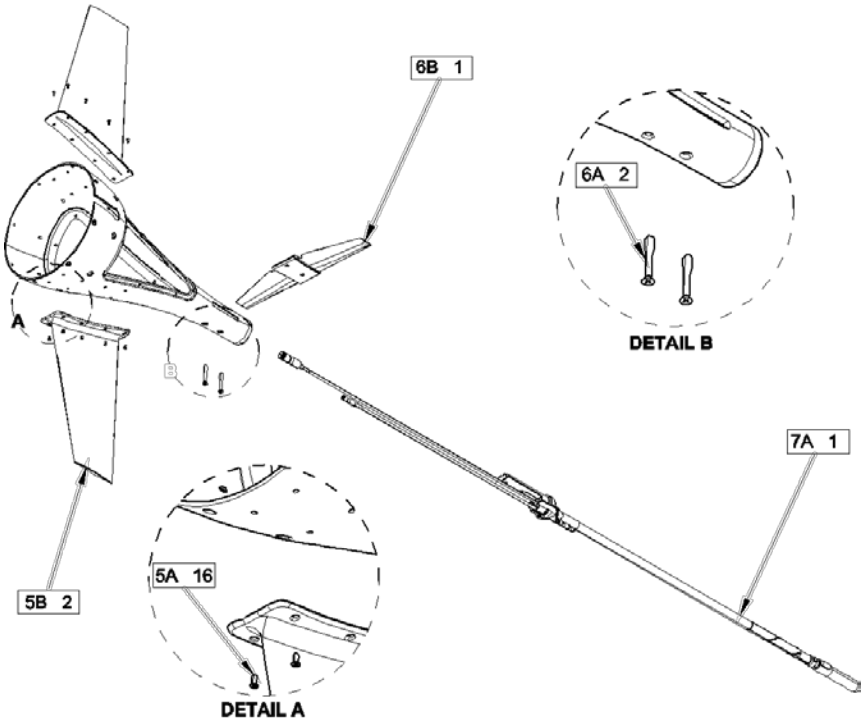
7.2.2.1 Loosen and remove the eight 6-32 x .375 Phillips screws (5A) securing the wing (5B) to the aft fairing (4B). Refer to figure 9.

7.2.2.2 Remove the wing from the aft fairing.

7.2.2.3 Check identification markings on the wing to ensure they are visible.

a. SG serial number
b. Port or starboard
c. Forward or aft edge

Figure 9: Wing and Rudder Removal



7.2.2.4 Repeat for the opposite side if necessary.

7.3 **Rudder Removal**

7.3.1 If the rudder is installed, remove it following the procedure below. Otherwise proceed to step 7.4

7.3.2 **Equipment Needed**

- #2 Phillips Screwdriver

7.3.3 **Procedure**

7.3.3.1 Loosen and remove the two 0.25- 20 x 2 Phillips screws securing the rudder to the aft fairing and remove the rudder. Refer to figure 9.

a. Check identification markings on the rudder to ensure they are visible
b. Set rudder aside

c. The two screws that retain the rudder also secure the antenna to the aft fairing. If the antenna is installed, it will be removed along with the fairings in step 7.4.

7.4 **Fairing and Antenna Removal**

7.4.1 **Equipment Needed:**

- #2 Phillips Screwdriver
- Small Vice Grips
- Dummy Plug for Antenna Cable Connector

7.4.2 **Procedure:**

7.4.2.1 If the glider is equipped with removable aft fairing hatches, follow the steps below. Otherwise, go to step 7.4.2.2.

a. Unscrew the nine (9) #6-32 x 0.375 Phillips screws from the upper hatch cover and remove the cover.
b. If there are sensors attached to the hatch cover, disconnect the respective cable(s) from the glider at the pressure hull aft endcap.
c. Set the screws and panel in a safe place.
d. Repeat steps a – c to remove the lower hatch cover and any sensors attached to it.
e. Disconnect the antenna cable (purple) from the aft endcap. A vice grip may be needed to gently loosen the connector.
f. Make sure that the O-ring does not fall out of the cable end of the antenna connector.
g. Attach a dummy plug to the antenna cable connector.
h. Disconnect the communications cable (black) from Port A (COMM).
i. Gently slide the antenna away from the aft fairing.
j. Inspect the antenna shoe, antenna mast, antenna, and antenna cable for damage. Contact Kongsberg if any damage is present.
k. Check the identification marking on the antenna shoe to ensure visibility.
l. Set antenna aside.
m. All cables should now be disconnected from the aft endcap.
n. Remove the eight (8) 10/32 x 3/8 Phillips head screws holding the forward and aft fairings together. See figure 10 below.
o. Carefully slide the forward fairing away from the aft fairing and set in a secure place.

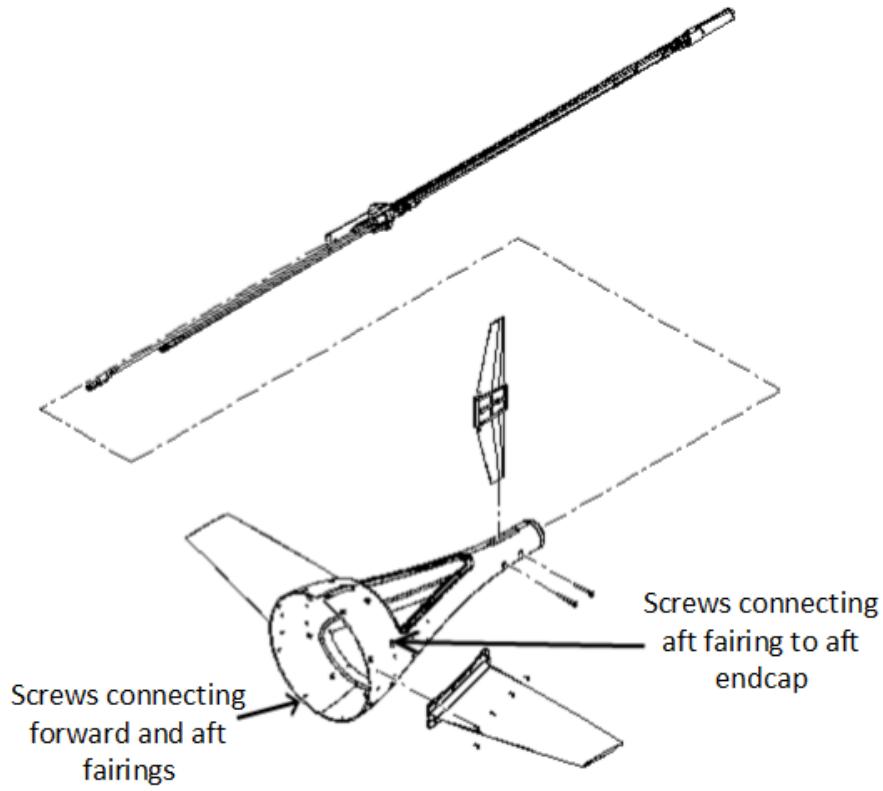
p. Remove the eight (8) (0.25-28 Phillips) screws attaching the aft fairing to the pressure hull aft endcap. See figure 10 below.
q. Gently slide the aft fairing away from the endcap and set in a secure place.
r. Proceed to step 7.4.2.3.

7.4.2.2 If the glider is not equipped with removable aft fairing hatches:

a. Remove the eight (8) 10/32 x 3/8 Phillips head screws holding the forward and aft fairings together. See figure 10 below.
b. Carefully slide the forward fairing away from the aft fairing and set in a secure place.
c. Remove the eight (8) (0.25-28 Phillips) screws attaching the aft fairing to the pressure hull aft endcap. See figure 10 below.
d. Gently slide the aft fairing away from the endcap until there is enough room between the two to disconnect at the aft endcap:
    - Any cables connecting a sensor attached to the aft fairing to the aft endcap.
    - The antenna cable (purple) from the aft endcap. A vice grip may be needed to gently loosen the connector. Make sure that the O-ring does not fall out of the cable end of the antenna connector.
    - The communications cable (black) connected to Port A (COMM).
e. Attach a dummy plug to the antenna cable connector.
f. Gently slide the antenna away from the aft fairing.
g. Inspect the antenna shoe, antenna mast, antenna, and antenna cable for damage. Contact Kongsberg if any damage is present.
h. Check the identification marking on the antenna shoe to ensure visibility
i. Set antenna aside.
j. Gently slide the aft fairing away from the endcap and set in a secure place.

7.4.2.3 Install dummy plugs on all open bulkhead connectors on the aft endcap.

Figure 10: Location of Forward and Aft Fairing Screws, Rudder and Antenna



7.5 Clean the Seaglider Fairings, Wings, Rudder

7.5.1 Equipment Needed

- Soaking tub, 1.5 m length x 1.0 m width x 0.5 m depth (recommended)
- Clean damp cloth
- Soft dry cloth

7.5.2 Procedure

7.5.2.1 Cleaning the Seaglider fairings and components is not a scheduled task but is performed on an as-required basis, such as after a deployment. Should soaking be necessary, the tub listed above will hold the fairings, wings, rudder and hatch covers. Otherwise a rinse area will be sufficient.

7.5.2.2 Rinse/soak all fairings and surfaces in fresh, clean water. If necessary, scrub the fairings, rudder, and wings with a non-abrasive damp cloth to remove any salt or other residue. A mild detergent can also be used. Do not use a Scotch-Brite type scrub pad.

7.5.2.3 Dry the system with a clean, soft cloth to ensure no water remains on the fairings, rudder or wings.

7.5.2.4 Ensure the external markings are still visible, such as the glider serial number, ON, OFF and top centerline markings. Use a black water-resistent marker to touch-up the markings, if necessary.

7.6 Clean the Pressure Hull

7.6.1 Equipment Needed

- Soaking tub, 1.5 m length x 1.0 m width x 0.5 m depth (recommended)
- Clean Damp Cloth
- Clean Dry Soft Cloth

7.6.2 Procedure

7.6.2.1 Check that dummy plugs are present in all bulkhead connectors.

7.6.2.2 Remove the ballasting, including rubber strip and tape from pressure hull. A slotted screw driver can be used to separate the buckle of the straps securing the ballasting to the hull.

7.6.2.3 Soak the pressure hull in clean, fresh water to loosen any salt or other residue.

7.6.2.4 Use a soft, non-abrasive cloth to clean the pressure hull. Do not use a Scotch-Brite type pad.

7.6.2.5 Dry the pressure hull, CT sensor, and non-metal surfaces with a clean, soft cloth.

7.6.2.6 Check the pressure hull to make sure markings such as the top centerlines are still visible. Use a water resistent black marker to touch-up any faded markings.

7.7 Inspect and Repair the Forward and Aft Fairings

7.7.1 Equipment Needed

- Scotch-Bright type pad
- Interlux Brightside Polyurethane Single Part Enamel (yellow, Y4152)

7.7.2 **Procedure**

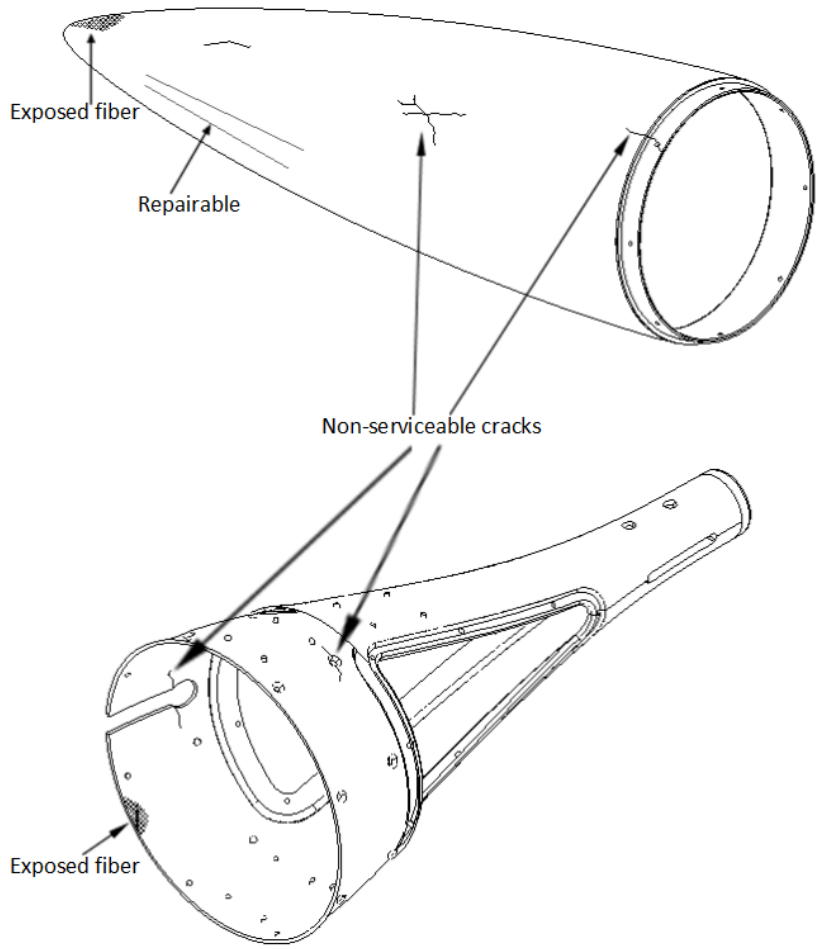
7.7.2.1 If no damage is present proceed to Step 7.8.

7.7.2.2 Shallow scratches, chips and gouges can be repaired. See step 8.7.4.

7.7.2.3 Replace the forward fairing for any of the following damage (figure 11):

a. Cracks initiating from screw holes
b. Cracks through paint (not impact scratches)
c. Damage that exposes fiberglass fabric

Figure 11: Evaluating Fairing Damage



7.7.2.4 Repairing fairings with minor damage

a. If you have any questions about the feasibility of making a repair to a fairing, please contact Kongsberg glider support for assistance. You will be asked to supply pictures of the damage.

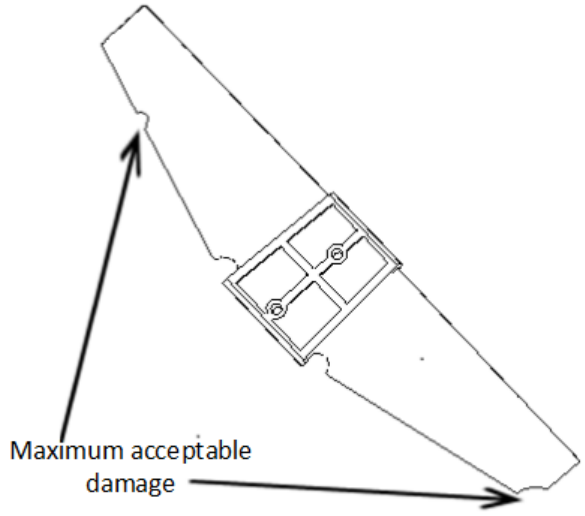
b. Lightly rub the affected area with a Scotch-Brite type pad. This will provide the rough surface needed for touch-up paint to adhere to the fairing.
c. Apply Interlux Brightside Polyurethane Single Part Enamel (yellow, Y4152) with a brush. Small amounts of this paint are available for purchase from Kongsberg. Allow the paint to dry thoroughly before getting the fairing wet.

7.8 Inspect the Rudder for Damage

7.8.1 Inspect the rudder for damage. If no damage is present, proceed to step 7.9.

7.8.2 If damage is present, evaluate using figure 12 to determine if the rudder should be replaced. Keep in mind that bent rudders or those missing chunks of material will adversely affect glider flight. Contact Kongsberg if you need help with the assessment. Pictures of the damage will be required by Kongsberg in order to properly evaluate the situation.

Figure 12: Evaluating Rudder Damage



7.9 Inspect Wings for Damage

7.9.1 Equipment Needed

- Scotch-Brite type pad
- Interlux Brightside Polyurethane Single Part Enamel (black, 4258)

7.9.2 Procedure

7.9.2.1 If no damage is present, proceed to step 7.10.

7.9.2.2 If damage is present, evaluate using the criteria below to determine if the wings can be repaired or should be replaced.

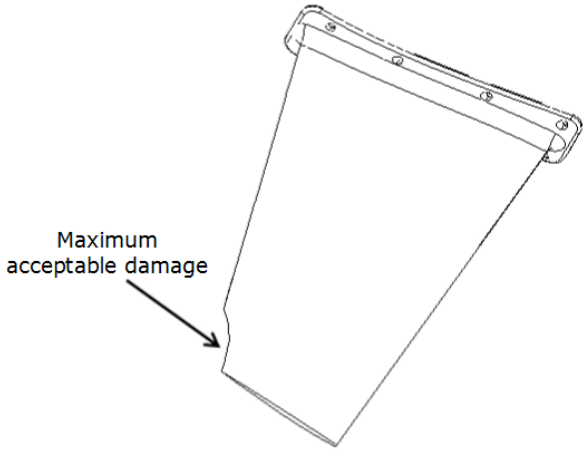
7.9.2.3 A wing can be repaired if a small amount from the corner of a wing tip is missing as shown in figure 13. See step 7.9.5.

7.9.2.4 If the damage is more substantial, wing replacement is necessary.

7.9.2.5 If the wing is repairable

a. Sand out gouges and raised or rough edges using a Scotch-Brite type pad.
b. Remove all sanding dust.
c. Apply epoxy paint and allow it to dry completely. Kongsberg recommends using Brightside Polyurethane Single Part Enamel (black, 4258). Small amounts of this paint are available for purchase from Kongsberg.
d. Buff the repaired area(s) to a slick surface finish.

Figure 13: Evaluating Wing Damage



7.10 Inspect Pressure Hull for Damage

7.10.1 Equipment Needed

- Fine wire brush
- Interlux Briteside Polyurethane Single Part Enamel (black, 4258)

7.10.2 Procedure

7.10.2.1 No cracking is allowed on the pressure hull, at flange screw holes, at areas around bulkhead connectors, or near O-ring surfaces.

7.10.2.2 No significant nicks, gouges or corrosion are allowed on the pressure hull, at the outermost circumferences.

7.10.2.3 The outermost circumferences are the areas where the pressure hull is thinnest.

7.10.2.4 Anodizing loss and minor pitting is acceptable on the thicker areas of the pressure hull.

7.10.2.5 Use figure 14 as a guide to determining seriousness of damage.

7.10.2.6 If an area is determined to be repairable:

a. Clean pitted area with a fine wire brush
b. Remove any dust or debris from pitted area
c. Coat the prepared pitted surfaces with a layer of sealant. Kongsberg recommends using Interlux Brightside Polyurethane Single Part Enamel, color black (4258). Small amounts of this paint are available for purchase from Kongsberg. Allow the sealant to dry thoroughly before putting the pressure hull in water.

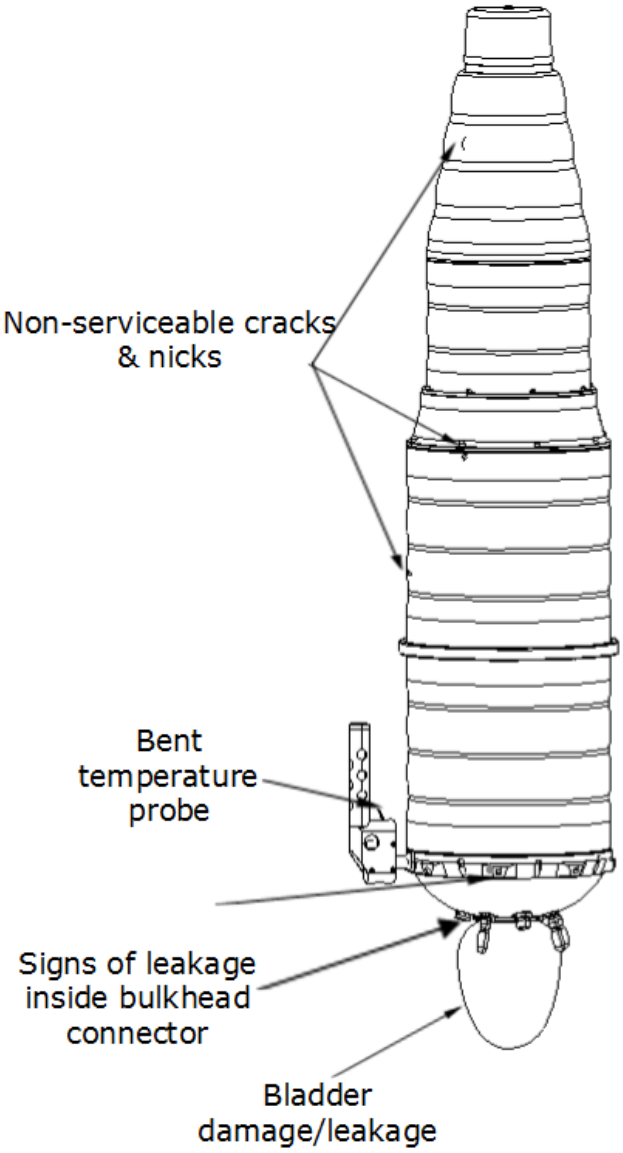
7.10.2.7 Inspect the CT sail thermistor for damage.

7.10.2.8 Inspect the bulkhead connectors for bent, corroded or missing sensor pins.

7.10.2.9 Inspect the sacrificial anode installed in one of the bulkhead connectors for erosion of material and the pressure hull under the anode for pitting. If pitting is seen on the pressure hull use the steps under 7.10.2 to determine if the aft endcap can be repaired or should be replaced. If significant erosion of the anode is seen, replace the anode. Verify that all portions of the glider pressure hull are electrically tied together. **Note:** If the bulkhead connector upgrade has not been completed on the glider, contact Kongsberg for upgrade instructions and the needed parts.

7.10.2.10 Inspect the VBD bladder for damage and leaked oil. If either condition is found, contact Kongsberg.

Figure 14: Non-repairable Pressure Hull Damage



7.11 Install the Pressure Hull in the Whirligig Fixture

7.11.1 Equipment Needed

- Pressure Hull Maintenance Fixture (Whirligig) - 4303135

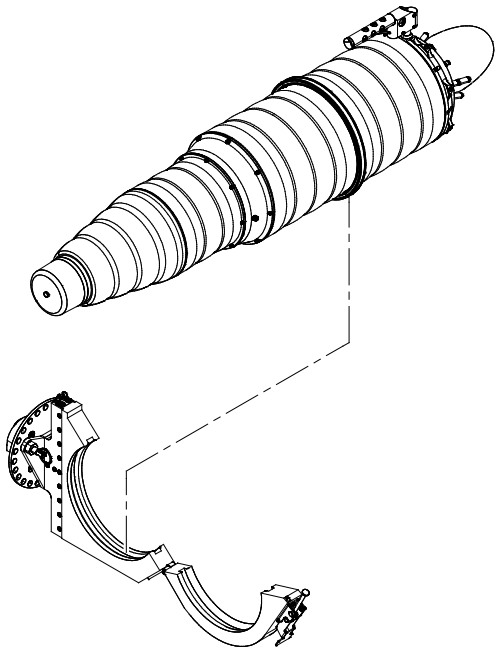
7.11.2 **Procedure**

7.11.2.1 Position the whirligig ring as shown in figure 15.

7.11.2.2 Unlatch the whirligig ring latch, and open the whirligig enclosure arm.

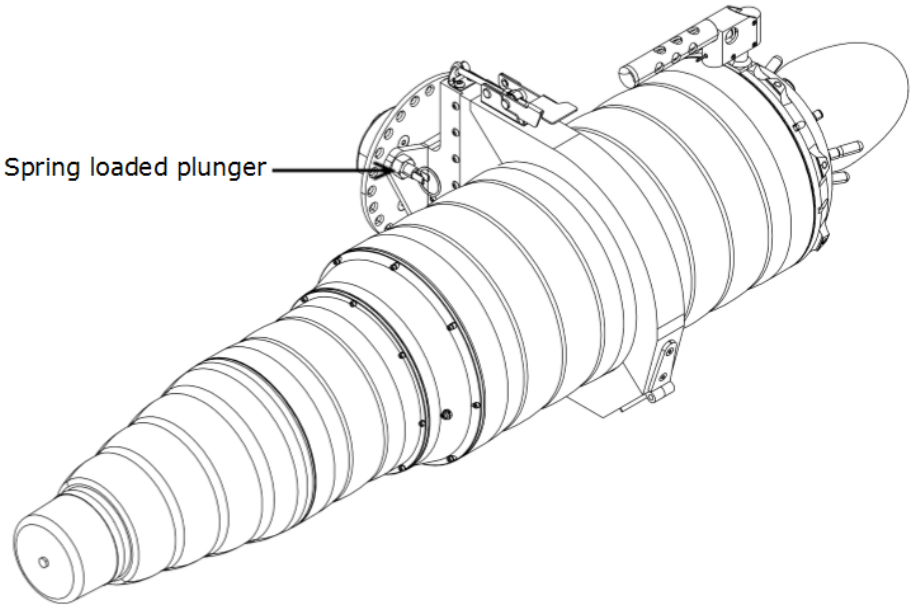
7.11.2.3 Install the pressure hull horizontally into the whirligig, so that the raised mounting ring fits into the groove of the fixture.

Figure 15: Installing the Pressure Hull into the Whirligig



7.11.2.4 Close the whirligig enclosure arm, and secure the latch. Refer to figure 16.

Figure 16: Pressure Hull Secured in Whirligig



CAUTION: Avoid rotating the whirligig into a position that has the latch facing the floor. If the latch is not fully closed, the pressure hull could drop onto the ground, resulting in damage.

7.11.2.5 Rotate the pressure hull by pulling out the spring loaded plunger pin while turning the pressure hull. Release the pin to lock the pressure hull into position.

7.12 Release Internal Vacuum from Pressure Hull

7.12.1 Equipment Needed

- Pressure Relief Valve Installation Tool

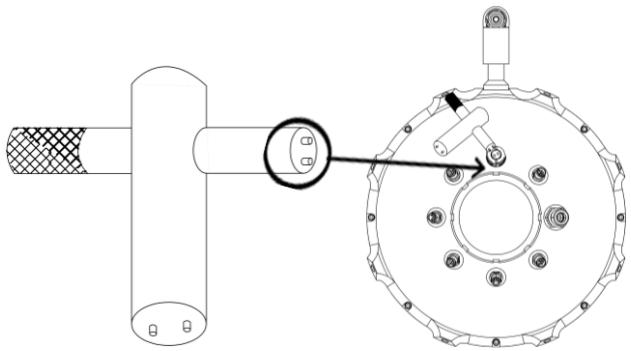
7.12.2 Procedure

7.12.2.1 Rotate the pressure hull so that the endcap is accessible

7.12.2.2 Insert the 2 prongs on the smaller end of the relief valve installation tool into the center holes of the pressure relief valve as seen in figure 17.

7.12.2.3 Turn the pressure relief valve installation tool counter clockwise approximately ten (10) turns. Air will be heard rushing into the pressure hull until pressure equalization occurs. Equalization will take less than one (1) minute.

Figure 17: Vacuum Release



7.13 Removing the Forward Hull

7.13.1 Equipment Needed

- 7/64 Inch Allen Wrench, T-Handle

7.13.2 Procedure

7.13.2.1 Rotate the pressure hull so that the nose is higher than the aft end.

7.13.2.2 Remove and discard eight (8) 6-32 x 0.50 socket head cap screws and eight (8) #6 lock washers. Refer to figure 18.

7.13.2.3 **Note:** If the glider has sacrificial anodes on six (6) of the socket head cap screws, Kongsberg strongly urges you to upgrade to our improved grounding system, which will reduce corrosion. Contact Kongsberg for details.

7.13.2.4 Gently pull the forward hull away from the rest of the pressure hull.

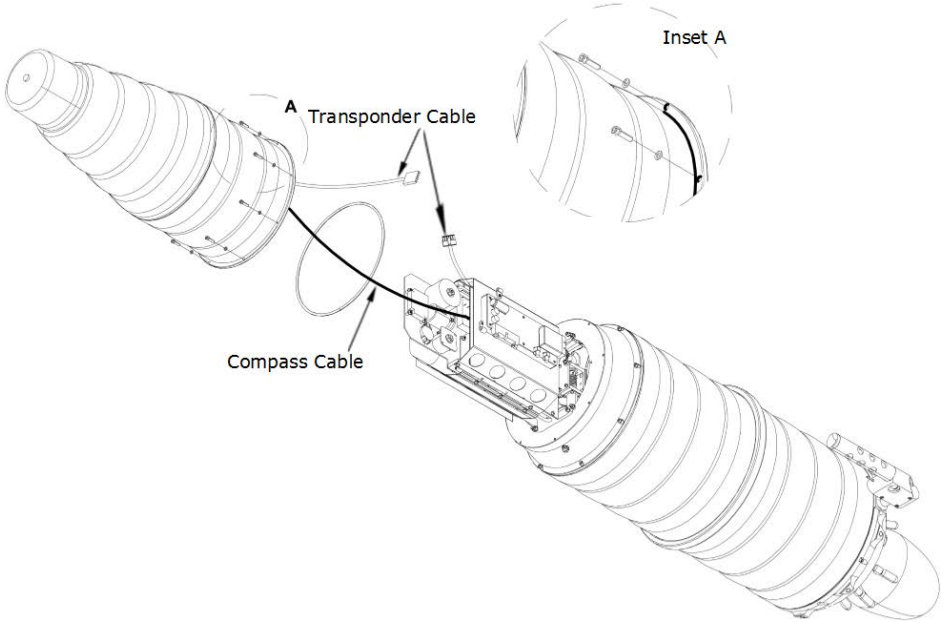
Caution: Cables connecting the compass and transponder, located in the front of the forward pressure hull, to the main electronics can be damaged if the forward hull is pulled too far from the main pressure hull before they are disconnected at the main electronics board.

7.13.2.5 Disconnect the compass cable from the main electronics assembly (J20) and the in-line transponder cable.

7.13.2.6 Discard the pressure hull O-ring.

7.13.2.7 Set the forward section of the pressure hull in a secure place.

Figure 18: Disconnecting Transponder and Compass Cables



7.14 Remove the Electronics Assembly

7.14.1 Equipment Needed

- 7/64 Inch T-Handle Allen Wrench, 18 Inches Long
- 5/16 Inch Wrench, SMA Connector, Torque 8 in-lbs.
- Loctite® 243

7.14.2 Procedure

ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

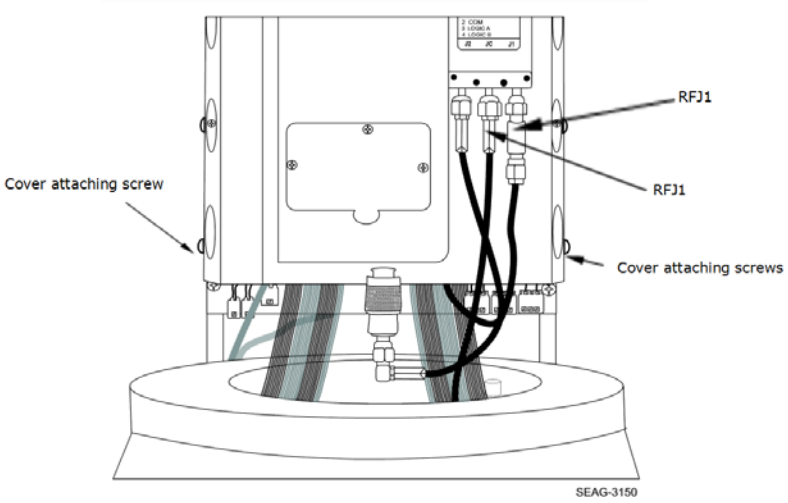
Caution: Take care not to damage the wand-activated ON and OFF switches, on the edges of the main board (figure 20). These are marked ON SW1 and OFF SW2 on the PCB. These reed switches consist of very small wire contacts enclosed in a fragile glass tube. Avoid any contact with these switches, as they are easily damaged, and will prevent the glider from powering on, if broken.

7.14.2.1 Rotate the pressure hull to horizontal in the whirligig fixture.

7.14.2.2 On the main board cover (the Iridium phone mounting bracket); disconnect the outer cable (labeled RFJ1) from the RF switch. Refer to figure 19.

7.14.2.3 On the board cover, disconnect the middle cable (labeled RFJC) from the RF switch.

Figure 19: RF Switch Connections on Main Board Cover



7.14.2.4 Remove the two rear-most screws (figure 19) from the main board cover, and tilt the cover up, to expose the main board and allow access to electrical connectors. If desired, the cover may be completely removed by removing the remaining two attaching screws.

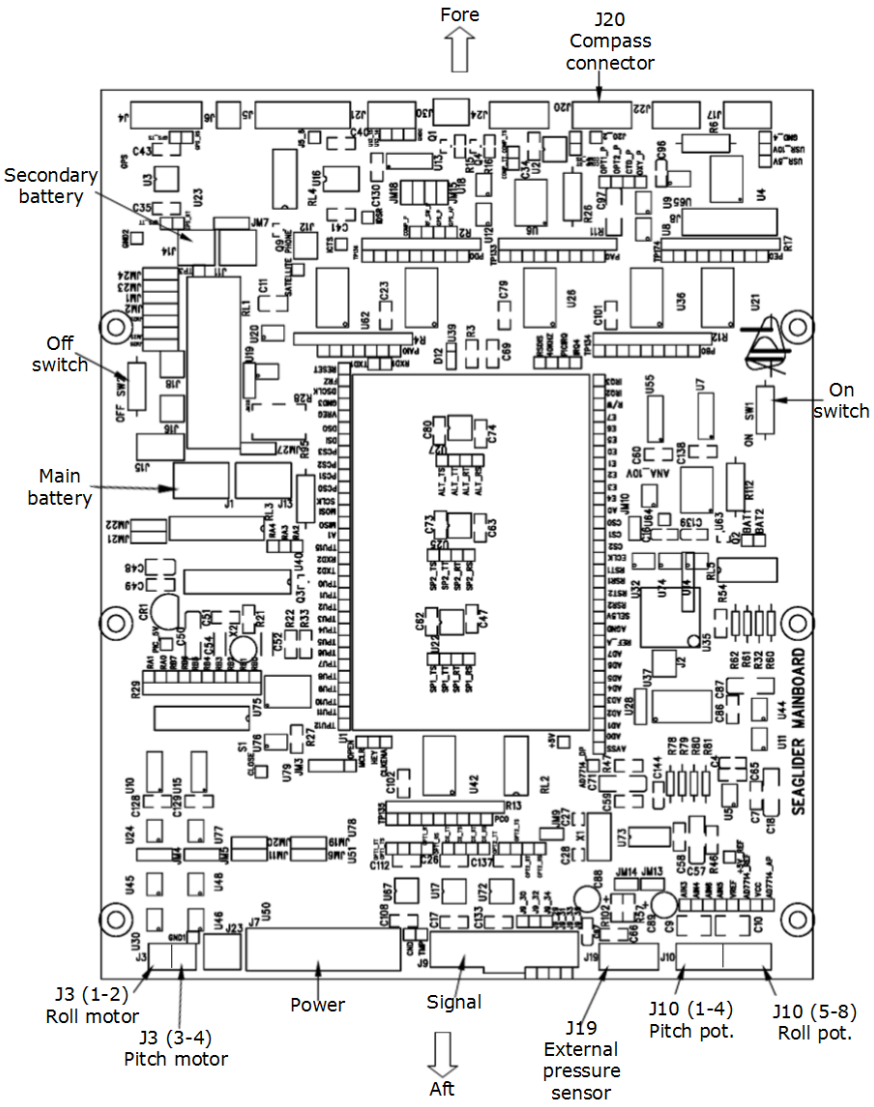
7.14.2.5 Disconnect the electrical cable connectors from the main board, in the following sequence (see figure 20):

Note: Each cable, except the battery/power cables, is identified by a label near its connector end.

a. Red and black secondary battery cable connector from J11

b. Red and black primary battery cable connector from J1
c. Roll motor cable (1-2) from J3
d. Pitch motor cable (3-4) from J3
e. Roll pot cable (5-8) from J10
f. Pitch pot cable (1-4) from J10
g. External pressure sensor from J19
h. Power ribbon cable (multi-colored) from J7 (Rotate the connector latch rearward to release the cable connector)
i. Signal ribbon cable (gray) from J9 (push in clips while pulling connector)

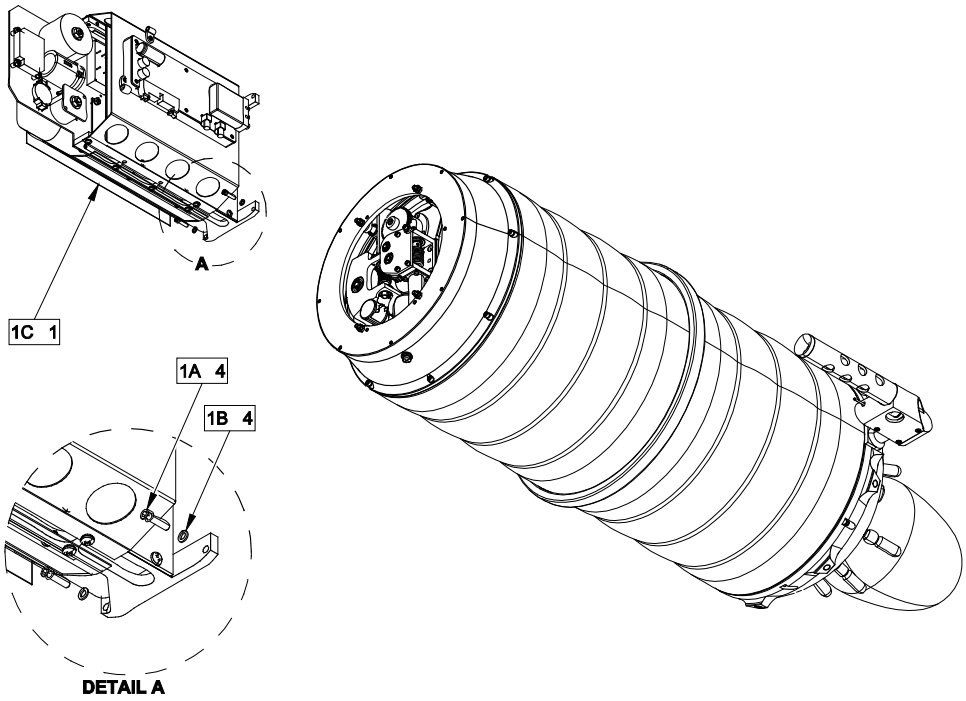
Figure 20: Main Board Connector Locations



7.14.2.6 Loosen and remove four 6-32 x ½ Socket Head Cap Screws (1A) and four #6 lock Washers (1B) attaching the electronics assembly to the pressure hull. Refer to figure 21.

7.14.2.7 Remove the Main Electronics assembly (1C) and place it on an anti-static mat, battery pack down.

Figure 21: Removing Electronics Assembly



7.15 Replace the Secondary Battery

7.15.1 Equipment Needed

- #2 Phillips Screwdriver
- Loctite® 243
- Carpet or Duct Tape

7.15.2 Procedure

7.15.2.1 Remove any tape used to retain the battery.

7.15.2.2 Disconnect the secondary battery cable from the main electronics assembly, if it has not already been disconnected.

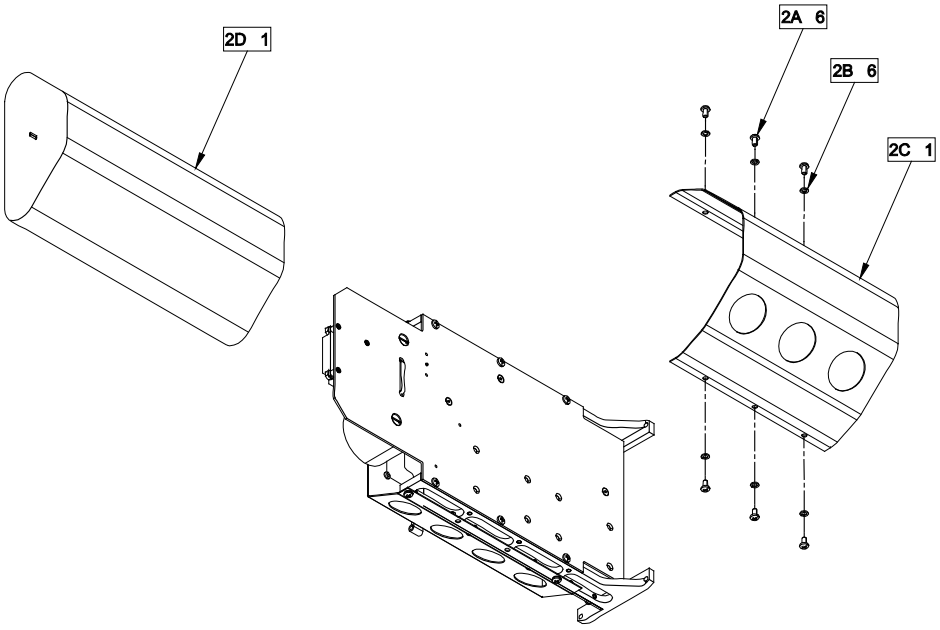
7.15.2.3 Loosen the six 6-32 x .250 pan head Phillips screws (2A) and six #6 lock washers (2B) retaining the battery cage (2C).

7.15.2.4 Attempt to push the secondary battery pack forward, out of the battery cage. If the battery does not slide out, or the battery shrink wrapping catches on the battery cage, remove the screws and lock washers and take off the battery cage.

Warning: Refer to Appendix C for the Material Safety Data sheet for battery handling, storage and disposal information. Improper handling of batteries can result in the release of toxic gasses and material and fire.

7.15.2.5 Remove the secondary battery pack (2D).

Figure 22: Replacing the Secondary Battery Pack



7.15.2.6 Measure the no load voltage of the new battery pack and record on the Refurbishment Checklist.

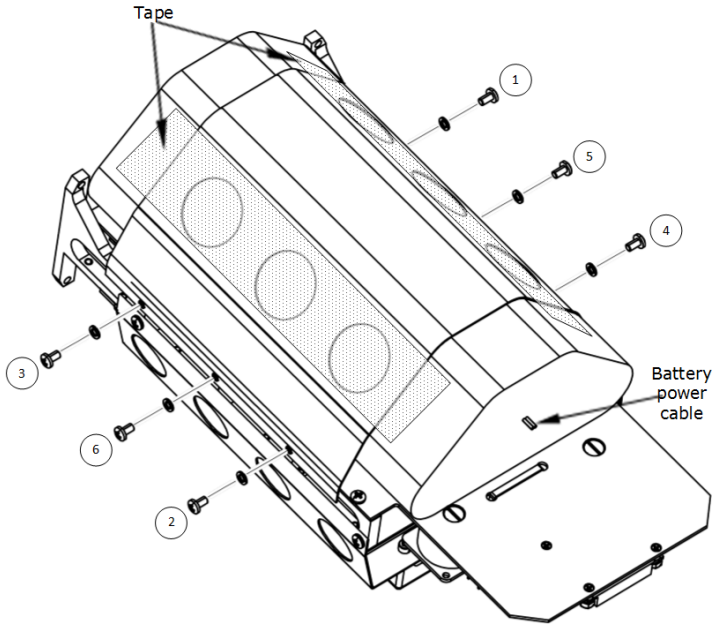
7.15.2.7 Weigh the new battery pack, and record the serial number, weight and installation date on the battery pack itself and on the Refurbishment Checklist.

7.15.2.8 Install the Secondary Battery Pack by sliding it into place, under the battery cage (2C) in figure 22.

7.15.2.9 If the new battery doesn't slide into the battery cage and the cage has to be removed in order to install the battery or if the cage was removed during battery removal, perform the following steps after getting the battery pack in place:

a. Apply Loctite 243 to the screw threads, and then install six 6-32 x .250 pan head Phillips screws (2A) and six #6 lock washers (2B).
b. Tighten the screws in a crisscross sequence (figure 23).

Figure 23: Secondary Battery Cover Screw Tightening Sequence



7.15.2.10 Position the aft edge of the battery flush with the plastic PCBA divider.

7.15.2.11 Do not connect the Secondary Battery cable now. Wait until the electronics assembly installation procedure.

7.15.2.12 Install 2 in. x 8 in. pieces of duct tape to hold battery in place when in use.

7.15.2.13 Set the main electronics assembly on the bench, battery side down, making sure ESD precautions are followed.

7.16 Replace the Coin Battery

7.16.1 Remove the used coin cell battery.

7.16.2 If the coin cell battery holder is loose or detached, re-glue the holder to the navigation plate. Kongsberg recommends using Dow Corning 748 non-corrosive silicone sealant to attach the holder.

7.16.3 Measure the voltage of the new coin battery (no load) and note it on the Refurbishment Checklist.

7.16.4 Mark the new battery with the installation date.

7.16.5 Install the battery into the holder.

7.16.6 Weigh the electronics assembly with the new battery installed, and record the new weight on the Refurbishment Checklist.

7.17 Backup and Reformat the CF Card

7.17.1 Equipment Needed

- Laptop
- CF Card Reader

7.17.2 Procedure

7.17.2.1 Remove the CF card from the Persistor CF2 located at the top of the board stack on the main electronics assembly.

7.17.2.2 Insert the CF card into a card reader attached to the computer.

7.17.2.3 Copy all files from the CF card to the computer.

7.17.2.4 Note the drive letter of the compact flash card.

7.17.2.5 If mkdosfs is not already installed, unzip mkdosf.zip into the directory c:\mkdosfs.

7.17.2.6 Reformat the CF card to ensure the file system has been properly reset and all files have been removed following the steps below:

a. From the Window Start menu, choose “Run”
b. Enter “cmd” into the dialog box and hit “OK”
c. At the command prompt execute the command:

cd mkdosfs <enter>

d. In the next step, be sure to use the drive letter of the compact flash card (it is not always “e:”)
e. At the command prompt execute the command:

mkdosfs –F16 –r32736 –v –c e: <enter>

Note: e: is the drive letter

f. Wait about one minute while the card is formatted and checked for errors.
g. Type “exit” to close the command prompt.

7.17.2.7 If you need to load a new version of glider software:

a. If you received zipped files, unzip them
b. Copy the files to the compact flash card

7.17.2.8 If you need to reload the software that was copied from the flash card just prior to the reformatting procedure:

a. Copy all of these files to the reformatted CF card, except the dive data files (have .A and .X extensions) and files starting with BG (battery gauge).

    1. .X extensions are files that have not been previously transferred to the basestation.
    2. .A extensions are files that have been transferred to the basestation.

7.17.2.9 Check the directory to make sure all needed files are present. The files are:

a. cmdfile
b. CURRENTS
c. MAIN.RUN
d. payload.cnf
e. qsp2150.cnf
f. science
g. SG001.PRM.TXT (001 is your glider ID)
h. targets
i. TCM2MAT.001 (001 is your glider ID)
j. wlbb2f.cnf
k. wlbb2fl.cnf
l. wlbbfl2.cnf
m. * If you use bathymetry maps, they will also be present. They are named BATHYMAP.xxx where xxx is a number.

7.17.2.10 Remove the compact flash card from the card reader.

7.17.2.11 Re-install the loaded CF card into the electronics assembly.

7.18 Remove the Mass Shifter

7.18.1 Equipment Needed

- 7/64 Inch Allen Wrench, T-Handle
- Tef Gel Anti-Seize Lubricant
- Blue Moly Grease
- Hi-Slip Grease
- Isopropyl Alcohol

7.18.2 Procedure

Note: This is a two-person procedure.

Note: The mass shifter should be set to the ¾ aft position (~3000 A/D counts). This will ensure that all electrical cables can be easily disconnected from the electronics assembly, and the main battery does not block access to the mass shifter mechanical assembly. The brass weight forward screws cannot be removed with the mass shifter full forward.

7.18.2.1 Rotate the pressure hull to the vertical position, bladder down.

7.18.2.2 Refer to figure 24 and:

a. Loosen and remove eight 6-32 x .625 socket head cap screws and #6 lock washers.
b. **Note:** If the glider has sacrificial anodes on six (6) of the socket head cap screws, Kongsberg strongly urges you to upgrade to their improved grounding system, which will reduce corrosion. Contact Kongsberg for details.
c. Gently lift the mass shifter away from the hull assembly while a second person feeds the two ribbon cables and the antenna RF cable through the mass shifter assembly. Refer to figure 24.
d. Set the mass shifter on two wooden blocks (or anything that supports the assembly as shown in figure 25).
e. Lay the two ribbon cables on the outside of the hull assembly.
f. **Note:** The RF cable should protrude 7 inches from the flange, for newer modems (with the metal cover plate). The cable should protrude 6.5 inches from the flange, for older modems (which are exposed, without the cover plate).
g. Place a mark on the antenna RF cable, at the point where it protrudes from the main pressure hull segment. This is necessary for proper re-installation of the mass shifter.
h. Remove and discard the .139 x 9.984 O-ring.
i. Inspect for loose fasteners and damaged wires.

Figure 24: Removing the Mass Shifter

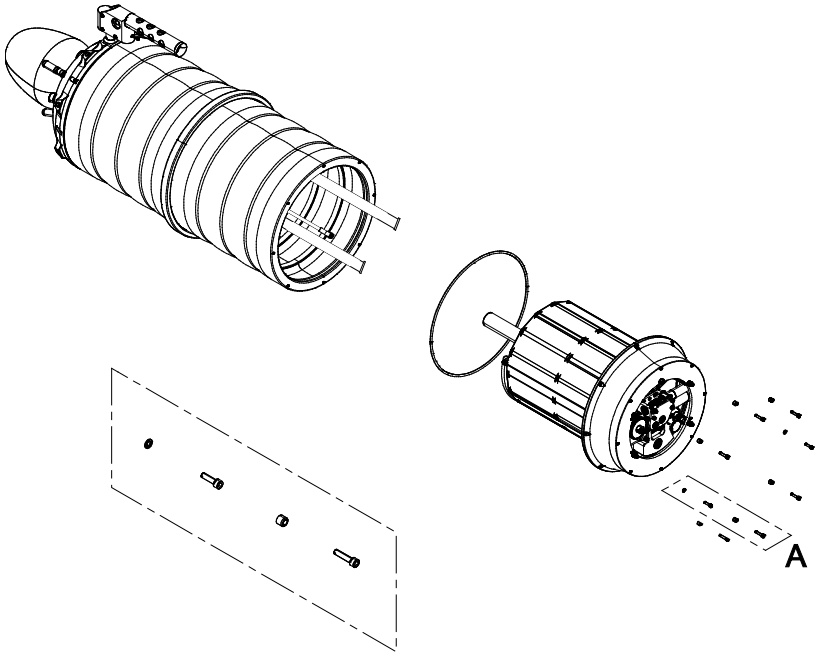
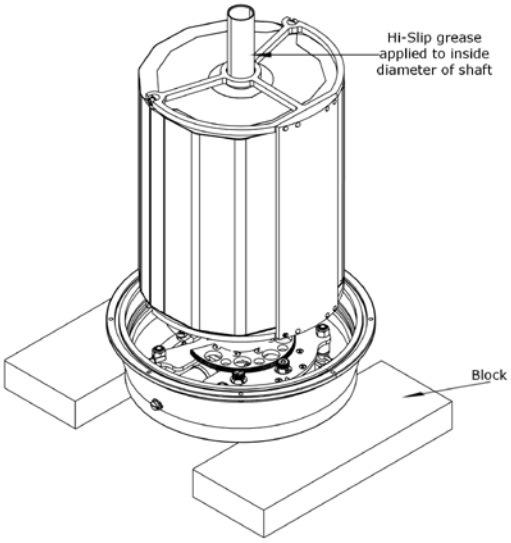


Figure 25: Positioning Mass Shifter on Blocks



7.19 **Remove the Aft Plate**

7.19.1 **Equipment Needed**

- 3/32 Inch Allen Wrench
- 9/64 Inch Allen Wrench

7.19.2 **Procedure**

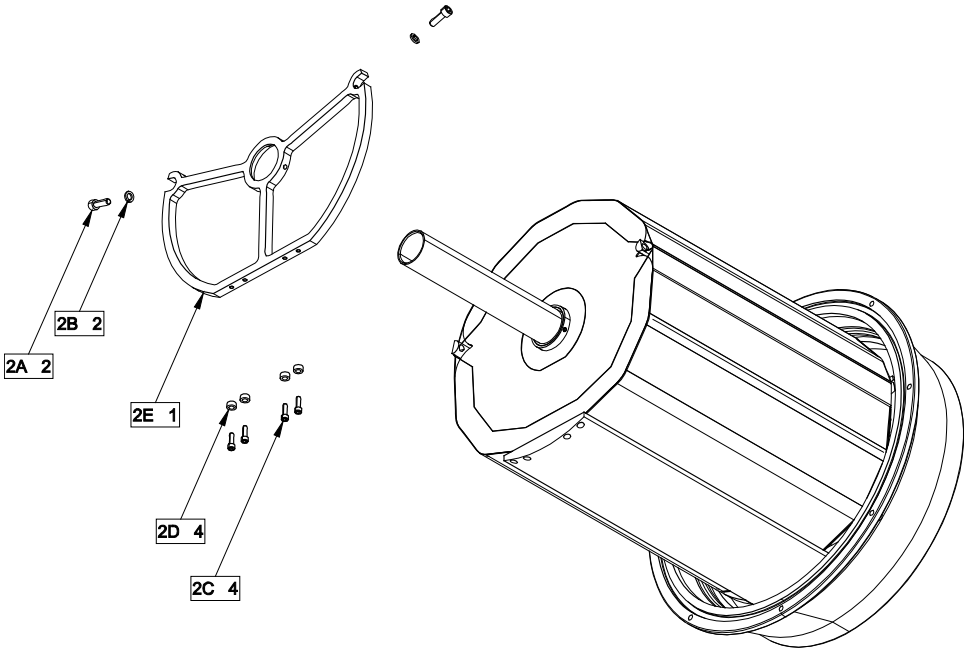
7.19.2.1 **Note:** The spacers (2D) are generally not installed on newer mass shifter configurations.

7.19.2.2 Using a 3/32 Allen wrench, remove eight (8) 4-40 x .375" socket head cap screws (2C) and eight (8) .140 x .250" round spacers (2D) (if installed) securing the brass weight to the mass shifter assembly. Refer to figure 26.

7.19.2.3 Using a 9/64 Allen wrench, loosen and remove two (2) 8-32 x 0.50" socket head cap screws (2A) and two (2) #8 lock washers (2B).

7.19.2.4 Remove the aft plate (2E).

Figure 26: Aft Plate Removal from Mass Shifter



7.20 **Replace Main Battery & Service Mass Shifter**

7.20.1 **Equipment Needed**

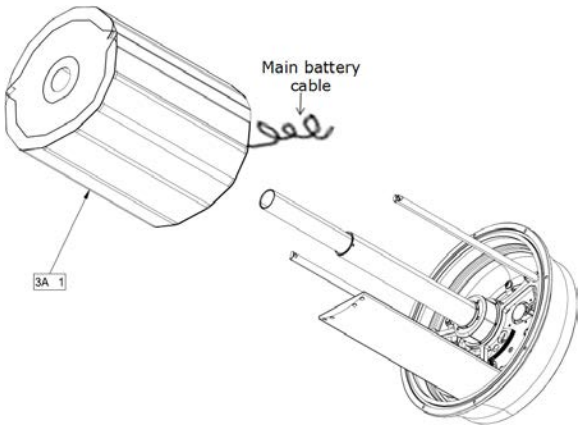
- 7/64 Inch Allen Wrench
- 5/16 Inch Wrench
- Loctite® 243
- Electrical Tape, Scotch 88, ¼ Inch Width (if necessary)
- Blue Moly Grease
- Heat Gun

7.20.2 **Procedure**

7.20.2.1 Remove the Main Battery

a. Remove the battery power cable retaining clip from the inside of the mass shifter housing.
b. **Note:** It may be easier to slide the battery out if a second person holds the mass shifter.
Slide the Main Battery away from the mass shifter assembly. Refer to figure 27. **Note:** It may be easier to slide the battery out if a second person holds the mass shifter.

Figure 27: Removing the Main Battery from the Mass Shifter

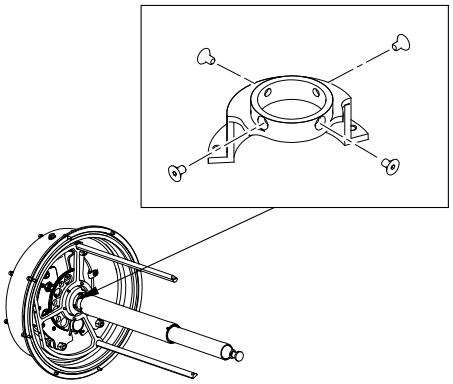


7.20.2.2 Lubricate and Inspect the Mass Shifter Assembly

a. Apply Blue Moly grease to the gear teeth on both sides of the mass shifter assembly (where grease is already visible).
b. Remove the Scotch 88 electrical tape covering the screws on the roll gear mount collar.

c. Remove the 4-40 x .188 flat-head screws on the roll gear mount collar and clean the old Loctite from the threads. Refer to figure 28.
d. Re-apply Loctite 243 and re-install the screws.
e. Wrap three layers of ¼ inch wide electrical tape around screw heads to prevent the screws from backing out. If wide tape is used, cut off the excess.

Figure 28: Roll Gear Mount Collar Screws



7.20.2.3 Install the Main Battery

a. Measure the voltage (no load) of the new battery and record on the Refurbishment Checklist.
b. Weigh the new battery.
c. Write the serial number, weight and installation date of the battery on the aft end of the battery.
d. Record the serial number, weight and voltage on the Refurbishment Checklist.
e. Measure 7.5 inches from the connector end of the battery cable and place a mark on the cable. This is to ensure that the cable is long enough to reach from the retaining clip to the main battery connector on the main board.
f. Starting at the base of the battery cable, coil the cable tightly around a 3/8 inch dowel, clockwise, until one full rotation around the 7.5 inch mark on the cable.
g. Place hot glue in and around the opening where the battery wires protrude from the battery. This provides strain relief for the battery cable assembly.
h. **Note:** If the batteries are shipped from Kongsberg, steps f and g will be done at the factory. If the batteries are drop shipped from the OEM, steps f and g will need to be done by the group doing the refurbishment.
i. **Note:** Protect the battery from heat by shielding it with a piece of cardboard.

j. Use a heat gun to heat the shrink-wrap around the battery cable, until the cable coil is warm to the touch and the heat shrink is tight around the cable.
k. Let the shrink-wrap cool for a minute and then remove the dowel. Make sure the battery cable remains in the coiled shape.
l. The cable coiling procedure prevents the battery cable from becoming caught in the pitch or roll mechanisms.
m. Carefully slide the main battery (figure 27) onto the battery cage with the power cord facing the mass shifter assembly. Take care not to damage the cellophane wrapper covering the battery.
n. Secure the battery cable, at the 7.5 inch marking, to the cable bracket on the pitch worm plate.

7.21 Install the Aft Plate

7.21.1 Equipment Needed

- 3/32 Inch Allen Wrench
- 9/64 Inch Allen Wrench
- Loctite® 243

7.21.2 Procedure

7.21.2.1 Place the aft plate on top of the main battery with the flat side facing the brass weight and the counter bore facing down toward the main battery. Refer to figure 29.

7.21.2.2 Apply Loctite 243 to the thread of two 8-32 x 0.50 socket head cap screws (2A) and eight 4-40 x .375 socket head cap screws (2C).

7.21.2.3 Install two 8-32 x 0.50 socket head cap screws (2A) and two #8 lock washers (2B).

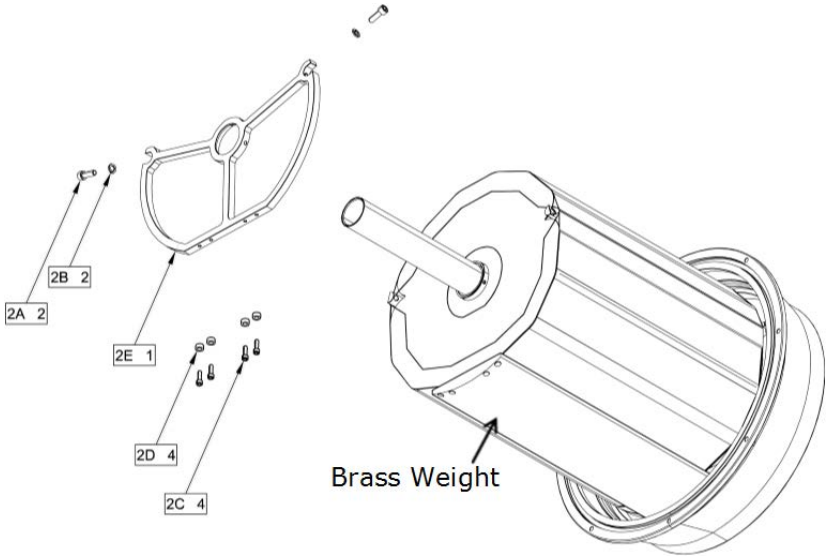
7.21.2.4 Loosely install eight 4-40 x .375 socket head cap screws (2C).

7.21.2.5 **Note:** Make sure the brass plate is not compressing the battery cells. If it is, install spacers (2D) with the eight 4-40 x .375 socket head cap screws.

7.21.2.6 Tighten the brass weight attaching screws.

7.21.2.7 Weigh the mass shifter assembly with the new battery installed and record on the Refurbishment Checklist.

Figure 29: Reinstalling the Aft Plate on the Mass Shifter



7.22 Remove the Aft Endcap

7.22.1 Equipment Needed

- 7/64 Inch Allen Wrench
- 9/64 Inch Allen Wrench

7.22.2 Procedure

7.22.2.1 Rotate the pressure hull so the bladder is facing downward and disconnect both ribbon cables and the antenna RF cable from the plastic retaining clips.

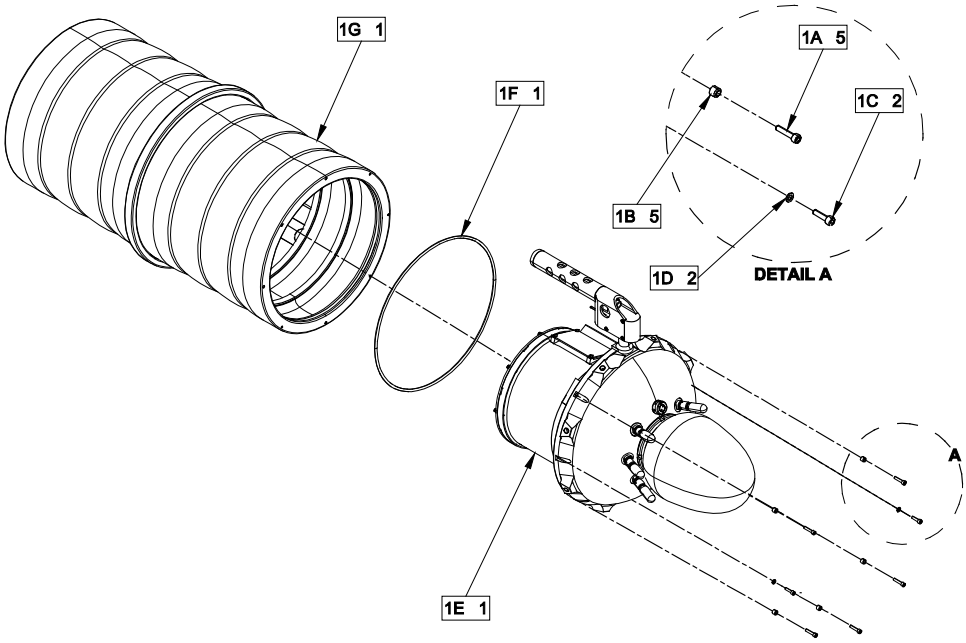
7.22.2.2 Rotate the pressure hull, so the bladder end is up.

7.22.2.3 Remove and discard the seven (7) 6-32 x .50 socket head cap screws (1A).

7.22.2.4 Note: If the glider has sacrificial anodes on five (5) of the socket head cap screws, Kongsberg strongly urges you to upgrade to their improved grounding system, which will reduce corrosion. Contact Kongsberg for details.

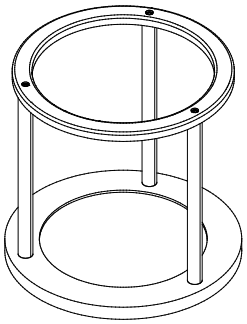
7.22.2.5 Gently remove the aft endcap (1E) from the hull assembly (1G). Refer to figure 30.

Figure 30: Aft Endcap Screw Removal



7.22.2.6 Set the aft endcap (1E) in the aft endcap maintenance fixture with the reservoir facing up and the bladder down. Refer to figure 31.

Figure 31: Aft Endcap Maintenance Fixture



7.22.2.7 Remove and discard the .139 x 8.984 O-ring.

7.22.2.8 Check for leaked oil inside the aft endcap. Contact Kongsberg Maritime Support if oil is present.

7.23 Remove the CT Sensor Assembly

7.23.1 Equipment Needed

- Soldering Equipment with Solder Removal (Sucker) Tool
- .75 Inch Wrench

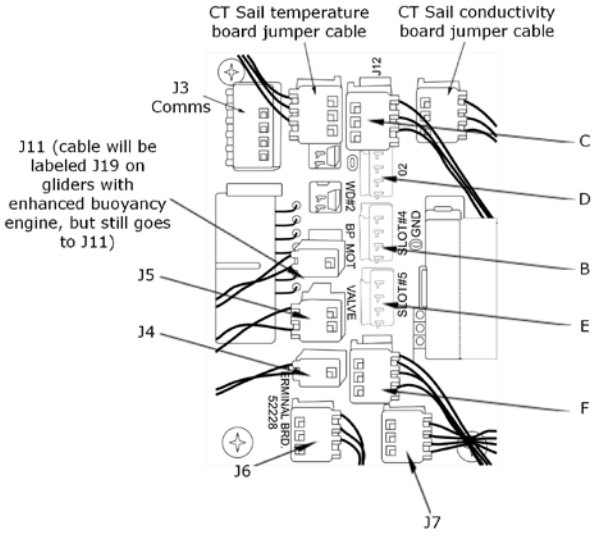
- 7/64 Allen Wrench
- .050 Inch Allen Wrench
- 3/32 Allen Wrench (on some assemblies)
- #1 Phillips Screwdriver (on some assemblies)
- Wire Cutters (to cut cable ties)

7.23.2 **Procedure**

ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

7.23.2.1 Disconnect all of the cable connectors from the aft terminal PCB. Refer to figure 32.

Figure 32: Aft Terminal PCB Connector



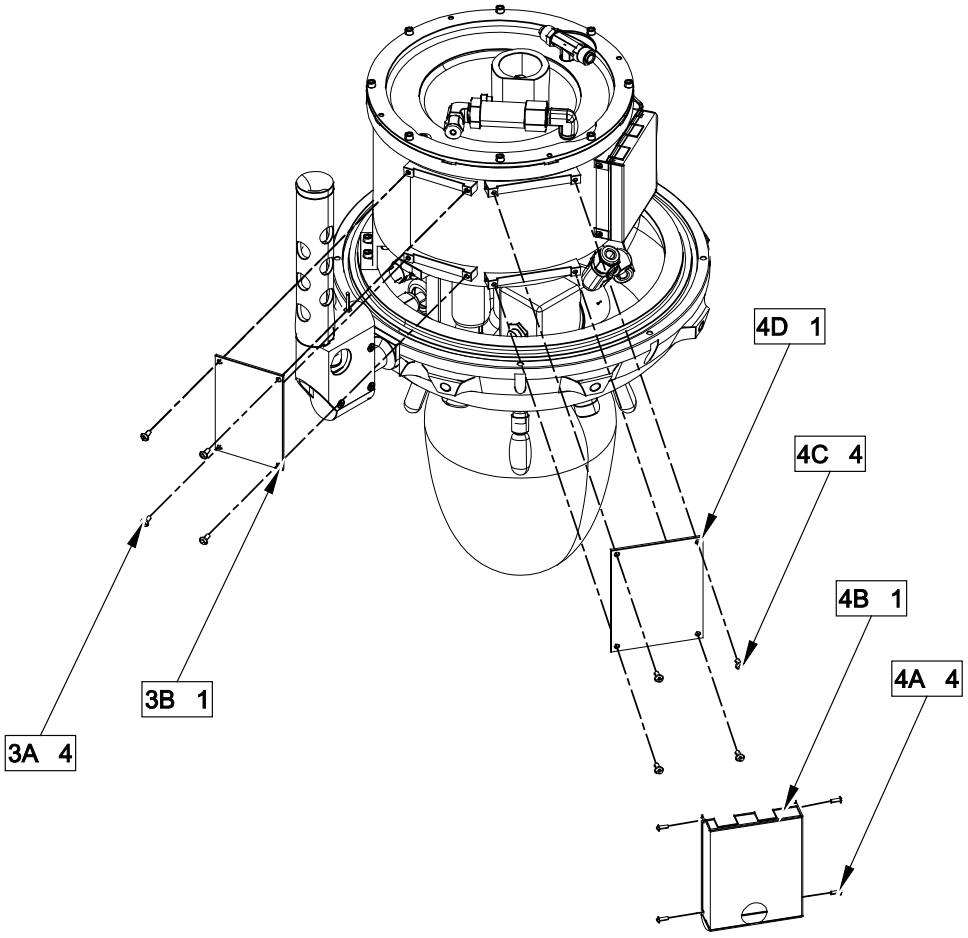
7.23.2.2 Use the .050 inch Allen wrench to remove the covers from the temperature and conductivity circuit boards on the aft endcap assembly. Refer to figure 33.

7.23.2.3 Loosen but do not remove four 2-56 x .250 button head screws (4A).

7.23.2.4 Remove the PCB Covers (4B).

7.23.2.5 Unhook the green ground wire from the upper corner PCB cover screw.

Figure 33: CT Sensor Disassembly



Caution: Take care not to touch the solder iron to the plastic hydraulic tube, as it would easily melt the tubing and cause a hydraulic oil leak.

Caution: Holding the solder iron on the circuit board/wire connection too long can damage the board.

7.23.2.6 Disconnect (desolder) the CT sail electrical cables from the temperature and conductivity circuit boards. Use a solder sucker to prevent solder material from dripping, when removing the wire. Refer to figure 34 for desoldering of conductivity connections and figure 35 for desoldering of temperature connections.

Figure 34: Conductivity Sensor PCB Wire Connections

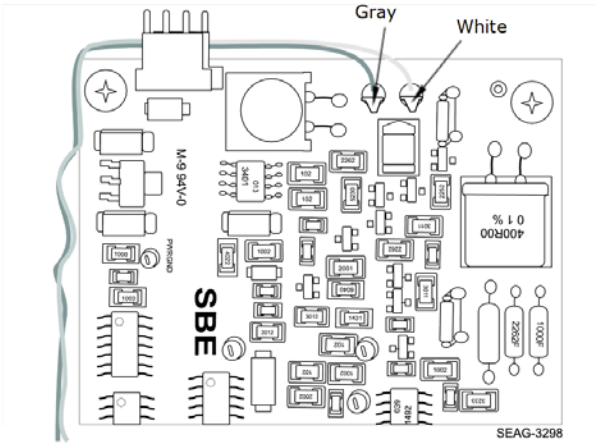
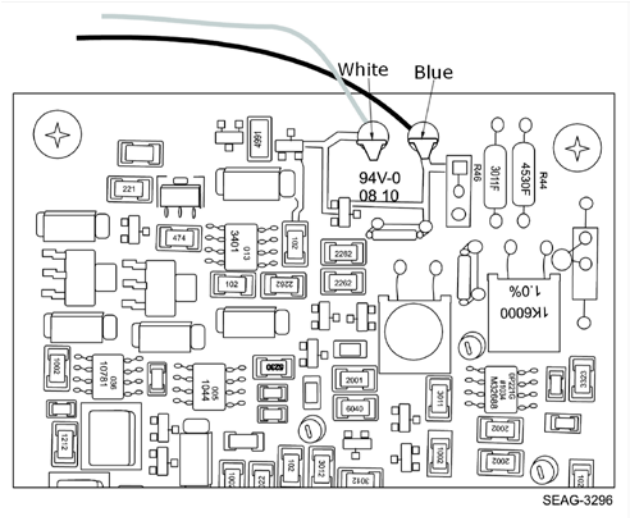
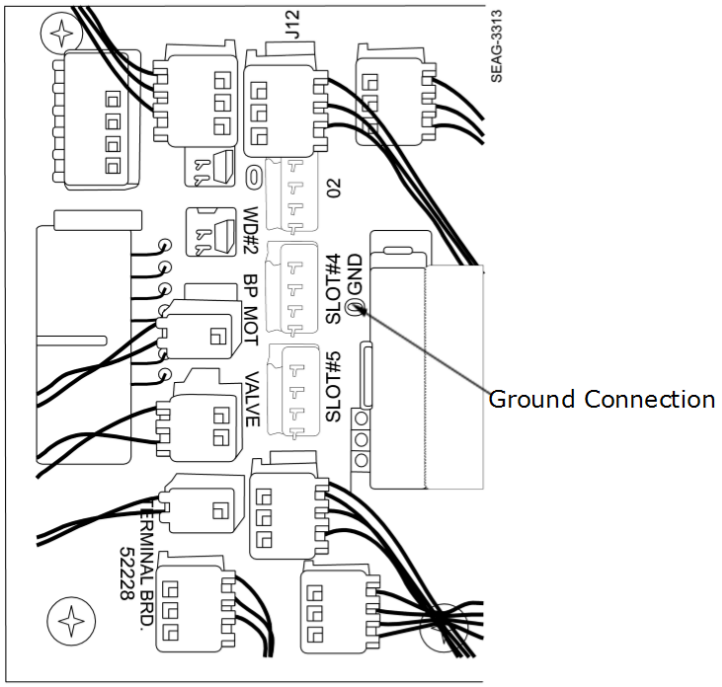


Figure 35: Temperature Sensor PCB Wire Connections



7.23.2.7 Disconnect (desolder) the green ground wire from the aft terminal PCB (figure 36).

Figure 36: Green Ground Wire Solder Location (Aft Terminal PCB)



7.23.2.8 Remove the four 4-40 x .250" pan head Phillips screws or socket head cap screws securing the temperature circuit board to the aft endcap and place the board on an ESD protected surface.

7.23.2.9 Remove the four 4-40 x .250" pan head Phillips screws or socket head cap screws securing the conductivity circuit board to the aft endcap and place the board on an ESD protected surface..

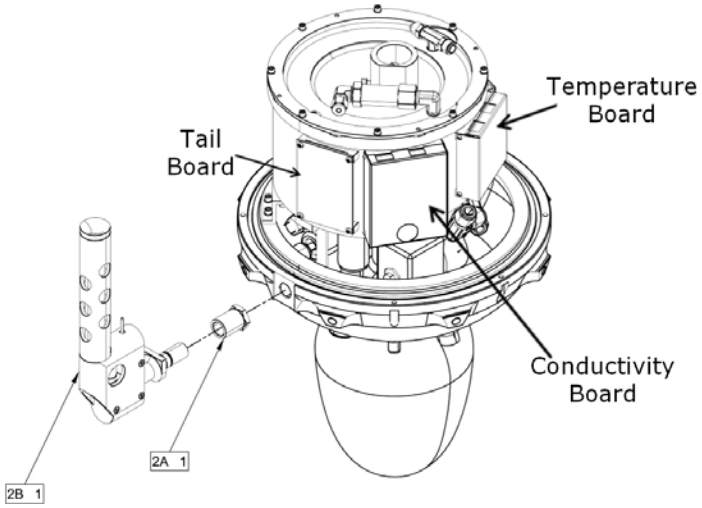
7.23.2.10 Remove four 6/32 x .5" screws attaching the reservoir cylinder standoff brackets to the aft endcap hull. Refer to figure 35.

7.23.2.11 Tilt the reservoir cylinder up, to allow access to the CT sail nut (2A). Use extreme caution when tilting the reservoir cylinder so that none of the hydraulic lines become dis-connected.

7.23.2.12 Use a ¾ (.75") wrench to loosen and remove the CT sail nut (2A). Exercise caution when feeding the CT Sail wires through the nut during the removal process.

7.23.2.13 Pull the CT Sail (2B) away from the aft endcap (1E).

Figure 37: Removing the CT Sail from the Aft Endcap



7.23.2.14 Remove the backplane from the CT sail calibration fixture and install the temperature and conductivity boards on the backplane (figure 36).

7.23.2.15 Install the CT sail in the test fixture, with the sensor facing away from the canister.

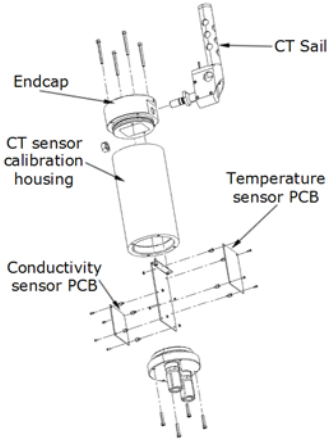
7.23.2.16 Solder the CT sail wire connections on the conductivity and temperature boards using figures 34 and 35 for reference.

7.23.2.17 Install the backplane in the test fixture with the temperature board on the same side of the fixture as the CT sail.

7.23.2.18 Twist all three green ground wires together and cover the connection with electrical tape.

7.23.2.19 Install fixture cover and write the CT Sail serial number on outside of the canister.

Figure 38: Installing the CT Assembly in the Calibration Fixture



7.23.2.20 Send the CT calibration fixture with installed CT and any external sensors needing calibration to Kongsberg following the procedure in Appendix B.

a. Sensor calibration takes on average 6-8 weeks.

7.24 Install the CT Sensor Assembly

7.24.1 Equipment Needed

- Soldering Equipment with Solder Removal (Sucker) Tool
- .75 Inch Wrench, open end
- 7/64 Allen Wrench
- .050 Inch Allen Wrench
- 3/32 Allen Wrench (on some assemblies)
- #1 Phillips Screwdriver (on some assemblies)
- Wire Cutters (to cut cable ties)
- Tef-Gel Anti-Seize Lubricant
- Loctite® 243

7.24.2 Procedure

 ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

7.24.2.1 Open the CT sensor calibration fixture and carefully slide out the conductivity and temperature board stack until there is sufficient room to desolder the sensor wires from their respective PCB.

7.24.2.2 Remove the backplane from the fixture and remove the temperature and conductivity boards from the backplane.

7.24.2.3 Remove the CT Sail from the calibration fixture and install it on the aft endcap.

a. Ensure the CT Sail O-rings are lubricated and installed. Kongsberg recommends lubricating with Dow Corning 4 silicone grease.
b. Put Tef-Gel on the threads of the CT Sail Nut.

c. Feed the CT sail cables through the aft endcap and then the CT sail nut (2A) as shown in figure 37.
d. Install the CT sail (2B) into the aft endcap.
e. Use a ¾ (.75 inch) wrench to tighten the CT sail nut (2A).
f. Put Loctite on the four 6/32 x .5" screws attaching the reservoir cylinder standoff brackets to the aft endcap hull, install and tighten

7.24.2.4 Install the conductivity PCB board on the aft endcap

a. See figure 37 for conductivity PCB location.
b. Align the conductivity sensor PCB with the screw holes on the mounting bracket.
c. Install and tighten four 4-40 x .250 pan head Phillips screws or socket head cap screws**.**

Caution: Holding the solder iron on the circuit board/wire connection too long can damage the board.

7.24.2.5 Solder the conductivity wires to the conductivity PCB.

a. Solder the gray wire first, then the white wire.
b. The gray wire is on the left and the white wire is on the right.

7.24.2.6 Install the conductivity sensor PCB cover.

a. Hook the green ground wire ends around the upper corner PCB cover retaining screws, where the anodizing is missing.
b. Tighten the four 2-56 x .250 button head screws.

7.24.2.7 Install the temperature PCB board on the aft endcap

a. See figure 37 for temperature PCB location.
b. Align the temperature sensor PCB with the screw holes on the mounting bracket.
c. Install and tighten four 4-40 x .250 pan head Phillips screws or socket head cap screws**.**

7.24.2.8 Solder the temperature wires to the temperature PCB.

a. Solder the white wire first, then the blue wire.
b. The white wire is on the left and the blue wire is on the right.

7.24.2.9 Install the temperature sensor PCB cover.

a. Hook the green ground wire ends around the upper corner PCB cover retaining screws, where the anodizing is missing.
b. Tighten tighten the four 2-56 x .250 button head screws.

7.24.2.10 On the aft terminal PCB, solder/connect the green ground wire. Refer to figure 36.

7.24.2.11 Reconnect the electrical cables to the aft terminal PCB (figure 32).

7.24.2.12 Reconnect (if removed), the multi-colored ribbon cable to J2 of the aft terminal PCB.

7.24.2.13 Fold both ribbon cables at their respective bends, then tape the ribbon cables to the reservoir housing so that they stay in position when the aft endcap is installed into the pressure hull.

7.25 Install the Aft Endcap

7.25.1 Equipment Needed

- 7/64 Inch Allen Wrench
- 9/64 Inch Allen Wrench
- Tef-Gel Anti-Seize Lubricant
- Hi-Slip Grease
- Loctite® 243
- Isopropyl Alcohol

7.25.2 Procedure

7.25.2.1 Clean the flange mating surfaces and O-ring groove with isopropyl alcohol.

7.25.2.2 Lubricate the 0.139 x 8.984 O-ring (**1F**) with Dow Corning 4 silicone grease and install the .139 x 8.984 O-ring.

7.25.2.3 Ensure the CT Sail is at Top Center with respect to the hull assembly (1G) and the forward end of the hull is lower than the aft end of the hull. Some prefer the hull to be vertical with the forward end facing down. Refer to figure 39.

7.25.2.4 Gently slide the aft endcap (1E) into the main hull assembly (1G).

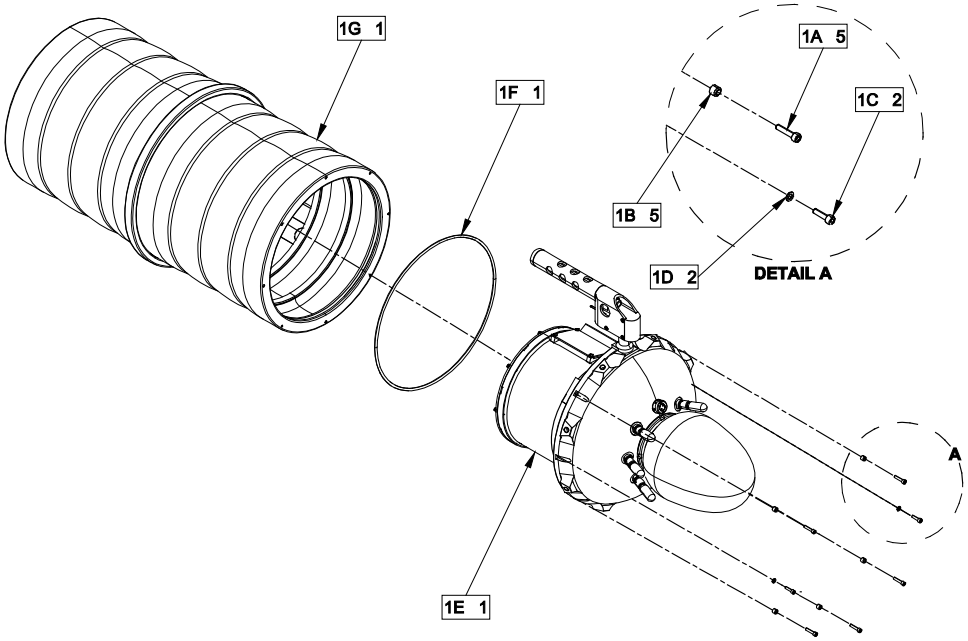
7.25.2.5 Apply Tef-Gel anti-seize compound to the tips of seven (7) 6-32 x 0.50 socket head cap screws.

7.25.2.6 Loosely install the seven (7) 6-32 x 0.50 socket head cap screws (1C) and #6 lock washers (1D) in the flange screw holes.

7.25.2.7 Tighten all fasteners in a crisscross pattern.

7.25.2.8 Rotate the pressure hull so that the bladder is slanted downward, and secure the antenna RF cable and ribbon cables to the plastic retaining clips. The mark placed on the RF cable in step 7.18.2.2g should protrude 7 inches from the flange, for newer modems (with the cover plate), and 6.5 inches for older modems, without the cover. The marks on both ribbon cables should protrude about 2.4 inches past the flange. Additionally, check that there is a fold in both ribbon cables that allows for proper orientation of the cables when they are connected to the main electronics board.

Figure 39: Aft Endcap Installation



7.26 Install the Mass Shifter

7.26.1 Equipment Needed

- 7/64 Inch Allen Wrench, T-Handle
- Tef-Gel Anti-Seize Lubricant
- Blue Moly Grease
- Hi-Slip Grease

- Isopropyl Alcohol

7.26.2 **Procedure**

Note: This is a two-person procedure.

7.26.2.1 Apply Hi-Slip grease to the inner diameter of the mass shifter center support tube. Coat the area up to the material thickness step on the inside of the tube.

7.26.2.2 Ensure both ribbon cables are secured in the plastic clips along the inner diameter of the main pressure hull segment. There are marks on both ribbon cables, which should protrude about 2.4 inches past the flange of the main pressure hull segment.

7.26.2.3 Ensure the mark on the antenna RF cable is visible and aligned with the flange of the main pressure hull segment, before securing the cable into the retaining clips.

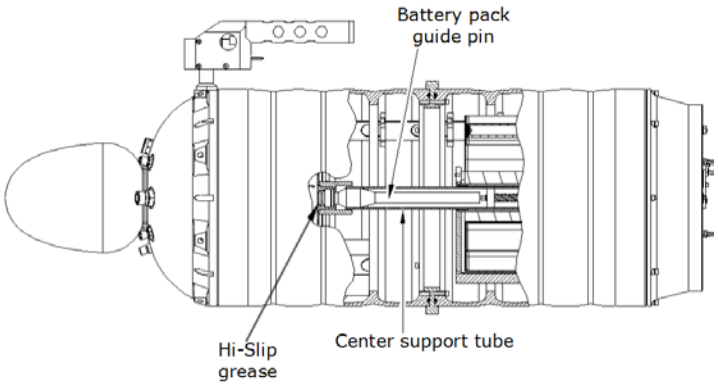
7.26.2.4 Clean the mating surfaces and O-ring groove with isopropyl alcohol.

7.26.2.5 Lubricate and install the new .139 x 9.984 O-ring.

7.26.2.6 Align the top centerline markings of the mass shifter with the top center mark on the main pressure hull segment. Refer to figure 40.

7.26.2.7 Slide the Mass Shifter assembly into the hull assembly, while a second person feeds the ribbon cables and RF cable through the open area of the mass shifter assembly. Ensure engagement of guide pin into center tube shown in figure 40.

Figure 40: Installing the Mass Shifter



7.26.2.8 Apply Tef-Gel to eight 6-32 x 0.50 socket head cap screws.

7.26.2.9 Install and tighten the eight 6-32 x 0.50 socket head cap screws and eight #6 lock washers using a crisscross pattern.

7.27 Install the Electronics Assembly

7.27.1 Equipment Needed

- 7/64 Inch T-Handle Allen Wrench, 18 Inches Long
- 5/16 Inch Wrench, SMA Connector, Torque 8 in-lbs.
- Loctite® 243

7.27.2 Procedure

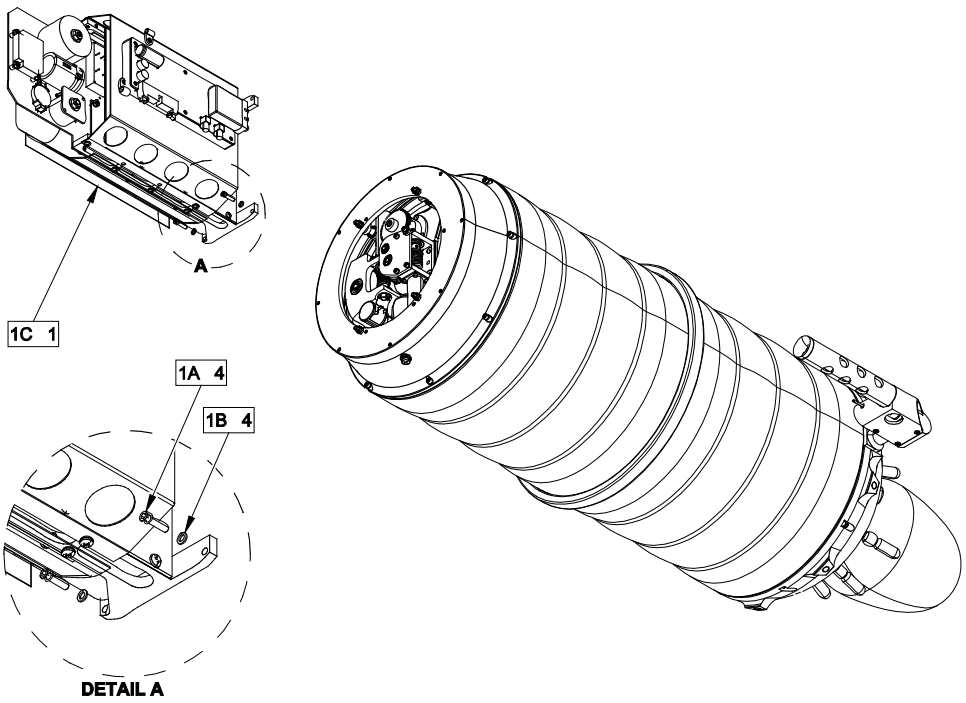
 ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

7.27.2.1 **Note:** This assembly is easiest to do with the pressure hull set at a slight incline (bladder down) or horizontal. Refer to figure 41.

7.27.2.2 Align the main electronics assembly (1C) with the holes in the mass shifter assembly. The electronics should be on the upper side, the secondary battery on the underside.

7.27.2.3 Apply Loctite 243, then install and tighten four 6-32 x ½ socket head cap screws (1A) with four #6 Lock Washers (1B).

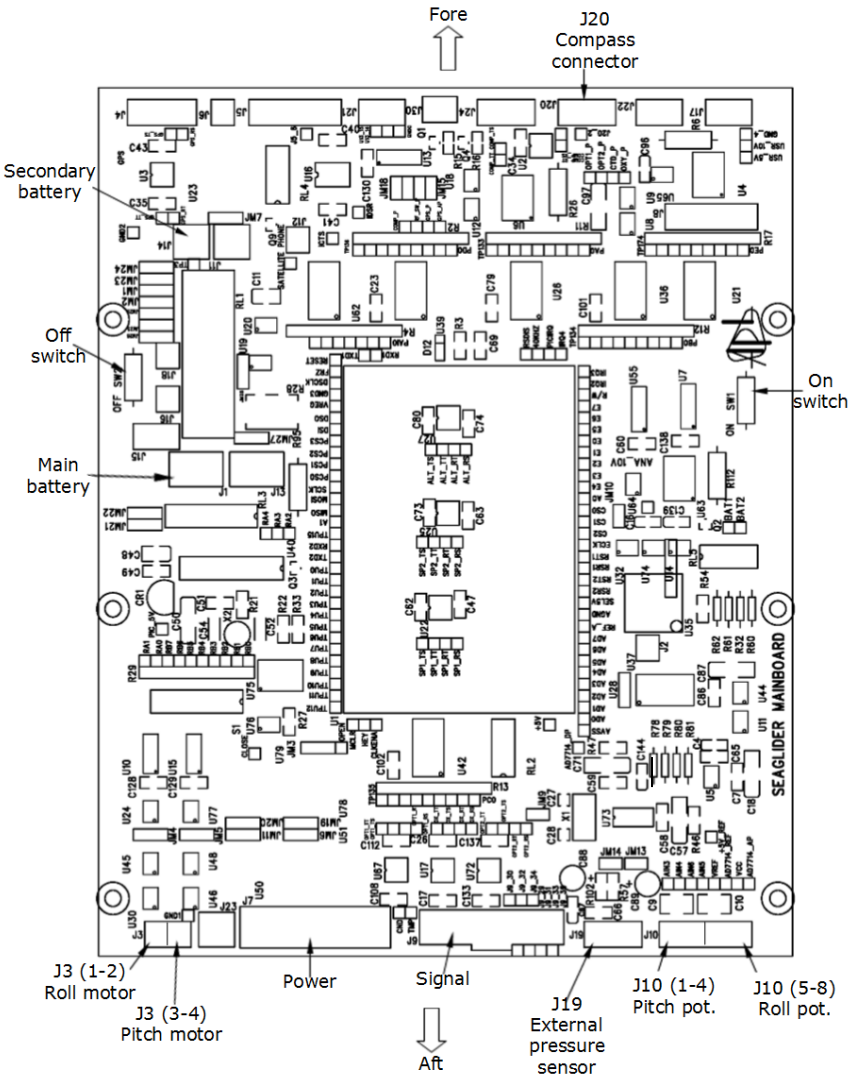
Figure 42: Installing Main Electronics Assembly to Pressure Hull



7.27.2.4 On the main board, connect the electrical connectors in the following sequence and using figure 42 as a guide:

a. Signal ribbon cable (gray) to J9
b. Power ribbon cable (multi-colored) to J7
c. External pressure sensor to J19
d. Pitch pot cable (1-4) to J10
e. Roll pot cable (5-8) to J10
f. Pitch motor cable (3-4) to J3
g. Roll motor cable (1-2) to J3
h. Red and black main battery cable connector to J1
i. Red and black secondary battery cable connector to J11

Figure 42: Main Board Connector Locations



7.27.2.5 Apply Loctite 243 to the two main board cover screws which were removed to tilt the cover up for board access.

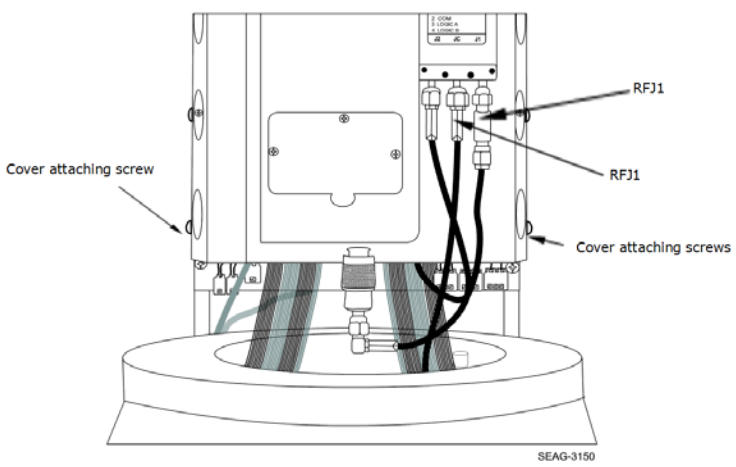
7.27.2.6 Position the main board cover down over the main board, and install the attaching screws.

7.27.2.7 Refer to technical service bulletin, TSB -017: Model SIM Card Cover Pad, to determine if the foam pad needs to be installed on the underside of the modem's SIM card cover. Install the pad per the bulletin instructions, if the glider is within TSB serial number effectivity. TSB-017 is included as Appendix C.

7.27.2.8 Connect the middle cable (labeled RFJC) to the RF switch connector JC. Torque to 8 in-lbs. Refer to figure 43.

7.27.2.9 Connect the outer cable (labeled RFJ1) to the RF switch connector J1. Torque to 8 in-lbs.

Figure 43: RF Switch Connections on Main Board Cover



7.28 Install the Forward Hull – part 1

7.28.1 Equipment Needed

- 7/64 Inch Allen Wrench, T-Handle
- Pressure Relief Valve Installation Tool (DeepSea Power & Light PN 701-00020-02)
- Tef-Gel Anti-Seize Lubricant
- Grease, Electrical Insulating Lubricant, Dow Corning 4

7.28.2 Procedure

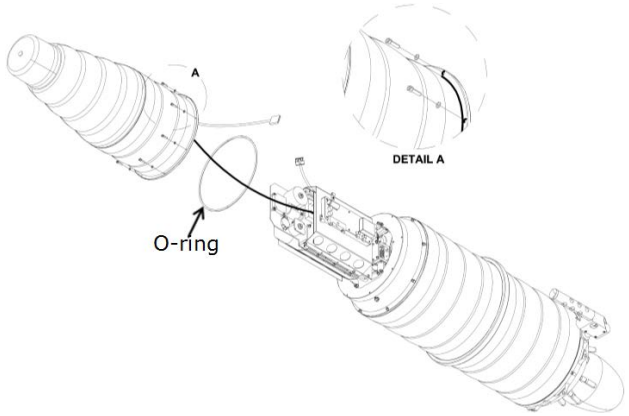
ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

7.28.2.1 Clean the mating surfaces of the forward hull and the main hull with isopropyl alcohol.

7.28.2.2 Lubricate and install a new .139 x 7.234 O-ring.

7.28.2.3 Connect the in-line transponder cable and plug the compass connector into the electronics assembly (J20). Refer to figures 44 and 42. The transponder MUST be connected to the electronics assembly BEFORE powering on the glider to prevent damage to the transponder OEM board.

Figure 44: Installing the Forward Pressure Hull



7.28.2.4 Closing of the pressure hull will be completed after the hardware check outlined below is completed.

7.29 Perform the Hardware Test and Verification

7.29.1 Equipment Needed

- Laptop with Tera Term loaded
- Magnetic Wand
- Communications Cable (either non-powered or powered)
- Power supply(ies) if using powered communications cable
- Ability to make Iridium call either on glider antenna or external antenna

7.29.2 Procedure

Caution: Do not power ON Seaglider without the transponder connected. Doing so will damage the OEM board.

7.29.2.1 Verify that the power supply(ies) are set correctly for your glider

a. 24V/2.0A and 10V/2.0A if the glider is configured for 24V/10V operation
b. 15V/2A if the glider is configured for 15V shared bus operation

7.29.2.2 Verify that there are no unconnected cables on the main electronics board or on the OEM board assembly.

7.29.2.3 Verify that the glider is commissioned on the basestation.

7.29.2.4 Verify that the glider is setup to make an Iridium call either through its own antenna or through a roof mount antenna.

7.29.2.5 Open up a Tera Term terminal session on the laptop and log the session to a file called SGXXX-Hardware-Verification-YYYYMMDD; where XXX is the glider serial number and YYYYMMDD is year month day.

7.29.2.6 Wand the Seaglider pressure hull on (ON switch is on the starboard/right side of the electronics assembly).

7.29.2.7 Set the time and date.

7.29.2.8 When asked if the Seaglider is running on bench power answer yes, if using shore power. If using glider battery power, answer no.

7.29.2.9 From the Main Manu, select Hardware tests and monitoring, option 2:

7.29.2.10 **Note:** If the software times out, type TT8 to wake up Tera Term.

7.29.2.11 Test Mass Shifter Pitch

a. In the Hardware Menu, select Pitch Control, option 1.
b. Under “Pitch Control” enter option 4.
c. Verify pitch limits match min/max with those on the trim sheet.
d. Under “Pitch Control” enter option 2 (AD count change).
e. Input “0” and visually verify the mass shifter moves full forward, and the cables do not bind or get pinched. Press CTRL-Q to stop the pitch operation, or any other operation, if a problem occurs.
f. As the mass shifter moves, make sure the A/D counts are moving on the Tera-Term log.
g. Input “4000” and visually verify the mass shifter moves full aft.
h. Set the mass shifter to 2000 A/D counts.
i. When the pitch tests are complete press <ENTER> to go back up to the Hardware Menu.

7.29.2.12 Test Mass Shifter Roll

a. In the Hardware Menu, select Roll Control, option 2.

b. Under “Roll Control” enter option 4.
c. Verify roll limits match min/max on the trim sheet.
d. Under “Roll Control” enter option 2 (AD count change).
    - Input “0” and visually verify the roll mechanism rotates to port, and the cables do not bind or get pinched. Press CTRL-Q to stop the roll operation, or any other operation, if a problem occurs.
    - Input “4000” and visually verify the roll mechanism rotates to starboard, and the cables do not bind or get pinched.
e. Under “Roll Control” enter option 3 (degree changes).
    - Set roll to “0” degrees.
f. When the roll tests are complete press <ENTER> to go back up to the Hardware Menu.

7.29.2.13 Test VBD System

a. In the Hardware Menu, select VBD Control, option 3.
b. Under “VBD” Control” enter option 4.
c. Verify min/max limits match trim sheet VBD limits.
d. Under “VBD” Control” enter option 1, and check current position.
e. Under “VBD” Control” enter option 2, and enter value lower than current position (AD count change).
f. Listen for pump noise, and make sure the A/D count changes on the Tera Term log (Press CTRL-Q to stop the pump, or any other operation).
g. Enter a higher value A/D, to make sure the bleed function is working. Listen for the valve to ‘click’.
h. When the VBD tests are complete press <ENTER> to go back up to the Hardware Menu.

7.29.2.14 Test Pressure Sensor

a. In the Hardware Menu, select Pressure Sensor, option 5.
b. Input option “2” and follow the prompts to verify ambient air pressure is displayed.

7.29.2.15 Test Compass

a. In the Hardware Menu, select Compass, option 6.
b. Under “Compass” enter option 3.
c. Move the forward hull side to side, and observe the displayed heading changes accordingly.
d. Roll the forward hull back and forth, and observe the displayed roll angle changes.
e. Point the forward hull up and down, and observe the displayed pitch angle changes.
f. Press CTRL-Q to stop scrolling data.

7.29.2.16 Test Modem

a. In the Hardware Menu, select Modem, option 8.

b. Under “Modem”, select direct comms
c. AT response = ok
d. Input: AT+CREG? Response = 00001. If there is a “4” in the string, wait 10-15 seconds, type A/ to repeat command, until the phone registers.
e. Type ATD00 followed by the customer phone number, including country code.
f. Verify “Connected” call.
g. A prompt to log in with SGXXX and Seaglider password should then appear.
h. If the login prompt is not seen do the following:
    - In the modem menu, select Upload data
    - The glider should now call the number in “telnum” and try to upload data to the basestation. However, since the flashcard was recently formatted, no data should be present. This is not a problem. The purpose of this exercise is to verify that the glider can call and connect to its basestation.

7.29.2.17 Test Internal Pressure Sensor

a. In the Hardware Menu, select Internal pressure.
b. Under “Internal pressure” enter option 1 and verify that realistic pressure and relative humidity values are displayed.
c. Press CTRL-Q to stop scrolling data.

7.29.2.18 Test Altimeter

a. In the Hardware Menu, select Altimeter, option 10.
b. Under “Altimeter” enter option 1 and listen for a ping.

7.29.2.19 Reset Battery Gauges

a. In the Hardware Menu, select Batteries and fuel gauges, option 13.
b. Input “2” and reset battery power levels.

7.29.2.20 Wand OFF the glider, disconnect the communications cable and install the forward hull following the instructions below.

7.30 **Install the Forward Hull – part 2**

7.30.1 **Equipment Needed**

- 7/64 Inch Allen Wrench, T-Handle
- Pressure Relief Valve Installation Tool (DeepSea Power & Light PN 701-00020-02)

- Tef-Gel Anti-Seize Lubricant
- Grease, Electrical Insulating Lubricant, Dow Corning 4

7.30.2 **Procedure**

 ESD PRECAUTIONS IMPORTANT NOTE: ESD sensitive devices can be damaged by humans, machines or a charged body. This process involves handling of ESD sensitive components. Only personnel trained and equipped in the handling of ESD sensitive materials should complete this procedure. Wear a grounded ESD wrist strap and work on a static-free, nonconductive surface when performing this procedure.

7.30.2.1 Check the mating surfaces of the forward hull and the main hull as well as the O-ring and verify that they are still clean. If dirt is present re-clean the mating surfaces with isopropyl alcohol and clean the O-ring with a near lint free cloth, such as a Kim Wipe, and regrease.

7.30.2.2 Align the external top centerline markings of the forward hull and the main hull, and align the screw holes. Refer to figure 35.

7.30.2.3 Apply Tef-Gel® or equivalent anti-seize compound to the tips of the screws.

7.30.2.4 Note: Be careful to avoid dropping screws down into the main hull assembly.

7.30.2.5 Install and tighten eight 6-32 x 0.50 Socket Head Cap Screws (2A) and eight #6 Lock Washers (2B). Tighten the screws in a crisscross pattern.

7.31 **Set the Vacuum Level in the Pressure Hull**

7.31.1 **Equipment Needed**

- Pressure Relief Valve Vacuum Adapter (PN 4199231).
- Pressure Relief Valve Installation Tool (PN 701-00020-02)
- Vacuum Pump Kit (PN 4339426)
- Laptop with Tera Term
- Communications Cable
- Magnetic Wand

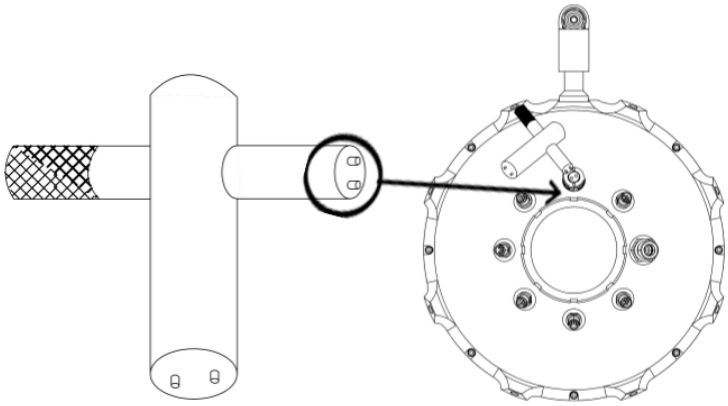
7.31.2 **Procedure**

7.31.2.1 Insert the Pressure Relief Valve Tool into the Pressure Relief Valve. See figure 45.

7.31.2.2 Close the valve by turning the tool clockwise.

7.31.2.3 Once closed, turn the valve six (6) complete turns counter clock-wise using the line on the tool handle.

Figure 45: Closing Pressure Relief Valve



7.31.2.4 Via the Main Menu enter Hardware test and monitoring menu, option 2.

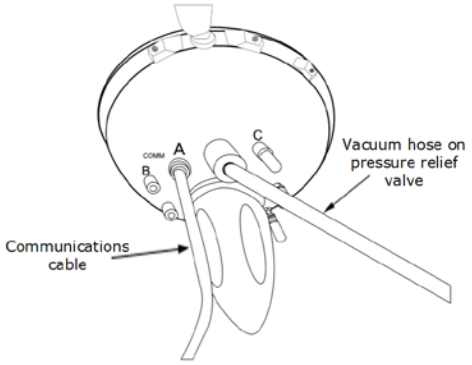
7.31.2.5 In the Hardware Menu, select Internal pressure.

7.31.2.6 In the Internal pressure menu, select Basic self-test.

7.31.2.7 Record the Starting Pressure and Relative Humidity numbers in the Refurbishment Checklist. Subtract 5 from the starting pressure number to find your “target internal pressure number.” Enter this value in the Refurbishment Checklist also.

7.31.2.8 Attach the vacuum hose from the vacuum pump compressor to the pressure relief valve and re-run the Basic self-test. See figure 46.

Figure 46: Vacuum Hose Adapter



7.31.2.9 With the self-test running, turn on the compressor and watch the pressure number decrease until it reaches the ”target internal pressure number.” Pull the compressor fitting off of the pressure relief valve.

7.31.2.10 Verify that your internal pressure is set 5psi below your starting internal pressure.

7.31.2.11 Turn the valve two (2) complete turns clockwise to set the valve’s venting pressure to the correct limit.

7.31.2.12 Continue to monitor the pressure for five (5) minutes to ensure there is no vacuum leak.

7.31.2.13 Record the starting and ending pressure and relative humidity numbers on the Refurbishment Checklist, then power down the glider.

7.31.2.14 Weigh the pressure hull and record the values on the Refurbishment Checklist.

7.32 Adding Paine Pressure Sensor Oil

7.32.1 Equipment Needed

- Flat-Head Screwdriver
- Fluid, Dow Corning XIAMETER PMX-200
- Plastic Syringe

7.32.2 Procedure

7.32.2.1 **Note:** The presence of oil in the Paine pressure sensor is used to impede intrusion of particulate material into the port and prevent corrosion.

7.32.2.2 Rotate the Mass Shifter Assembly so that the white plastic screw is facing up.

7.32.2.3 Remove the white plastic screw from the Mass Shifter section of the pressure hull (figure 20).

7.32.2.4 Use the plastic syringe to draw oil from the supply bottle.

7.32.2.5 ***Slowly*** add the new oil to the Paine Sensor reservoir until full.

7.32.2.6 Install the plastic screw and tighten. Do not over-tighten. A small amount of oil will be forced out of the pressure port when the screw is inserted.

7.33 Install the Aft Fairing

7.33.1 Equipment Needed

- #2 Phillips Screwdriver
- Tef-Gel Anti-Seize Lubricant

7.33.2 Procedure

7.33.2.1 Refer to figure 47. For aft fairings with hatch covers skip to step 7.34.2.5.

7.33.2.2 For aft fairings without removable hatches:

a. Install any sensors to the fairing that were previously uninstalled for cleaning and/or calibration.
b. Apply spray silicon lubricant to the sensor cable connectors going to the bulkhead.
c. Connect any sensors cables from the aft fairing to the aft endcap.
d. Inspect the antenna cable plug and the aft endcap antenna connector for damage, and replace if necessary.
e. Prepare the communications cable mating ends by spraying them with silicone lubricant. Do not spray-lubricate the antenna connector.
f. Feed cables attached to the antenna into the aft fairing.

CAUTION: Inspect a new antenna O-ring for nicks, cuts or wear. A bad O-ring can cause a failed connector seal which will result in damage to the connector pins and poor or no communications.

g. Replace the O-ring in the antenna connector. Apply Dow Corning 4 silicon grease to the O-ring before installing into the antenna connector.
h. Insert the antenna into the aft fairing.

i. Connect the antenna cable to the pressure hull aft endcap. Tighten to finger tight and then use the vise grips to snug the connector no more than an additional 1/8 turn.
j. Connect the communications cable to the aft endcap.

7.33.2.3 Align the holes in the aft fairing with the holes in the pressure hull as well as with the CT Sail.

7.33.2.4 Apply Tef Gel to the thread tips of the screws and install eight 0.25 - 28 Phillips screws through the aft fairing into the pressure hull.

7.33.2.5 For aft fairings with removable hatches, install the antenna.

a. Inspect the antenna cable plug and the aft endcap antenna connector for damage and replace if necessary.
b. Prepare the communications connector mating ends by spraying them with silicone lubricant. Do not spray-lubricate the antenna connector.
c. Feed cables attached to the antenna into the aft fairing.

CAUTION: Inspect a new antenna O-ring for nicks, cuts or wear. A bad O-ring can cause a failed connector seal which will result in damage to the connector pins and poor or no communications.

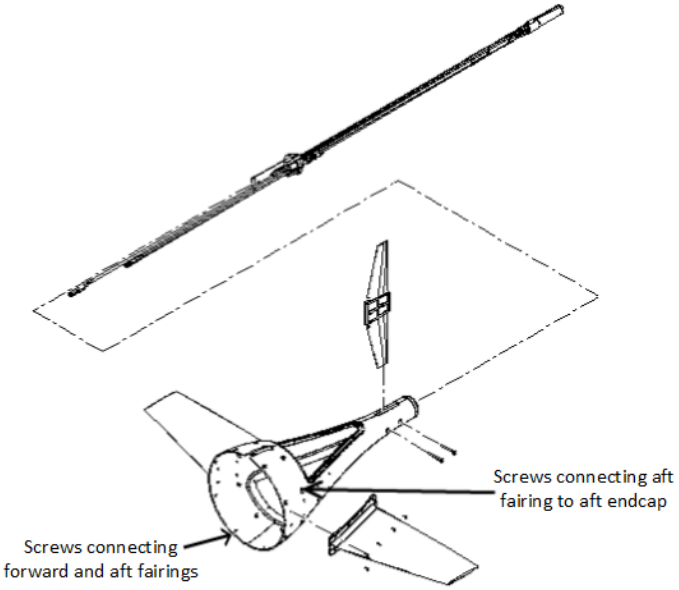
d. Replace the O-ring in the antenna connector. Apply Dow Corning 4 silicon grease to the O-ring before installing into the antenna connector.
e. Insert the antenna into the aft fairing.
f. Connect the antenna cable to the pressure hull aft endcap. Tighten to finger tight and then use the vise grips to snug the connector no more than an additional 1/8 turn.
g. Connect the communications jumper cable to the aft endcap.

7.33.2.6 Apply spray silicon lubricant to the sensor cable connectors going to the bulkhead.

7.33.2.7 Connect the cables from any sensors attached to the hatch covers to the aft endcap.

7.33.2.8 Install the hatch covers.

Figure 47: Installing the Aft Endcap and Antenna



7.34 Perform a Compass Calibration

7.34.1 Equipment Needed

- Magnetically quiet area
- Flat surface to spin the whirligig on. A piece of plywood can be used.
- Seaglider
- Whirligig installed on a mobile cart
- Magnetic wand
- Computer with Tera Term installed
- Computer with MATLAB version 2009a or newer with the Optimization toolbox and an internet connection. (This may be the same computer as the field laptop.
- Non-powered communications cable

7.34.2 Procedure

7.34.2.1 Mount the Seaglider in the whirligig if it is not already.

7.34.2.2 Put the glider in travel mode, if it is not already.

a. Connect the glider to a laptop with Tera Term.
b. Wand the glider on.
c. Via the Main Menu, select Hardware Test and Monitoring, option 2.

d. In the Hardware Menu, select Miscellaneous (travel, timeouts, date/time).
e. In the Miscellaneous hardware functions, select Prepare for travel.
f. Once done, wand the Seaglider pressure hull off and exit the Tera Term session.
g. Wand glider off.
h. Disconnect the communications cable from the glider and the laptop.

7.34.2.3 Move the assembly outside to a magnetically quiet area, taking into consideration the following:

a. We recommend going over the area with a metal detector to find a quiet spot.
b. The compass is sensitive to magnetic influence within approximately 3 pupa lengths. Pause the data collection if any magnetic object enters this area.
c. The compass is sensitive to small objects such as keys only in close proximity (about 1 foot). Keep these items away from the compass.
d. Avoid having cell phones in your pocket while performing compass calibrations.

7.34.2.4 Place the whirligig on the flat surface

7.34.2.5 Start up the capture file on the field laptop

7.34.2.6 Connect the communications cable between the Seaglider and the laptop

7.34.2.7 Get into the compass hardware menu.

a. At the main menu select Hardware tests and monitoring, option 2.
b. In the hardware menu select Compass.
c. In the Compass menu select the 'whirly' option. **DO NOT** select the 'whirlraw' option.

7.34.2.8 After warming up, the compass should start streaming data to the terminal, which is being captured by the log/capture file utility. (If you are using a recent glider software release, you should be able to pause and resume this flow using the space bar at any time. This is sometimes useful, for example, to pause recording data as you adjust the pitch and roll of the vehicle or if trucks/cars pass by your calibration fixture. If you can't pause, don't worry. It doesn't appear to matter as long as you can avoid trucks and other large moving magnets.) Hitting control-Q will quit.

7.34.2.9 By hand, roll the Seaglider to port about 30 degrees. Watch the output on the laptop to determine the roll. The roll does not have to be exactly 30 degrees.

7.34.2.10 Pitch the glider down about 30 degrees and watch the output on the laptop to determine the pitch. The pitch does not need to be exactly 30 degrees.

7.34.2.11 Rotate the whirligig (and hence the glider) in a 360 degree horizontal circle.

a. The spin direction does not matter.
b. The rotation should take about one (1) minute to get good data density (roughly 30 degrees per five (5) seconds.

7.34.2.12 Leave the roll degree as is but pitch the glider up by 15 degrees (the glider should now be at a -15 degree angle).

7.34.2.13 Repeat step 7.34.2.13. **Note:** Since direction does not matter you can reverse the direction of this rotation to prevent tangling of the communications cable.

7.34.2.14 Pitch the gilder up to +15 degrees, leaving the roll as is.

7.34.2.15 Repeat step 7.34.2.13.

7.34.2.16 Pitch the gilder up to +30 degrees, leaving the roll as is.

a. Repeat step 7.34.2.13.

7.34.2.17 Set the glider back to horizontal position and roll it to approximately 30 degrees to starboard. Watch the output on the laptop to determine roll. The roll does not need to be exactly 30 degrees.

7.34.2.18 Repeat steps 7.32.2.13 - 7.34.2.18.

7.34.2.19 When the eight 360 degree rotations have been completed quit the ‘whirly’ program with a **ctrl Q.**

7.34.2.20 Turn off the glider.

7.34.2.21 Close the log/capture file.

7.34.2.22 Process the calibration data.

a. Link a copy of the log/capture file to your MATLAB path
b. In MALAB run the ‘whirlymagcal’ script
c. When prompted input:

i. Glider ID (3 digit glider number)
ii. Compass serial number (found on Trim Sheet, Cal tab)
iii. Name of the log/capture file
iv. Calibration date

d. The program will determine

v. The local geomagnetic field strength via the internet
vi. If the data collected is insufficient or if the field appears to be non-uniform
vii. When complete, the script creates a file named whirly_tcm2mat.GGG (where GGG is the Seaglider id number). Copy or save this file as tcm2mat.GGG and install it on the Seaglider. The glider can now navigate.

7.34.2.23 Seaglider rotation at zero degrees pitch is not performed because the glider does not fly at that angle.

7.34.2.24 Prepare the Pressure Hull for Travel

a. Via the Main Menu, select Hardware Test and Monitoring, option 2.
b. In the Hardware Menu, select Miscellaneous (travel, timeouts, date/time).
c. In the Miscellaneous hardware functions, select Prepare for travel.
d. Once done, wand the Seaglider pressure hull off and exit the Tera Term session.
e. Wand glider off.
f. Disconnect the communications cable from the glider and the laptop.

7.35 Install Forward Fairing

7.35.1 Equipment Needed

- Eight (8) 10/32 x 3/8 Phillips head screws
- #2 Phillips Screwdriver
- Tef-Gel Anti-Seize Lubricant

7.35.2 Procedure

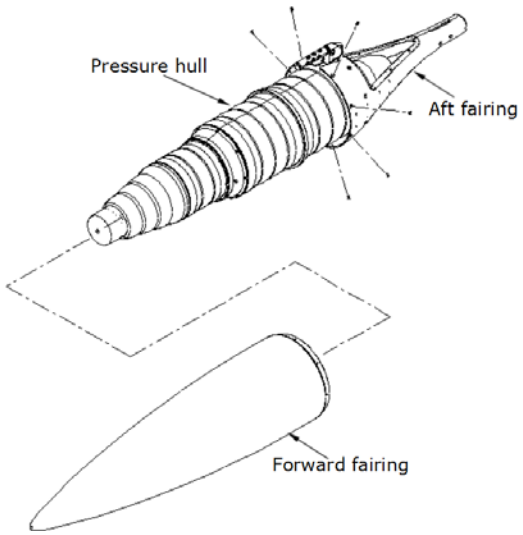
7.35.2.1 Transfer the glider from the whirligig to the cradle.

7.35.2.2 Refer to figure 39 and carefully slide the Forward Fairing over the pressure hull and align the screw holes with the Aft Fairing. Ensure the top centerline marking on the forward fairing is aligned with the top centerline marking of the aft fairing.

7.35.2.3 **Note:** Ensure the "ON" and "OFF" labels are aligned correctly with the pressure hull.

7.35.2.4 Apply Tef Gel, install and tighten eight (8) 10/32 x 3/8 Phillips head screws to secure the forward fairing to the aft fairing.

Figure 48: Install the Forward Fairing



7.35.2.5 Weigh the fully assembled glider, including wings, rudder, and antenna and record on the Refurbishment Checklist.

7.36 Update the Trim Sheet

7.36.1 Equipment Needed

- Refurbishment Checklist
- Electronic copy of the most recent trim sheet for the refurbished glider

7.36.2 **Procedure**

7.36.2.1 The trim sheet must be updated during the refurbishment process, in order to accurately calculate the required ballasting. The trim sheet is an Excel file containing several sheets (tabs), including a “Weight sheet”, and a “Trim sheet” which record the weights of all replaceable components and assemblies. The cells with green text are calculated results and should not be over-written. The cells containing red text/numbers can be updated as necessary.

7.36.2.2 To update the trim sheet:

a. Save a copy of the previous trim sheet to the new name.
b. Open the Weight Sheet tab and update the following:
    - Main battery mass - cell G456
    - Secondary battery mass – cell G499
    - Battery serial numbers
        - Main – cell H461
        - Secondary – cell H500
    - Electronics assembly mass – cell G472
    - Mass shifter assembly mass – cell G452
    - Full pressure housing mass – G231
    - Full glider mass – cell H2
    - Review total unit scale weight, no lead (cell H2) and make a note of value as it will be needed later.
c. Open Trim tab
    - Zero out lead ballasting – D76, D78, D80, D82, D87
    - Go back to weight sheet and zero out F32:F41 and F50-56
    - Go back to trim tab
    - Check cells C47 and C48, pupa weights. C48 should be the value entered on the Weight Sheet. C47 is the sum of the independent component weight and should be close to C48.
    - Cells C9 and C10 should be the same. They are the total weight of the glider with ballast.
    - Do not change water density in C18
    - Use Goal Seek Button to see where you are in terms of ballasting
    - If C20 is greater than 70% glider is too buoyant – need to add lead
    - If lead is added, rubber (EDPM) and tape also need to be added
    - Go to Weight Sheet tab
    - Start by adding rubber (EDPM) to the bottom (Weight Sheet F32)
    - Add straps – Weight Sheet F37
    - Go back to Trim tab

- Do goal seek to get updated picture
- If still need adjustment add lead strips on Trim tab
- Note E73 is the average weight of a lead strip i.e. 130g
- Add 1 lead strip to D76 and press return or exit cell
- Go back to top of Trim tab and click Goal Seek and see if more changes are needed
- +/- 5% of goal (70%) is preferred
- Now check VCB-VCG separation, cell C33
- Desired separation is ~.5 with a +/- 0.1
- Mystery weight = C10-F51 (difference between summed masses and measured weight of full up glider) and is located in cell F52
- What do we do with the mystery mass?
- Difference should be less than 10
- Mystery moment arm is located in G53 and is used to correct pitch center
    - There are offsets in the trim sheet for the pitch center. The pitch center found in the original tank test done by the manufacturer does not match the pitch center calculated by the trim sheet. To account for this difference, the manufacturer takes the mystery mass (difference between scale weight and summed weight) and multiplies by a mystery moment arm to equate the two centers. The mystery moment is not generally changed during refurbishment because the glider's weight should not vary significantly between build and refurbishment and cannot be done without a tank.

d. Note the new centers on Trim tab in E20 and E27. Verify that the same values should be present on the Cal tab
e. Pull needed lead strips and weigh.
    - record these weights on the Trim tab, E73
        - 2 methods
            i. Set D73 to the number of strips needed and E73 to the average weight per strip
            ii. Set D73 to 1 and E73 to the sum of lead strips weight
f. Go to Lead Worksheet tab and add the lead strips to appropriate line
    - The added weight is generally biased to the bottom starboard side
    - Column P is validation that the lead strips specified on the Trim tab are accounted for

g. Use the pinwheel at the bottom of the Lead Worksheet for visualization
h. Install the lead
    - Clean the pressure hull, the rubber and the lead will isopropyl alcohol. Otherwise, the tape will not stick.
    - Apply carpet tape to the rubber and the lead
    - Apply rubber to pressure hull
    - Apply lead to rubber
    - Use a ballpeen hammer to shape lead to pressure hull
    - Install straps – put buckles going opposite directions and make sure that they are not on the lead
i. Install forward fairing
j. Weigh and verify with summed value on Trim sheet tab, C10
k. Update Weight Sheet tab, cell H1 with full up weight and K1 with date
l. Save the Trim Sheet

7.36.2.3 On the Maint sheet, add brief narrative of maintenance actions/repairs performed during refurbishment tasks.

7.36.2.4 On the Cal sheet, record the compass and sensor calibration dates, the calibration coefficients and the glider software version. Also, enter new CT sail calibration coefficients in the cmdfile.

7.37 **Self Test**

7.37.1 Using battery power, run an autonomous self test using the instructions in the Seaglider User's Guide.

7.38 **Simulation Dives**

7.38.1 Using battery power, run three (3) simulation dives using the instructions in the Seaglider User's Guide.

Appendix A: Seaglider Refurbishment Checklist

Seaglider Serial Number SG_____

Owner _____

Refurbishment Start Date: _____ End Date: _____

Case Contents and Condition

Item Description	Present
Forward Fairing Condition:	Y / N
Aft Fairing Condition:	Y / N
Port Wing Condition:	Y / N
Starboard Wing Condition:	Y / N
Rudder Condition:	Y / N
Antenna Mast Condition:	Y / N

Item Description	Present
(2x) Power ON/OFF Magnetic Wands or /shorting plugs (1) On, (1) Off (circle appropriate option)	Y / N
Laptop Computer for Communications (optional)	Y / N
50 Ft. Non-Powered Communications Cable (optional)	Y / N
10 Ft. Powered Communications Cable (optional)	Y / N
WET Labs Calibration Cap (optional)	Y / N
Collapsible Launch Cradle: (Optional) ____ (2x) End Plates ____ (4x) Rails ____ (8x) Screw, Hex Head - 1/2-13 X 1.500, 18-8 SS ____ mesh ____ (4x) Eye Screws (size) ____(4X) light weight line to connect eye screws to mesh	Y / N
Sensors *CT Sail Serial Number:* Condition of Conductivity Cell: Condition of Thermistor: Condition of Stand-off:	

Item Description	Present
Port B Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port C*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port D*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor:	

Item Description	Present
Port E: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor: *Port F*: Make: Model: Serial Number: Condition of cable and connectors: Condition of sensor:	
Pressure Hull Condition:	Y / N
Notes:	Y / N

Serial Numbers, Weights and Voltages of Refurbishment Components

Serial Numbers, Weights and Voltages
Main Battery Pack S/N: Weight: Voltage (no load):
Secondary Battery Pack S/N: Weight: Voltage (no load):
Coin Cell Battery Voltage (no load):
Electronics Assembly w/ New Secondary Battery Weight:
Mass Shifter Assembly w/ New Main Battery Weight:
Pressure Hull with Vacuum Pulled Weight:
Fully Assembled Glider including wings, rudder and antenna Weight:
Internal Pressure Target value: Starting value (before vacuum pulled): Ending Value (after vacuum pulled):
Internal Humidity Before vacuum pulled: After vacuum pulled:

Appendix B: Trim Sheets

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta:	-7.9
									Delta:	2341.1
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight			
0	**Flying Seaglider**	**4197060**	**49801**							
1	(8x) 10-32 x 3/8 FHMS, joint ring to aft fairing	4199128	55240		1	12.2	11.9			
1	(8x) 1/4-28 x 1/2 FHMS, Aft fairing to endcap or Ogive fairing screw	4199153	55294		1	27.5	47.9			
1	**Assy, Standard Forward Fairing**	**4199433**	**55494**							
				Subtotal Weight			0.0	gm	diff	
			Note:no plates	Scale Weight		7388.0		gm	0.0	<-- includes Radiati
2	Combined Forward Fairing & Joint Ring	4199347 / 4199330		Change Qty to 1 if installed	0					
2	Forward Fairing	4199347	49897	Change Qty to 1 if installed	0	5527.5	0.0			
2	Joint Ring, Fwd to Aft Fairing (bonded to fwd fairing before paint; Long ring = 875g, short ring 688g)	4199330	49834	Change Qty to 1 if installed	0	688.0	0.0			
2	Nose weight (2 hole - bonded to fwd fairing after paint)	4199334	49844	Change Qty to 1 if installed	0	1245.0				
2	Detachable Fairing Nose	??	??		0	50.0				
2	Nose Weight (5 hole)	??	??		0	1276.0				
2	Nose Weight to Detachable Nose Screws	4199435	??		0	39.0				
2	Nose weight plates	4199426	55448		0	124.5				
2	(2x) 1/4-20 x 2" SHCS + 1/4 LW brass, nose plate to nose base (4 - 5 plates)	/4199135	55186 / 55253		0	28.3				
2	(2x) 1/4-20 x 1.5" SHCS + 1/4 LW brass, nose plate to nose base (2 -3 plates)	4199112 / 4199135	55185 / 55253		0	23.2				
2	(2x) 1/4-20 x .75" SHCS + 1/4 LW brass, nose plate to nose base (1 plate)	/4199135	55473 / 55253		0	15.7				
1	**Assy., Ballast (STANDARD)**									
				Subtotal Weight			0.0	gm		
				Scale Weight			0.0	gm		
2	Trim .600" aft of pupa joint ring - bottom (5" strip)				0	300.0	650.2			
2	Trim .600" aft of pupa joint ring - port side (5" strip)				0	0.0	0.0			
2	Trim .600" aft of pupa joint ring - starboard side (5" strip)				0	0.0	0.0			
2	Trim .600" aft of pupa joint ring - top (5" strip)				0	0.0	0.0			
2	Trim 1.000" **fwd of bulkhead** - bottom (5" strip)				0	103.2	0.0			
2	EPDM base (5"x6") + (2x) 2"x 6" tape - bottom		not in BOM	Change Qty to 1 if installed	0	50.0	53.7			
2	EPDM base (5"x6") + (2x) 2"x 6" tape - port		not in BOM	Change Qty to 1 if installed	0	51.6				
2	EPDM base (5"x6") + (2x) 2"x 6" tape - starboard		not in BOM	Change Qty to 1 if installed	0	50.0				
2	EPDM base (5"x6") + (2x) 2"x 6" tape - top		not in BOM	Change Qty to 1 if installed	0	50.0				
2	EPDM base (5"x6") + (2x) 2"x 6" tape - **fwd of bulkhead** - bottom		not in BOM	Change Qty to 1 if installed	0	30.0				
2	(2) Straps - cut to length (start at 34g, subtract trimmed)		not in BOM	Change Qty to 1 if installed	0	30.0	33.9			
2	(2) Straps - cut to length (start at 17g, subtract trimmed) **fwd of bulkhead**		not in BOM	Change Qty to 1 if installed	0	30.0				
2	Trim Lead tape (~1g per 5" lead strip)		not in BOM	Change Qty to 1 if installed	0	1.0				
2	Trim Lead tape (~1g per 5" lead strip) **fwd of bulkhead**		not in BOM	Change Qty to 1 if installed	0	1.0				
2	(2) black tape wraps over foam (1 1/2" width)		not in BOM	Change Qty to 1 if installed	0	43.5	13.2			

Unit # SG:	506

Total Unit Scale Weight /w Lead		52629.0	gm
Total Unit Scale Weight no Lead		50280.0	gm
Subtotal Unit Weight		50287.9	gm

Weighted on: 6/2/2014
Weighted on: 6/18/2014
Delta: -7.9
Delta: 2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		
1	**Assy., Ballast (BATTERY HULL FORWARD JOINT RING)**								
				Subtotal Weight			0.0	gm	
				Scale Weight			0.0	gm	
2	Trim .600" aft of pupa joint ring - bottom (5" strip)				0	300.0	0.0		
2	Trim .600" aft of pupa joint ring - port side (5" strip)				0	0.0	0.0		
2	Trim .600" aft of pupa joint ring - starboard side (5" strip)				0	0.0	0.0		
2	Trim .600" aft of pupa joint ring - top (5" strip)				0	0.0	0.0		
2	EPDM base (5"x6") + (2x) 2"x 6" tape - bottom		not in BOM	Change Qty to 1 if installed	0	50.0			
2	EPDM base (5"x6") + (2x) 2"x 6" tape - port		not in BOM	Change Qty to 1 if installed	0	51.6			
2	EPDM base (5"x6") + (2x) 2"x 6" tape - starboard		not in BOM	Change Qty to 1 if installed	0	50.0			
2	EPDM base (5"x6") + (2x) 2"x 6" tape - top		not in BOM	Change Qty to 1 if installed	0	50.0			
2	(2) Straps - cut to length (start at 34g, subtract trimmed)		not in BOM	Change Qty to 1 if installed	0	30.0			
2	Trim Lead tape (~1g per 5" lead strip)		not in BOM	Change Qty to 1 if installed	0	1.0			
2	(2) black tape wraps over foam (1 1/2" width)		not in BOM	Change Qty to 1 if installed	0	43.5			
1	**Assy, Ojive Forward Fairing**	**4199433**	**55494**						
				Subtotal Weight			5975.3	gm	diff
			Note:no plates	Scale Weight		7388.0	**5974.0**	gm	-1.3 **<-- includes Radiati**
2	Ojive Forward Fairing	??	??	Change Qty to 1 if installed	1	5535.0	4665.0		
2	Detacable Fairing Nose	??	??	Change Qty to 1 if installed	1	50.0	52.0		
2	Nose weight (5 hole)	??	49844	Change Qty to 1 if installed	1	1276.0	1218.6		
2	Nose weight to detachable nose screws	4199435		Change Qty to 1 if installed	1	39.0	39.7		
2	Nose weight plates	4199426	55448		0	124.5	729.8		
2	(2x) 1/4-20 x 2" SHCS + 1/4 LW brass, nose plate to nose base (4 - 5 plates)	/4199135	55186 / 55253		0	28.3			
2	(2x) 1/4-20 x 1.5" SHCS + 1/4 LW brass, nose plate to nose base (2 -3 plates)	4199112 / 4199135	55185 / 55253		0	23.2	19.9		
2	(2x) 1/4-20 x .75" SHCS + 1/4 LW brass, nose plate to nose base (1 plate)	/4199135	55473 / 55253		0	15.7			
1	**Assy., Standard Aft Fairing**	**4199434**	**55497**						
				Subtotal Weight			0.0	gm	diff
				Scale Weight		5073.0		gm	0.0 **<-- includes Antenn**
2	Aft Fairing	4199495	56972	Change Qty to 1 if installed	0	2062.0			
2	Wing, Starboard (1m)	4199438	56751	Change Qty to 1 if installed	0	686.0			
2	Wing, Port (1 m)	4199438	56751	Change Qty to 1 if installed	0	697.0			
2	(16x) 6-32 x 3/8 FHMS (WING SCREWS)	4199270	56912	Change Qty to 1 if installed	0	11.2			
2	Rudder	4199331	49839	Change Qty to 1 if installed	0	120.0			
2	(2x) 1/4-20 x 2" FHMS, rudder to rudder shoe	4199237	55487	Change Qty to 1 if installed	0	20.3			
2	Top panel	4199496	57651	Change Qty to 1 if installed	0	226.0			
2	Top panel (Bump Out)	?	?	Change Qty to 1 if installed	0	0.0			

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta:	-7.9
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		Delta:	2341.1
2	Bottom panel	4199496	57651	Change Qty to 1 if installed	0	230.0				
2	Bottom panel (Bump Out)	?	?	Change Qty to 1 if installed	0	0.0				
2	Panel screws - (18) FHMS 6-32 x .375	4205790	57671	Change Qty to 1 if installed	0	17.6				
1	**Assy., Ojive Aft Fairing**	**4199434**	**55497**							
				Subtotal Weight			5163.5	gm	diff	
				Scale Weight		5073.0	**5169.0**	gm	5.5	**<-- includes Antenn**
2	Combined Aft Fairing & Joint Ring			Change Qty to 1 if installed	1		2536.0			
2	Aft Fairing (Ogive)	??	??	Change Qty to 1 if installed	1	2062.0	1867.0			
2	Joint Ring, Aft to Forward Fairing (bonded to Aft fairing before paint)	??	??	Change Qty to 1 if installed	1	669.0	669.0			
2	Wing, Starboard (Ogive)	??	??	Change Qty to 1 if installed	1	686.0	621.2			
2	Wing, Port (Ogive)	??	??	Change Qty to 1 if installed	1	697.0	614.1			
2	(16x) 6-32 x 3/8 FHMS (WING SCREWS)	4199270	56912	Change Qty to 1 if installed	1	11.2	11.2			
2	Rudder (Ogive)	??	??	Change Qty to 1 if installed	1	120.0	121.8			
2	(2x) 1/4-20 x 2" FHMS, rudder to rudder shoe	4199237	55487	Change Qty to 1 if installed	1	20.3	20.3			
2	Top panel (Ogive)	??	??	Change Qty to 1 if installed	1	226.0	266.8			
2	Bottom panel (Ogive)	??	??	Change Qty to 1 if installed	1	230.0	212.3			
2	Panel screws - (18) FHMS 6-32 x .375	4205790	57671	Change Qty to 1 if installed	1	17.6	17.6			
2	**Assy., Antenna**	**4199332**	**49841**							
				Subtotal Weight			502.0	gm	diff	
				Scale Weight		476.5	**502.0**	gm	0.0	
3	Antenna Assembly GPSI (Shoe, mast, antenna, clamp, heat shrink, comm cable, dummy plug, dummy plug line, zip ties)	4199393 / 4199395 / 4199089 / 4199352 /4199234 / 4199105 / 4199262 /4199266 /4199394	52336 / 52341 / 52454 / 52231 / 55474 /52481 / 56875 /56884 / 52340		1	528.1	502.0			
				Antenna SN:						
2	**Assy., Aanderaa Optode Oxygen Sensor**	**4196239**	**55481**							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight		338.1		gm	0.0	
3	O2 Sensor Assy. (Aanderaa optode, mount base, SS hose clamp, (2x) 8-32 x 5/8 FHMS, (2x) 8-32 nylok)	4199035 / 4205811 / 4199129 / 4199163 / 4199130	52220 / 56905 / 55245 / 55321 / 55246	Change Qty to 1 if installed	0	433.0	324.8			
				Aanderaa Optode SN:			**13**			
					0					
2	**Assy., SBE 43f Oxygen Sensor (**Not Pumped**)**	**4192455**	**55482**							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	O2 Sensor Assy. (O2 sensor, Plenum, (2x) 6-32 x 5/8 SHCS - plenum to sensor, O2 bracket, (2x) 8-32 x 5/8 FHMS - bracket to aft fairing, (2x) SS hose clamp)	4199047 / 4199435 / 4199129 /4199489 / 4199269	52356 / 55518/ 55245 / 56906 / 56911	Change Qty to 1 if installed	0	308.3				
				SBE 43f SN:						
3	O2 Sensor Cable Assembly	4199353	52236	Change Qty to 1 if installed	0	59.1				
3	Plug assy, SBE 43f plenum	4199435	55518		0	NA				

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta:	-7.9
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		Delta:	2341.1
2	Assy., WET Labs Optical - FWD Hole - (Bump OUT)	4192457	55521							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight		233.5		gm	0.0	
3	Wet Labs sensor Assy. (WL Triplet sensor, Bracket (BUMP), (2x) 6-32 x .625 SHCS - sensor clamp, 6-32 x 0.375 THCS)	4199039 / 4295315 / 4199120 / 4205790		Change Qty to 1 if installed	0	233.5				
				WET Labs SN:						
2	Assy., WET Labs Optical - aft hole	4192457	55521							
				Subtotal Weight			240.2	gm	diff	
				Scale Weight		233.5	240.2	gm	0.0	
3	Wet Labs sensor Assy. (WL Triplet sensor, (2x) Wet labs sensor clamp, (2x) 8-32 x 5/8 FHMS - sensor clamp to fairing)	4199039 / 4199388 / 4199129	52296 / 52312 / 55245	Change Qty to 1 if installed	1	233.5	240.2			
				WET Labs SN:			885			
3	Cover, WL sensor used in shipping	4199254	55520		0	NA				
2	Assy., WET Labs Optical - Dual Hole Closest to PUPA	4192457	55521							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight		233.5	0.0	gm	0.0	
3	Wet Labs sensor Assy. (WL Triplet sensor, Bracket Ext mount, 6-32 x 0.625 SHCS, 2x 6-32 x 0.375in Truss Head Phillips)	4199039 / 4295315 / 4199120 / 4205790	52296 / 52312 / 55245	Change Qty to 1 if installed	0	233.5				
				WET Labs SN:						
3	Cover, WL sensor used in shipping	4199254	55520		0	NA				
2	Assy., SBE CTD & Pumped 43f Oxygen Sensor	4295305								
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	GPCTD 90688.007, Bracket CTD Rear, Bracket CTD Forward, 6-32 x 0.625in SHCS, 8-32 x 0.25in Pan Head, 6-32 x 0.375in Flat Head	4272424 / 4289667 / 4289656 / 4199120 / 4233372 / 4199270	?	Change Qty to 1 if installed	0	917.7				
3	GPCTD PUMP PWR Cable, GPCTD PWR/Serial Cable	4293654 / 4274285	?	Change Qty to 1 if installed	0	102.5				
3	TUBING 2x 3/8in id x 1/2" od, 2x 1/2" id x 3/4" od	4291710 / 4291709	?	Change Qty to 1 if installed	0	119.0				
				SBE CTD SN:						
3	GPCTD 90696 Pump, Pump Bracket, 6-32 x 0.375 Flat Head, Cable Ties	4272326 / 4295332 / 4199270 / 4199110	?	Change Qty to 1 if installed	0	381.4				
				SBE CTD PUMP SN:						
3	O2 Sensor			Change Qty to 1 if installed	0	413.8				
3	O2 Sensor Cable Assembly	4293655		Change Qty to 1 if installed	0	52.1				
				SBE 43f (O^2) SN:						
2	Assy., Argos Mount	?	?							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	Argos Tag	?	?	Change Qty to 1 if installed	0	53.8				

		Unit # SG:	**506**		**Total Unit Scale Weight /w Lead**		**52629.0**	**gm**	Weighted on:	6/2/2014
					Total Unit Scale Weight no Lead		**50280.0**	**gm**	Weighted on:	6/18/2014
					Subtotal Unit Weight		50287.9	**gm**	**Delta:**	-7.9
	Description	**iRobot part #**	**UW Part #**		**Qty**	**Ref Weight**	**Weight**		**Delta:**	**2341.1**
				Argos SN:						HEX #
3	Argos Mount Hardware. (?) - Clamp to Antenna, 4 screws, 2 brackets	2601, 4258110	?	Change Qty to 1 if installed	0	24.4				Uplink ID
2	**Assy., PAR, BSI - QSP2000**	**?**	**?**							
				Subtotal Weight	**0**		0.0	**gm**	**diff**	
				Scale Weight			**864.2**	**gm**	864.2	
3	SENSOR, PAR BSI - QSP-200 SERIES + SHIELD, LIGHT- PAR BSI + (1x) SCREW, FLAT HEAD-PHILLIPS, #6-32 X .375, SS	?	?	Change Qty to 1 if installed	0	728.6	734.0			
				PAR SN:			**50132**			
3	BRACKET, PAR QSP 2000, INTERNAL + SCREW, (2x) TRUSS HEAD - PHILLIPS, #6-32 X .375, SS + CLAMP, HOSE - WORM DRIVE 2.0IN TO 3.0IN, SS	?	?	Change Qty to 1 if installed	0	57.4	67.4			
3	ASSY, CABLE - PAR SENSOR INTERFACE	4222385	?	Change Qty to 1 if installed	0	63.0	62.8			
2	**Assy., Radiation Detector**	**4314372**	**?**							
				Subtotal Weight			0.0	**gm**	**diff**	
				Scale Weight				**gm**	0.0	
3	SENSOR, RADIATION DETECTOR	4314373	?	Change Qty to 1 if installed	0	?				
				Radiation SN:						
3	BRACKET, SENSOR, RADIATION DETECTOR / BRACKET, FAIRING SUPPORT, RADIATION DETECTOR / (6x) SCREW, FLAT HEAD - PHILLIPS, #8-32X .625IN SS	4318407 / 4334120 / 4199129	?	Change Qty to 1 if installed	0	?				
3	FAIRING, SENSOR, RADIATION DETECTOR / (6x) SCREW, BUTTON HEAD - ALLEN, #10-32 X 1.5IN SS	4318408 / 4254832	?	Change Qty to 1 if installed	0	?				
3	ASSY, CABLE - RADIATION DETECTOR / 1.5IN WIDE ELECTRICAL TAPE	4326393 / ??????		Change Qty to 1 if installed	0	?				
2	**Assy, Nortek ADCP**	**4314562**	**?**							
				Subtotal Weight			0.0	**gm**	**diff**	
				Scale Weight				**gm**	0.0	
3	SENSOR, ACOUSTIC DOPPLER CURRENT PROFILER, NORTEK / BRACKET, SENSOR - ADCP / (4x) SCREW, SHCS, 10-32 X .500, SS / (3x) #6-32 X .375 TRUSS HEAD, SS	4314562 / 4328749 / 2539 / ????	?	Change Qty to 1 if installed	0	?				
				ADCP SN:						
3	SENSOR, CABLE	?????	?	Change Qty to 1 if installed	0	?				
2	**Assy, Imagenex ECHOSounder**	**4321091**	**?**							
				Subtotal Weight			0.0	**gm**	**diff**	
				Scale Weight				**gm**	0.0	
3	SENSOR, ECHOSOUNDER 853, IMAGENEX / BRACKET, SENSOR, BASE - ECHOSOUNDER / BRACKET, SENSOR, STANDOFF - ECHOSOUNDER / (2x) SCREW #8-32 X .500, SS / (3x) SCREW TRUSS HEAD #6-32 X .375, SS / (4x) SCREW #8-32 X .25 TRUSS HEAD	4321091 / 4328900 / 4329102	?	Change Qty to 1 if installed	0	?				
				ECHOSOUNDER SN:						
3	SENSOR CABLE	-	?	Change Qty to 1 if installed	0	?				
3	New Sensor Cable	?	?	Change Qty to 1 if installed	0	?				
2	**Assy, RAFOS**	**??**	**?**							
				Subtotal Weight			0.0	**gm**	**diff**	

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta:	-7.9
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		Delta:	2341.1
				Scale Weight				gm	0.0	
3	Hydrophone for RAFOS system - added by UW-SFC	?	?	Change Qty to 1 if installed	0	114.8				
				RAFOS SN:						
3	RAFOS Mount Hardware. (?)	?	?	Change Qty to 1 if installed	0	?				
3	RAFOS Cable	?	?	Change Qty to 1 if installed	0	?				
2	Assy, New Sensor #1	??	?							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	New Sensor #1	?	?	Change Qty to 1 if installed	0	?				
				New Sensor #1 SN:						
3	New Sensor #1 Mount Hardware. (?)	?	?	Change Qty to 1 if installed	0	?				
3	New Sensor #1 Cable	?	?	Change Qty to 1 if installed	0	?				
2	Assy, New Sensor #2	??	?							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	New Sensor #2	?	?	Change Qty to 1 if installed	0	?				
				New Sensor #2 SN:						
3	New Sensor #2 Mount Hardware. (?)	?	?	Change Qty to 1 if installed	0	?				
3	New Sensor #2 Cable	?	?	Change Qty to 1 if installed	0	?				
2	Assy, AFT Foam Block Ballast	??	?							
				Subtotal Weight			0.0	gm	diff	
				Scale Weight				gm	0.0	
3	Foam Block location "under Ogive Top hatch cover"	?	?	Change Qty to 1 if installed	0	1400.0				
3	Hardware for Foam Block location "under Ogive Top hatch cover"	?	?	Change Qty to 1 if installed	0	8.4				
3	Foam Block location "Ogive Bottom Hatch cover"	?	?	Change Qty to 1 if installed	0	574.0				
3	Hardware for Foam Block location "Ogive Bottom Hatch cover"	?	?	Change Qty to 1 if installed	0	8.4				
3	Foam Block location "C"	?	?	Change Qty to 1 if installed	0	?				
3	Hardware for Foam Block location "C"	?	?	Change Qty to 1 if installed	0	?				
3	Foam Block location "D"	?	?	Change Qty to 1 if installed	0	?				
3	Hardware for Foam Block location "D"	?	?	Change Qty to 1 if installed	0	?				
1	Assy., Pupa	4199431	55486							
				Subtotal Weight			39089.3	gm	diff	
				Scale Weight			38500.0	39076.0	gm	-13.3
	Complete pupae volume - sum this sheet									

	Unit # SG:	**506**		**Total Unit Scale Weight /w Lead**			**52629.0**	**gm**	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			**50280.0**	**gm**	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	**gm**	**Delta:**	-7.9

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		**Delta:**	2341.1
2	Position B (Opt O2): IE55 dummy plug	4199651	55309	Change Qty to 1 if installed	1	7.4	7.5			
2	Position C (WL-1): IE55 dummy plug	4199651	55309	Change Qty to 1 if installed	0	7.4				
2	Position D: Zinc Anode	4199651	55309	Change Qty to 1 if installed	1	7.4	48.3			
2	Position E (WL-2): IE55 dummy plug	4199651	55309	Change Qty to 1 if installed	1	7.4	7.5			
2	Position F (WL-3): IE55 dummy plug	4199651	55309	Change Qty to 1 if installed	1	7.4	7.5			
2	O-Ring, E70-270, Endcap to Batt Hull	4199059	52411		1	8.0	8.7			
2	(7x) 6-32 x 1/2 SHCS w/ LW, endcap to battery hull	4199111 / 4199122	55183 / 55217 / 55214 / 49884		1	13.0	12.9			
2	O-Ring, E70-270, Bulkhead to batt. hull	4199059	52411		1	8.0	8.7			
2	(8x) 6-32 x 1/2 SHCS w/ LW, bulkhead to battery hull	4199111 / 4199122	55183 / 55217 / 55214 / 49884		1	15.1	15.0			
2	(4x) 6-32 x 1/2 SHCS + #6 LW, rails to bulkhead	4199111 / 4199122	55183 / 55217		1	5.2	5.2			
2	O-Ring, E70-263, elec hull to bulkhead	4199058	52410		1	6.6	7.1			
2	(8x) 6-32 x 1/2 SHCS + #6 LW, elec hull to bulkhead	4199111 / 4199122	55183 / 55217		1	10.5	10.5			
		Start Relative Humidity	50.00	**Start internal Pressure**	12.15					
		End Relative Humidity	41.80	**End internal pressure**	7.12					
2	**ASSY, AFT ENDCAP, ENHANCED - CT SAIL**	**4293521-00001**	**-**							
2	**ASSY, AFT ENDCAP, ENHANCED - PLUG**	**4293521-00002**	**-**							
	Endcap Subassembly Serial Number:			**Subtotal Weight**	**1**		7696.0	**gm**	**diff**	
				Scale Weight		7250.0	**7697.0**	**gm**	1.0	
3	OIL, HYDRAULIC SYNTHETIC: ***End Cap Without Oil***	4199066	5585		gm		**5958**			
	End Cap With Oil		6699		gm		**7054**			
	Oil Added To System		1114		gm		1096.0			
	Volume of Oil In System (=Oil_wt_2/Oil_density)		1353.75		cc		1331.9			
				Max		**Min**				
			VBD A	**4060**		**418**				
			VBD B	**4060**		**417**				
			HW Ave	4060		418				
			SW Ave	3960		518				

	Unit # SG:	**506**		**Total Unit Scale Weight /w Lead**			**52629.0**	**gm**	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			**50280.0**	**gm**	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	**gm**	**Delta:**	-7.9

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		**Delta:**	2341.1
3	**ASSY, HYDRAULIC DRIVE**	**4293235**	**-**							
	Hydraulic Drive Serial Number:			**Subtotal Weight**			4696.2	**gm**	diff	
	Note: Adjusted scale weight includes the Union Elbow			**Adjusted Scale Weight**		3962	4695.7			
				Scale Weight		3962	**4695.7**	**gm**	-0.5	
4	ENDCAP, HULL, AFT (6 - Port)	4199325	49815	Change Qty to 1 if installed	1		2019.2			
4	(2x) PIN, SPRING, SLOTTED - 5/32" DIA x .375L, 18-8 SS	4199132	55248		1	1.1	1.1			
4	FITTING, TUBE, MALE - RUN TEE 2 x 1/4" TUBE, 1/8" NPT M	4250762	-		1	??	8.5			
4	FITTING, TUBE, MALE - CONNECTOR, 1/4" OD, 7/16-20 SAE/MS, SS	4199245	55506		1	27.8	27.6			
4	ASSY, CABLE - VBD VALVE - A1W19 *("SKINNER VALVE")*	4199367	52254		1	605.7	606.4			
4	FITTING, TUBE, MALE - ADAPTER, 1/4" TUBE, 1/8" NPT M, SS	4199072	52430		1	10.5	10.5			
4	FITTING, TUBE, MALE - BRANCH TEE 2 x 1/4" TUBE, 1/8" NPT M	4250878	-		1	8.5	8.5			
	For STANDARD BOOST PUMP									
4	**Tubing, 1/4 DIA x 8" (Cut 8.25")**	4199064	52419	Change Qty to 1 if installed	0	3.3				
4	**Tubing, 1/4 Dia x 6.0" (Cut 6.5")**	4199064	52419	Change Qty to 1 if installed	0	2.6				
4	Check Valve, Kepner 204 A-1	4199084	52448	Change Qty to 1 if installed	0	22.6				
4	Union Elbow, Male, 1/4 tube x 1/4 tube, alum	4199076	52435	Change Qty to 1 if installed	0	16.1				
4	**Tubing, 1/4 DIA x 9.625" (Cut 9.75")**	4199064	52419	Change Qty to 1 if installed	0	3.8				
4	Run Tee, Male,1/4 tube x 1/4 tube x 1/8 NPT, alum	4199075	52428	Change Qty to 1 if installed	0	18.9				
4	**Tubing, 1/4 Dia x 4.375" (Cut 4.375")**	4199064	52419	Change Qty to 1 if installed	0	1.9				
	For HIGH VOL BOOST PUMP									
4	TUBING, 1/4" OD 310 PSI *(9.0in)*	4263534	-	Change Qty to 1 if installed	1	4.1	4			
4	TUBING, 1/4" OD 310 PSI *(10.0in)*	4263534	52419	Change Qty to 1 if installed	1	4.5	4.5			
4	VALVE , CHECK, INLINE - SPRING POPPET 1/8" NPT F. 1/8" NPT M	4199084	52448	Change Qty to 1 if installed	1	22.6	22.4			
4	TUBING, 1/4" OD 310 PSI *(8.0in)*	4263534	-	Change Qty to 1 if installed	1	3.6	3.6			
4	TUBING, 1/4" OD 310 PSI *(11.0in)*	4263534	-	Change Qty to 1 if installed	1	4.5	4.4			
4	TUBING, 1/4" OD 310 PSI *(4.375in)*	4263535	-	Change Qty to 1 if installed	1	2	1.9			
4	TUBING, 1/4" OD 310 PSI *(4.375in)*	4263536	-	Change Qty to 1 if installed	1	2	1.9			
4	FITTING, MALE - 1/4" TUBE, 1/8" NPT M	4275380	-	Change Qty to 1 if installed	1	6.2	6.4			
4	TUBING, 1/4" OD 310 PSI *(1.25in)*	4263536	-	Change Qty to 1 if installed	1	0.6	0.5			
4	FITTING, TUBE, TEE - COUPLING 3 x 1/4" TUBE	4251058	-	Change Qty to 1 if installed	1	2.9	2.8			
4	FITTING, TUBE, MALE - 90DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251059	-	Change Qty to 1 if installed	1	7.5	7.5			
4	FITTING, TUBE, MALE - 45DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251060	-	Change Qty to 1 if installed	1	7.4	7.4			
4	VALVE, CHECK, INLINE - 1-2 PSI CRACK 2x 1/8" NPT F, AL	4259549	-	Change Qty to 1 if installed	1	25.4	25.3			
4	WASHER, FLAT, STEEL, ZINC, SEAL	4199043	52350		1	0.9	1.1			
4	SCREW, PUMP OUTLET	4199400	52349		1	7.2	7.6			

Unit # SG:	506

				Total Unit Scale Weight /w Lead		52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead		50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight		50287.9	gm	Delta:	-7.9
								Delta:	2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight
4	PUMP, HYDRAULIC - 3 PISTON *(LEDUC)*	4199399	52348		1	315.5	316.6
				Leduc pump SN:			**109**
4	ENDCAP, HYDRAULIC PUMP LEDUC	4259549	-		1	110.0	111.6
4	BEARING, BALL - 8mm SHAFT, SS, OPEN	4199093	52459		1	3.2	3.1
4	O-RING, BUNA-N, 70A -032	4199055	52407		1	0.5	0.4
4	FITTING, TUBE, MALE - PIPE ADAPTER, 10-32 UNF, 1/8" TUBE	4250882	-		1	3.0	2.9
4	TUBING, 1/8" OD 500 PSI *(8.875in)*	4263530	-		1	1.5	1.4
4	SEAL, MAGNETIC *(Replace O-ring with 4214427 prior to weighing)*	4199046	52353		1	13.9	13.8
4	SCREW, SOCKET HEAD - ALLEN #6-32 x .500 L, 18-8 SS	4199111	55183		1	7.0	7.1
4	PLUG - .250" DIA, 3000PSI, Al / PIN - .250" DIA PLUG, 3000PSI *(LEE PLUG)*	4199081 / 4199082	52445 / 52446		1	0.4	0.4
4	VALVE, CHECK, BLADDER *(altered Kepner 1106 A-1-1)* / O-RING, BUNA-N, 90A -906 *(N70 3-906)*	4199338 / 4199056	49852 / 52408		1	47.9	47.8
4	BLADDER, ACCUMULATOR	4199078	52441	**Bladder Date code:**	1	113.5	118.4
4	NUT, BLADDER	4199318	49802		1	109.4	109.0
4	ASSY, CABLE, - INTERNAL COMMS - A1W17 *(POSITION A {INTERNAL COMMS})*	4199365	-		1	11.5	12.3
4	ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 *(POSITION B {OPT O2})*	4199375	-		1	11.5	11.7
4	ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 *(POSITION C {WL-1})*	4199375	-		1	11.5	11.8
4	Anode Adaptor + O-Ring	4068150 / 4199057	-		1	24.4	24.5
4	ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 *(POSITION E {WL-2})*	4199375	-		1	11.5	11.7
4	ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 *(POSITION F)*	4199375	-		1	11.5	11.8
4	ASSY, CABLE - IRIDIUM/GPS ANTENNA - A1W5 (LM-195 cable)	4199354	52241		1	64.6	64
4	VALVE, PRESSURE RELIEF *(DEEP SEA)*	4199085	52449		1	11.5	11.5
4	PLATE, PUMP DRIVE	4199320	49804		1	41.6	41.3
				Main Pump Motor SN: (start current, end current) -->			**35M**
4	ASSY, CABLE - PUMP MOTOR, VBD HIGH PRESSURE - A11W18	4199366	52253		1	130.9	131.1
4	(3X) SCREW, FLAT HEAD PHILLIPS, M2 x 0.4 X 6, 18-8 SS	8254	55203		1	0.3	0.5
4	REDUCER, BORE - 3mm ID , AL	4199044	52351		1	0.7	0.6
4	PULLEY, TIMING BELT, AL *(LEDUC DRIVE MOTOR)*	4199045	52352		1	5.7	5.6
4	(6X) SCREW, FLAT HEAD - ALLEN, #4-40 x .375, 18-8 SS	17437	55229		1	3.0	3.0
4	PULLEY, PUMP *(LEDUC PUMP PULLEY)*	4199321	49806		1	91.5	91.6
4	BELT, TIMING 6mm WIDE, NEOPRENE	4199048	52357		1	3.4	3.8
4	COVER, BELT, PUMP DRIVE	4199429	55476		1	18.5	18.2
4	(4X) SCREW, SOCKET HEAD - ALLEN, #4-40 x .250, SS	2549	-		1	2.0	2.0
4	(2x) 6-32 x 1/2 SHCS + #6 LW, boost pump bracket to endcap	4199111 / 4199122	55183 / 55217		1	1.9	1.9
4	Grounding Strap 27.5"				1	2.7	4.9
3	**Assy., Boost Pump (Standard)**	**4199411**	52378				
	Boost Pump Serial Number:			**Subtotal Weight**			0.0 gm diff
	Note Union Elbow weight is added to the Drive system Scale weight			**Adjusted Scale Weight**		384.0	0.0 gm 0.0

Unit # SG:	506

Total Unit Scale Weight /w Lead		52629.0	gm
Total Unit Scale Weight no Lead		50280.0	gm
Subtotal Unit Weight		50287.9	gm

Weighted on:	6/2/2014
Weighted on:	6/18/2014
Delta:	-7.9
Delta:	2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight
	Note: Adjusted scale weight removes the Union Elbow			Scale Weight		400.1	
4	Pump Bracket	4199322	49808	Change Qty to 1 if installed	0	21.8	
4	Motor, Chrge Pump w/ W34	4199384	52288	Change Qty to 1 if installed	0	59.7	
		Boost Pump Motor SN: (start current, end current) -->					
4	(2x) M2 x 6 FHMS, motor to bracket	8254	55203	Change Qty to 1 if installed	0	0.2	
4	Magnet Rotor Housing	4199092	52457	Change Qty to 1 if installed	0	10.3	
4	(4x) 6-32 x 1/4 PHMS, bracket to housing	4146090	55209	Change Qty to 1 if installed	0	3.0	
4	Rotary Magnet	4199090	52455	Change Qty to 1 if installed	0	17.6	
4	Pumphead, Micropump + mounting plate + (3x) 4-40 x 3/8 FHMS	4199051 / 4199091 / 17437	52360 / 52456 / 55229	Change Qty to 1 if installed	0	224.3	
				Micropump SN:			
4	(4x) 4-40 x 3/16 SHCS + #4 LW, housing to flange	4199155 / 19928	55296 / 55233	Change Qty to 1 if installed	0	2.0	
4	(2x) Elbow, 1/8 npt x 1/4 tube, alum	4251059	52431	Change Qty to 1 if installed	0	24.9	
4	Filter, Balston	4199068	52425	Change Qty to 1 if installed	0	19.9	
	Union Elbow, Male, 1/4 tube x 1/4 tube, alum	4199076	52435	Change Qty to 1 if installed	0	16.1	

	Unit # SG:	**506**		**Total Unit Scale Weight /w Lead**			**52629.0**	**gm**	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			**50280.0**	**gm**	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	**gm**	**Delta:**	-7.9
	Description	**iRobot part #**	**UW Part #**		**Qty**	**Ref Weight**	**Weight**		**Delta:**	**2341.1**
3	**ASSY, PUMP, BOOST** (Enhanced)	**4254582**	-							
	Boost Pump Serial Number:			**Subtotal Weight**			716.8	**gm**		
				Scale Weight		**711.7**	**717.0**	**gm**	**diff**	
4	BRACKET, BOOST PUMP	4250419	-	Change Qty to 1 if installed	1	35.2	36.9		0.2	
4	ASSY, CABLE, MOTOR, BOOST PUMP HIGH VOL	4261167	-	Change Qty to 1 if installed	1	233.4	235.7			
		Boost Pump Motor SN: (start current, end current) -->					**BP1**			
4	(4X) SCREW, FLAT HEAD - PHILLIPS, M3 X 0.5 X 8, 18-8 SS	4260277	-	Change Qty to 1 if installed	1	1.8	1.7			
4	HOUSING, PUMP - RE-MAX 29	4249845	-	Change Qty to 1 if installed	1	88.9	94.4			
4	(10X) SCREW, SOCKET HEAD, ALLEN, #4-40 X .250 + #4 LW	2549 / 19928	-	Change Qty to 1 if installed	1	4.8	4.8			
4	HUB ASSEMBLY, ROTARY MAGNET / SCREW, SET, CUP POINT- ALLEN 10-32 X .188, 18-8 SS	4259021 / 4258345	-	Change Qty to 1 if installed	1	77.0	76.2			
4	PUMP, GEAR, MAGNETIC DRIVE - 5.2 BAR	4258747	-	Change Qty to 1 if installed	1	251.0	252.1			
				Micropump SN:			**1661949**			
4	(2X) FITTING, TUBE, MALE - 90DEG ELBOW 1/4" TUBE , 1/8" NPT	4251059	-	Change Qty to 1 if installed	1	14.8	15.0			
3	**ASSY, HYDRAULIC RESERVOIR** ***(STANDARD)***	**4199397**	**-**							
	Standard Reservoir Serial Number:			**Subtotal Weight**			0.0	**gm**		
	Scale Weight is just down to the yellow line			**Scale Weight**		1148.4		**gm**	**diff**	
4	Piston, Diaphragm	4199323	49811	Change Qty to 1 if installed	0	137.4			0.0	
4	Diaphragm, Internal (Bellofram)	4206402	56874	Change Qty to 1 if installed	0	94.3				
4	Sikaflex Adhesive Compound	4199233	55459	Change Qty to 1 if installed	0	12.3				
4	Cylinder Head, Diaphragm	4199474	56798	Change Qty to 1 if installed	0	334.4				
4	Branch Tee, Male, 1/4 tube x 1/8 NPT x 1/4 tube, brass + Plastic plug (X59P4)	4199080 / 4205772	52443 / 52434	Change Qty to 1 if installed	0	23.3				
	Elbow, 1/8 NPT M x 1/8 NPT M, brass	4199069	52426	Change Qty to 1 if installed	0	26.9				
4	Kepner Chk Valve 404A-1-10	4199083	52447	Change Qty to 1 if installed	0	26.8				
4	Elbow, 1/8 npt x 1/8 tube, alum	4199070	52427	Change Qty to 1 if installed	0	25.8				
4	Bleed screw, 10-32 x .125 PHMS with seal	4210092	55477	Change Qty to 1 if installed	0	1.9				
4	Cylinder, Diaphragm	4199324	56943	Change Qty to 1 if installed	0	422.5				
4	(8x) 5-40 x 3/8 SHCS +#5 LW, head to cylinder	4209126 / 4199125	? / 55225	Change Qty to 1 if installed	0	7.5				
4	Standoff (starboard)	4199418	55299	Change Qty to 1 if installed	0	12.5				
4	Standoff (port)	4199418	55299	Change Qty to 1 if installed	0	12.5				
4	(4x) 6-32 x 3/8 SHCS +#6 LW, standoff to cylinder	4199119 / 4199122	55183 / 55217	Change Qty to 1 if installed	0	4.5				
4	(2x) Saddles, mounting, Aft PCB + (4x) 4-40 x 1/4 PHMS	4199410 / 4134111	52373 / 55257	Change Qty to 1 if installed	0	5.0				
4	(2x) Saddles, mounting, C PCB + (4x) 4-40 x 1/4 PHMS	4199345 / 4134111	49888 / 55257	Change Qty to 1 if installed	0	6.4				
4	(2x) Saddles, mounting, T PCB + (4x) 4-40 x 1/4 PHMS	4199345 / 4134111	49888 / 55257	Change Qty to 1 if installed	0	6.3				
4	(2x) Saddles, mounting, O2 PCB + (4x) 4-40 x 1/4 PHMS (only used with SBE 43f)	4199345 / 4134111	49888 / 55257	Change Qty to 1 if installed	0	6.4				
4	Ball Bearing joint / ring retaining spiral / stud mount / ball swivel ring	4205785 / 4205787 / 4205808 / 4205809		Change Qty to 1 if installed	0	10.0				
	Weigh Hydraulic res. Assy, then Oil fill & add sub-assy fasteners									

Unit # SG: 506	Total Unit Scale Weight /w Lead	52629.0	gm	Weighted on:	6/2/2014
	Total Unit Scale Weight no Lead	50280.0	gm	Weighted on:	6/18/2014
	Subtotal Unit Weight	50287.9	gm	Delta:	-7.9
				Delta:	2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight	
3	**ASSY, HYDRAULIC RESERVOIR** ***(ENHANCED)***	**4199397**	**-**					
	Enhanced Reservoir Serial Number:			**Subtotal Weight**			1232.0	gm
				Scale Weight		1148.4	**1232.1**	gm diff
4	PISTON DIAPHRAGM	4199323	49811	Change Qty to 1 if installed	1	140.0	136.7	0.1
4	DIAPHRAGM, ROLLING NITRILE (BELLOWFRAM)	4206402	56874	Change Qty to 1 if installed	1	94.3	97.0	
4	ADHESIVE, STRUCTURAL - POLYURETHANE, SIKAFLEX 292	4199233	55459	Change Qty to 1 if installed	1	12.3	15.4	
4	CYLINDER HEAD, SWIVEL MOUNT	4261356	-	Change Qty to 1 if installed	1	334.4	329.5	
4	FITTING, TUBE, MALE - BRANCH TEE 2 X 1/4" TUBE , 1/8" NPT / FITTING, TUBE, PLUG - 1/4" TUBE, NYL, RED	4250878 / 4251094	-	Change Qty to 1 if installed	1	23.3	9.1	
4	FITTING, PIPE - 90 DEG ELBOW 2 x 1/8" NPT, M, BRASS	4199069	52426	Change Qty to 1 if installed	1	26.9	26.9	
4	VALVE, CHECK, INLINE - 200 PSI CRACK, 2 x 1/8" NPT, F, ALUM	4282752	-	Change Qty to 1 if installed	1	24.0	71.4	
4	FITTING, TUBE, MALE - 90DEG ELBOW, 1/8" TUBE , 1/8" NPT, M	4251095	-	Change Qty to 1 if installed	1	7.4	7.4	
4	SCREW, PAN HEAD - PHILLIPS, #8-32 x .250, 18-8 SS, SEALING	4262362	-	Change Qty to 1 if installed	1	1.2	1.1	
4	CYLINDER, DIAPHRAGM	4261328	-	Change Qty to 1 if installed	1	422.1	439.4	
4	(8X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500,+ #6 LW	4199111 / 4199122	-	Change Qty to 1 if installed	1	6.6	8.0	
4	STANDOFF, RESERVOIR CYLINDER *(STARBOARD)*	4199418	55299	Change Qty to 1 if installed	1	12.5	12.4	
4	STANDOFF, RESERVOIR CYLINDER *(PORT)*	4199418	55299	Change Qty to 1 if installed	1	12.5	12.4	
4	(4X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500 + #6 LW	4199111 / 4199122	-	Change Qty to 1 if installed	1	4.1	4.1	
4	(2x) MOUNT, SADDLE, TERMINAL PCBA	4199410	52373	Change Qty to 1 if installed	1	3.3	3.9	
4	(2X) MOUNT, SADDLE, PCBA *(CONDUCTIVITY)*	4199345	49888	Change Qty to 1 if installed	1	6.4	4.6	
4	(2X) MOUNT, SADDLE, PCBA *(TEMP)*	4199345	49888	Change Qty to 1 if installed	1	6.3	4.7	
4	(2X) MOUNT, SADDLE, PCBA *(OXYGEN)*	4199345	49888	Change Qty to 1 if installed	0	6.4		
4	BRACKET, BALSTON FILTER	4275539	-	Change Qty to 1 if installed	1	7.3	7.3	
4	FILTER, INLINE - 1/4" TUBE 25um, 125 PSI, GLASS FIBER, PVDF	4199068	-	Change Qty to 1 if installed	1	21.0	20.9	
4	CABLE TIE, 2.0IN BUNDLE - 8.75 LG, NYL, BLK, UV	4199110	-	Change Qty to 1 if installed	1	0.5	0.5	
4	FITTING, TUBE, MALE - 90DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251059	-	Change Qty to 1 if installed	1	7.4	7.5	
	FITTING, TUBE, STRAIGHT - COUPLING, 2 x 1/4" TUBE	4251092	-	Change Qty to 1 if installed	1	1.8	1.8	
4	STUD, MOUNT, SWIVEL - TTI / BEARING, BALL JOINT, SWIVEL / RING, RETAINER, BALL JOINT - TTI / RING, RETAINING, INTERNAL - SPIRAL	4205808 / 4205785 / 4205809 / 4205787	-	Change Qty to 1 if installed	1	10.0	10.0	
	Weigh Hydraulic res. Assy, then Oil fill & add sub-assy fasteners							
	ASSY, LINEAR TRANSDUCER - VBD POSITION A	**4264853**						
3	ASSY, CABLE, LINEAR TRANSDUCER, VBD POSITION A - A1W20 / SPRING, COMPRESSION / KNOB, ROD END / CLAMP, LINEAR TRANSDUCER, POSTION VBD / SCREW, SOCKET HEAD, ALLEN #6-32 X .500, 18-8 SS	4199368 / 4198939 / 4199123	-		1	41.0	41.6	
	ASSY, LINEAR TRANSDUCER - VBD POSITION B	**4264855**						
3	ASSY, CABLE, LINEAR TRANSDUCER, VBD POSITION B - A1W21 / SPRING, COMPRESSION / KNOB, ROD END / CLAMP, LINEAR TRANSDUCER, POSTION VBD / SCREW, SOCKET HEAD, ALLEN #6-32 X .500, 18-8 SS	4199369 / 4198939 / 4199123	-		1	38.6	39.3	
2	(2X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500, 18-8 SS	4199111	55183		1	2.6	2.6	
3	(4X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500 + #6 LW	4199111 / 4199122	55183		1	5.4	5.1	
	aft endcap electronic parts - mount with CT sail							
3	PCBA, AFT TERMINAL + (4X) #4-40 x .250 SHCS	4199419 / 2549	55302		1	25.0	27.5	
				Aft Terminal SN:			**91860006**	
3	PCBA, CONDUCTIVITY SENSOR *(SEABIRD)* + (4X) #4-40 x .250 SHCS	4199423 / 2549	55385	Change Qty to 1 if installed	1	33.6	34.3	

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on: 6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on: 6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta: -7.9
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		Delta: 2341.1
3	ASSY, CABLE CONDUCTIVITY ELECTRONICS - A1W26	4199373	52261	Change Qty to 1 if installed	1	3.2	3.2		
3	COVER, PCBA, COND. SENSOR / (4x) SCREW, BH #2-56 x .25 , 18-8 SS	4199344 / 4199124	49887 / 55221	Change Qty to 1 if installed	1	20.4	19.9		
3	PCBA, TEMPERATURE SENSOR *(SEABIRD)* + (4X) #4-40 x .250 SHCS	4199425 / 2549	55388	Change Qty to 1 if installed	1	22.5	22.6		
3	ASSY, CABLE TEMPERATURE ELECTRONICS - A1W25	4199372	52260	Change Qty to 1 if installed	1	5.4	5.5		
3	COVER, PCBA TEMP. SENSOR / (4X) SCREW, BH #2-56 x .25 , 18-8 SS	4199409 / 4199124	52371 / 55221	Change Qty to 1 if installed	1	14.7	15.9		
3	PCBA, OXYGEN SENSOR + (4X) #4-40 x .250 SHCS	4199436 / 2549	55524	Change Qty to 1 if installed	0	23.4			
				SBE 43f PCB SN:					
3	ASSY, CABLE - OXYGEN SENSOR PROCESSED SIGNAL - A1W33	4199377	52265	Change Qty to 1 if installed	0	6.0			
3	ASSY, CABLE - TAIL PCBA SIGNAL INTERFACE - A1W13 *(GREY)*	4199361	52248		1	29.5	29.5		
3	ASSY, CABLE - TAIL PCBA POWER INTERFACE - A1W14 *(RAINBOW)*	4199362	52249		1	37.8	36.3		
3	Tape for Grey Ribbon Cable				0	0.5			
3	Tape for Rainbow Ribbon Cable				0	1.2			
3	ASSY, SAIL, CONDUCTIVITY - TEMPERATURE *(SEABIRD)*	4199407	52368	Change Qty to 1 if installed	1	288.1	280.0		
				CT sail SN:			**110**		
	ASSY, PLUG, CT SAIL	**4286191**							
	PLUG, CT SAIL / RING, BACKUP , O-RING - TEFLON -016 / O-RING, EPDM -016 / O-RING EPDM - 012	4286190 / 4199255 / 4199067 / 4199057	-	Change Qty to 1 if installed	1	18.1	18.10		
	NUT, CT SAIL	4199406	-		1	9.0	8.60		
3	PIN, GUIDE, BATTERY PACK - TTI *("STINGER")* / HARDSTOP, PITCH - TTI / SCREW, SOCKET HEAD - ALLEN, #8-32 x .375, SS	4205807 / 4205810 / 2601	-		1	75.0	81.8		

Unit # SG:	506

Total Unit Scale Weight /w Lead		52629.0	gm
Total Unit Scale Weight no Lead		50280.0	gm
Subtotal Unit Weight		50287.9	gm

Weighted on: 6/2/2014
Weighted on: 6/18/2014
Delta: -7.9
Delta: 2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight	
2	**Assy., Mass shifter**	**4199448**	**56768**					
	Mass Shifter Subassembly Serial Number:							
				Scale Weight	**1**	14079.0	**14162.0**	**gm**
	Moveable Weight							
	Battery Enclosure (moving assembly only not the support tube)	too many to record	56759		1	464.0	463.7	
				Total Moveable Weight:	**1**	**1835**	**1823.7**	
	HV Battery	4199485	56831		1	9724.0	9796.0	
	Brass weight, screws and Spacers (if required)				1	1362.2	1360.0	
		Pitch Motor SN: (start current, end current) -->						
		Roll Motor SN: (start current, end current) -->						
				Battery SN:			**1100089**	
				Pressure sensor SN:			**253665**	
				Max		**Min**		
			Pitch HW	**3990**		**160**		
			Pitch SW Ave	**3890**		**260**		
			Roll HW	**4023**		**27**		
			Roll SW Ave	**3873**		**177**		
2	**Assy., Electronics**	**4199398**	**52347**					
	Main Electronics Subassembly Serial Number:			**Subtotal Weight**			**3958.0**	**gm** **diff**
				Scale Weight		3993.0	**3960.4**	**gm** 2.4
3	Electronics rail, port	4199465	56785		1	61.2	51.2	
3	Electronics rail, starboard	4199499	57672		1	62.0	53.6	
3	Seaglider Main board (Mother board, TT8, CF8, flash card)	4199386	52290		1	261.9	261.4	
				Main board SN:			**92450020**	
				TT8 SN:			**2422122**	
				CF8V2 SN:			**2586**	
				Flash Card SN:			**22887**	
3	Insulation Sheet-OEM/Main	4199408	52370		1	4.8	4.8	
3	(6x) 6-32 x 1/4 PHMS, main board to rails	4146090	55209		1	4.5	4.6	
3	Assy., OEM Navigation Board (transponder PCB, transformer/inductor, capacitors, GPS receiver, W6 GPS serial interface, GPS antenna cable,DC-DC converter, Cable Assembly W7, all soldered on wiring)	4199370	52257		1	583.7	557.4	
				OEM board SN:			**95190001**	
				GPS SN:			**1QH001132**	
				DC-DC converter SN:				
				Acoustic amin board SN:			**203**	

Unit # SG:	506

				Total Unit Scale Weight /w Lead			52629.0	gm	Weighted on:	6/2/2014
				Total Unit Scale Weight no Lead			50280.0	gm	Weighted on:	6/18/2014
				Subtotal Unit Weight			50287.9	gm	Delta:	-7.9
	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight		Delta:	2341.1
				Acoustic sub board SN:			203			
				RAFOS clock module						
				RAFOS reciever module						
3	(6x) 6-32 x 1/4 PHMS, OEM board to rails	4146090	55209		1	4.5	4.1			
3	Assy., Iridium Modem and bracket (includes satellite receiver - iridium LBT, cable assy W3, all clamps for wires, RF switch, DC block, and mounting hardware)	4199389	52324		1	280.0	280.5			
				Modem SN:			Q005RD			
				Modem IMEI:			30012510001610			
	SIM Chip Phone #:	881600005273		SIM Chip SN:			8988169234000597914			
				RF Switch SN:			272			
				Modem PWR/Serial Cable SN:						
3	(4x) 6-32 x 1/4 PHMS + #6 LW, modem cage to rails	4146090 / 4199122	55209 / 55217		1	3.4	3.1			
3	Battery Pack, LV w/ CA W1	4199484	56830		1	2640.8	2651.0			
				Battery SN:			100095			
3	Battery Pack Cage, LV + Two strips of tape	4199335	49847		1	72.4	82.2			
3	(6x) 6-32 x 1/4 PHMS + #6 LW, batt. cage to rails	4146090 / 4199122	55209 / 55217		1	5.2	4.1			
2	Assy., Battery Hull Sections	4199340	49878							
	Battery Hull Subassembly Serial Number:			Subtotal Weight			7975.6	gm	diff	
				Scale Weight		7972.0	7974.2	gm	-1.4	
3	Hull, Fwd Battery	4199326	49817		1	3602.0	3607.0			
3	Hull, Aft Battery	4199326	49817		1	3604.0	3606.0			
3	Joint Ring , battery hulls	4199327	49818		1	686.0	681.6			
3	(8x) 6-32 x 3/4 SHCS + #6 LW, joint ring to fwd/aft batt. Hull	4199121 / 4199122	55215 / 55217		1	13.2	13.2			
3	Grounding Strap 17.5"				1	2.3	3.7			
3	(2x) O-Ring, E70-271	4199060	52412		1	16.7	17.3			
3	(12x) Clips, Rib	4199341	49883		1	22.0	20.4			
3	(12x) Clips, Wiring	4199412	52405		1	18.6	18.7			
3	Oil Absorption pad, 1.9" x 10.125" + (2x) rib clips	4134111 / 4199341	55527 / 49883		1	7.7	7.7			
2	Assy., Forward Hull Sections	4199339	49877							
	Forward Hull Subassembly Serial Number:			Subtotal Weight			5158.8	gm	diff	
				Scale Weight		5153.0	5158.1	gm	-0.7	
3	Endcap, Forward	4199329	49830		1	1899.4	1892.0			
3	Acoustic transducer (ITC-3013), w/ cable W36	4199379 / 4199036	52267 / 52223		1	1442.2	1438.1			
				Transducer SN:			5171			
3	O-Ring, E70-238, transducer to Endcap	4199062	52413		1	3.2	3.2			
3	(6x) Alum 1/4-20 x 3/4 SHCS + 1/4 LW, xducer to end cap	4199127 / 4199134	55236 / 55252		1	15.2	15.2			
3	Hull, Electronics	4199328	49829		1	1689.0	1691.0			

Unit # SG:	506

Total Unit Scale Weight /w Lead		52629.0	gm
Total Unit Scale Weight no Lead		50280.0	gm
Subtotal Unit Weight		50287.9	gm

Weighted on:	6/2/2014
Weighted on:	6/18/2014
Delta:	-7.9
Delta:	2341.1

	Description	iRobot part #	UW Part #		Qty	Ref Weight	Weight
3	O-Ring, E70-263, elec hull to fwd endcap	4199058	52410		1	6.6	7.1
3	(8x) 6-32 x 1/2 SHCS + #6 LW, elec hull to fwd endcap	4199111 / 4199122	55183 / 55217		1	10.4	10.4
3	Grounding Strap 24"				1	2.9	4.6
3	Compass bracket,Compass w/compass carrier PCB (w/ tywrap),(4x) 4-40 x 3/8 SHCS + #4 x 1/8L stand off + #4LW	4199336,4199420 / 4205793,4199126 / 4199146 /19928	49848, 55305 / 57690,55228 / 55282		1	74.3	73.7
				Compass PCB SN:			91880002
				Compass Module SN:			K895
3	(2x) 4-40 X 3/8 SHCS + #4 LW, comp mt to fwd endcap	4199126 / 19928	55228 / 55233		1	1.4	1.4
3	Cable Assembly W9 (compass cable)	4199357	52244		1	22.1	22.1

Calibration Sheet for Seaglider — Serial No. 506

Date: **19-Jun-14** (From Weight sheets)

Time: **6/19/2014 7:03**

Software Revision — Glider PW:

Pitch Mass

Last updated 6/2/2014

Comments

	Headroom, fwd / Headroom, aft Hardware Limit (counts)	100 / 100 Software Limit (counts)	AD counts / AD counts cm travel*
Minimum (full forward)	160	260	-6.51
Maximum (full aft)	3990	3890	4.84
Stroke Length			11.35
Pitch Center	(as defined by $C_PITCH)	2343	0.00
		cm full stroke:	12.8
Conversion constant	0.003125763	cm per AD	($PITCH_CNV)
(conversion inverse)	319.92	AD per cm	

equation cm = (AD –center) conversion factor (cm/AD)
(-) cm is fwd of center, (+) cm is aft of center

Roll Mass

Last updated 6/2/2014

Comments

	Headroom Hardware Limit (counts)	150 Software Limit (counts)	AD counts degrees roll*
Full roll to port	27	177	-66.10
Full roll to starboard	4023	3873	38.39
Dive Roll Center	2025	2515	($C_ROLL_DIVE)
Climb Roll Center	2025	2515	($C_ROLL_CLIMB)
Conversion constant	0.02827	degree per AD	($ROLL_CONV)
(conversion inverse)	35.37	AD per degree	

*Equation: deg=(AD-center) * conversion factor

Variable Buoyancy Drive (VBD)

Last updated 6/2/2014

Comments

LeDuc Pump Serial # 109 (short shaft Serial #)

Boost Pump Serial # 1661949

	Headroom Hardware Limit (counts)	100 Software Limit (counts)	AD counts cm3 (cc) oil*
$VBD_Min (Ext Bladder full)	418	518	584
$VBD_Max (Ext Bladder empty)	4060	3960	-261
Total movable oil volume	3643	3443	844
Neutral Trim (from Ballast sheet)	($C_VBD for neutral)	2896	nominally 0 at spec rho)
Conversion constant	-0.245296	cc per AD	$VBD_CNV
(conversion inverse)	-4.07671	AD per cc	

equation: cc oil=(AD@neutral trim) conv. factor (cc/counts)
(1 cc oil = 1.025 g buoyancy)

Pressure Sensor

Last updated 6/2/2014

(all values fed from press-cal worksheet including date)

Comments

Values from Pres Cal sheet

Manufacturer	Paine	
Model #	211-75-710-05	
Serial #	253665	
Calibration date	1/0/1900	
A/D Gain	128	*PSI = Slope *AD_Count + Y_Intercept*
Atmos @ cal.	14.70	
Temp @ cal.	0.00	Psig/AD count
Calibrated Slope	1.164562E-04	*(either PresCal-B64)*
Cal. Y-Intercept	-42.25	*(Changed each time sensor set for "sea level")*
Depth Offset	-28.94	Meters
	Conversion Factor	*0.685 psig/meter*

Internal Pressure

Last updated 6/2/2014

Initial psi:	12.15	End psi:	7.12
Initial RH:	50.0	End RH:	41.8

Compass

Last updated xx/xx/xx

Comments

Manufacturer	Sparton
Model #	SP3004D
Serial #	K895
Compass SW version #	
Compass carrier PCB	91880002
Kongsberg Calibration Date	
TCM2MAT file creation date	

Main Board

Last updated xx/xx/xx

Comments

Model #	52290	(52290=normal glider)
Mainboard Revision	B.4	
Mainboard Serial #	92450020	
Computer Type	TT8	Onset Computers
Computer Serial #	2422122	
Disk system	CF8V2	Persistor Corp.
Serial #	2586	
Compact Flash Card Manu.	Silicon Systems	
CF card size		
CF card serial/ID #	22887	
Watchdog (PIC) setting (min)	10 min	(10min = dips 2&4 on)

OEM Board & Sub-systems

Last updated xx/xx/xx

Comments

GPS Manufacturer	Garmin
GPS Model #	15H-W
GPS Serial #	1QH001132
GPSI Antenna Serial #	0
DC-DC converter Serial #	0
Transducer Manu.	ITC
Transducer Model	3013
Transducer Serial #	5171

Acoustic Transponder

Last updated 6/2/2014

Comments

Manufacturer	AAE	
Model	955	
Main-board Serial #	203	
Sub-board Serial #	203	
AAE software ver #	Ver	
Interrogate Frequency	14.0	KHz
Reply Frequency	11.5	KHz
DIP switch settings	9 / 9	(sw-1/sw-2)

Iridium Modem

Last updated xx/xx/xx

Comments

Model	A3LA-XG		
IMEI #	300125100016l0		
Modem Serial #:	Q005RD		
SIM Card Owner		phone #	data #
SIM Card Serial #	8988169234000597914	881600005273	
Base Modem Type:	9522B		

External Sensors Options

SBE C and T Sensors

Last updated 5/28/2014

Comments

Sail Serial #	110
Temp PCB Serial #	110
Cond PCB Serial #	110
SBE Calibration date:	2/17/2012

Conductivity Calibration Coefficients		Temperature Calibration Coefficients	
g=	-9.96502297E+00	g=	4.29133935E-03
h=	1.15474107E+00	h=	6.24158617E-04
i=	-1.33872302E-03	i=	2.26615751E-05
j=	1.87840867E-04	j=	2.34807267E-06
Cpcor (nom) =	-9.57000000E-08	f0 =	1000.0
Ctcor (nom) =	3.25000000E-06		
INST FREQ Min (kHz)=	2.94057000E+00	INST FREQ Min (Hz)=	2.90999200E+03
INST FREQ Max (kHz)=	8.00000000E+00	INST FREQ Max (Hz)=	5.59600700E+03

Optical Sensor(s)

Last updated 5/28/2014

Forward or Bump Out

cal date xx/xx/xx

Manufacturer	Wetlab
Model	BBFL2
Serial #	0

Chlorophyll cal Constants	Chlorophyll	xx/xx/xx
WETLabsCalData.Chlorophyll.darkCounts		counts
WETLabsCalData.Chlorophyll.scaleFactor		ug/l/count
WETLabsCalData.Chlorophyll.maxOutput		counts
WETLabsCalData.Chlorophyll.resolution		counts
WETLabsCalData.Chlorophyll.calTemperature		C

CDOM or Scattering Sensor	CDOM	
WETLabsCalData.CDOM.maxOutput		counts
WETLabsCalData.CDOM.scaleFactor		ppb/count
WETLabsCalData.CDOM.darkCounts		counts
WETLabsCalData.CDOM.resolution		counts
WETLabsCalData.CDOM.calTemperature		C

Scattering Sensor		None
WETLabsCalData.Scatter_.wavelength	0	nm
WETLabsCalData.Scatter_.scaleFactor		(m^-1sr^-1)/counts
WETLabsCalData.Scatter_.darkCounts		counts
WETLabsCalData.Scatter_.resolution		counts

Aft cal date 12/3/2013

Manufacturer	Wetlab
Model	BB2FL
Serial #	885

Chlorophyll A Sensor	Chlorophyll	
WETLabsCalData.Chlorophyll.darkCounts	47	counts
WETLabsCalData.Chlorophyll.scaleFactor	0.0112	ug/l/count
WETLabsCalData.Chlorophyll.maxOutput	4130	counts
WETLabsCalData.Chlorophyll.resolution	1.1	counts
WETLabsCalData.Chlorophyll.calTemperature	21.0	C

CDOM or Scattering Sensor	470	(BLUE)
WETLabsCalData.Scatter_470.wavelength	470	nm
WETLabsCalData.Scatter_470.scaleFactor	1.29E-05	(m^-1sr^-1)/counts
WETLabsCalData.Scatter_470.darkCounts	46	counts
WETLabsCalData.Scatter_470.resolution	1.0	counts

Scattering Sensor	700	None
WETLabsCalData.Scatter_700.wavelength	700	nm
WETLabsCalData.Scatter_700.scaleFactor	3.25E-06	(m^-1sr^-1)/counts
WETLabsCalData.Scatter_700.darkCounts	47	counts
WETLabsCalData.Scatter_700.resolution	1.0	counts

Dissolved Oxygen Sensor - Seabird

Last updated xx/xx/xx

cal date xx/xx/xx

Manufacturer	SBE
Model	43f
Serial #	0
Oxygen PCB Serial #	0

Sea-Bird 43f coefficients

Soc =	
Boc =	
Tcor =	
Pcor =	
Foffset=	
A=	
B=	
C=	
E=	
Tau20=	

SEAGLIDER - Trim and Balance

	SG	506	Date:	19-Jun-14									Spreadsheet Usage Notes from Russ Light					
			Time:	##########														
Comments:																		
												Fwd Fairing assy scale wt:	0.0					
		Enter data only where font is RED										Aft fairing assy scale wt:	0.0	<-- Fairing, Wings, Rudder, Antenna				
Density Trim												Fairing screws scale wt:	59.8					
Total Weight (in air), summed items, corrected		50288	gm									Pupa assy w/lead scale wt:	39076.0					
Total Weight		50280	gm									Total glider wt by assy scale wts:	39135.8					
Weight difference/"error"		-7.9	gm										Actual	50280				
Variable wt, including nose-wt-plates		0.0	gm										diff	-11144				
Displaced Volume, measured in tank		#DIV/0!	cc	diff	see Ballast worksheet for more volume details													
Displaced Volume, summed items		50863	cc	#DIV/0!														
Tank VOL_MAX		52061		-1198														
Water Density		1.023500	gm/cc															
Net Buoyancy (relative to neutral, positive floats, no thrust)		1770	cc		predicted using this spreadsheet, actual may vary!									See note to make Buttons work				
Internal Oil Stroke (100% is all inside, ext. bladder empty)		69.11%		2,896	A/D counts	(input %, not counts)												
Set Target Stroke %		71.30%		Target for Tank testing								Goal Seek Only						
					($PITCH_VBD_SHIFT)	0.00167	cm per cc											
Pitch Trim																		
Longitudinal CG		91.053	cm	*35.848*	inches													
Longitudinal CB		90.588	cm	*35.664*	inches													
LCB-LCG Separation		0.465	cm															
Pitch-mass Stroke (100% is fully aft, nominal is 70%)		57.38%		2,343	A/D counts	(input %, not counts)						If % is lower than 63% add another nose plate						
Pitch-mass (batt) Location		7.345	cm									If % is greater than 77% remove another nose plate						
Vehicle Pitch Angle (positive is nose up)		50.2	deg	(goal is change of ~28 deg per cm travel, use goal-seek on Location by +/-1cm to test)														
													1.232607324	<- Ref to Fairing Density for Macros				
Vertical CG (VCG)		-0.324	cm	(goal is ~ -0.45 from prior builds)				range -0.35 t0 -0.65 from history										
Computed VCB		0.064	cm	(goal is ~0.07 from prior builds)				range 0.05 to 0.1 from history										
VCB-VCG Separation		0.388	cm	(goal is ~0.53 from prior builds)				range 0.4 to 0.65 from history										
Roll-mass (batt) Angle		0	deg															

Description	iRobot Part #	UW Part # (or Assy Wt)	Qty	Weight grams	Total Weight grams	LCG inch	LCG cm	Moment LCG gm-cm	Volume cc	Total Vol cc	LCB inch	LCB cm	Moment LCB cc-cm	VCG&B inch	VCG&B cm	Moment VCG gm-cm	Moment VCB cc-cm
Complete fairing & antenna																	
Subtotal (summed) Weight		**11138.8**	gm	diff													
Scale Weight		**11143.0**	gm	4.2													
Summed volume		**8111.1**	cc														
				sum-diff's	-9.10												
Complete pupa																	
Subtotal (summed) Weight		**39089.3**	gm	diff													
Scale Weight		**39076.0**	gm	-13.3													
Summed volume		**42752**	cc														
Total weights and volume - Flying SG - without adjustment					50288			4578867		50863			4607535			-16291	3262
Adjustment to reflect trims found in tank & Port Susan					0.0	1135.0	2882.9	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Total weights and volume - Flying SG - adjusted, reported above					50288			4578867		50863			4607535			-16291	3262
Flying Seaglider	4197060	49801															
(8x) 10-32 x 3/8 FHMS, joint ring to aft fairing	4199128	55240	1	11.9	11.9	46.00	116.8	1390	1.5	1	46.0	116.8	173	0.00	0.0	0	0.0
(8x) 1/4-28 x 1/2 FHMS, Aft fairing to endcap	4199153	55294	1	47.9	47.9	49.50	125.7	6022	6.0	6	49.5	125.7	750	0.00	0.0	0	0.0
Assy, Forward Fairing	4199433	55494															
Subtotal Weight		0.0	gm	diff													
Scale Weight		0.0	gm	0.0													
Forward Fairing	4199347	49897	0.0	0.0	0.0	28.22	71.7	0	0.0	0	28.2	71.7	0	0.00	0.0	0	0.0
Joint Ring, Fwd to Aft Fairing (bonded to fwd fairing before paint; Long ring = 875g, short ring 688g)	4199330	49834	0.0	0.0	0.0	45.85	116.5	0	0.0	0	45.9	116.5	0	0.00	0.0	0	0.0
Nose weight (2 hole - bonded to fwd fairing after paint)	4199334	49844	0.0	0.0	0.0	3.72	9.4	0	0.0	0	3.7	9.4	0	0.00	0.0	0	0.0
Detachable Fairing Nose	??	??	0.0	0.0	0.0	1.35	3.4	0	0.0	0	1.4	3.4	0	0.00	0.0	0	0.0
Nose Weight (5 hole)	??	??	0.0	0.0	0.0	2.54	6.5	0	0.0	0	2.5	6.5	0	0.00	0.0	0	0.0
Nose Weight to Detachable Nose Screws	4199435	??	0.0	0.0	0.0	3.42	8.7	0	0.0	0	3.4	8.7	0	0.00	0.0	0	0.0
Nose weight plates	4199426	55448	0.0	0.0	0.0	3.72	9.4	0	0.0	0	3.7	9.4	0	0.00	0.0	0	0.0
(2x) 1/4-20 x 2" SHCS + 1/4 LW brass, nose plate to nose base (4 - 5 plates)	/4199135	55186 / 55253	0.0	28.3	0.0	3.72	9.4	0	3.4	0	3.7	9.4	0	0.00	0.0	0	0.0
(2x) 1/4-20 x 1.5" SHCS + 1/4 LW brass, nose plate to nose base (2 -3 plates)	4199112 / 4199135	55185 / 55253	0.0	23.2	0.0	3.72	9.4	0	2.8	0	3.7	9.4	0	0.00	0.0	0	0.0
(2x) 1/4-20 x .75" SHCS + 1/4 LW brass, nose plate to nose base (1 plate)	/4199135	55473 / 55253	0.0	15.7	0.0	3.72	9.4	0	1.9	0	3.7	9.4	0	0.00	0.0	0	0.0
Assy., Ballast (STANDARD)																	
Subtotal Weight		0.0	gm	diff													
Scale Weight		0.0	gm	0.0													
Trim .600" aft of pupa joint ring - bottom (5" strip)			0	650.2	0.0	42.08	106.9	0	57.5602	0	42.08	106.9	0	-5.16	-13.1	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - bottom		not in BOM	0	53.7	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	-5.00	-12.7	0	0.0
Trim .600" aft of pupa joint ring - port side (5" strip)			0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	0.00	0.0	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - port		not in BOM	0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	0.00	0.0	0	0.0
Trim .600" aft of pupa joint ring - starboard side (5" strip)			0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	0.00	0.0	0	0.0

EPDM base (5"x6") + (2x) 2"x 6" tape - starboard		not in BOM	0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	0.00	0.0	0	0.0
Trim .600" aft of pupa joint ring - top (5" strip)			0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	5.10	13.0	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - top		not in BOM	0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	5.00	12.7	0	0.0
Trim Lead tape (~1g per 5" lead strip)		not in BOM	0	0.0	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	5.10	13.0	0	0.0
(2) Straps - cut to length (start at 34g, subtract trimmed)			0	33.9	0.0	42.08	106.9	0	29.5	0	42.08	106.9	0	0.00	0.0	0	0.0
(2) black tape wraps over foam (1 1/2" width)		not in BOM	0	13.2	0.0	42.08	106.9	0	0.0	0	42.08	106.9	0	0.00	0.0	0	0.0
Trim 1.000" fwd of bulkhead - bottom (5" strip)			0	0.0	0.0	22.45	57.0	0	0.0	0	22.45	57.0	0	-4.04	-10.2	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - fwd of bulkhead - bottom		not in BOM	0	0.0	0.0	22.45	57.0	0	0.0	0	22.45	57.0	0	-4.04	-10.2	0	0.0
Trim Lead tape (~1g per 5" lead strip) -fwd of bulkhead - bottom			0	0.0	0.0	22.45	57.0	0	0.0	0	22.45	57.0	0	-4.04	-10.2	0	0.0
(2) Straps - cut to length (start at 17g, subtract trimmed) fwd of bulkhead		not in BOM	0	0.0	0.0	22.45	57.0	0	0.0	0	22.45	57.0	0	-4.04	-10.2	0	0.0
	lead goal	1310.0															
	currently at	1159.8	150.2	diff													
Assy., Ballast (BATTERY HULL FORWARD JOINT RING)																	
	Subtotal Weight	0.0	gm	diff													
	Scale Weight	0.0	gm	**0.0**													
Trim .600" aft of pupa joint ring - bottom (5" strip)			0	0.0	0.0	34.08	86.6	0	0.0000	0	34.08	86.6	0	-5.16	-13.1	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - bottom		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	-5.00	-12.7	0	0.0
Trim .600" aft of pupa joint ring - port side (5" strip)			0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - port		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
Trim .600" aft of pupa joint ring - starboard side (5" strip)			0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - starboard		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
Trim .600" aft of pupa joint ring - top (5" strip)			0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	5.10	13.0	0	0.0
EPDM base (5"x6") + (2x) 2"x 6" tape - top		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	5.00	12.7	0	0.0
Trim Lead tape (~1g per 5" lead strip)		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	5.10	13.0	0	0.0
(2) Straps - cut to length (start at 34g, subtract trimmed)			0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
(2) black tape wraps over foam (1 1/2" width)		not in BOM	0	0.0	0.0	34.08	86.6	0	0.0	0	34.08	86.6	0	0.00	0.0	0	0.0
	lead goal	1310.0															
	currently at	1159.8	150.2	diff													
Assy, Ojive Forward Fairing	**4199433**	**55494**															
	Subtotal Weight	5975.3	gm	diff													
	Scale Weight	5974.0	gm	**-1.3**													
Ojive Forward Fairing	??	??	1	4665.0	4665.0	30.72	78.0	364004	3784.7	3785	30.7	78.0	295313	0.00	0.0	0	0.0
Detacable Fairing Nose	??	??	1	52.0	52.0	1.35	3.4	178	36.6	37	1.4	3.4	126	0.00	0.0	0	0.0
Nose weight (5 hole)	??	49844	1	1218.6	1218.6	2.54	6.5	7862	144.8	145	2.5	6.5	934	0.00	0.0	0	0.0
Nose weight to detachable nose screws	4199435	0	1	39.7	39.7	3.42	8.7	345	4.7	5	3.4	8.7	41	0.00	0.0	0	0.0
Nose weight plates	4199426	55448	0.0	729.8	0.0	4.88	12.4	0	86.7	0	4.9	12.4	0	0.00	0.0	0	0.0
(2x) 1/4-20 x 2" SHCS + 1/4 LW brass, nose plate to nose base (4 - 5 plates)	/4199135	55186 / 55253	0.0	0.0	0.0	4.89	12.4	0	0.0	0	4.9	12.4	0	0.00	0.0	0	0.0
(2x) 1/4-20 x 1.5" SHCS + 1/4 LW brass, nose plate to nose base (2 -3 plates)	4199112 / 4199135	55185 / 55253	0.0	19.9	0.0	4.64	11.8	0	2.4	0	4.6	11.8	0	0.00	0.0	0	0.0
(2x) 1/4-20 x .75" SHCS + 1/4 LW brass, nose plate to nose base (1 plate)	/4199135	55473 / 55253	0.0	0.0	0.0	4.39	11.2	0	0.0	0	4.4	11.2	0	0.00	0.0	0	0.0
Assy., Standard Aft Fairing	**4199434**	**55497**															
	Subtotal Weight	0.0	gm	diff													
	Scale Weight	0.0	gm	**0.0**													
Aft Fairing	4199495	56972	0	0.0	0.0	54.87	139.4	0	0.0	0	54.9	139.4	0	-0.02	-0.1	0	0.0
Wing, Starboard (1m)	4199438	56751	0	0.0	0.0	51.46	130.7	0	0.0	0	51.5	130.7	0	0.00	0.0	0	0.0
Wing, Port (1 m)	4199438	56751	0	0.0	0.0	51.46	130.7	0	0.0	0	51.5	130.7	0	0.00	0.0	0	0.0
(16x) 6-32 x 3/8 FHMS (WING SCREWS)	4199270	56912	0	0.0	0.0	50.00	127.0	0	0.0	0	50.0	127.0	0	0.00	0.0	0	0.0
Rudder	4199331	49839	0	0.0	0.0	67.58	171.7	0	0.0	0	67.6	171.7	0	0.00	0.0	0	0.0
(2x) 1/4-20 x 2" FHMS, rudder to rudder shoe	4199237	55487	0	0.0	0.0	67.75	172.1	0	0.0	0	67.8	172.1	0	0.00	0.0	0	0.0
Top panel	4199496	57651	0	0.0	0.0	54.30	137.9	0	0.0	0	54.3	137.9	0	1.65	4.2	0	0.0
Top panel (Bump Out)	?	?	0	0.0	0.0	54.30	137.9	0	232.4	0	54.3	137.9	0	1.65	4.2	0	0.0
Bottom panel	4199496	57651	0	0.0	0.0	54.30	137.9	0	0.0	0	54.3	137.9	0	-1.65	-4.2	0	0.0
Bottom panel (Bump Out)	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Panel screws - (18) FHMS 6-32 x .375	4205790	57671	0	0.0	0.0	54.30	137.9	0	0.0	0	54.3	137.9	0	0.00	0.0	0	0.0
Assy., Ojive Aft Fairing	**4199434**	**55497**															
	Subtotal Weight	5163.5	gm	diff													
	Scale Weight	5169.0	gm	**5.5**													
Aft Fairing (Ogive)	??	??	1	1867.0	1867.0	62.24	158.1	295153	1514.7	1515	62.2	158.1	239454	-0.01	0.0	-38	-30.8
Joint Ring, Aft to Forward Fairing (bonded to Aft fairing before paint)	??	??	1	669.0	669.0	48.73	123.8	82805	246.6	247	48.7	123.8	30522	0.00	0.0	0	0.0
Wing, Starboard (Ogive)	??	??	1	621.2	621.2	56.25	130.7	81191	641.6	642	56.3	130.7	83857	0.00	0.0	0	0.0
Wing, Port (Ogive)	??	??	1	614.1	614.1	56.25	130.7	80263	641.6	642	56.3	130.7	83857	0.00	0.0	0	0.0
(16x) 6-32 x 3/8 FHMS (WING SCREWS)	4199270	56912	1	11.2	11.2	55.71	141.5	1585	1.4	1	55.7	141.5	197	0.00	0.0	0	0.0
Rudder (Ogive)	??	??	1	121.8	121.8	75.50	191.8	23358	100.7	101	75.5	191.8	19304	0.00	0.0	0	0.0
(2x) 1/4-20 x 2" FHMS, rudder to rudder shoe	4199237	55487	1	20.3	20.3	74.83	190.1	3858	2.5	3	74.8	190.1	481	0.00	0.0	0	0.0
Top panel (Ogive)	??	??	1	266.8	266.8	58.62	148.9	39725	220.5	220	58.6	148.9	32831	4.90	12.4	3321	2744.3
Bottom panel (Ogive)	??	??	1	212.3	212.3	58.62	148.9	31610	175.5	175	58.6	148.9	26124	-4.74	-12.0	-2556	-2112.4
Panel screws - (18) FHMS 6-32 x .375	4205790	57671	1	17.6	17.6	58.10	147.6	2597	2.2	2	58.1	147.6	324	0.00	0.0	0	0.0
Assy., Antenna	**4199332**	**49841**															
	Subtotal Weight	502.0	gm	diff													
	Scale Weight	502.0	gm	**0.0**													
Antenna Assembly GPSI (Shoe, mast, antenna, clamp, heat shrink, comm cable, dummy plug, dummy plug line, zip ties)	4199393 / 4199395 / 4199089 / 4199352 /4199234 / 4199105 / 4199262 /4199266 /4199394	52336 / 52341 / 52454 / 52231 / 55474 /52481 / 56875 /56884 / 52340	1	502.0	502.0	85.00	215.90	108382	355.5	356	81.31	206.5	73416	0.00	0.0	0	0.0
Cap (DGO protector during build - do not weigh)		52481	0	NA													
Assy., Aanderaa Optode Oxygen Sensor	**4196239**	**55481**															

	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
O2 Sensor Assy. (Aanderaa optode, mount base, SS hose clamp, (2x) 8-32 x 5/8 FHMS, (2x) 8-32 nylok)	4199035 / 4205811 / 4199129 / 4199163 / 4199130	52220 / 56905 / 55245 / 55321 / 55246	0	324.8	0.0	57.48	146.0	0	105.2	0	57.5	146.0	0	6.03	15.3	0	0.0
Assy., SBE 43f Oxygen Sensor (Not Pumped)	**4192455**	**55482**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
O2 Sensor Assy. (O2 sensor, Plenum, (2x) 6-32 x 5/8 SHCS - plenum to sensor, O2 bracket, (2x) 8-32 x 5/8 FHMS - bracket to aft fairing, (2x) SS hose clamp)	4199047 / 4199435 / 4199129 /4199489 / 4199269	52356 / 55518/ 55245 / 56906 / 56911	0	0.0	0.0	56.37	143.2	0	164.7	0	56.4	143.2	0	2.50	6.4	0	0.0
O2 Sensor Cable Assembly	4199353	52236	0	0.0	0.0	50.00	127.0	0	29.0	0	50.0	127.0	0	2.00	5.1	0	0.0
Plug assy, SBE 43f plenum	4199435	55518	0	NA														
Assy., WET Labs Optical - FWD Hole - (Bump OUT)	**4192457**	**55521**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
Wet Labs sensor Assy. (WL Triplet sensor, Bracket (BUMP), (2x) 6-32 x .625 SHCS - sensor clamp, 6-32 x 0.375 THCS)	4199039 / 4295315 / 4199120 / 4205790	0	0	0.0	0.0	53.03	134.7	0	269.0	0	53.0	134.7	0	-1.24	-3.1	0	0.0
Assy., WET Labs Optical - aft hole	**4192457**	**55521**																
	Subtotal Weight	240.2	gm	diff														
	Scale Weight	240.2	gm	0.0														
Wet Labs sensor Assy. (WL Triplet sensor, (2x) Wet labs sensor clamp, (2x) 8-32 x 5/8 FHMS - sensor clamp to fairing)	4199039 / 4199388 / 4199129	52296 / 52312 / 55245	1	240.2	240.2	62.33	158.3	38028	237.6	238	62.3	158.3	37616	-1.24	-3.1	-755	-746.5
Cover, WL sensor used in shipping	4199254	55520	0	NA														
Assy., WET Labs Optical - Dual Hole Closest to PUPA	**4192457**	**55521**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
Wet Labs sensor Assy. (WL Triplet sensor, Bracket Ext mount, 6-32 x 0.625 SHCS, 2x 6-32 x 0.375in Truss Head Phillips)	4199039 / 4295315 / 4199120 / 4205790	52296 / 52312 / 55245	0	0.0	0.0	60.15	152.8	0	237.6	0	60.2	152.8	0	-1.24	-3.1	0	0.0
Cover, WL sensor used in shipping	4199254	55520	0	NA														
Assy., SBE CTD & Pumped 43f Oxygen Sensor	**4295305**	**0**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
GPCTD 90688.007, Bracket CTD Rear, Bracket CTD Forward, 6-32 x 0.625in SHCS, 8-32 x 0.25in Pan Head, 6-32 x 0.375in Flat Head	4272424 / 4289667 / 4289656 / 4199120 /	?	0	0.0	0.0	55.18	140.2	0	635.0	0	55.2	140.2	0	3.80	9.6	0	0.0
GPCTD PUMP PWR Cable, GPCTD PWR/Serial Cable	4293654 / 4274285	?	0	0.0	0.0	55.18	140.2	0	130.0	0	55.2	140.2	0	0.00	0.0	0	0.0
TUBING 2x 3/8in id x 1/2" od, 2x 1/2" id x 3/4" od	4291710 / 4291709	?	0	0.0	0.0	59.46	151.0	0	60.0	0	59.5	151.0	0	0.00	0.0	0	0.0
GPCTD 90696 Pump, Pump Bracket, 6-32 x 0.375 Flat Head, Cable Ties	4272326 / 4295332 / 4199270 / 4199110	?	0	0.0	0.0	64.30	163.3	0	286.0	0	64.3	163.3	0	0.00	0.0	0	0.0
O2 Sensor	0	0	0	0.0	0.0	59.50	151.1	0	336.0	0	59.5	151.1	0	0.00	0.0	0	0.0
O2 Sensor Cable Assembly	4293655	0	0	0.0	0.0	50.00	127.0	0	75.0	0	50.0	127.0	0	0.00	0.0	0	0.0
Assy., Argos Mount	**?**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
Argos Tag	?	?	0	0.0	0.0	103.83	263.7	0	34.2	0	103.8	263.7	0	0.75	1.9	0	0.0
Argos Mount Hardware. (?) - Clamp to Antenna, 4 screws, 2 brackets	2601, 4258110	?	0	0.0	0.0	103.33	262.5	0	8.3	0	103.3	262.5	0	0.15	0.4	0	0.0
Assy., PAR, BSI - QSP2000	**?**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	864.2	gm	864.2														
SENSOR, PAR BSI - QSP-200 SERIES + SHIELD, LIGHT- PAR BSI + (1x) SCREW, FLAT HEAD- PHILLIPS, #6-32 X .375, SS	?	?	0	734.0	0.0	60.05	152.5	0	320.0	0	60.1	152.5	0	2.00	5.1	0	0.0
BRACKET, PAR QSP 2000, INTERNAL + SCREW, (2x) TRUSS HEAD - PHILLIPS, #6-32 X .375, SS + CLAMP, HOSE - WORM DRIVE 2.0IN TO 3.0IN, SS	?	?	0	67.4	0.0	62.10	157.7	0	26.0	0	62.1	157.7	0	1.00	2.5	0	0.0
ASSY, CABLE - PAR SENSOR INTERFACE	4222385	?	0	62.8	0.0	55.00	139.7	0	3.5	0	55.0	139.7	0	0.00	0.0	0	0.0
Assy., Radiation Detector	**4314372**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
SENSOR, RADIATION DETECTOR	4314373	?	0	0.0	0.0	-1.88	-4.8	0	2886.83	0	-1.9	-4.8	0	0.00	0.0	0	0.0
BRACKET, SENSOR, RADIATION DETECTOR / BRACKET, FAIRING SUPPORT, RADIATION DETECTOR / (6x) SCREW, FLAT HEAD - PHILLIPS, #8-32X .625IN SS	4318407 / 4334120 / 4199129	?	0	0.0	0.0	7.75	19.7	0	262.52	0	7.8	19.7	0	0.00	0.0	0	0.0
FAIRING, SENSOR, RADIATION DETECTOR / (6x) SCREW, BUTTON HEAD - ALLEN, #10-32 X 1.5IN SS	4318408 / 4254832	?	0	0.0	0.0	4.28	10.9	0	167.31	0	4.3	10.9	0	0.00	0.0	0	0.0
ASSY, CABLE - RADIATION DETECTOR / 1.5IN WIDE ELECTRICAL TAPE	4326393 / ??????	0	0	0.0	0.0	30.69	78.0	0	64.99	0	30.7	78.0	0	5.00	12.7	0	0.0
Assy, Nortek ADCP	**4314562**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														
SENSOR - ADCP / (4x) SCREW, SHCS, 10-32 X .500, SS / (3x) #6-32 X .375	2539 / ????	?	0	0.0	0.0	54.63	138.8	0	1307.9	0	54.6	138.8	0	-5.33	-13.5	0	0.0
SENSOR, CABLE	?????	?	0	0.0	0.0	54.00	137.2	0	51.5	0	54.0	137.2	0	0.00	0.0	0	0.0
Assy, Imagenex ECHOSounder	**4321091**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	0.0														

ECHOSOUNDER / BRACKET, SENSOR, STANDOFF - ECHOSOUNDER / (2x)	4329102	?	0	0.0	0.0	61.93	157.3	0	516.2	0	61.9	157.3	0	0.00	0.0	0	0.0
SENSOR CABLE	-	?	0	0.0	0.0	58.00	147.3	0	57.0	0	58.0	147.3	0	0.00	0.0	0	0.0
New Sensor Cable	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Assy, RAFOS	**?**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	**0.0**														
Hydrophone for RAFOS system - added by UW-SFC	?	?	0	0.0	0.0	63.30	160.8	0	70.0	0	63.3	160.8	0	1.50	3.8	0	0.0
RAFOS Mount Hardware. (?)	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
RAFOS Cable	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Assy, New Sensor #1	**?**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	**0.0**														
New Sensor #1	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
New Sensor #1 Mount Hardware. (?)	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
New Sensor #1 Cable	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Assy, New Sensor #2	**?**	**?**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	**0.0**														
New Sensor #2	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
New Sensor #2 Mount Hardware. (?)	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
New Sensor #2 Cable	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0	0.0	0.0	0	0.00	0.0	0	0.0
Assy, AFT Foam Block Ballast	**0**	**0**																
	Subtotal Weight	0.0	gm	diff														
	Scale Weight	0.0	gm	**0.0**														
Foam Block location "under Ogive Top hatch cover"	?	?	0	0.0	0.0	58.25	148.0	0	0.0	0.0	58.3	148.0	0	4.02	10.2	0	0.0
Hardware for Foam Block location "under Ogive Top hatch cover"	?	?	0	0.0	0.0	58.25	148.0	0	0.0	0.0	58.3	148.0	0	5.26	13.4	0	0.0
Foam Block location "Ogive Bottom Hatch cover"	?	?	0	0.0	0.0	60.00	152.4	0	0.0	0.0	60.0	152.4	0	-4.00	-10.2	0	0.0
Hardware for Foam Block location "Ogive Bottom Hatch cover"	?	?	0	0.0	0.0	60.00	152.4	0	0.0	0.0	60.0	152.4	0	-5.00	-12.7	0	0.0
Foam Block location "C"	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0.0	0.0	0.0	0	0.00	0.0	0	0.0
Hardware for Foam Block location "C"	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0.0	0.0	0.0	0	0.00	0.0	0	0.0
Foam Block location "D"	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0.0	0.0	0.0	0	0.00	0.0	0	0.0
Hardware for Foam Block location "D"	?	?	0	0.0	0.0	0.00	0.0	0	0.0	0.0	0.0	0.0	0	0.00	0.0	0	0.0
Assy., Pupa	**4199431**	**55486**																
	Subtotal Weight	**39089.3**	gm	diff														
	Scale Weight	39076.0	gm	**-13.3**														
Complete pupae volume - sum this sheet		**42708.6**	cc															
Position B (Opt O2): IE55 dummy plug	4199651	55309	1	7.5	7.5	51.75	131.4	986	3.7	3.7	51.8	131.4	486	2.20	5.6	42	20.7
Position C (WL-1): IE55 dummy plug	4199651	55309	0	0.0	0.0	51.75	131.4	0	0.0	0.0	51.8	131.4	0	1.30	3.3	0	0.0
Position D: Zinc Anode	4199651	55309	1	48.3	48.3	51.75	131.4	6349	3.7	3.7	51.8	131.4	486	0.00	0.0	0	0.0
Position E (WL-2): IE55 dummy plug	4199651	55309	1	7.5	7.5	51.75	131.4	986	3.7	3.7	51.8	131.4	486	-1.30	-3.3	-25	-12.2
Position F (WL-3): IE55 dummy plug	4199651	55309	1	7.5	7.5	51.75	131.4	986	3.7	3.7	51.8	131.4	486	-2.20	-5.6	-42	-20.7
O-Ring, E70-270, Endcap to Batt Hull	4199059	52411	1	8.7	8.7	48.55	123.3	1073	7.1	7	48.6	123.3	879	2.70	6.9	60	48.9
(7x) 6-32 x 1/2 SHCS w/ LW, endcap to battery hull	4199111 / 4199122	55183 / 55217 /	1	12.9	12.9	48.64	123.5	1594	1.6	2	48.6	123.5	199	0.00	0.0	0	0.0
O-Ring, E70-270, Bulkhead to batt. hull	4199059	52411	1	8.7	8.7	28.72	72.9	635	7.1	7.1	28.7	72.9	520	0.00	0.0	0	0.0
(8x) 6-32 x 1/2 SHCS w/ LW, bulkhead to battery hull	4199111 / 4199122	55183 / 55217 /	1	15.0	15.0	25.75	65.4	981	1.9	2	25.8	65.4	122	0.00	0.0	0	0.0
(4x) 6-32 x 1/2 SHCS + #6 LW, rails to bulkhead	4199111 / 4199122	55183 / 55217	1	5.2	5.2	23.41	59.5	309	0	0	23.4	59.5	0	0.00	0.0	0	0.0
O-Ring, E70-263, elec hull to bulkhead	4199058	52410	1	7.1	7.1	26.13	66.4	471	5.8	5.8	26.1	66.4	382	0.00	0.0	0	0.0
(8x) 6-32 x 1/2 SHCS + #6 LW, elec hull to bulkhead	4199111 / 4199122	55183 / 55217	1	10.5	10.5	25.92	65.8	691	0	0	25.9	65.8	0	0.00	0.0	0	0.0
Assy., Aft Endcap	**4293521-00001**	**-**																
	Subtotal Weight	**7696.0**	gm	diff														
	Scale Weight	7697.0	gm	**1.0**														
Hydraulic oil:	End Cap Without Oil	5958	gm															
	End Cap With Oil	7054	gm															
	Oil Added To System	1096	gm															
	Volume of Oil In System	1331.875076	cc	1331.9														
Assy., Hydraulics drive system	**4293235**	**-**																
	Subtotal Weight	4696.2	gm	diff														
	Scale Weight	4695.7	gm	**-0.5**														
ENDCAP, HULL, AFT (6 - Port)	4199325	49815	1	2019.2	2019.2	50.01	127.0	256510	2885.0	2885	49.8	126.4	364578	0.00	0.0	0	0.0
(2x) PIN, SPRING, SLOTTED - 5/32" DIA x .375L, 18-8 SS	4199132	55248	1	1.1	1.1	48.41	123.0	135	0	0	48.4	123.0	0	0.00	0.0	0	0.0
FITTING, TUBE, MALE - RUN TEE 2 x 1/4" TUBE, 1/8" NPT M	4250762	-	1	8.5	8.5	49.30	125.2	1064	0	0	49.3	125.2	0	0.00	0.0	0	0.0
FITTING, TUBE, MALE - CONNECTOR, 1/4" OD, 7/16-20 SAE/MS, SS	4199245	55506	1	27.6	27.6	49.30	125.2	3456	0	0	49.3	125.2	0	0.50	1.3	35	0.0
ASSY, CABLE - VBD VALVE - A1W19 ("SKINNER VALVE")	4199367	52254	1	606.4	606.4	49.02	124.5	75503	0	0	49.0	124.5	0	0.60	1.5	924	0.0
FITTING, TUBE, MALE - ADAPTER, 1/4" TUBE, 1/8" NPT M, SS	4199072	52430	1	10.5	10.5	50.43	128.1	1345	0	0	50.4	128.1	0	0.50	1.3	13	0.0
FITTING, TUBE, MALE - BRANCH TEE 2 x 1/4" TUBE, 1/8" NPT M	4250878	-	1	8.5	8.5	48.79	123.9	1053	0	0	48.8	123.9	0	-0.50	-1.3	-11	0.0
For STANDARD BOOST PUMP																		
Tubing, 1/4 DIA x 8" (Cut 8.25")	4199064	52419	0	0.0	0.0	47.00	119.4	0	0	0	47.0	119.4	0	0.00	0.0	0	0.0
Tubing, 1/4 Dia x 6.0" (Cut 6.5")	4199064	52419	0	0.0	0.0	47.00	119.4	0	0	0	47.0	119.4	0	0.00	0.0	0	0.0
Check Valve, Kepner 204 A-1	4199084	52448	0	0.0	0.0	49.10	124.7	0	0	0	49.1	124.7	0	-0.50	-1.3	0	0.0
Union Elbow, Male, 1/4 tube x 1/4 tube, alum	4199076	52435	0	0.0	0.0	50.43	128.1	0	0	0	50.4	128.1	0	-0.50	-1.3	0	0.0
Tubing, 1/4 DIA x 9.625" (Cut 9.75")	4199064	52419	0	0.0	0.0	47.00	119.4	0	0	0	47.0	119.4	0	0.00	0.0	0	0.0
Run Tee, Male,1/4 tube x 1/4 tube x 1/8 NPT, alum	4199075	52428	0	0.0	0.0	49.30	125.2	0	0	0	49.3	125.2	0	0.00	0.0	0	0.0
Tubing, 1/4 Dia x 4.375" (Cut 4.375")	4199064	52419	0	0.0	0.0	47.00	119.4	0	0	0	47.0	119.4	0	0.00	0.0	0	0.0

For HIGH VOL BOOST PUMP																			
TUBING, 1/4" OD 310 PSI (9.0in)	4263534	-	1	4.0	4.0	47.00	119.4	478	0	0	47.0	119.4	0	0.00	0.0	0	0.0		
TUBING, 1/4" OD 310 PSI (10.0in)	4263534	52419	1	4.5	4.5	47.00	119.4	537	0	0	47.0	119.4	0	0.00	0.0	0	0.0		
VALVE , CHECK, INLINE - SPRING POPPET 1/8" NPT F. 1/8" NPT M	4199084	52448	1	22.4	22.4	49.10	124.7	2794	0	0	49.1	124.7	0	-0.50	-1.3	-28	0.0		
TUBING, 1/4" OD 310 PSI (8.0in)	4263534	-	1	3.6	3.6	50.43	128.1	461	0	0	50.4	128.1	0	0.00	0.0	0	0.0		
TUBING, 1/4" OD 310 PSI (11.0in)	4263534	-	1	4.4	4.4	47.00	119.4	525	0	0	47.0	119.4	0	0.00	0.0	0	0.0		
TUBING, 1/4" OD 310 PSI (4.375in)	4263535	-	1	1.9	1.9	49.10	124.7	237	0	0	49.1	124.7	0	0.00	0.0	0	0.0		
TUBING, 1/4" OD 310 PSI (4.375in)	4263536	-	1	1.9	1.9	49.10	124.7	237	0	0	49.1	124.7	0	0.00	0.0	0	0.0		
FITTING, MALE - 1/4" TUBE, 1/8" NPT M	4275380	-	1	6.4	6.4	49.30	125.2	801	0	0	49.3	125.2	0	-0.50	-1.3	-8	0.0		
TUBING, 1/4" OD 310 PSI (1.25in)	4263536	-	1	0.5	0.5	47.00	119.4	60	0	0	47.0	119.4	0	0.00	0.0	0	0.0		
FITTING, TUBE, TEE - COUPLING 3 x 1/4" TUBE	4251058	-	1	2.8	2.8	49.30	125.2	351	0	0	49.3	125.2	0	0.00	0.0	0	0.0		
FITTING, TUBE, MALE - 90DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251059	-	1	7.5	7.5	50.43	128.1	961	0	0	50.4	128.1	0	0.00	0.0	0	0.0		
FITTING, TUBE, MALE - 45DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251060	-	1	7.4	7.4	50.43	128.1	948	0	0	50.4	128.1	0	0.00	0.0	0	0.0		
VALVE, CHECK, INLINE - 1-2 PSI CRACK 2x 1/8" NPT F, AL	4259549	-	1	25.3	25.3	50.43	128.1	3241	0	0	50.4	128.1	0	0.00	0.0	0	0.0		
WASHER, FLAT, STEEL, ZINC, SEAL	4199043	52350	1	1.1	1.1	50.90	129.3	142	0	0	50.9	129.3	0	0.00	0.0	0	0.0		
SCREW, PUMP OUTLET	4199400	52349	1	7.6	7.6	51.04	129.6	985	0	0	51.0	129.6	0	0.00	0.0	0	0.0		
PUMP, HYDRAULIC - 3 PISTON (LEDUC)	4199399	52348	1	316.6	316.6	49.58	125.9	39870	0	0	49.6	125.9	0	0.00	0.0	0	0.0		
ENDCAP, HYDRAULIC PUMP LEDUC	4259549	-	1	111.6	111.6	47.72	121.2	13527	0	0	47.7	121.2	0	0.00	0.0	0	0.0		
BEARING, BALL - 8mm SHAFT, SS, OPEN	4199093	52459	1	3.1	3.1	47.69	121.1	376	0	0	47.7	121.1	0	0.00	0.0	0	0.0		
O-RING, BUNA-N, 70A -032	4199055	52407	1	0.4	0.4	48.23	122.5	49	0	0	48.2	122.5	0	0.00	0.0	0	0.0		
FITTING, TUBE, MALE - PIPE ADAPTER, 10-32 UNF, 1/8" TUBE	4250882	-	1	2.9	2.9	47.75	121.3	352	0	0	47.8	121.3	0	1.15	2.9	8	0.0		
TUBING, 1/8" OD 500 PSI (8.875in)	4263530	-	1	1.4	1.4	45.17	114.7	161	0	0	45.2	114.7	0	0.00	0.0	0	0.0		
SEAL, MAGNETIC (Replace O-ring with 4214427 prior to weighing)	4199046	52353	1	13.8	13.8	47.69	121.1	1672	0	0	47.7	121.1	0	0.00	0.0	0	0.0		
SCREW, SOCKET HEAD - ALLEN #6-32 x .500 L, 18-8 SS	4199111	55183	1	7.1	7.1	48.12	122.2	868	0	0	48.1	122.2	0	0.00	0.0	0	0.0		
PLUG - .250" DIA, 3000PSI, Al / PIN - .250" DIA PLUG, 3000PSI (LEE PLUG)	4199081 / 4199082	52445 / 52446	1	0.4	0.4	51.51	130.8	52	0.0	0	51.5	130.8	0	-0.50	-1.3	-1	0.0		
VALVE, CHECK, BLADDER (altered Kepner 1106 A-1-1) / O-RING, BUNA-N, 90A -906 (N70 3-906)	4199338 / 4199056	49852 / 52408	1	47.8	47.8	52.47	133.3	6370	0.0	0.0	52.5	133.3		0.00	0.0	0	0.0		
BLADDER, ACCUMULATOR	4199078	52441	1	118.4	734.2	54.61	138.7	101845	866.7	866.7	54.6	138.7	120229	0.00	0.0	0	0.0		
NUT, BLADDER	4199318	49802	1	109.0	109.0	51.60	131.1	14286	40.2	40	51.6	131.1	5266	0.00	0.0	0	0.0		
ASSY, CABLE, - INTERNAL COMMS - A1W17 (POSITION A {INTERNAL COMMS})	4199365	-	1	12.3	12.3	51.51	130.8	1609	0.8	0.8	51.5	130.8	104	2.20	5.6	69	4.4		
ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 (POSITION B {OPT O2})	4199375	-	1	11.7	11.7	51.51	130.8	1531	0.8	0.8	51.5	130.8	104	1.30	3.3	39	2.6		
ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 (POSITION C {WL-1})	4199375	-	1	11.8	11.8	51.51	130.8	1544	0.8	0.8	51.5	130.8	104	0.00	0.0	0	0.0		
Anode Adaptor + O-Ring	4068150 / 4199057	-	1	24.5	24.5	51.51	130.8	3206	0.8	0.8	51.5	130.8	104	-1.30	-3.3	-81	-2.6		
ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 (POSITION E {WL-2})	4199375	-	1	11.7	11.7	51.51	130.8	1531	0.8	0.8	51.5	130.8	104	-2.20	-5.6	-65	-4.4		
ASSY, CABLE, - RS232 SENSOR INTERFACE - A1W30 (POSITION F)	4199375	-	1	11.8	11.8	51.51	130.8	1544	0.8	0.8	51.5	130.8	104	-3.00	-7.6	-90	-6.0		
ASSY, CABLE - IRIDIUM/GPS ANTENNA - A1W5 (LM-195 cable)	4199354	52241	1	64.0	64.0	51.51	130.8	8374	6.8	6.8	51.5	130.8	890	0.00	0.0	0	0.0		
VALVE, PRESSURE RELIEF (DEEP SEA)	4199085	52449	1	11.5	11.5	51.51	130.8	1505	2.7	2.7	51.5	130.8	353	2.30	5.8	67	15.8		
PLATE, PUMP DRIVE	4199320	49804	1	41.3	41.3	47.30	120.1	4962	0	0	47.3	120.1	0	0.75	1.9	79	0.0		
ASSY, CABLE - PUMP MOTOR, VBD HIGH PRESSURE - A11W18	4199366	52253	1	131.1	131.1	48.50	123.2	16150	0	0	48.5	123.2	0	1.80	4.6	599	0.0		
(3X) SCREW, FLAT HEAD PHILLIPS, M2 x 0.4 X 6, 18-8 SS	8254	55203	1	0.5	0.5	47.30	120.1	60	0	0	47.3	120.1	0	1.80	4.6	2	0.0		
REDUCER, BORE - 3mm ID , AL	4199044	52351	1	0.6	0.6	46.77	118.8	71	0	0	46.8	118.8	0	0.00	0.0	0	0.0		
PULLEY, TIMING BELT, AL (LEDUC DRIVE MOTOR)	4199045	52352	1	5.6	5.6	46.77	118.8	665	0	0	46.8	118.8	0	1.85	4.7	26	0.0		
(6X) SCREW, FLAT HEAD - ALLEN, #4-40 x .375, 18-8 SS	17437	55229	1	3.0	3.0	47.28	120.1	360	0	0	47.3	120.1	0	0.00	0.0	0	0.0		
PULLEY, PUMP (LEDUC PUMP PULLEY)	4199321	49806	1	91.6	91.6	46.77	118.8	10882	0	0	46.8	118.8	0	0.00	0.0	0	0.0		
BELT, TIMING 6mm WIDE, NEOPRENE	4199048	52357	1	3.8	3.8	46.77	118.8	451	0	0	46.8	118.8	0	0.50	1.3	5	0.0		
COVER, BELT, PUMP DRIVE	4199429	55476	1	18.2	18.2	46.50	118.1	2150	0	0	46.5	118.1	0	0.75	1.9	35	0.0		
(4X) SCREW, SOCKET HEAD - ALLEN, #4-40 x .250, SS	2549	-	1	2.0	2.0	46.63	118.4	237	0	0	46.6	118.4	0	0.00	0.0	0	0.0		
(2x) 6-32 x 1/2 SHCS + #6 LW, boost pump bracket to endcap	4199111 / 4199122	55183 / 55217	1	1.9	1.9	47.64	121.0	230	0	0	47.6	121.0	0	1.00	2.5	5	0.0		
Grounding Strap 27.5"			1	4.9	4.9	43.90	111.5	546	0	0	43.9	111.5	0	0.00	0.0	0	0.0		
Assy., Boost Pump (Standard)	**8254**	**55203**																	
	Subtotal Weight	0.0	gm	diff															
	Scale Weight	0.0	gm	**0.0**															
Pump Bracket	4199322	49808	0	0.0	0.0	48.91	124.2	0	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
Motor, Chrge Pump w/ W34	4199384	52288	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	1.00	2.5	0	0.0		
(2x) M2 x 6 FHMS, motor to bracket	8254	55203	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
Magnet Rotor Housing	4199092	52457	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	-0.40	-1.0	0	0.0		
(4x) 6-32 x 1/4 PHMS, bracket to housing	4146090	55209	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
Rotary Magnet	4199090	52455	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	-0.40	-1.0	0	0.0		
Pumphead, Micropump + mounting plate + (3x) 4-40 x 3/8 FHMS	4199051 / 4199091 / 17	52360 / 52456 /	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	-0.80	-2.0	0	0.0		
(4x) 4-40 x 3/16 SHCS + #4 LW, housing to flange	4199155 / 19928	55296 / 55233	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	-0.50	-1.3	0	0.0		
(2x) Elbow, 1/8 npt x 1/4 tube, alum	4251059	52431	0	0.0	0.0	48.90	124.2	0	0	0	48.9	124.2	0	-0.90	-2.3	0	0.0		
Filter, Balston	4199068	52425	0	0.0	0.0	47.00	119.4	0	0	0	47.0	119.4	0	0.00	0.0	0	0.0		
ASSY, PUMP, BOOST (Enhanced)	**4254582**	**-**																	
	Subtotal Weight	716.8	gm	diff															
	Scale Weight	717.0	gm	**0.2**															
BRACKET, BOOST PUMP	4250419	-	1	36.9	36.9	48.91	124.2	4584	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
ASSY, CABLE, MOTOR, BOOST PUMP HIGH VOL	4261167	-	1	235.7	235.7	48.90	124.2	29275	0	0	48.9	124.2	0	1.00	2.5	599	0.0		
(4X) SCREW, FLAT HEAD - PHILLIPS, M3 X 0.5 X 8, 18-8 SS	4260277	-	1	1.7	1.7	48.90	124.2	211	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
HOUSING, PUMP - RE-MAX 29	4249845	-	1	94.4	94.4	48.90	124.2	11725	0	0	48.9	124.2	0	-0.40	-1.0	-96	0.0		
(10X) SCREW, SOCKET HEAD, ALLEN, #4-40 X .250 + #4 LW	2549 / 19928	-	1	4.8	4.8	48.90	124.2	596	0	0	48.9	124.2	0	0.00	0.0	0	0.0		
32 X .188, 18-8 SS	4259021 / 4258345	-	1	76.2	76.2	48.90	124.2	9464	0	0	48.9	124.2	0	-0.40	-1.0	-77	0.0		
PUMP, GEAR, MAGNETIC DRIVE - 5.2 BAR	4258747	-	1	252.1	252.1	48.90	124.2	31312	0	0	48.9	124.2	0	-0.80	-2.0	-512	0.0		
(2X) FITTING, TUBE, MALE - 90DEG ELBOW 1/4" TUBE , 1/8" NPT	4251059	-	1	15.0	15.0	48.90	124.2	1863	0	0	48.9	124.2	0	-0.90	-2.3	-34	0.0		
Assy., Hydraulic Reservoir (Standard)	**4199425 / 2549**	**55388**																	
	Subtotal Weight	0.0	gm	diff															

Note: Scale Weight is only E295:E313	Scale Weight	0.0	gm	**0.0**														
Piston, Diaphragm	4199323	49811	0	0.0	0.0	45.00	114.3	0	0	0	45.0	114.3	0	0.00	0.0	0	0.0	
Diaphragm, Internal (Bellofram)	4206402	56874	0	0.0	0.0	45.62	115.9	0	0	0	45.6	115.9	0	0.00	0.0	0	0.0	
Sikaflex Adhesive Compound	4199233	55459	0	0.0	0.0	45.00	114.3	0	0	0	45.0	114.3	0	0.00	0.0	0	0.0	
Cylinder Head, Diaphragm	4199474	56798	0	0.0	0.0	43.90	111.5	0	0	0	43.9	111.5	0	0.00	0.0	0	0.0	
Branch Tee, Male, 1/4 tube x 1/8 NPT x 1/4 tube, brass + Plastic plug (X59P4)	4199080 / 4205772	52443 / 52434	0	0.0	0.0	43.24	109.8	0	0	0	43.2	109.8	0	-2.39	-6.1	0	0.0	
Elbow, 1/8 NPT M x 1/8 NPT M, brass	4199069	52426	0	0.0	0.0	43.24	109.8	0	0	0	43.2	109.8	0	2.39	6.1	0	0.0	
Kepner Chk Valve 404A-1-10	4199083	52447	0	0.0	0.0	43.24	109.8	0	0	0	43.2	109.8	0	0.80	2.0	0	0.0	
Elbow, 1/8 npt x 1/8 tube, alum	4199070	52427	0	0.0	0.0	43.24	109.8	0	0	0	43.2	109.8	0	-0.10	-0.3	0	0.0	
Bleed screw, 10-32 x .125 PHMS with seal	4210092	55477	0	0.0	0.0	43.24	109.8	0	0	0	43.2	109.8	0	3.00	7.6	0	0.0	
Cylinder, Diaphragm	4199324	56943	0	0.0	0.0	45.30	115.1	0	0	0	45.3	115.1	0	0.00	0.0	0	0.0	
(8x) 5-40 x 3/8 SHCS +#5 LW, head to cylinder	4209126 / 4199125	? / 55225	0	0.0	0.0	43.56	110.6	0	0	0	43.6	110.6	0	0.00	0.0	0	0.0	
Standoff (starboard)	4199418	55299	0	0.0	0.0	47.75	121.3	0	0	0	47.8	121.3	0	2.60	6.6	0	0.0	
Standoff (port)	4199418	55299	0	0.0	0.0	47.75	121.3	0	0	0	47.8	121.3	0	-2.60	-6.6	0	0.0	
(4x) 6-32 x 3/8 SHCS +#6 LW, standoff to cylinder	4199119 / 4199122	55183 / 55217	0	0.0	0.0	47.50	120.7	0	0	0	47.5	120.7	0	0.00	0.0	0	0.0	
(2x) Saddles, mounting, Aft PCB + (4x) 4-40 x 1/4 PHMS	4199410 / 4134111	52373 / 55257	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	3.20	8.1	0	0.0	
(2x) Saddles, mounting, C PCB + (4x) 4-40 x 1/4 PHMS	4199345 / 4134111	49888 / 55257	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	1.50	3.8	0	0.0	
(2x) Saddles, mounting, T PCB + (4x) 4-40 x 1/4 PHMS	4199345 / 4134111	49888 / 55257	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	-1.50	-3.8	0	0.0	
(2x) Saddles, mounting, O2 PCB + (4x) 4-40 x 1/4 PHMS (only used with SBE 43f)	4199345 / 4134111	49888 / 55257	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	-3.20	-8.1	0	0.0	
Ball Bearing joint / ring retaining spiral / stud mount / ball swivel ring	4205785 / 4205787 / 4205808 / 4205809	0	0	0.0	0.0	43.90	111.5	0	0	0	43.9	111.5	0	0.00	0.0	0	0.0	
Weigh Hydraulic res. Assy, then Oil fill & add sub-assy fasteners																		
Assy., Hydraulic Reservoir (Enhanced)	**4199397**	-																
	Subtotal Weight	1232.0	gm	diff														
Note: Scale Weight is only E291:E314	Scale Weight	1232.1	gm	**0.1**														
PISTON DIAPHRAGM	4199323	49811	1	136.7	136.7	45.00	114.3	15625	0	0	45.0	114.3	0	0.00	0.0	0	0.0	
DIAPHRAGM, ROLLING NITRILE (BELLOWFRAM)	4206402	56874	1	97.0	577.2	45.62	115.9	66887	0	0	45.6	115.9	0	0.00	0.0	0	0.0	
ADHESIVE, STRUCTURAL - POLYURETHANE, SIKAFLEX 292	4199233	55459	1	15.4	15.4	45.00	114.3	1760	0	0	45.0	114.3	0	0.00	0.0	0	0.0	
CYLINDER HEAD, SWIVEL MOUNT	4261356	-	1	329.5	329.5	43.90	111.5	36741	0	0	43.9	111.5	0	0.00	0.0	0	0.0	
FITTING, TUBE, MALE - BRANCH TEE 2 X 1/4" TUBE , 1/8" NPT / FITTING, TUBE, PLUG - 1/4" TUBE, NYL, RED	4250878 / 4251094	-	1	9.1	9.1	43.24	109.8	999	0	0	43.2	109.8	0	-2.39	-6.1	-55	0.0	
FITTING, PIPE - 90 DEG ELBOW 2 x 1/8" NPT, M, BRASS	4199069	52426	1	71.4	71.4	43.24	109.8	7842	0	0	43.2	109.8	0	2.39	6.1	433	0.0	
VALVE, CHECK, INLINE - 200 PSI CRACK, 2 x 1/8" NPT, F, ALUM	4282752	-	1	7.4	7.4	43.24	109.8	813	0	0	43.2	109.8	0	0.80	2.0	15	0.0	
FITTING, TUBE, MALE - 90DEG ELBOW, 1/8" TUBE , 1/8" NPT, M	4251095	-	1	26.9	26.9	43.24	109.8	2954	0	0	43.2	109.8	0	-0.10	-0.3	-7	0.0	
SCREW, PAN HEAD - PHILLIPS, #8-32 x .250, 18-8 SS, SEALING	4262362	-	1	1.1	1.1	43.24	109.8	121	0	0	43.2	109.8	0	3.00	7.6	8	0.0	
CYLINDER, DIAPHRAGM	4261328	-	1	439.4	439.4	45.30	115.1	50558	0	0	45.3	115.1	0	0.00	0.0	0	0.0	
(8X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500,+ #6 LW	4199111 / 4199122	-	1	8.0	8.0	43.56	110.6	885	0	0	43.6	110.6	0	0.00	0.0	0	0.0	
STANDOFF, RESERVOIR CYLINDER (STARBOARD)	4199418	55299	1	12.4	12.4	47.75	121.3	1504	0	0	47.8	121.3	0	2.60	6.6	82	0.0	
STANDOFF, RESERVOIR CYLINDER (PORT)	4199418	55299	1	12.4	12.4	47.75	121.3	1504	0	0	47.8	121.3	0	-2.60	-6.6	-82	0.0	
(4X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500 + #6 LW	4199111 / 4199122	-	1	4.1	4.1	47.50	120.7	495	0	0	47.5	120.7	0	0.00	0.0	0	0.0	
(2x) MOUNT, SADDLE, TERMINAL PCBA	4199410	52373	1	3.9	3.9	45.50	115.6	451	0	0	45.5	115.6	0	3.20	8.1	32	0.0	
(2X) MOUNT, SADDLE, PCBA (CONDUCTIVITY)	4199345	49888	1	4.6	4.6	45.50	115.6	532	0	0	45.5	115.6	0	1.50	3.8	18	0.0	
(2X) MOUNT, SADDLE, PCBA (TEMP)	4199345	49888	1	4.7	4.7	45.50	115.6	543	0	0	45.5	115.6	0	-1.50	-3.8	-18	0.0	
(2X) MOUNT, SADDLE, PCBA (OXYGEN)	4199345	49888	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	-3.20	-8.1	0	0.0	
BRACKET, BALSTON FILTER	4275539	-	1	7.3	7.3	43.80	111.3	812	0	0	43.8	111.3	0	-2.00	-5.1	-37	0.0	
FILTER, INLINE - 1/4" TUBE 25um, 125 PSI, GLASS FIBER, PVDF	4199068	-	1	20.9	20.9	43.50	110.5	2309	0	0	43.5	110.5	0	-2.00	-5.1	-106	0.0	
CABLE TIE, 2.0IN BUNDLE - 8.75 LG, NYL, BLK, UV	4199110	-	1	0.5	0.5	43.50	110.5	55	0	0	43.5	110.5	0	-2.00	-5.1	-3	0.0	
FITTING, TUBE, MALE - 90DEG ELBOW, 1/4" TUBE, 1/8" NPT M	4251059	-	1	7.5	7.5	43.50	110.5	829	0	0	43.5	110.5	0	-2.00	-5.1	-38	0.0	
FITTING, TUBE, STRAIGHT - COUPLING, 2 x 1/4" TUBE	4251092	-	1	1.8	1.8	43.50	110.5	199	0	0	43.5	110.5	0	-2.00	-5.1	-9	0.0	
STUD, MOUNT, SWIVEL - TTI / BEARING, BALL JOINT, SWIVEL / RING, RETAINER, BALL JOINT - TTI / RING, RETAINING, INTERNAL - SPIRAL	4205808 / 4205785 / 4205809 / 4205787	-	1	10.0	10.0	43.90	111.5	1115	0	0	43.9	111.5	0	0.00	0.0	0	0.0	
Weigh Hydraulic res. Assy, then Oil fill & add sub-assy fasteners																		
ASSY, CABLE, LINEAR TRANSDUCER, VBD POSITION A - A1W20 / SPRING, COMPRESSION / KNOB, ROD END / CLAMP, LINEAR TRANSDUCER, POSTION VBD / SCREW, SOCKET HEAD, ALLEN #6-32 X .500, 18-8 SS	4199368 / 4198939 / 4199123	-	1	41.6	41.6	47.75	121.3	5045	0	0	47.8	121.3	0	2.50	6.4	264	0.0	
ASSY, CABLE, LINEAR TRANSDUCER, VBD POSITION B - A1W21 / SPRING, COMPRESSION / KNOB, ROD END / CLAMP, LINEAR TRANSDUCER, POSTION VBD / SCREW, SOCKET HEAD, ALLEN #6-32 X .500, 18-8 SS	4199369 / 4198939 / 4199123	-	1	39.3	39.3	47.75	121.3	4767	0	0	47.8	121.3	0	2.50	6.4	250	0.0	
(2X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500, 18-8 SS	4199111	55183	1	2.6	2.6	48.28	122.6	319	0	0	48.3	122.6	0	0.00	0.0	0	0.0	
(4X) SCREW, SOCKET HEAD - ALLEN, #6-32 x .500 + #6 LW	4199111 / 4199122	55183	1	5.1	5.1	47.90	121.7	620	0	0	47.9	121.7	0	0.00	0.0	0	0.0	
aft endcap electronic parts - mount with CT sail																		
PCBA, AFT TERMINAL + (4X) #4-40 x .250 SHCS	4199419 / 2549	55302	1	27.5	27.5	45.50	115.6	3178	0	0	45.5	115.6	0	3.40	8.6	237	0.0	
PCBA, CONDUCTIVITY SENSOR (SEABIRD) + (4X) #4-40 x .250 SHCS	4199423 / 2549	55385	1	34.3	34.3	45.50	115.6	3964	0	0	45.5	115.6	0	1.70	4.3	148	0.0	
ASSY, CABLE CONDUCTIVITY ELECTRONICS - A1W26	4199373	52261	1	3.2	3.2	44.40	112.8	361	0	0	44.4	112.8	0	1.50	3.8	12	0.0	
COVER, PCBA, COND. SENSOR / (4x) SCREW, BH #2-56 x .25 , 18-8 SS	4199344 / 4199124	49887 / 55221	1	19.9	19.9	45.50	115.6	2300	0	0	45.5	115.6	0	1.90	4.8	96	0.0	
PCBA, TEMPERATURE SENSOR (SEABIRD) + (4X) #4-40 x .250 SHCS	4199425 / 2549	55388	1	22.6	22.6	45.50	115.6	2612	0	0	45.5	115.6	0	-1.70	-4.3	-98	0.0	
ASSY, CABLE TEMPERATURE ELECTRONICS - A1W25	4199372	52260	1	5.5	5.5	44.40	112.8	620	0	0	44.4	112.8	0	0.50	1.3	7	0.0	
COVER, PCBA TEMP. SENSOR / (4X) SCREW, BH #2-56 x .25 , 18-8 SS	4199409 / 4199124	52371 / 55221	1	15.9	15.9	45.50	115.6	1838	0	0	45.5	115.6	0	-1.90	-4.8	-77	0.0	
PCBA, OXYGEN SENSOR + (4X) #4-40 x .250 SHCS	4199436 / 2549	55524	0	0.0	0.0	45.50	115.6	0	0	0	45.5	115.6	0	-3.40	-8.6	0	0.0	
ASSY, CABLE - OXYGEN SENSOR PROCESSED SIGNAL - A1W33	4199377	52265	0	0.0	0.0	44.40	112.8	0	0	0	44.4	112.8	0	0.00	0.0	0	0.0	
ASSY, CABLE - TAIL PCBA SIGNAL INTERFACE - A1W13 (GREY)	4199361	52248	1	29.5	29.5	38.6	98.1	2894	0	0	38.6	98.1	0	3.50	8.9	262	0.0	
ASSY, CABLE - TAIL PCBA POWER INTERFACE - A1W14 (RAINBOW)	4199362	52249	1	36.3	36.3	38.6	98.1	3561	0	0	38.6	98.1	0	3.50	8.9	323	0.0	
Tape for Grey Ribbon Cable			0	0.0	0.0	45.5	115.6	0	0	0	45.5	115.6	0	3.50	8.9	0	0.0	
Tape for Rainbow Ribbon Cable			0	0.0	0.0	45.5	115.6	0	0	0	45.5	115.6	0	3.50	8.9	0	0.0	
ASSY, SAIL, CONDUCTIVITY - TEMPERATURE (SEABIRD)	4199407	52368	1	280.0	280.0	47.86	121.6	34041	184.0	184	47.9	121.6	22373	7.06	17.9	5020	3299.1	
PLUG, CT SAIL / RING, BACKUP , O-RING - TEFLON -016 / O-RING, EPDM - 016 / O-RING EPDM -012	4286190 / 4199255 / 4199067 / 4199057	-	1	18.1	18.1	49.30	125.2	2267	5.0	5	49.3	125.2	626	4.90	12.4	225	62.2	
NUT, CT SAIL	4199406	-	1	8.6	8.6	49.30	125.2	1077	0	0	49.3	125.2	0	4.80	12.2	105	0.0	

PIN, GUIDE, BATTERY PACK - TTI ("STINGER") / HARDSTOP, PITCH - TTI / SCREW, SOCKET HEAD - ALLEN, #8-32 x .375, SS	4205807 / 4205810 / 2601	-	1	81.8	81.8	43.90	111.5	9121	0	0	43.9	111.5	0	0.00	0.0	0	0.0
					Total			Moment					Moment			Moment	Moment
			Qty	Weight	Weight	LCG	LCG	LCG	Volume	Total Vol	LCB	LCB	LCB	VCG	VCB	VCG	VCB
				grams	grams	inch	cm	gm-cm	cc	cc	inch	cm	cc-cm	cm	cm	gm-cm	cc-cm
Assy., Mass shifter	**4199448**	**56768**															
	Scale Weight	14162.0	gm	14162.0	2542.3	27.817323	70.7	179628.7		2669.8		70.2	187420.0	-0.6	0.0	-1449.1	0.0
Moveable Weight																	
Battery Enclosure (with Brass weight)	too many to record	56759	1	1823.7	1823.7	35.424821	90.0	164094.8		0.0		90.0	0.0	-6.8	0.0	-12311.8	0.0
HV Battery	4199485	56831	1	9796.0	9796.0	35.731514	90.8	889065.8		0.0		90.8	0.0	0.0	0.0	-195.9	0.0
Assy., Electronics	**4199398**	**52347**															
	Subtotal Weight	**3958.0**	gm	diff													
	Scale Weight	3960.4	gm	**2.4**													
Electronics rail, port	4199465	56785	1	51.2	51.2	23.51	59.7	3057	0	0	23.5	59.7	0	0.00	0.0	0	0.0
Electronics rail, starboard	4199499	57672	1	53.6	53.6	23.51	59.7	3200	0	0	23.5	59.7	0	0.00	0.0	0	0.0
Seaglider Main board (Mother board, TT8, CF8, flash card)	4199386	52290	1	261.4	261.4	21.50	54.6	14275	0	0	21.5	54.6	0	0.70	1.8	465	0.0
Insulation Sheet-OEM/Main	4199408	52370	1	4.8	4.8	21.73	55.2	265	0	0	21.7	55.2	0	0.44	1.1	5	0.0
(6x) 6-32 x 1/4 PHMS, main board to rails	4146090	55209	1	4.6	4.6	21.50	54.6	251	0	0	21.5	54.6	0	0.50	1.3	6	0.0
Assy., OEM Navigation Board (transponder PCB, transformer/inductor, capacitors, GPS receiver, W6 GPS serial interface, GPS antenna cable,DC-DC converter, Cable Assembly W7, all soldered on wiring)	4199370	52257	1	557.4	557.4	21.50	54.6	30440	0	0	21.5	54.6	0	-0.43	-1.1	-609	0.0
(6x) 6-32 x 1/4 PHMS, OEM board to rails	4146090	55209	1	4.1	4.1	21.48	54.6	224	0	0	21.5	54.6	0	-0.43	-1.1	-4	0.0
Assy., Iridium Modem and bracket (includes satellite receiver - iridium LBT, cable assy W3, all clamps for wires, RF switch, DC block, and mounting hardware)	4199389	**52324**	1	280.5	280.5	21.60	54.9	15389	0	0	21.6	54.9	0	1.90	4.8	1354	0.0
(4x) 6-32 x 1/4 PHMS + #6 LW, modem cage to rails	4146090 / 4199122	55209 / 55217	1	3.1	3.1	20.77	52.8	164	0	0	20.8	52.8	0	0.29	0.7	2	0.0
Battery Pack, LV w/ CA W1	4199484	56830	1	2651.0	2651.0	21.60	54.9	145444	0	0	21.6	54.9	0	-1.81	-4.6	-12188	0.0
Battery Pack Cage, LV + Two strips of tape	4199335	49847	1	82.2	82.2	21.60	54.9	4510	0	0	21.6	54.9	0	-1.64	-4.2	-342	0.0
(6x) 6-32 x 1/4 PHMS + #6 LW, batt. cage to rails	4146090 / 4199122	55209 / 55217	1	4.1	4.1	21.78	55.3	227	0	0	21.8	55.3	0	-0.25	-0.6	-3	0.0
Assy., Battery Hull Sections	**4199340**	**49878**															
	Subtotal Weight	**7975.6**	gm	diff													
	Scale Weight	7974.2	gm	**-1.4**													
Hull, Fwd Battery	4199326	49817	1	3607.0	3607.0	43.5	110.6	398895	12257.8	12257.8	43.5	110.6	1355579	0.00	0.0	0	0.0
Hull, Aft Battery	4199326	49817	1	3606.0	3606.0	33.7	85.5	308401	12257.8	12257.8	33.7	85.5	1048340	0.00	0.0	0	0.0
Joint Ring , battery hulls	4199327	49818	1	681.6	681.6	38.9	98.9	67407	436.8	436.8	38.9	98.9	43197	0.00	0.0	0	0.0
(8x) 6-32 x 3/4 SHCS + #6 LW, joint ring to fwd/aft batt. Hull	4199121 / 4199122	55215 / 55217	1	13.2	13.2	38.6	98.1	1295	0.0	0.0	38.6	98.1	0	0.00	0.0	0	0.0
Grounding Strap 17.5"			1	3.7	3.7	38.6	98.0	363	0.0	0.0	38.6	98.0	0	3.95	10.0	37	0.0
(2x) O-Ring, E70-271	4199060	52412	1	17.3	17.3	38.6	98.1	1697	7.3	7.3	38.6	98.1	718	0.00	0.0	0	0.0
(12x) Clips, Rib	4199341	49883	1	20.4	20.4	38.6	98.1	2001	0	0	38.6	98.1	0	3.95	10.0	205	0.0
(12x) Clips, Wiring	4199412	52405	1	18.7	18.7	38.6	98.1	1835	0	0	38.6	98.1	0	3.95	10.0	188	0.0
Oil Absorption pad, 1.9" x 10.125" + (2x) rib clips	4134111 / 4199341	55527 / 49883	1	7.7	7.7	38.6	98.1	755	0	0	38.6	98.1	0	3.95	10.0	77	0.0
Assy., Forward Hull Sections	**4199339**	**49877**															
	Subtotal Weight	**5158.8**	gm	diff													
	Scale Weight	5158.1	gm	**-0.7**													
Endcap, Forward	4199329	49830	1	1892.0	1892.0	15.57	39.5	74805	5178.3	5178.3	15.8	40.1	207566	0.00	0.0	0	0.0
Acoustic transducer (ITC-3013), w/ cable W36	4199379 / 4199036	52267 / 52223	1	1438.1	1438.1	9.02	22.9	32930	656.2	656.2	9.0	22.9	15026	0.00	0.0	0	0.0
O-Ring, E70-238, transducer to Endcap	4199062	52413	1	3.2	3.2	10.50	26.7	85	0	0	10.5	26.7	0	0.00	0.0	0	0.0
(6x) Alum 1/4-20 x 3/4 SHCS + 1/4 LW, xducer to end cap	4199127 / 4199134	55236 / 55252	1	15.2	15.2	10.70	27.2	413	0	0	10.7	27.2	0	0.00	0.0	0	0.0
Hull, Electronics	4199328	49829	1	1691.0	1691.0	22.84	58.0	98114	5240.9	5240.9	22.9	58.2	305095	0.00	0.0	0	0.0
O-Ring, E70-263, elec hull to fwd endcap	4199058	52410	1	7.1	7.1	19.77	50.2	357	5.8	5.8	19.8	50.2	289	0.00	0.0	0	0.0
(8x) 6-32 x 1/2 SHCS + #6 LW, elec hull to fwd endcap	4199111 / 4199122	55183 / 55217	1	10.4	10.4	19.87	50.5	525	0	0	19.9	50.5	0	0.00	0.0	0	0.0
Grounding Strap 24"			1	4.6	4.6	15.33	38.9	179	0	0	15.3	38.9	0	0.38	1.0	4	0.0
Compass bracket,Compass w/compass carrier PCB (w/ tywrap),(4x) 4-40 x 3/8 SHCS + #4 x 1/8L stand off + #4LW	4199336,4199420 / 4205793,4199126 / 4199146 /19928	49848, 55305 / 57690,55228 / 55282	1	73.7	73.7	12.01	30.5	2248	0	0	12.0	30.5	0	-0.35	-0.9	-66	0.0
(2x) 4-40 X 3/8 SHCS + #4 LW, comp mt to fwd endcap	4199126 / 19928	55228 / 55233	1	1.4	1.4	10.80	27.4	38	0	0	10.8	27.4	0	-0.81	-2.1	-3	0.0
Cable Assembly W9 (compass cable)	4199357	52244	1	22.1	22.1	15.33	38.9	861	0	0	15.3	38.9	0	0.38	1.0	21	0.0

SG lead worksheet

SG	**506**			
date	2-Jun-14	**Ballast for:**	Shilshole	
time	15:50	**Density:**	1.0235	
who	Ross	**Thrust:**	**cc**	

Forward Fairing	Wt. goal grams	Actual grams/pcs										Actual sum grams	
Nose plates (qty)	0	pc-1	pc-2	pc-3	pc-4	pc-5	pc-6	pc-7	pc-8	pc-9			
weights	0.0											0.0	0.0
screws	0.0											0.0	0.0
									sum lead			**0.0**	

Scale weight of fwd fairing with nose plates added 0 **gm**

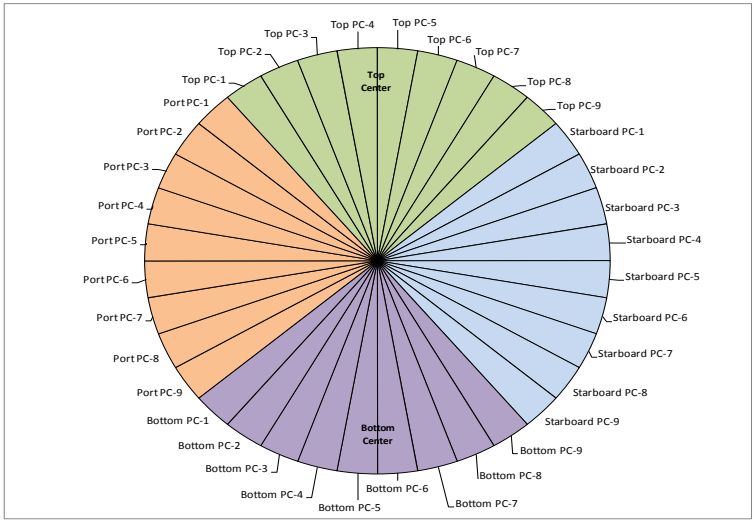
Lead On Pupa At Fairing Joint Ring		***port/top***				***middle***				***stbrd/bottom***			
Bottom side Weight													
weight tape	0.0					109.4	175.6	173.2	69.1	122.9		650.2	-650.2
rubber & tape	0.0							53.7				53.7	-53.7
Port side Weight													
weight tape	0.0											0.0	0.0
rubber & tape	0.0											0.0	0.0
Starboard side Weight													
weight tape	0.0											0.0	0.0
rubber & tape	0.0											0.0	0.0
Top side Weight													
weight tape	0.0											0.0	0.0
rubber & tape	0.0											0.0	0.0
Trim Lead tape	0.0											0.0	0.0
All around strap	0.0					33.9						33.9	-33.9
Total tape at aft	0.0					13.2						13.2	-13.2
										sum lead		**751.0**	

Scale weight of pupa with lead added: 39076 **gm**

Forward, bottom lead		***port/top***				***middle***				***stbrd/bottom***			
weight tape	0.0											0.0	0.0
rubber & tape	0.0											0.0	0.0
All around strap	0.0											0.0	0.0
Total tape	0.0											0.0	0.0
									sum lead			**0.0**	

sum all variable wt. 751.0

Whole glider weight - BEFORE PUTTING IN TANK or BOX - DRY!!! 50280 **gm**



Ballasting worksheet **SG 506**

Date: **19-Jun-14** Time: ######

	Conversions		*Units*	
VBD	-4.07671	counts/cc	cc=cm3	gm=grams
	-0.2453	cc/counts	counts=AtoD counts	

In tank to find original volume of SG

Tank Temp		deg C	Where	
Tank Salinity (meas)		S/m	Where	
Tank Salinity (corr)		ppt	0.963895238	ratio for tank salt
Tank Density		gram/cc	calculated using web-calculator	
SG Mass		grams	measured with lead est. from orig. trim sheet	
SG Volume	#DIV/0!	cc	at neutral, when achieved relative to C_VBD	
Neutral by interation in tank		0	cc	
Relative to set C_VBD		3445	counts	
(Neil's table)	counts*	VBD rel V0, cc	Displacement	
Vol max (oil outside)	518	718	#DIV/0!	cc (pos. floats)
Vol neutral	3445	(obsv in tank)	#DIV/0!	cc
Vol min (oil inside)	3960	-126	#DIV/0!	cc (neg. sinks)
Max movable vol.		*844*		

New enviornment ballasting

SG Mass (observed)	0		Where		
SG Vol max (obsv/est)	0		Where		
SG Vol min	-844				
New enivron density	0.00000	g/cc	Where		
Goal for thrust	0	cc	Where		
New Vol neutral	-844	cc	lead density	11.296	gm/cc
Change mass by	0	gm	vol lead change	0	cc
Projected new mass	0	gm			
Proj. Vol. max	0	cc			

VBD points for new environ

(Neil's table)	counts*	VBD rel V0, cc	Displacement	
Vol max	518	844	0	cc
Vol neutral (C_VBD)	3960	***0***	-844	cc
Vol min	3960	0	-844	cc
Max movable vol.		*844*		
Actual new mass	50280	gm		
Est. Vol. neutral	#DIV/0!	cc		
Est. C_VBD	#DIV/0!	counts		

Regression data From Ocean test	
Mass:	50280.0
Max volume:	
Neutral density:	
C_VBD:	
C_PITCH:	
C_ROLL_DIVE:	
C_ROLL_CLIMB:	
Nose Wt *	
Trim Lead - bottom *	
EPDM base - bottom *	
Trim - port side *	
EPDM base - port *	
Trim Lead - starboard side *	
EPDM base - starboard *	
Trim Lead- top *	
EPDM base - top *	
Trim Lead tape *	
(2) Straps *	
(2) black tape wraps over foam *	
Trim Lead fwd of bulkhead - bottom *	
Trim Lead tape *	
EPDM base fwd of bulkhead - bottom *	
Strap - fwd of bulkhead *	
Measured Thrust *	

Max Volume for:

* - filled in by Macro

Customer Environment	
Density	
Requested Thrust	

Shilshole 52004 cc

Appendix C: Technical Service Bulletin: SIM Card Pad Installation

This service bulletin directs Seaglider customers who perform their own vehicle refurbishments to install a foam pad on the underside of the modem's SIM card cover.

Part Number/Serial Number Effectivity
This TSB applies to Seagliders with serial numbers below 557, except S/N 550 and S/N 554.

Maintenance Level: Intermediate Maintenance Level

Related Documents:
- Part #: 4311043 – Seaglider Refurbishment Manual

Affected Items:
- Part #: 4258969 – Modem, L-Band Transceiver, FIPS, Iridium

Definitions and Acronyms:
- SIM – Subscriber Identity Module

Equipment Needed:
- #1 Phillips Screwdriver
- Isopropyl Alcohol
- Pad, SIM Card, Modem – Part #: 4354701

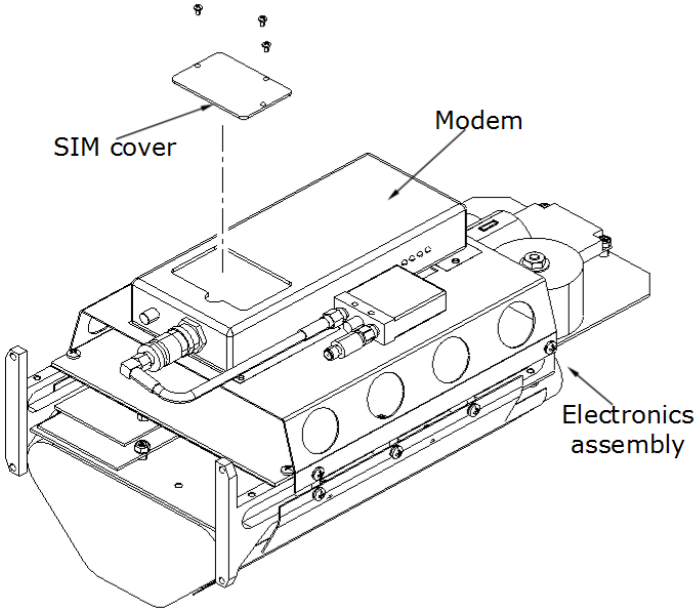
Description:
The design of the modem has been modified to include a foam pad, adhered to the underside of the SIM card cover plate. The purpose of the added pad is to secure the SIM card in place, preventing any movement and ensuring a constant connection with the modem. The pad has been incorporated into the latest build configuration, but will need to be installed in already-fielded systems during the next scheduled refurbishment activity or unscheduled maintenance.

Work Instructions
1. When the forward hull segment of the pressure hull is removed during the refurbishment process, perform the following procedure to install the SIM card pad:

   a. Locate the SIM card cover on top of the modem (the cover should be marked "SIM").

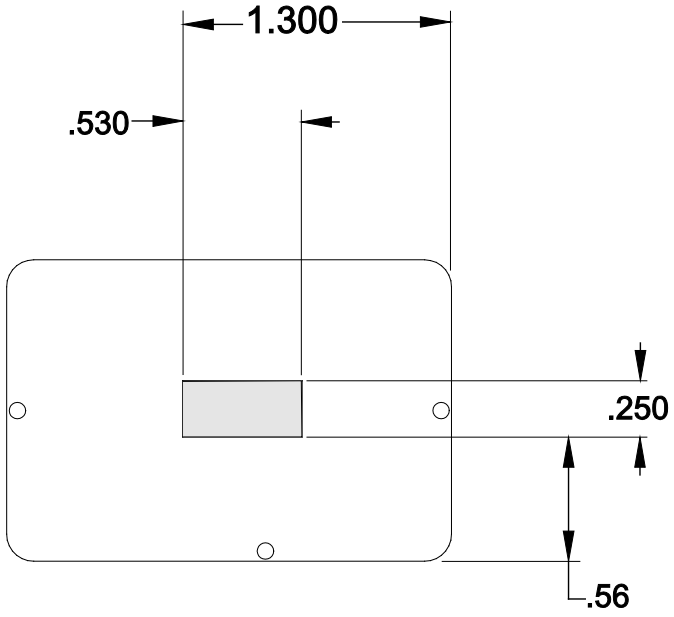
   b. Use a #1 Phillips screwdriver to remove the three screws attaching the cover to the modem assembly (figure 1).

Figure 1: SIM Card Cover Removal



1. Clean the underside of the SIM cover with isopropyl alcohol.
2. Remove the backing from the foam pad, and attach the pad to the underside of the SIM cover (figure 2).

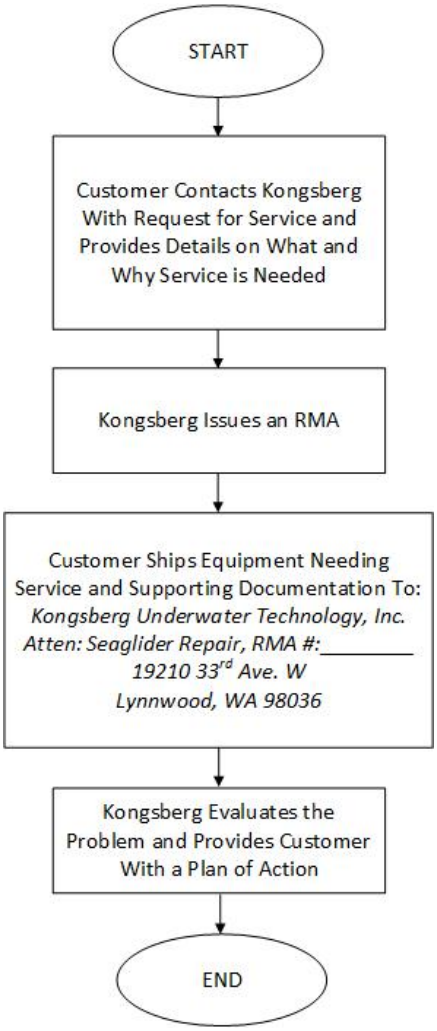
Figure 2: Placement of Foam Pad on SIM Cover (Dimensions in Inches)



3. Install the SIM cover on the modem with three the Phillips head screws.

Appendix D: Equipment Return for Repair/Calibration

The CT sensor and externally-mounted sensors require re-calibration as part of the refurbishment process. Sensors should be returned to Kongsberg for re-calibration, following the same RMA process as repair returns. Refer to the flow chart below.



Appendix E: Material Safety Data Sheets

The following safety data sheets outline the proper handling, storage and disposal information.

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product name	**Never-Seez Blue Moly**
MSDS name	Never-Seez Blue Moly Series
Product name(s) covered	See Section 16 for Product Names Covered.
CAS #	Mixture
Generic description	Petroleum Based Grease Formulations
Manufacturer	Bostik, Inc. 211 Boston Street Middleton, MA 01949 USA
24 hour emergency assistance	Telephone: 1-800-227-0332 (Outside U.S.) 1-703-527-3887
General assistance	Telephone: 1-978-777-0100
MSDS assistance	Telephone: 1-414-607-1347

2. Hazards Identification

Emergency overview	Contact with this material can cause irritation to the skin, eyes and mucous membranes. Irritating fumes and gases may be released upon thermal processing or during combustion. Primary Routes of Exposure: eyes, skin, and inhalation.
Potential health effects	
Eyes	This product may cause irritation to the eyes.
Skin	This product may cause irritation to the skin. Prolonged and/or repeated skin contact with this product may cause irritation/dermatitis.
Inhalation	Fumes released during thermal processing may irritate respiratory system, skin and eyes.
Ingestion	Ingestion can cause gastrointestinal irritation, nausea, vomiting and diarrhea.
Target organs	Skin.

3. Composition / Information on Ingredients

Hazardous components	CAS #	Percent
Nickel	7440-02-0	10 - 30
Aluminum	7429-90-5	0.1 - 1

4. First Aid Measures

First aid procedures	
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention or advice.
Skin contact	For skin contact flush with large amounts of water while removing contaminated clothing. If skin irritation persists, call a physician.
Inhalation	Move to fresh air in case of accidental inhalation of fumes from overheating or combustion. If the affected person is not breathing, apply artificial respiration. Call a physician if symptoms develop or persist.
Ingestion	If the material is swallowed, get immediate medical attention or advice. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting without medical advice.
Notes to physician	Provide general supportive measures and treat symptomatically. Contact Bostik to determine whether any additional information is available.
Medical conditions aggravated by exposure	Dermatitis.

5. Fire Fighting Measures

Extinguishing media	
Suitable extinguishing media	Dry chemical, foam, carbon dioxide, water fog.
Fire fighting equipment/instructions	Firefighters should wear full protective clothing including self contained breathing apparatus.
Dust explosion hazard	None Known
Sensitivity to static discharge	None Known
Unusual fire & explosion hazards	Product may burn and produce toxic gases in a fire.
Flash point	475 °F (246.1 °C)

6. Accidental Release Measures

Emergency action	Wear appropriate protective equipment and clothing during clean-up. Do not allow product to enter sewer or waterways. Follow all Local, State, Federal and Provencial regulations for disposal.
Spill or leak procedure	Scrape up grease and deposit into appropriate containers for disposal.
Containment procedures	Stop source of leak if possible. Contain the discharged material.
Reporting	See Federal reporting requirements listed in Section 15. We recommend you contact local authorities to determine if there may be other local reporting requirements.

7. Handling and Storage

Handling	Wear appropriate protective equipment to avoid contact with skin and eyes.
Storage	Keep tightly closed in a dry and cool place.
Empty container precaution	Attention! Follow label warnings even after container is emptied since empty containers may retain product residues. Do not reuse empty container without professional cleaning for food, clothing, or products for human or animal consumption, or where skin contact can occur.

8. Exposure Controls / Personal Protection

Engineering controls	Ventilation is not normally required.
Personal protective equipment	
Eye protection	Wear safety glasses with side shields.
Skin and body protection	Use impervious gloves. Work clothing sufficient to prevent all skin contact should be worn, such as coveralls and long sleeves.
Respiratory protection	Not normally needed. Special applications may necessitate the use of more stringent respiratory protection equipment.

9. Physical & Chemical Properties

Target solids	100 %
Density	1.2 g/cc
Odor	Greaselike
Color	Blue
Physical state	Paste
Freeze protect	No
VOC (Volatile Organic Compounds)	0 lb/gal

10. Chemical Stability & Reactivity Information

Hazardous reactions/decomposition products	Upon decomposition, this product emits carbon monoxide, carbon dioxide and/or low molecular weight hydrocarbons.
Hazardous polymerization	Will not occur.
Stability	Stable under normal conditions.

11. Toxicological Information

Chronic effects Chronic exposure may cause dermatitis. Chronic overexposure to the hazardous materials in this product has been associated with skin sensitization and dermatitis.

Carcinogenicity If this product contains any carcinogens, they will be noted below:

12. Ecological Information

Ecotoxicological information No data available for this product.

13. Disposal Considerations

It is the obligation of each user of the product mentioned herein to determine and comply with the requirements of all applicable local, state and federal regulations.

Waste disposal Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

14. Transport Information

DOT

Not regulated as hazardous goods.

IATA

Not regulated as hazardous goods.

IMDG

Not regulated as hazardous goods.

15. Regulatory Information

The product(s) covered by this M(SDS) do not include any of the substances above a concentration of 0.1% weight by weight (w/w) in the Candidate List of Substances of Very High Concern (SVHC) for authorization published or proposed by ECHA as follows: the list of 15 substances for authorization published on October 28, 2008, the list of 15 substances proposed on August 31, 2009, the list of 14 substances proposed on January 13, 2010, the list of 8 substances proposed on March 8, 2010, the list of 8 substances proposed on June 18, 2010, the list of 11 substances proposed on October 14, 2010.

Federal regulations All components are on the U.S. EPA TSCA Inventory List.

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance

Aluminum	7429-90-5	ALUMINUM (FUME OR DUST) US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance
Nickel	7440-02-0	NICKEL US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance

State regulations If this product contains any California Proposition 65 chemicals at reportable levels they will be listed below:
Nickel (Metallic)

International regulations This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and contains all the information required by the Controlled Products Regulations.

All components are included on the Canadian Domestic Substances List (DSL).

HMIS Ratings
Health: 2*
Flammability: 1
Physical hazard: 0
Personal protection: X

SARA 311/312 HAZARD CATEGORIES
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

WHMIS status Controlled

WHMIS labeling

WHMIS classification D2A - Other Toxic Effects-VERY TOXIC
D2B - Other Toxic Effects-TOXIC

16. Other Information

Product name(s) covered

BNBM1-BTC12 - BLUE MOLY 12/1# BT C
BNBM42PP1 - BLUE MOLY 42#PP NB42B
BNBM42PS1 - BLUE MOLY 42# PS
BNBM8BTC12 - BLUE MOLY 12/8 OZ BT C
V141701 - NEV-SZ BLUE MOLY NB160 1LB CAN
V141710 - NEV-SZ BLUE MOLY NBBT 16OZ BTC
V141742 - NEV-SZ BLUE MOLY 42LB PL
V141780 - NEV-SZ BLUE MOLY NBBT 8OZ BTC

Disclaimer

The data in this MSDS has been compiled from publicly available sources. This data relates only to the designated product and not to the use of said product in combination with other materials. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist. Responsibility for proper precautions and safe use of the product lies with the user. All data in this MSDS is typical of the product as a whole, and does not represent any individual lot or batch, therefore, Bostik, Inc. makes no warranty about the accuracy of the data herein and assumes no liability for the use of such data. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations.

Further information

If there are any characters following an individual item number, they are just designations for the various types of packaging that are available for this product. For example, a product "G12345-XX" is item number "G12345" with a packaging designation of "XX". These characters do not indicate a different product nor a different regulatory, health, safety and/or environmental status. This document covers the item numbers listed above for all of their packaging types.

Issue date 11/19/2010

Prepared by Bostik, Inc. Regulatory Affairs

Supercedes 08/16/2010

This data sheet contains changes from the previous version in section(s): Regulatory Information: State regulations

DOW CORNING

DOW CORNING CORPORATION
Material Safety Data Sheet

Version: 1.5
Revision Date: 2011/09/07

DOW CORNING(R) 4 ELECTRICAL INSULATING COMPOUND

1. PRODUCT AND COMPANY IDENTIFICATION

Dow Corning Corporation
South Saginaw Road
Midland, Michigan 48686

24 Hour Emergency Telephone: (989) 496-5900
Customer Service: (989) 496-6000
Product Disposal Information: (989) 496-6315
CHEMTREC: (800) 424-9300

MSDS No.: 01903128
Revision Date: 2011/09/07

Generic Description: Inorganic compound
Physical Form: Grease
Color: Translucent white
Odor: Some odor

NFPA Profile: Health 0 Flammability 1 Instability/Reactivity 0

Note: NFPA = National Fire Protection Association

2. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Acute Effects

Eye: Direct contact may cause temporary redness and discomfort.

Skin: No significant irritation expected from a single short-term exposure.

Inhalation: No significant effects expected from a single short-term exposure.

Oral: Low ingestion hazard in normal use.

Prolonged/Repeated Exposure Effects

Skin: No known applicable information.

Inhalation: No known applicable information.

Oral: No known applicable information.

Signs and Symptoms of Overexposure

No known applicable information.

Medical Conditions Aggravated by Exposure

No known applicable information.

The above listed potential effects of overexposure are based on actual data, results of studies performed upon similar compositions, component data and/or expert review of the product. Please refer to Section 11 for the detailed toxicology information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

None present. This is not a hazardous material as defined in the OSHA Hazard Communication Standard.

4. FIRST AID MEASURES

Eye:	If irritation occurs, flush eye(s) with lukewarm gently flowing water for 5 minutes. Obtain medical attention.
Skin:	No health effects expected. If irritation does occur flush with lukewarm, gently flowing water for 5 minutes. If irritation persists, obtain medical advice.
Inhalation:	If symptoms are experienced remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
Oral:	If irritation or discomfort occur, obtain medical advice.
Notes to Physician:	Treat according to person's condition and specifics of exposure.

5. FIRE FIGHTING MEASURES

Flash Point:	212 °F / 100 °C (Closed Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.
Extinguishing Media:	On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO2), dry chemical or water spray. Water can be used to cool fire exposed containers.
Fire Fighting Measures:	Self-contained breathing apparatus and protective clothing should be worn in fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool.
Unusual Fire Hazards:	None.

6. ACCIDENTAL RELEASE MEASURES

Containment/Clean up:	Observe all personal protection equipment recommendations described in Sections 5 and 8. Wipe up or scrape up and contain for salvage or disposal. Clean area as appropriate since spilled materials, even in small quantities, may present a slip hazard. Final cleaning may require use of steam, solvents or detergents. Dispose of saturated absorbant or cleaning materials appropriately, since spontaneous heating may occur. Local, state and federal laws and regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which federal, state and local laws and regulations are applicable. Sections 13 and 15 of this MSDS provide information regarding certain federal and state requirements.

Note: See Section 8 for Personal Protective Equipment for Spills. Call (989) 496-5900, if additional information is required.

7. HANDLING AND STORAGE

Use with adequate ventilation. Avoid eye contact.

Use reasonable care and store away from oxidizing materials. This material in its finely divided form presents an explosion hazard. Follow NFPA 654 (for chemical dusts) or 484 (for metal dusts) as appropriate for managing dust hazards to minimize secondary explosion potential.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component Exposure Limits

There are no components with workplace exposure limits.

Engineering Controls

Local Ventilation:	None should be needed.
General Ventilation:	Recommended.

Personal Protective Equipment for Routine Handling

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Suitable Gloves:	Handle in accordance with good industrial hygiene and safety practices.
Inhalation:	No respiratory protection should be needed.
Suitable Respirator:	None should be needed.

Personal Protective Equipment for Spills

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Inhalation/Suitable Respirator:	No respiratory protection should be needed.
Precautionary Measures:	Avoid eye contact. Use reasonable care.

Note: These precautions are for room temperature handling. Use at elevated temperature or aerosol/spray applications may require added precautions.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Grease
Color:	Translucent white
Odor:	Some odor
Specific Gravity @ 25°C:	> 1
Viscosity:	Not determined.
Freezing/Melting Point:	Not determined.
Boiling Point:	Not determined.
Vapor Pressure @ 25°C:	Not determined.
Vapor Density:	Not determined.
Solubility in Water:	Not determined.
pH:	Not determined.
Volatile Content:	Not determined.
Flash Point:	212 °F / 100 °C (Closed Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.

Note: The above information is not intended for use in preparing product specifications. Contact Dow Corning before writing specifications.

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable.
Hazardous Polymerization:	Hazardous polymerization will not occur.
Conditions to Avoid:	None.
Materials to Avoid:	Oxidizing material can cause a reaction.

Hazardous Decomposition Products

Thermal breakdown of this product during fire or very high heat conditions may evolve the following decomposition products: Carbon oxides and traces of incompletely burned carbon compounds. Silicon dioxide. Formaldehyde.

11. TOXICOLOGICAL INFORMATION

Special Hazard Information on Components

No known applicable information.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution

Complete information is not yet available.

Environmental Effects

Complete information is not yet available.

Fate and Effects in Waste Water Treatment Plants

Complete information is not yet available.

Ecotoxicity Classification Criteria

Hazard Parameters (LC50 or EC50)	High	Medium	Low
Acute Aquatic Toxicity (mg/L)	<=1	>1 and <=100	>100
Acute Terrestrial Toxicity	<=100	>100 and <= 2000	>2000

This table is adapted from "Environmental Toxicology and Risk Assessment", ASTM STP 1179, p.34, 1993.

This table can be used to classify the ecotoxicity of this product when ecotoxicity data is listed above. Please read the other information presented in the section concerning the overall ecological safety of this material.

13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class (40 CFR 261)

When a decision is made to discard this material, as received, is it classified as a hazardous waste? No

State or local laws may impose additional regulatory requirements regarding disposal. Call (989) 496-6315, if additional information is required.

14. TRANSPORT INFORMATION

DOT Road Shipment Information (49 CFR 172.101)

Not subject to DOT.

Ocean Shipment (IMDG)

Not subject to IMDG code.

Air Shipment (IATA)

Not subject to IATA regulations.

Call Dow Corning Transportation, (989) 496-8577, if additional information is required.

15. REGULATORY INFORMATION

Contents of this MSDS comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA Status: All chemical substances in this material are included on or exempted from listing on the TSCA Inventory of Chemical Substances.

EPA SARA Title III Chemical Listings

Section 302 Extremely Hazardous Substances (40 CFR 355):
None.

Section 304 CERCLA Hazardous Substances (40 CFR 302):
None.

Section 311/312 Hazard Class (40 CFR 370):

Acute:	No
Chronic:	No
Fire:	No
Pressure:	No
Reactive:	No

Section 313 Toxic Chemicals (40 CFR 372):
None present or none present in regulated quantities.

Note: Chemicals are listed under the 313 Toxic Chemicals section only if they meet or exceed a reporting threshold.

Supplemental State Compliance Information

California

Warning: This product contains the following chemical(s) listed by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as being known to cause cancer, birth defects or other reproductive harm.

None known.

Massachusetts

CAS Number	Wt %	Component Name
7631-86-9	7.0 - 13.0	Silica, amorphous

New Jersey

CAS Number	Wt %	Component Name
68037-74-1	70.0 - 90.0	Dimethyl, methyl silicone resin
7631-86-9	7.0 - 13.0	Silica, amorphous
70131-67-8	5.0 - 10.0	Dimethyl siloxane, hydroxy-terminated

Pennsylvania

CAS Number	Wt %	Component Name
68037-74-1	70.0 - 90.0	Dimethyl, methyl silicone resin
7631-86-9	7.0 - 13.0	Silica, amorphous
70131-67-8	5.0 - 10.0	Dimethyl siloxane, hydroxy-terminated

16. OTHER INFORMATION

Prepared by: Dow Corning Corporation

These data are offered in good faith as typical values and not as product specifications. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

(R) indicates Registered Trademark

DOW CORNING

DOW CORNING CORPORATION
Material Safety Data Sheet

Version: 5.2
Revision Date: 2013/05/17

DOW CORNING(R) 748 NON-CORROSIVE SEALANT

1. PRODUCT AND COMPANY IDENTIFICATION

Dow Corning Corporation
South Saginaw Road
Midland, Michigan 48686

24 Hour Emergency Telephone: (989) 496-5900
Customer Service: (989) 496-6000
Product Disposal Information: (989) 496-6315
CHEMTREC: (800) 424-9300

MSDS No.: 02184346
Revision Date: 2013/05/17

Generic Description: Sealant.
Physical Form: Paste
Color: White
Odor: Alcoholic odor

NFPA Profile: Health 2 Flammability 1 Instability/Reactivity 0

Note: NFPA = National Fire Protection Association

2. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Acute Effects

Eye: Direct contact may cause temporary redness and discomfort.

Skin: No significant irritation expected from a single short-term exposure.

Inhalation: Irritates respiratory passages very slightly.

Oral: Low ingestion hazard in normal use.

Prolonged/Repeated Exposure Effects

Skin: Repeated skin contact may cause allergic skin reaction. Repeated or prolonged exposure may cause irritation.

Inhalation**:** No known applicable information.

Oral: Repeated ingestion or swallowing large amounts may injure internally.

Signs and Symptoms of Overexposure

No known applicable information.

Medical Conditions Aggravated by Exposure

No known applicable information.

The above listed potential effects of overexposure are based on actual data, results of studies performed upon similar compositions, component data and/or expert review of the product. Please refer to Section 11 for the detailed toxicology information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS Number	Wt %	Component Name
1185-55-3	3.0 - 7.0	Methyltrimethoxysilane

The above components are hazardous as defined in 29 CFR 1910.1200.

4. FIRST AID MEASURES

Eye:	If irritation occurs, flush eye(s) with lukewarm gently flowing water for 5 minutes. Obtain medical attention.
Skin:	As quickly as possible remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Quickly and gently blot or brush away excess chemical. Immediately flush with lukewarm gently flowing water for 15 minutes. Completely decontaminate clothing, shoes and leather goods before reuse or discard. If irritation persists, obtain medical advice.
Inhalation:	If symptoms are experienced remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
Oral:	If irritation or discomfort occur, obtain medical advice.
Notes to Physician:	Treat according to person's condition and specifics of exposure.

5. FIRE FIGHTING MEASURES

Flash Point:	Not applicable.
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.
Extinguishing Media:	On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO2), dry chemical or water spray. Water can be used to cool fire exposed containers.
Fire Fighting Measures:	Self-contained breathing apparatus and protective clothing should be worn in fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool.

Unusual Fire Hazards: None.

6. ACCIDENTAL RELEASE MEASURES

Containment/Clean up: Observe all personal protection equipment recommendations described in Sections 5 and 8. Wipe up or scrape up and contain for salvage or disposal. Clean area as appropriate since spilled materials, even in small quantities, may present a slip hazard. Final cleaning may require use of steam, solvents or detergents. Dispose of saturated absorbant or cleaning materials appropriately, since spontaneous heating may occur. Local, state and federal laws and regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which federal, state and local laws and regulations are applicable. Sections 13 and 15 of this MSDS provide information regarding certain federal and state requirements.

Note: See Section 8 for Personal Protective Equipment for Spills. Call (989) 496-5900, if additional information is required.

7. HANDLING AND STORAGE

Use with adequate ventilation. Product evolves flammable methyl alcohol when exposed to water or humid air. Provide ventilation during use to control exposure within Section 8 guidelines or use air-supplied or self-contained breathing apparatus. Avoid eye contact. Avoid skin contact. Do not take internally.

Use reasonable care and store away from oxidizing materials. Keep container closed and store away from water or moisture. This material in its finely divided form presents an explosion hazard. Follow NFPA 654 (for chemical dusts) or 484 (for metal dusts) as appropriate for managing dust hazards to minimize secondary explosion potential.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component Exposure Limits

CAS Number	Component Name	Exposure Limits
1185-55-3	Methyltrimethoxysilane	Dow Corning guide: TWA 50 ppm. See methyl alcohol comments.

Methyl alcohol forms on contact with water or humid air. Provide adequate ventilation to control exposures within guidelines of OSHA PEL: TWA 200 ppm and ACGIH TLV-skin: TWA 200 ppm, STEL 250 ppm.

Engineering Controls

Local Ventilation: None should be needed.
General Ventilation: Recommended.

Personal Protective Equipment for Routine Handling

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Wash at mealtime and end of shift. If skin contact occurs, change contaminated clothing as soon as possible and thoroughly flush affected areas with cool water. Chemical protective gloves are recommended.
Suitable Gloves:	Avoid skin contact by implementing good industrial hygiene practices and procedures. Select and use gloves and/or protective clothing to further minimize the potential for skin contact. Consult with your glove and/or personnel protective equipment manufacturer for selection of appropriate compatible materials.
Inhalation:	No respiratory protection should be needed.
Suitable Respirator:	None should be needed.

Personal Protective Equipment for Spills

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Wash at mealtime and end of shift. If skin contact occurs, change contaminated clothing as soon as possible and thoroughly flush affected areas with cool water. Chemical protective gloves are recommended.
Inhalation/Suitable Respirator:	No respiratory protection should be needed.
Precautionary Measures:	Avoid eye contact. Avoid skin contact. Do not take internally. Use reasonable care.
Comments:	Product evolves flammable methyl alcohol when exposed to water or humid air. Provide ventilation during use to control exposure within Section 8 guidelines or use air-supplied or self-contained breathing apparatus.

Note: These precautions are for room temperature handling. Use at elevated temperature or aerosol/spray applications may require added precautions.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Paste
Color:	White
Odor:	Alcoholic odor
Specific Gravity @ 25°C:	1.34
Viscosity:	Not determined.
Freezing/Melting Point:	Not determined.
Boiling Point:	Not determined.
Vapor Pressure @ 25°C:	Not determined.
Vapor Density:	Not determined.

Solubility in Water:	Not determined.
pH:	Not determined.
Volatile Content:	Not determined.
Flash Point:	Not applicable.
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.

Note: The above information is not intended for use in preparing product specifications. Contact Dow Corning before writing specifications.

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable.
Hazardous Polymerization:	Hazardous polymerization will not occur.
Conditions to Avoid:	None.
Materials to Avoid:	Oxidizing material can cause a reaction. Water, moisture, or humid air can cause hazardous vapors to form as described in Section 8.

Hazardous Decomposition Products

Thermal breakdown of this product during fire or very high heat conditions may evolve the following decomposition products: Metal oxides. Carbon oxides and traces of incompletely burned carbon compounds. Silicon dioxide. Formaldehyde. Quartz.

11. TOXICOLOGICAL INFORMATION

Component Toxicology Information

This material contains methyltrimethoxysilane (MTMS). MTMS was evaluated in a combined repeated-dose toxicity study with the reproduction/developmental toxicity screening test (OECD 422). Sprague-Dawley rats were gavaged daily at dose levels of 0, 50, 250, and 1000 mg MTMS (in corn oil)/kg body weight. Test article-related effects were seen in one or both sexes at the two top dose levels (unless otherwise noted) and included (but not limited to): increased liver weights; increased incidence of hyperplasia and/or hypertrophy in the liver, thyroid and adrenals (high dose only); acanthocytosis (high dose only); increased prothrombin time; elevations in blood platelet count (high dose only), serum total protein and cholesterol. The no observed adverse effect level (NOAEL) was determined to be 50 mg/kg/day for parental toxicity and 1000 mg/kg/day for effects on reproductive performance and on developmental toxicity.

In a 90-day study, five (5) groups of 10 male and 10 female Sprague-Dawley rats were exposed to target methyltrimethoxysilane concentrations of 0 (control), 25, 100, 400 and 1600 ppm for groups 1 through 5, respectively, for six hours per day, five days per week. Additional satellite groups of 10 males and 10 females were included in the 0 and 1600 ppm exposure groups for evaluation of a 28-day post-exposure recovery period. Based on the grossly observed urinary bladder calculi and kidney dilation at the 400 and 1600 ppm exposure levels, the No Observable Effect Level (NOEL) for methyltrimethoxysilane was 100 ppm.

This material may liberate methanol upon exposure to moisture or humid air. Overexposure to methanol can result in blindness and nervous system effects.

Special Hazard Information on Components

Sensitizers

CAS Number	Wt %	Component Name	
1185-55-3	3.0 - 7.0	Methyltrimethoxysilane	Possible skin sensitizer.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution

Complete information is not yet available.

Environmental Effects

Complete information is not yet available.

Fate and Effects in Waste Water Treatment Plants

Complete information is not yet available.

Ecotoxicity Classification Criteria

Hazard Parameters (LC50 or EC50)	High	Medium	Low
Acute Aquatic Toxicity (mg/L)	<=1	>1 and <=100	>100
Acute Terrestrial Toxicity	<=100	>100 and <= 2000	>2000

This table is adapted from "Environmental Toxicology and Risk Assessment", ASTM STP 1179, p.34, 1993.

This table can be used to classify the ecotoxicity of this product when ecotoxicity data is listed above. Please read the other information presented in the section concerning the overall ecological safety of this material.

13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class (40 CFR 261)

When a decision is made to discard this material, as received, is it classified as a hazardous waste? No

State or local laws may impose additional regulatory requirements regarding disposal. Call (989) 496-6315, if additional information is required.

14. TRANSPORT INFORMATION

DOT Road Shipment Information (49 CFR 172.101)

Not subject to DOT.

Ocean Shipment (IMDG)

Not subject to IMDG code.

Air Shipment (IATA)

Not subject to IATA regulations.

Call Dow Corning Transportation, (989) 496-8577, if additional information is required.

15. REGULATORY INFORMATION

Contents of this MSDS comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA Status: All chemical substances in this material are included on or exempted from listing on the TSCA Inventory of Chemical Substances.

EPA SARA Title III Chemical Listings

Section 302 Extremely Hazardous Substances (40 CFR 355):
None.

Section 304 CERCLA Hazardous Substances (40 CFR 302):
None.

Section 311/312 Hazard Class (40 CFR 370):

Acute:	Yes
Chronic:	Yes
Fire:	No
Pressure:	No
Reactive:	No

Section 313 Toxic Chemicals (40 CFR 372):
None present or none present in regulated quantities.

Note: Chemicals are listed under the 313 Toxic Chemicals section only if they meet or exceed a reporting threshold.

Supplemental State Compliance Information

California

Warning: This product contains the following chemical(s) listed by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as being known to cause cancer, birth defects or other reproductive harm.

None known.

New Jersey

CAS Number	Wt %	Component Name
P871176	40.0 - 60.0	Dimethyl siloxane, trimethoxysilyl-terminated
471-34-1	30.0 - 50.0	Calcium carbonate
68083-19-2	5.0 - 10.0	Dimethyl siloxane, dimethylvinyl-terminated
1185-55-3	3.0 - 7.0	Methyltrimethoxysilane
13463-67-7	1.0 - 5.0	Titanium dioxide
14808-60-7	<=0.1	Quartz

Pennsylvania

CAS Number	Wt %	Component Name
P871176	40.0 - 60.0	Dimethyl siloxane, trimethoxysilyl-terminated
471-34-1	30.0 - 50.0	Calcium carbonate
68083-19-2	5.0 - 10.0	Dimethyl siloxane, dimethylvinyl-terminated
1185-55-3	3.0 - 7.0	Methyltrimethoxysilane
13463-67-7	1.0 - 5.0	Titanium dioxide

16. OTHER INFORMATION

Prepared by: Dow Corning Corporation

These data are offered in good faith as typical values and not as product specifications. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

(R) indicates Registered Trademark

XIAMETER(R) PMX-200 SILICONE FLUID 12500CS

1. PRODUCT AND COMPANY IDENTIFICATION

Dow Corning Corporation
South Saginaw Road
Midland, Michigan 48686

24 Hour Emergency Telephone: (989) 496-5900
Customer Service: (989) 496-6000
Product Disposal Information: (989) 496-6315
CHEMTREC: (800) 424-9300

MSDS No.: 04088901 Revision Date: 2011/02/01

Generic Description: Silicone
Physical Form: Viscous Liquid
Color: Colorless
Odor: Characteristic odor

NFPA Profile: Health 0 Flammability 1 Instability/Reactivity 0

Note: NFPA = National Fire Protection Association

2. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Acute Effects

Eye: Direct contact may cause temporary redness and discomfort.

Skin: No significant irritation expected from a single short-term exposure.

Inhalation: No significant effects expected from a single short-term exposure.

Oral: Low ingestion hazard in normal use.

Prolonged/Repeated Exposure Effects

Skin: No known applicable information.

Inhalation**:** No known applicable information.

Oral: No known applicable information.

Signs and Symptoms of Overexposure

No known applicable information.

Medical Conditions Aggravated by Exposure

No known applicable information.

The above listed potential effects of overexposure are based on actual data, results of studies performed upon similar compositions, component data and/or expert review of the product. Please refer to Section 11 for the detailed toxicology information.

XIAMETER(R) PMX-200 SILICONE FLUID 12500CS

3. COMPOSITION/INFORMATION ON INGREDIENTS

None present. This is not a hazardous material as defined in the OSHA Hazard Communication Standard.

4. FIRST AID MEASURES

Eye:	If irritation occurs, flush eye(s) with lukewarm gently flowing water for 5 minutes. Obtain medical attention.
Skin:	No health effects expected. If irritation does occur flush with lukewarm, gently flowing water for 5 minutes. If irritation persists, obtain medical advice.
Inhalation:	If symptoms are experienced remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
Oral:	If irritation or discomfort occur, obtain medical advice.
Notes to Physician:	Treat according to person's condition and specifics of exposure.

5. FIRE FIGHTING MEASURES

Flash Point:	610 °F / 321.1 °C (Closed Cup) > 482 °F / > 250 °C (Cleveland Open Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.
Extinguishing Media:	On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO2), dry chemical or water spray. Water can be used to cool fire exposed containers.
Fire Fighting Measures:	Self-contained breathing apparatus and protective clothing should be worn in fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool.
Unusual Fire Hazards:	None.

6. ACCIDENTAL RELEASE MEASURES

Containment/Clean up:	Determine whether to evacuate or isolate the area according to your local emergency plan. Observe all personal protection equipment recommendations described in Sections 5 and 8. For large spills, provide diking or other appropriate containment to keep material from spreading. If diked material can be pumped, store recovered material in appropriate container. Clean up remaining materials from spill with suitable absorbant. Clean area as appropriate since spilled materials, even in small quantities, may present a slip hazard. Final cleaning may require use of steam, solvents or detergents. Dispose of saturated absorbant or cleaning materials appropriately, since spontaneous heating may occur. Local, state and federal laws and regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which federal, state and local laws and regulations are applicable. Sections 13 and 15 of this MSDS provide information regarding certain federal and state requirements.

Note: See Section 8 for Personal Protective Equipment for Spills.

7. HANDLING AND STORAGE

Use with adequate ventilation. Avoid eye contact.

Use reasonable care and store away from oxidizing materials.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component Exposure Limits

There are no components with workplace exposure limits.

Engineering Controls

Local Ventilation:	None should be needed.
General Ventilation:	Recommended.

Personal Protective Equipment for Routine Handling

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Suitable Gloves:	Handle in accordance with good industrial hygiene and safety practices.
Inhalation:	No respiratory protection should be needed.
Suitable Respirator:	None should be needed.

Personal Protective Equipment for Spills

XIAMETER(R) PMX-200 SILICONE FLUID 12500CS

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Inhalation/Suitable Respirator:	No respiratory protection should be needed.
Precautionary Measures:	Avoid eye contact. Use reasonable care.
Comments:	When heated to temperatures above 150°C (300°F) in the presence of air, product can form formaldehyde vapors. Physical and health hazard information is readily available on the Material Safety Data Sheet.

Note: These precautions are for room temperature handling. Use at elevated temperature or aerosol/spray applications may require added precautions. For further information regarding aerosol inhalation toxicity, please refer to the guidance document regarding the use of silicone-based materials in aerosol applications that has been developed by the silicone industry (www.SEHSC.com) or contact the Dow Corning customer service group.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Viscous Liquid
Color:	Colorless
Odor:	Characteristic odor
Specific Gravity @ 25°C:	0.97
Viscosity:	12500 cSt
Freezing/Melting Point:	Not determined.
Boiling Point:	> 65 °C
Vapor Pressure @ 25°C:	Not determined.
Vapor Density:	Not determined.
Solubility in Water:	Not determined.
pH:	Not determined.
Volatile Content:	Not determined.
Flash Point:	610 °F / 321.1 °C (Closed Cup)> 482 °F / > 250 °C (Cleveland Open Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.

Note: The above information is not intended for use in preparing product specifications.

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable.
Hazardous Polymerization:	Hazardous polymerization will not occur.
Conditions to Avoid:	None.
Materials to Avoid:	Oxidizing material can cause a reaction.

Hazardous Decomposition Products

Thermal breakdown of this product during fire or very high heat conditions may evolve the following decomposition products: Carbon oxides and traces of incompletely burned carbon compounds. Silicon dioxide. Formaldehyde.

11. TOXICOLOGICAL INFORMATION

Special Hazard Information on Components

No known applicable information.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution

Air:	This product is a high molecular weight liquid polymer which has a very low vapour pressure (<1 mm Hg). As a result it is unlikely to become an atmospheric contaminant unless generated as an aerosol.
Water:	This product has a very low water solubility (< 100 ppb). As it has a specific gravity of < 1, if discharged to water, it will initially form a surface film. As the product is non volatile and has a high binding affinity for particulate matter, it will adsorb to particulates and sediment out.
Soil:	If discharged to surface water, this product will bind to sediment. If discharged in effluent to a waste water treatment plant, the product is removed from the aqueous phase by binding to sewage sludge. If the sewage sludge is subsequently spread on soil, the silicone product is expected to degrade.
Degradation:	This product, polydimethylsiloxane, degrades in soil abiotically to form smaller molecules. These in turn are either biodegraded in soil or volatilized into the air where they are broken down in the presence of sunlight. Under appropriate conditions, the ultimate degradation products are inorganic silica, carbon dioxide and water vapour. Due to the very low water solubility of this product, standard OECD protocols for ready and inherent biodegradability are not suitable for measuring the biodegradability of this product. The product is removed >80% during the sewage treatment process.

Environmental Effects

Toxicity to Water Organisms:	Based on analogy to similar materials this product is expected to exhibit low toxicity to aquatic organisms.
Toxicity to Soil Organisms:	Experiments show that when sewage sludge containing polydimethylsiloxane is added to soil, it has no effect on soil micro-organisms, earthworms or subsequent crops grown in the soil.

Bioaccumulation: This product is a liquid and is a high molecular weight polymer. Due to its physical size it is unable to pass through, or be absorbed by biological membranes. This has been confirmed by testing or analogy with similar products.

Fate and Effects in Waste Water Treatment Plants

This product or similar products has been shown to be non-toxic to sewage sludge bacteria.

Ecotoxicity Classification Criteria

Hazard Parameters (LC50 or EC50)	High	Medium	Low
Acute Aquatic Toxicity (mg/L)	<=1	>1 and <=100	>100
Acute Terrestrial Toxicity	<=100	>100 and <= 2000	>2000

This table is adapted from "Environmental Toxicology and Risk Assessment", ASTM STP 1179, p.34, 1993.

This table can be used to classify the ecotoxicity of this product when ecotoxicity data is listed above. Please read the other information presented in the section concerning the overall ecological safety of this material.

13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class (40 CFR 261)

When a decision is made to discard this material, as received, is it classified as a hazardous waste? No

State or local laws may impose additional regulatory requirements regarding disposal.

14. TRANSPORT INFORMATION

DOT Road Shipment Information (49 CFR 172.101)

Not subject to DOT.

Ocean Shipment (IMDG)

Not subject to IMDG code.

Air Shipment (IATA)

Not subject to IATA regulations.

15. REGULATORY INFORMATION

Contents of this MSDS comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA Status: All chemical substances in this material are included on or exempted from listing on the TSCA Inventory of Chemical Substances.

EPA SARA Title III Chemical Listings

Section 302 Extremely Hazardous Substances (40 CFR 355):
None.

Section 304 CERCLA Hazardous Substances (40 CFR 302):
None.

Section 311/312 Hazard Class (40 CFR 370):

Acute:	No
Chronic:	No
Fire:	No
Pressure:	No
Reactive:	No

Section 313 Toxic Chemicals (40 CFR 372):
None present or none present in regulated quantities.

Note: Chemicals are listed under the 313 Toxic Chemicals section only if they meet or exceed a reporting threshold.

Supplemental State Compliance Information

California

Warning: This product contains the following chemical(s) listed by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as being known to cause cancer, birth defects or other reproductive harm.

None known.

Massachusetts

No ingredient regulated by MA Right-to-Know Law present.

New Jersey

CAS Number	Wt %	Component Name
63148-62-9	85.0 - 100.0	Polydimethylsiloxane

Pennsylvania

CAS Number	Wt %	Component Name
63148-62-9	85.0 - 100.0	Polydimethylsiloxane

XIAMETER(R) PMX-200 SILICONE FLUID 12500CS

16. OTHER INFORMATION

Prepared by: Dow Corning Corporation

These data are offered in good faith as typical values and not as product specifications. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

http://www.xiameter.com

ELECTROCHEM
CREATING TOMORROW

Electrochem Solutions, Inc.
A Subsidiary of Greatbatch, Inc.
670 Paramount Drive
Raynham, MA 02767 USA
Tel: 781.830.5800 Fax: 781.575.1545

Greatbatch

MATERIAL SAFETY DATA SHEET

Issued: 8/30/2011

Section 1 – IDENTIFICATION

Product Name:

LITHIUM SULFURYL CHLORIDE CELLS AND BATTERIES

Hermetically-Sealed Lithium Sulfuryl Chloride Cells & Batteries

All Electrochem CSC & PMX Cells and Batteries

Section 2 – COMPOSITION/INFORMATION ON INGREDIENTS

Sulfuryl Chloride 7791-25-5	**TLV/PEL: N/A**
Lithium 7439-93-2	**TLV/PEL: N/A**
Chlorine 7782-50-5	**ACGIH: 1.5mg/m3 TLV/TWA**
Carbon 1333-86-4	**ACGIH: 3.5 mg/m3 TLV/TWA**

Section 3 – HAZARDS IDENTIFICATION

****DANGER**** INTERNAL CONTENTS ARE EXTREMELY HAZARDOUS. LEAKING FLUID IS CORROSIVE AND DANGEROUS UPON INHALATION. BATTERY MAY BE EXPLOSIVE AT HIGHER TEMPERATURES.

Do not expose to temperatures above the maximum rated temperature as specified by the manufacturer due to leak hazard.

If cell or battery leaks or vents

Primary Routes of Entry: Inhalation.
Carcinogenicity: Not listed by NTP, IARC, or regulated by OSHA.
Health Hazards: **Acute –** Vapors are very irritating to skin, eyes, and mucous membranes. Inhalation of Thionyl chloride or sulfuryl chloride vapors may result in pulmonary edema.
Chronic – Overexposure can cause symptoms of non-fibrotic lung injury.
Signs and Symptoms of Exposure: Eye and mucous membrane irritation.
Medical Conditions Generally Aggravated by Exposure: Asthma, other respiratory disorders, skin allergies, and eczema.

Section 4 – FIRST AID MEASURES

Eye Contact: Flush with running water for at least 15 minutes. Hold eyelids apart. Seek immediate medical attention. Contact results in acidic burns.
Skin Contact: Rinse with large amounts of running water. Avoid hot water and rubbing skin. If burns develop, seek medical attention. Contact results in acidic burns.
Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. May result in pulmonary edema.
Ingestion: Drink copious amounts of water (or milk if available). Do not induce vomiting. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Immediately seek medical attention.

Section 5 – FIRE FIGHTING MEASURES

Flash Point: N/A **Auto-Ignition Temp:** N/A **Flammable Limits:** N/A
Extinguisher Media: Copious amounts of water. Lith-X powder, Class D fire extinguisher, Dry Lithium Chloride, Graphite Powder, Pyrene G-1 may not be effective on resulting secondary fires.
Special Fire Fighting Procedures: Cover with Lith-X powder, Class D fire extinguisher, dry lithium chloride, or graphite powder. DO NOT USE CO_2, Class ABC, or soda ash extinguisher. Wear protective breathing apparatus; a positive pressure Self Contained Breathing Apparatus (SCBA), or Air Purifying Respirator (APR). Be aware of secondary fires.
Unusual Fire and Explosion Hazards: Do not short circuit, recharge, over discharge (discharge below 0.0 Volts), puncture, crush or expose to temperatures above the maximum rated temperature as specified by the manufacturer**.** Cell may leak, vent, or explode. If a bright white flame is present, lithium content is exposed and on fire.

Section 6 – ACCIDENTAL RELEASE MEASURES

Accidental Releases: Do not breathe vapors or touch liquid with bare hands (see section 4).
Waste Disposal Methods: Evacuate area. If possible, a trained person should attempt to stop or contain the leak by neutralizing spill with soda lime or baking soda. A NIOSH Approved Acid Gas Filter Mask or Self-Contained Breathing Apparatus should be worn. Seal leaking battery and soda lime or baking soda in a plastic bag and dispose of as hazardous waste.
Other: Follow North American Emergency Response Guide (NAERG) #138 for cells involved in an accident, cells that have vented, or have exploded.

Section 7 – HANDLING & STORAGE

Storage: Cells should be stored at room temperature, approx. 21°C (70°F). Do not store batteries in high humidity environments for long periods. High Temperature storage will degrade performance.
Precautions: Do not short circuit or expose to temperatures above the maximum rated temperature as specified by the manufacturer. Do not recharge, over discharge, puncture or crush.
Other Conditions: Do not store cells in close proximity of other combustible / flammable materials.

Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

When handling internal components:

Respiratory Protection: NIOSH Approved Acid Gas Filter Mask, or Self-Contained Breathing Apparatus.
Protective Gloves: Nitrile or PVC, Gloves should be 15 ml (0.015 in), or thicker.
Eye Protection: Chemical Worker Safety Glasses or face shield.
Ventilation To Be Used: Negative pressure chemical fume hood.
Other Protective Clothing & Equipment: Chemical Laboratory Safety Glasses, Protective Apron, Acid Resistant Protective Clothing, and face shield.
Hygienic Work Practices: Use good chemical hygiene practice. Do not eat or drink when handling contents. Avoid unnecessary contact.

Section 9 – PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	Sulfuryl Chloride: 69oC
Vapor Pressure:	Sulfuryl Chloride: 105mm @ 20 °C
Vapor Density:	Sulfuryl Chloride: 4.7 (air = 1)
Solubility in Water:	Sulfuryl Chloride: Decomposes violently on contact with water.
Specific Gravity:	Sulfuryl Chloride: 13.8 lb/gal
Melting Point:	Sulfuryl Chloride: -54 °C
Evaporation Rate:	No Data
Water Reactive:	Sulfuryl Chloride hydrolyzes to form sulfuric, chlorosulfuric, and hydrochloric acids and strongly acidic wastewater.
Appearance & Odor:	Sulfuryl Chloride – Yellow; sharp, pungent odor.
Other:	N/A

Section 10 – STABILITY & REACTIVITY

Stability: Stable **Incompatibility:** N/A **Hazardous Polymerization:** Will not occur.
Conditions to Avoid: Temperatures above the maximum rated temperature as specified by the manufacturer due to leak hazard. High humidity for extended periods.
Hazardous Decomposition Products: Sulfur Dioxide $_{(g)}$, Hydrogen Chloride $_{(g)}$, Hydrogen $_{(g)}$

Section 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity (as applicable):

Thionyl Chloride		**Sulfuryl Chloride**	
LC_{50} (Inhalation):	500 ppm (rat 1-hr)	**LC_{50}** (Inhalation):	130-250 ppm (rat 1-hr)
LD_{50}:	N/A	**LD_{50}:**	N/A
Eye Effects:	Corrosive	**Eye Effects:**	Corrosive
Skin Effects:	Corrosive	**Skin Effects:**	Corrosive

Section 12 – ECOLOGICAL INFORMATION

Aquatic Toxicity: Do not let internal components enter marine environments. Avoid releases into waterways, wastewater or groundwater.

Section 13 – DISPOSAL CONSIDERATIONS

Proper Shipping Name: Waste Lithium Batteries
UN Number: 3090
Hazard Classification: Class 9 (Misc.)
Packing Group: II
Labels Required: MISCELLANEOUS, HAZARDOUS WASTE
Waste Disposal Code: D003
Other: All lithium thionyl chloride batteries should be disposed of by a certified hazardous waste disposal facility.

Section 14 – TRANSPORT INFORMATION

US DOT (per 49 CFR 172.101) and IATA/ICAO
Proper Shipping Name: Lithium Metal Batteries
UN Number: UN 3090 (UN 3091 for *Lithium Metal Batteries Contained in Equipment or Lithium Metal batteries Packed With Equipment)*)
Hazard Classification: Class 9 (Misc.)
Packing Group: II
Labels Required: MISCELLANEOUS HAZARD CLASS 9, LITHIUM BATTERY LABEL (IATA 7.4.8)
Other: CARGO AIRCRAFT ONLY (Forbidden as cargo aboard passenger aircraft)
Shipping Requirements
DOT: Lithium batteries and cells are subject to shipping requirements exceptions under 49 CFR 173.185.
IATA: Shipping of lithium batteries in aircrafts are regulated by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) requirements in Special Provision A48, A88, A99, A154, A164 and Packing Instruction 968, 969, or 970.

Section 15 – REGULATORY INFORMATION

OSHA Status: This product is considered an "Article" and the internal component (thionyl chloride / sulfuryl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200.

Section 16 – OTHER INFORMATION

Lithium Battery Safety
With proper use and handling, lithium batteries have demonstrated an excellent safety record. The success and wide use of lithium batteries is partially due to the fact that they contain more energy per unit weight than conventional batteries. However, the same properties that result in a high energy density also contribute to potential hazards if the energy is released at a fast-uncontrolled rate. In recognition of the high-energy content of lithium systems, safety has been incorporated into the design and manufacture of all Electrochem batteries. However, abuse or mishandling of lithium batteries can still result in hazardous conditions. The information provided here is intended to give users some guidelines to safe handling and use of Electrochem lithium batteries.

Cell Abuse
In general, the conditions that cause damage to cells and jeopardize safety are summarized on the label of each cell. These conditions include:

- Short Circuit
- Charging
- Forced Over discharge
- Excessive heating or incineration
- Crush, puncture or disassembly
- Very rough handling or high shock and vibration could also result in cell damage.

Cell Handling and Inspection Guidelines
The most frequent forms of cell abuse can easily be identified and controlled in the workplace. It is our experience that inadvertent short circuits are the largest single cause of field failures.

Problems associated with shorting as well as other hazardous conditions can be greatly reduced by observing the following guidelines:

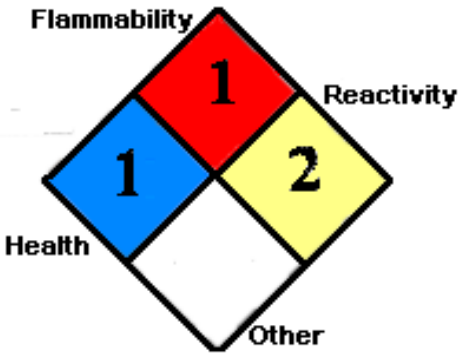
- Cover all metal work surfaces with an insulating material.
- The work area should be clean and free of sharp objects that could puncture the insulating sleeve on each cell.
- Never remove the shrink-wrap from a cell or battery pack.
- All persons handling cells should remove jewelry items such as rings, wristwatches, pendants, etc., that could come in contact with the battery terminals.
- If cells are removed from their original packages for inspection, they should be neatly arranged to preclude shorting.
- Cells should be transported in plastic trays set on pushcarts. This will reduce the chances of cells being dropped on the floor, causing physical damage.
- All inspection tools (calipers, rulers, etc.) should be made from non-conductive materials, or covered with a non-conductive tape.
- Cells should be inspected for physical damage. Cells with dented cases or terminal caps should be inspected for electrolyte leakage. If any is noted, the cell should be disposed of in the proper manner.

Cell Storage
Cells should be stored in their original containers. Store cells in a well ventilated, cool, dry area. Store cells in an isolated area, away from combustible materials. Never stack heavy objects on top of boxes containing lithium batteries to preclude crushing or puncturing the cell case.

Handling During Product Assembly
All personnel handling batteries should wear appropriate protective equipment such as safety glasses.

- Do not solder wires or tabs directly to the battery. Only solder to the leads welded to the cell by the manufacturer.
- Never touch a cell case directly with a hot soldering iron. Heat sinks should be used when soldering to the tabs, and contact with the solder tabs should be limited to a few seconds.
- Cells should not be forced into (or out of) battery holders or housings. This could deform the cell causing an internal short circuit, or fracturing the glass to metal hermetic seal.
- All ovens or environmental chambers used for testing cells or batteries should be equipped with an over-temperature controller to protect against excessive heat.
- Only precision convection ovens should be used for cell testing. Lesser ovens may exhibit uneven heating and hot spots that can exceed the rated temperature of the battery.
- Do not connect cells or batteries of different chemistries together.
- Do not connect cells or batteries of different sizes together.
- Do not connect old and new batteries together.
- Consult Electrochem before encapsulating batteries during discharge. Cells may exceed their maximum rated temperature if insulated.
- Although we have provided a general overview of lithium battery safety and handling, we urge you to call us with any questions. Our technical services staff will be pleased to assist you with your questions.

NFPA RATING



- For cells or battery packs involved in an accident, cells that have vented, or exploded, follow the North American Emergency Response Guide (NAERG) #138.

- **24-HOUR EMERGENCY RESPONSE PHONE NUMBER:**
  (800) 255-3924

Rev. 2010A
Date: 05/05/2010

MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

BRIGHTSIDE BLACK

MSDS Revision No: E3 –7
MSDS Revision Date: 10/25/2005

International Paint LLC
6001 Antoine Drive
Houston, Texas 77091

EMERGENCY NUMBERS:

(800) 424–9300	CHEMTREC (USA)
(703) 527–3887	CHEMTREC (Intl)
(800) 854–6813	Poison Control Center
CUSTOMER SERVICE:	(Non–Emergency)
(800) 589–1267	International Paint
(800) 631–7481	Interlux

1. GENERAL INFORMATION

Product Identity: BRIGHTSIDE BLACK

Bulk Sales Reference No: Y4258

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.

NOTICE: OSHA hazardous chemicals are listed in Section 2 if present at 1% or more. Carcinogens and extraordinarily/special hazardous chemicals are listed in Section 2 if present at .1% or more. Additional regulatory information for specific chemical categories is included in Section 15.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
000091–20–3	Naphthalene 0.10 – 1.0% by Weight	OSHA:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL
		ACGIH:	10 ppm TWA15 ppm STEL
		NIOSH:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL250 ppm IDLH
		Supplier:	No Established Limit
		OHSA, CAN:	10 ppm TWAEV; 52 mg/m3 TWAEV15 ppm STEV; 78 mg/m3 STEV
		Mexico:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	Hemolysis and eye irritation that causes cataracts
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: Yes; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
000100–41–4	Ethyl benzene 0.10 – 1.0% by Weight	OSHA:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL
		ACGIH:	100 ppm TWA125 ppm STEL
		NIOSH:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL800 ppm IDLH
		Supplier:	No Established Limit
		OHSA, CAN:	100 ppm TWAEV; 435 mg/m3 TWAEV125 ppm STEV; 540 mg/m3 STEV
		Mexico:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL
		Brazil:	78 ppm TWA; 340 mg/m3 TWA
		Source	Health Data
		NIOSH:	Eye skin
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No

		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: Yes; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001333−86−4	Carbon black 1.0 – 10% by Weight	OSHA:	3.5 mg/m3 TWA
		ACGIH:	3.5 mg/m3 TWA
		NIOSH:	3.5 mg/m3 TWA; 0.1 mg/m3 TWA (as PAH, carbon black in presence of polycyclic aromatic hydrocarb1750 mg/m3 IDLH
		Supplier:	No Established Limit
		OHSA, CAN:	3.5 mg/m3 TWAEV
		Mexico:	3.5 mg/m3 TWA7 mg/m3 STEL
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	Lung cardiovascular
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: Yes; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
008052−41−3	Stoddard solvent 10 – 25% by Weight	OSHA:	500 ppm TWA; 2900 mg/m3 TWA
		ACGIH:	100 ppm TWA
		NIOSH:	350 mg/m3 TWA1800 mg/m3 Ceiling (15 minute)20000 mg/m3 IDLH
		Supplier:	No Established Limit
		OHSA, CAN:	525 mg/m3 TWAEV (140 Degree C Flash Aliphatic Solvent)
		Mexico:	100 ppm TWA; 523 mg/m3 TWA200 ppm STEL; 1050 mg/m3 STEL
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	Eye nose
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
064742−47−8	Petroleum distillates, hydrotreated light 1.0 – 10% by Weight	OSHA:	No Established Limit
		ACGIH:	200 mg/m3 TWA (application restricted to conditions in which there are negligible aerosol expos
		NIOSH:	No Established Limit
		Supplier:	No Established Limit
		OHSA, CAN:	No Established Limit
		Mexico:	No Established Limit
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	No Established Limit
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data

064742−88−7	Solvent naphtha (petroleum), medium aliphatic 10 – 25% by Weight	OSHA:	No Established Limit
		ACGIH:	No Established Limit
		NIOSH:	No Established Limit
		Supplier:	No Established Limit
		OHSA, CAN:	No Established Limit
		Mexico:	No Established Limit
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	No Established Limit
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
064742−94−5	Naphtha (petroleum), heavy aromatic 1.0 – 10% by Weight	OSHA:	No Established Limit
		ACGIH:	No Established Limit
		NIOSH:	No Established Limit
		Supplier:	No Established Limit
		OHSA, CAN:	No Established Limit
		Mexico:	No Established Limit
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	No Established Limit
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Avoid contact with eyes, skin and clothing.		
Inhalation:	Harmful if inhaled. Causes nose and throat irritation. Vapors may affect the brain or nervous system causing dizziness, headache or nausea.		
Eyes:	Causes severe eye irritation. Do not get in eyes.		
Skin:	Causes skin irritation. May be harmful if absorbed through the skin.		
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.		
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient). Birth defect hazard. Contains an ingredient which can cause birth defects (See Section 2 and Section 15 for each ingredient). Possible cancer hazard. Contains an ingredient which may cause cancer based on animal data (See Section 2 and Section 15 for each ingredient). Risk of cancer depends on duration and level of exposure.		
HMIS Rating:	Health: Unknown	Flammability: Unknown	Reactivity: Unknown

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	

	If swallowed, immediately contact Poison Control Center at 1−800−854−6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Select equipment to provide protection from the ingredients listed in Section 2 of this document. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates dust, vapor, or mist levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1−800−243−4630, in Canada call 1−800−267−4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site−specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site−specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Prevent build−up of vapors by opening all windows and doors to achieve cross−ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: 105 C: 41
Lower Explosive Limit (LEL):	1 (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	Combustible liquid and vapor. FLAMMABLE/COMBUSTIBLE MATERIALS: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks) creating a vapor explosion hazard. Runoff to sewers may create fire or explosion hazard. Containers may explode when heated.
Fire Fighting Procedures:	Also Reference Emergency Response Guide Number: Not Determined

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
pH:	No Established Limit
Specific Gravity:	0.920761
Boiling Point (F):	250
Vapor Density:	Heavier than air
VOC Content (lbs):	Refer to the Technical Data Sheet for this product.
Evaporation Rate:	Slower than ether

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 32 and 120 F
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Vapors may cause flash fire or ignite explosively. Prevent build−up of vapors by opening all windows and doors to achieve cross−ventilation. Do not get in eyes, on skin or clothing. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Use only non−sparking equipment to handle spilled material and absorbent. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand, or other non−combustible material and transfer to containers. Use non−sparking tools to collect absorbed material.
Public Safety:	CALL CHEMTREC at (800)−424−9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. LARGE SPILLS: Consider initial downwind evacuation for at least 300 meters (1000 feet). Also, Reference Emergency Response Guide Number: Not Determined

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		IMO / IMDG (Ocean Transportation)	
DOT Proper Shipping Name: CONSUMER COMMODITY, ORM−D		IMDG Proper Shipping Name: Paint	
DOT Hazard Class:	NR	IMDG Hazard Class:	Flammable Liquid, 3
UN / NA Number:	Not Regulated	UN Number:	UN 1263
DOT Packing Group:	Not Regulated	IMDG Packing Group:	III
CERCLA/DOT RQ:	1622 gal. / 12444 lbs.	System Reference Code:	181

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all−inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory. **Note:** Any chemical ingredients listed in Section 15, that do not also appear in Section 2, are contained in the product at a concentration below the applicable OSHA threshold level of 1% or 0.1%.

WHMIS Classification:	No Established Limit
Regulatory List	Product Ingredients on List
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%):	
(No Product Ingredients Listed)	
EPCRA 311/312 Chemicals and RQs (>.1%) :	
000100−41−4	Ethyl benzene : 1000 lb final RQ; 454 kg final RQ
000091−20−3	Naphthalene : 100 lb final RQ; 45.4 kg final RQ
001330−20−7	Xylenes (o−, m−, p− isomers) : 100 lb final RQ; 45.4 kg final RQ
EPCRA 302 Extremely Hazardous (>.1%) :	
(No Product Ingredients Listed)	
EPCRA 313 Toxic Chemicals (>.1%) :	
000100−41−4	Ethyl benzene
000091−20−3	Naphthalene
000107−98−2	Propylene glycol monomethyl ether
001330−20−7	Xylenes (o−, m−, p− isomers)
Mass RTK Substances (>1%) :	
001333−86−4	Carbon black
008052−41−3	Stoddard solvent
Mass Extraordinarily Haz Sub (>.01%) :	
(No Product Ingredients Listed)	
Penn RTK Substances (>1%) :	
001333−86−4	Carbon black
008052−41−3	Stoddard solvent
Penn Special Hazardous Substances (>.01%) :	
001333−86−4	Carbon black
Rhode Island Hazardous Substances (>.1%) :	
001333−86−4	Carbon black
000100−41−4	Ethyl benzene
000091−20−3	Naphthalene
000107−98−2	Propylene glycol monomethyl ether
008052−41−3	Stoddard solvent
001330−20−7	Xylenes (o−, m−, p− isomers)
RCRA Status (>.01%) :	
(No Product Ingredients Listed)	
N.J. RTK Substances (>1%) :	
001333−86−4	Carbon black
008052−41−3	Stoddard solvent
N.J. Special Hazardous Substances (>.01%) :	
(No Product Ingredients Listed)	
000100−41−4	Ethyl benzene
000107−98−2	Propylene glycol monomethyl ether
001330−20−7	Xylenes (o−, m−, p− isomers)
N.J. Env. Hazardous Substances (>.1%) :	
000100−41−4	Ethyl benzene
000091−20−3	Naphthalene
000107−98−2	Propylene glycol monomethyl ether
001330−20−7	Xylenes (o−, m−, p− isomers)
Proposition 65 − Carcinogens (>0%):	
001333−86−4	Carbon black
000091−20−3	Naphthalene
014808−60−7	Quartz

Proposition 65 – Female Repro Toxins (>0%):
(No Product Ingredients Listed)
Proposition 65 – Male Repro Toxins (>0%):
(No Product Ingredients Listed)
Proposition 65 – Developmental Toxins (>0%):
(No Product Ingredients Listed)

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

End Of Document

MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

BRIGHTSIDE YELLOW

MSDS Revision No: B0 -4
MSDS Revision Date: 01/19/2002

International Paint Inc.
6001 Antoine Drive
Houston, Texas 77091

EMERGENCY NUMBERS:

(800) 424-9300	CHEMTREC (USA)
(703) 527-3887	CHEMTREC (Intl)
(800) 854-6813	Poison Control Center

CUSTOMER SERVICE: (Non-Emergency)

(800) 589-1267	International Paint
(800) 631-7481	Interlux

1. GENERAL INFORMATION

Product Identity: BRIGHTSIDE YELLOW

Bulk Sales Reference No: Y4152

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
000091-20-3	Naphthalene 0.10 - 1.0% by Weight	OSHA:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL
		ACGIH:	10 ppm TWA15 ppm STEL
		NIOSH:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL250 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	10 ppm TWAEV; 52 mg/m3 TWAEV15 ppm STEV; 78 mg/m3 STEV
		Mexico:	10 ppm TWA; 50 mg/m3 TWA15 ppm STEL; 75 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Hemolysis and eye irritation that causes cataracts
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data

001330-20-7	Xylenes (o-, m-, p- isomers) 0.10 - 1.0% by Weight	OSHA:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		ACGIH:	100 ppm TWA150 ppm STEL
		NIOSH:	100 ppm TWA; 435 mg/m3 TWA900 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 435 mg/m3 TWAEV150 ppm STEV; 650 mg/m3 STEV
		Mexico:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		Brazil:	78 ppm; 340 mg/m3; skin absorber; medium degree of harm
		Source	**Health Data**
		NIOSH:	Central nervous system depressant; respiratory and eye irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
007631-86-9	Silica, amorphous 0.10 - 1.0% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	6 mg/m3 TWA3000 mg/m3 IDLH
		Supplier:	No Data Available
		OHSA, CAN:	0.10 mg/m3 TWAEV (designated substance regulation)0.20 mg/m3 CEV (designated substance regulation)0.20 mg/m3 TWAEV; See Ontario Reg. 845 for full information
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: Yes
		NTP:	Known Carcinogen: Yes; Suspected Carcinogen: Yes
		IARC:	Group 1: Yes; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
008008-20-6	Kerosene 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	100 mg/m3 TWA
		Supplier:	No Data Available
		OHSA, CAN:	35 ppm TWAEV; 250 mg/m3 TWAEV
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Eye nose
		Source	**Carcinogen Data**

		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
008052-41-3	Stoddard solvent 10 - 25% by Weight	OSHA:	500 ppm TWA; 2900 mg/m3 TWA
		ACGIH:	100 ppm TWA
		NIOSH:	350 mg/m3 TWA1800 mg/m3 Ceiling20,000 mg/m3 IDLH
		Supplier:	No Data Available
		OHSA, CAN:	525 mg/m3 TWAEV (140 Degree C Flash Aliphatic Solvent)
		Mexico:	100 ppm TWA; 523 mg/m3 TWA200 ppm STEL; 1050 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Eye nose
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
013463-67-7	Titanium dioxide 10 - 25% by Weight	OSHA:	15 mg/m3 TWA (total dust)
		ACGIH:	10 mg/m3 TWA
		NIOSH:	NIOSH Potential Occupational Carcinogen - see Appendix APotential NIOSH carcinogen.
		Supplier:	No Data Available
		OHSA, CAN:	10 mg/m3 TWAEV (total dust)
		Mexico:	10 mg/m3 TWA (nuisance particulate)20 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Lung tumors in animals
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
		OSHA:	No Data Available
		ACGIH:	No Data Available

064742-88-7	Solvent naphtha (petroleum), medium aliphatic 10 - 25% by Weight	NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
064742-94-5	Naphtha (petroleum), heavy aromatic 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Avoid contact with eyes, skin and clothing.
Inhalation:	Harmful if inhaled. Causes nose and throat irritation. Vapors may affect the brain or nervous system causing dizziness, headache or nausea.
Eyes:	Causes severe eye irritation. Do not get in eyes.
Skin:	Causes skin irritation. May be harmful if absorbed through the skin.
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient). Possible cancer hazard. Contains an ingredient which may cause cancer based on animal data (See Section 2 and Section 15 for each ingredient). Risk of cancer depends on duration and level of exposure.
HMIS Rating:	Health: Unknown Flammability: Unknown Reactivity: Unknown

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	If swallowed, immediately contact Poison Control Center at 1-800-854-6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Select equipment to provide protection from the ingredients listed in Section 2 of this document. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates dust, vapor, or mist levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1-800-243-4630, in Canada call 1-800-267-4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: 100 C: 38
Lower Explosive Limit (LEL):	.5 (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	Combustible liquid and vapor. FLAMMABLE/COMBUSTIBLE MATERIALS: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks) creating a vapor explosion hazard. Runoff to sewers may create fire or explosion hazard. Containers may explode when heated.
Fire Fighting Procedures:	**Also Reference Emergency Response Guide Number:** Not Determined

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
pH:	Not Determined
Specific Gravity:	1.014836
Boiling Point (F):	300
Vapor Density:	Heavier than air
VOC Content (lbs):	Refer to the Technical Data Sheet for this product
Evaporation Rate:	Slower than ether

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 32 and 120 F
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Vapors may cause flash fire or ignite explosively. Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation. Do not get in eyes, on skin or clothing. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Use only non-sparking equipment to handle spilled material and absorbent. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers. Use non-sparking tools to collect absorbed material.
Public Safety:	CALL CHEMTREC at (800)-424-9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. LARGE SPILLS: Consider initial downwind evacuation for at least 300 meters (1000 feet). **Also, Reference Emergency Response Guide Number: Not Determined**

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		**IMO / IMDG (Ocean Transportation)**	
DOT Proper Shipping Name:		**IMDG Proper Shipping Name:**	
CONSUMER COMMODITY, ORM-D		CONSUMER COMMODITY, ORM-D	
DOT Hazard Class:	NR	**IMDG Hazard Class:**	Not Regulated
UN / NA Number:	Not Regulated	**UN Number:**	Not Regulated
DOT Packing Group:	Not Regulated	**IMDG Packing Group:**	Not Regulated
CERCLA/DOT RQ:	1777 gal. / 15023 lbs.	**System Reference Code:**	5

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory.
WHMIS Classification:	Not Determined

Regulatory List	**Product Ingredients on List**
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%):	
(No Product Ingredients Listed)	
EPCRA 311/312 Chemicals and RQs:	
000091-20-3	Naphthalene : final RQ = 100 pounds (45.4 kg)
001330-20-7	Xylenes (o-, m-, p- isomers) : final RQ = 100 pounds (45.4 kg)
EPCRA 302 Extremely Hazardous:	
(No Product Ingredients Listed)	
EPCRA 313 Toxic Chemicals:	
000091-20-3	Naphthalene
001330-20-7	Xylenes (o-, m-, p- isomers)
Mass RTK Substances:	
008008-20-6	Kerosene
008052-41-3	Stoddard solvent
013463-67-7	Titanium dioxide
Mass Extraordinarily Haz Substances:	
(No Product Ingredients Listed)	
Penn RTK Substances:	
008008-20-6	Kerosene
008052-41-3	Stoddard solvent
013463-67-7	Titanium dioxide
Penn Special Hazardous Substances:	
(No Product Ingredients Listed)	
Rhode Island Hazardous Substance:	
008008-20-6	Kerosene
000091-20-3	Naphthalene
009002-84-0	Polytetrafluoroethylene
008052-41-3	Stoddard solvent
013463-67-7	Titanium dioxide
001330-20-7	Xylenes (o-, m-, p- isomers)
RCRA Status:	
(No Product Ingredients Listed)	
N.J. RTK Substances:	
008008-20-6	Kerosene
008052-41-3	Stoddard solvent
013463-67-7	Titanium dioxide
N.J. Special Hazardous Substances:	
000107-98-2	Propylene glycol monomethyl ether
001330-20-7	Xylenes (o-, m-, p- isomers)
N.J. Env. Hazardous Substance	
008008-20-6	Kerosene
000091-20-3	Naphthalene
001330-20-7	Xylenes (o-, m-, p- isomers)
Proposition 65 - Carcinogens:	
Proposition 65 - Female Reproductive Toxins:	
(No Product Ingredients Listed)	
Proposition 65 - Male Reproductive Toxins:	
(No Product Ingredients Listed)	
Proposition 65 - Developmental Toxins:	
(No Product Ingredients Listed)	

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

End Of Document

Product Safety
Product Safety Assessment
Industry Standards
Safety & Handling
Chemical Testing
Position Statements
Contact Us

Product Safety Assessment Finder
2015 Sustainability Goals
Our Commitments
REACH

Product Safety -

Product Safety Assessment (PSA): Isopropanol

Printer-friendly version of this PSA (64KB PDF)

Select a Topic:

Names

CAS No. 67-63-0	Propyl alcohol	1-Methylethyl alcohol
Isopropyl alcohol	2-Propyl alcohol	1-Methylethanol
Isopropanol	Propan-2-ol	2-Hydroxypropan
2-Propanol	Dimethyl carbinol	2-Hydroxypropane
IPA		

back to top

Product Overview

Isopropanol (IPA) is one of the most widely used solvents in the world; also used as a chemical intermediate. See Product Uses.

IPA exposure is possible in both industrial and consumer applications. Occupational exposure limits have been established to control the allowable amount of exposure in workplace settings. Consumer exposure, generally infrequent and short in duration, is also highly dependent upon the conditions under which IPA is used. See Exposure Potential.

IPA does not cause adverse health or environmental effects at levels typically found in the workplace or in the environment.

Flammable with high vapor pressure; use good ventilation and avoid all ignition sources. See Physical Hazard Information.

back to top

Manufacture of Product

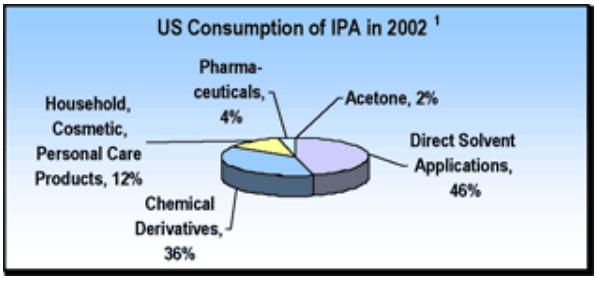
Capacity – Global IPA production capacity reached 2,153 thousand metric tons (4,747 million pounds) in 2003, although global capacity use was roughly 80%.[1] Approximately 74% of the global IPA capacity is concentrated in the United States, Western Europe and Japan. Dow produced approximately 12% of the IPA in 2003[2] at its site in Texas City, Texas, where it has 411 thousand metric tons (906 million pounds) capacity.

Process – Two processes are used to produce IPA.

1. A two-step (indirect) hydrogenation and then hydrolysis of a petroleum product, propylene, using acid and water.
2. A one-step (direct) hydrogenation of a petroleum product, propylene, with an acid catalyst. (Not used in the United States.)

back to top

Product Description



IPA is a colorless, flammable liquid with a characteristic alcohol / acetone-like odor.[3] It mixes completely with most solvents, including water. One well-known yet relatively small use for IPA is "rubbing alcohol," which is a mixture of IPA and water and can be purchased in many pharmacies and grocery stores.

back to top

Product Uses

The largest use for IPA is as a solvent. The second largest use is as a chemical intermediate. IPA is also found in many everyday products such as paints, inks, general-purpose cleaners, disinfectants, room sprays and windshield deicing agents.

IPA produced by Dow is commonly used in nitrocellulose-based lacquers and thinners for wood finishing, in adhesives, pharmaceuticals, cosmetics and toiletries, disinfectants, rubbing compounds, and lithography. It is also used as an ingredient in cleaners and polishers, as a chemical intermediate, and as a dehydrating agent and extractant.

back to top

Exposure Potential[4]

Based on the uses for IPA, the public could be exposed through:

Workplace exposure – Exposure can occur either in an IPA manufacturing facility or through the evaporation of IPA in various industrial and consumer product applications. Generally, personnel exposures in IPA manufacturing facilities are low because the process, storage and handling operations are enclosed. Less is known about customer workplace exposures, but a study done by the U.S. Environmental Protection Agency (EPA) in 1997 showed that the highest occupational exposures to IPA occurred in the printing industry. In the EPA survey of the printing industry, the highest 8-hour time-weighted average (TWA) exposure was 161 ppm. The U.S. Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) is 400 ppm (980 mg/m^3) (8-hour TWA). The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs®) are: 200 ppm (8-hour TWA) and 400 ppm for short-term exposure limit (STEL)[5].

Consumer exposure to products containing IPA – This category of exposure is highly variable depending on the products used and the conditions under which they are used. Exposure of the majority of consumers to IPA is likely to be infrequent and of short duration. Exposure could occur through use of IPA in personal care items or in lacquers and thinners. The estimate prepared by the U.S. EPA in 1997 was on the order of grams/person for each use.

Environmental releases – Fugitive emissions (loss of IPA through evaporation from manufacturing facilities) were estimated at 1.5% of the total U.S. production in 1976, and 3.3% in the Netherlands from 1974-1979. However, care must be exercised to minimize environmental releases due to IPA's flammability, which is one of its largest risks.

Large release – Industrial spills or releases are infrequent and often controlled. A spill poses a significant flammability issue. Emergency response personnel generally respond with a controlled burn that limits over-exposure or uncontrolled burning. The combustion products are carbon monoxide (CO), carbon dioxide (CO_2) and water (H_2O).

back to top

Health Information

Under usual conditions of exposure, IPA is quickly converted to acetone once taken into the body. Acetone is naturally present in virtually every organ and tissue in the human body as a result of metabolic processes.[6]

Toxicology studies have shown that IPA poses a low health hazard and does not cause adverse health or environmental effects at levels typically found in the workplace or the environment.[7] Overexposure to IPA can cause irritation to the eyes, nose and throat, and may produce central nervous system depression.[8] These effects are typically mild and end shortly after exposure is terminated, not showing any permanent adverse health affects. In coordination, confusion, hypotension, hypothermia, circulatory collapse, respiratory arrest and death may follow a longer duration or higher levels. Swallowing small amounts is not likely to cause injury; however swallowing larger amounts may cause serious injury, and

even death.[9]

Chronic, prolonged or repeated overexposure to IPA has produced adverse liver effects and kidney effects and/or tumors in male rats. Such effects are believed to be species-specific, however, and unlikely to occur in humans.[10] For more information, view the Safety Data Sheet.

back to top

Environmental Information

Public and wildlife exposure through environmental releases is limited because IPA rapidly biodegrades in water and undergoes photo-oxidation relatively rapidly in the atmosphere. IPA is not expected to persist in soil due to its rapid evaporation, and has a low potential to bio-accumulate in aquatic organisms. IPA studies show low toxicity to aquatic organisms and micro-organisms, and toward plant germination and growth.[11]

back to top

Physical Hazard Information

IPA is a flammable material and should be handled only with adequate ventilation and in areas where ignition sources have been removed (e.g., matches and unprotected light switches).

The flash point for IPA is 53°F / 12°C.[12]

back to top

Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use and/or disposal of Isopropanol. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant Safety Data Sheet or Contact Us.

back to top

Additional Information:

- Safety Data Sheet
- OECD SIDS Dossier on 2-Propanol (272KB PDF)
  - For further information, see OECD SIDS program
- Product Information: Isopropanol (Anhydrous) (51KB PDF)

For additional business information about products like IPA, visit Dow's Oxygenated Solvents web site.

Last Updated: May, 2, 2006

In order to view some information you may need to download Adobe Reader.

back to top

References

[1] *Chemical Economics Handbook – SRI International*, March 2003, page 3.
[2] *Chemical Economics Handbook – SRI International*, March 2003, page 3.
[3] *Isopropanol Material Safety Data Sheet*, Dow MSDS#1194, August 6, 2003, page 2.
[4] *Chemical Manufacturers Association IPA SIDS Assessment Profile*, January, 1998, pp. 8-10.
[5] *Isopropanol Material Safety Data Sheet*, Dow MSDS#1194, August 6, 2003, page 7.
[6] *ISOPROPANOL Uses, Benefits and Regulatory Status*, Chemical Manufacturers Association, October 1999, page 4.
[7] *ISOPROPANOL Uses, Benefits and Regulatory Status*, Chemical Manufacturers Association, October 1999, page 2.
[8] *ISOPROPANOL Uses, Benefits and Regulatory Status*, Chemical Manufacturers Association, October 1999, page 4.
[9] *Isopropanol Material Safety Data Sheet*, Dow MSDS#1194, August 6, 2003, page 3.
[10] *Isopropanol Material Safety Data Sheet*, Dow MSDS#1194, August 6, 2003, page 3.
[11] *ISOPROPANOL Uses, Benefits and Regulatory Status*, Chemical Manufacturers Association, October, 1999, page 6.
[12] *NFPA Fire Protection Guide to Hazardous Materials 10th Edition*.

back to top

< Back

Product Safety Home : Product Safety Assessment Finder : Isopropanol

Material Safety Data Sheet

Revision Date: 02/14/2008 **Issue date:** 09/12/2008

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name: Loctite(R) 243 Threadlocker Medium Strength
Product type: Anaerobic Sealant
Company address:
Henkel Corporation
1001 Trout Brook Crossing
Rocky Hill, Connecticut 06067

Item No. : 24078 / IDH No. 209726
Region: United States
Contact Information:
Telephone: (860) 571-5100
Emergency telephone: (860) 571-5100
Internet: www.loctite.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous components	%	ACGIH TLV	OSHA PEL	OTHER
Polyglycol dimethacrylate 25852-47-5	60-100	None	None	None
Polyglycol dioctanoate 18268-70-7	10-30	None	None	None
Amorphous fumed silica 68611-44-9	1-5	None	None	None
Saccharin 81-07-2	1-5	None	None	None
1-Acetyl-2-phenylhydrazine 114-83-0	0.1-1	None	None	None

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

HMIS:

Physical state: Liquid
Color: Blue
Odor: Characteristic

HEALTH: 2*
FLAMMABILITY: 1
PHYSICAL HAZARD: 1
Personal Protection: See Section 8

WARNING: CAUSES EYE IRRITATION.
MAY CAUSE ALLERGIC SKIN REACTION.
MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION.

Relevant routes of exposure: Skin, Inhalation, Eyes

Potential Health Effects

Inhalation: May cause respiratory tract irritation.
Skin contact: May cause allergic skin reaction. May cause skin irritation.
Eye contact: Contact with eyes will cause irritation.
Ingestion: Not expected to be harmful by ingestion.

Existing conditions aggravated by exposure: Eye, skin, and respiratory disorders.

See Section 11 for additional toxicological information.

4. FIRST AID MEASURES

Inhalation: Remove to fresh air. If symptoms develop and persist, get medical attention.

Skin contact: Wash with soap and water. Remove contaminated clothing and shoes. Wash clothing before reuse. Get medical attention if symptoms occur.

Eye contact: Flush with copious amounts of water, preferably, lukewarm water for at least 15 minutes, holding eyelids open all the time. Get medical attention.

Ingestion: Do not induce vomiting. Keep individual calm. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Flash point: Greater than 93ºC (200ºF) Tagliabue closed cup

Autoignition temperature: Not available

Flammable/Explosive limits-lower %: Not available

Flammable/Explosive limits-upper %: Not available

Extinguishing media: If product is involved in fire extinguish with dry powder, foam or carbon dioxide.

Special fire fighting procedures: Wear self-contained breathing apparatus and full protective clothing, such as turn-out gear.

Unusual fire or explosion hazards: None

Hazardous combustion products: Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.

6. ACCIDENTAL RELEASE MEASURES

Environmental precautions: Prevent product from entering drains or open waters.

Clean-up methods: Soak up with inert absorbent. Store in a partly filled, closed container until disposal.

7. HANDLING AND STORAGE

Handling: Avoid contact with eyes, skin and clothing. Avoid breathing vapor and mist. Wash thoroughly after handling.

Storage: For safe storage, store at or below 38°C (100°F). Keep in a cool, well ventilated area away from heat, sparks and open flame. Keep container tightly closed until ready for use.

Incompatible products: Refer to Section 10.

For information on product shelf life contact Henkel Customer Service at (800) 243-4874.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls: No specific ventilation requirements noted, but forced ventilation may still be required if concentrations exceed occupational exposure limts.

Respiratory protection: Use NIOSH approved respirator if there is potential to exceed exposure limit(s).

Skin protection: Use impermeable gloves and protective clothing as necessary to prevent skin contact. Neoprene gloves. Butyl rubber gloves. Natural rubber gloves.

Eye/face protection: Safety goggles or safety glasses with side shields.

See Section 2 for exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Liquid
Color:	Blue
Odor:	Characteristic
Vapor pressure:	Less than 0.1 mm Hg at 27ºC (80ºF)
pH:	Not applicable
Boiling point/range:	Greater than 149ºC (300ºF)
Melting point/range:	Not available
Specific gravity:	1.08 at 20ºC (68ºF)
Vapor density:	Not available
Evaporation rate:	Not available
Solubility in water:	Slight
Partition coefficient (n-octanol/water):	Not available
VOC content:	0.7339%; 7.21 grams/liter

10. STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization: Will not occur.

Hazardous decomposition products: Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.

Incompatability: Strong oxidizers. Reducing agents. Strong alkalis. Oxygen scavengers. Oxidizing agents. Other polymerization initiators.

Conditions to avoid: See "Handling and Storage" (Section 7) and "Incompatabilty" (Section 10).

11. TOXICOLOGICAL INFORMATION

Product toxicity data: Acute oral LD50 greater than 10, 000 mg/kg (rat). Acute dermal LD50 greater than 5000 mg/kg (rabbit). (estimated).

Carcinogen Status

Hazardous components	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen
Polyglycol dimethacrylate 25852-47-5	No	No	No
Polyglycol dioctanoate 18268-70-7	No	No	No
Amorphous fumed silica 68611-44-9	No	No	No
Saccharin 81-07-2	No	No	No
1-Acetyl-2-phenylhydrazine 114-83-0	No	No	No

Literature Referenced Target Organ & Other Health Effects

Hazardous components	Health Effects/Target Organs
Polyglycol dimethacrylate 25852-47-5	Allergen, Irritant
Polyglycol dioctanoate 18268-70-7	Irritant
Amorphous fumed silica 68611-44-9	No Target Organs
Saccharin 81-07-2	No Target Organs
1-Acetyl-2-phenylhydrazine 114-83-0	Allergen, Blood, Kidney, Mutagen, Some evidence of carcinogenicity

12. ECOLOGICAL INFORMATION

Ecological information: Not available

13. DISPOSAL CONSIDERATIONS

Information provided is for unused product only.

Recommended method of disposal: Dispose of according to Federal, State and local governmental regulations.

EPA hazardous waste number: Not a RCRA hazardous waste.

14. TRANSPORT INFORMATION

The shipping classifications in this section are for non-bulk packaging only (unless otherwise specified). Shipping classification may be different for bulk packaging.

U.S. Department of Transportation Ground (49 CFR):

Proper shipping name:	Unrestricted
Hazard class or division:	None
Identification number:	None
Packing group:	None

International Air Transportation (ICAO/IATA):

Proper shipping name:	Unrestricted
Hazard class or division:	None
Identification number:	None
Packing group:	None

WaterTransportation (IMO/IMDG):

Proper shipping name:	Unrestricted
Hazard class or division:	None
Identification number:	None
Packing group:	None
Marine pollutant:	None

15. REGULATORY INFORMATION

United States Regulatory Information

TSCA 8 (b) Inventory Status: All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.
TSCA 12 (b) Export Notification: None above reporting de minimus.

CERCLA/SARA Section 302 EHS: None above reporting de minimus.
CERCLA/SARA Section 311/312: Immediate Health Hazard, Delayed Health Hazard
CERCLA/SARA 313: None above reporting de minimus.

California Proposition 65: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Canada Regulatory Information

CEPA DSL/NDSL Status: All components are listed on or are exempt from listing on the Domestic Substances List.
WHMIS hazard class: D.2.B

16. OTHER INFORMATION

This material safety data sheet contains changes from the previous version in sections: 3, 15

Prepared by: Regulatory Affairs

DISCLAIMER: The data contained herein are furnished for information only and are believed to be reliable. However, Henkel Corporation does not assume responsibility for any results obtained by persons over whose methods Henkel Corporation has no control. It is the user's responsibility to determine the suitability of Henkel's products or any production methods mentioned herein for a particular purpose, and to adopt such precautions as may be advisable for the protection of property and persons against any hazards that may be involved in the handling and use of any of Henkel Corporation's products. In light of the foregoing, Henkel Corporation specifically disclaims all warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation further disclaims any liability for consequential or incidental damages of any kind, including lost profits.

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: SILICONE LUBRICANT
MANUFACTURER: 3M
DIVISION: Electrical Markets Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 03/10/2009
Supercedes Date: 12/08/2008

Document Group: 10-2656-6

Product Use:
Intended Use: SILICONE LUBRICANT GREASE FOR ELECTRICAL SPLICES

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
SILICONE GREASE	63148-62-9	75 - 95
SYNTHETIC AMORPHOUS SILICA, FUMED, CRYSTALLINE FREE	112945-52-5	5 - 25

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: GREASE
Odor, Color, Grade: Light colored grease, no odor
General Physical Form: Solid grease
Immediate health, physical, and environmental hazards:

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Mild Eye Irritation: Signs/symptoms may include redness, pain, and tearing.

Skin Contact:
Mild Skin Irritation: Signs/symptoms may include localized redness, swelling, and itching.

Inhalation:
No health effects are expected.

Ingestion:
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, stomach upset, nausea, vomiting and diarrhea.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Wash affected area with soap and water. If signs/symptoms develop, get medical attention.

Inhalation: No need for first aid is anticipated.

If Swallowed: Do not induce vomiting unless instructed to do so by medical personnel. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get medical attention.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	*No Data Available*
Flash Point	*Not Applicable*
Flammable Limits - LEL	*No Data Available*
Flammable Limits - UEL	*No Data Available*

5.2 EXTINGUISHING MEDIA
Ordinary combustible material. Use fire extinguishers with class A extinguishing agents (e.g., water, foam).

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: Not applicable. No unusual fire or explosion hazards are anticipated. Non-flammable: ordinary combustible material.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Ventilate the area with fresh air. Collect as much of the spilled material as possible. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and MSDS. Collect the resulting residue containing solution. Place in a closed container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

Avoid eye contact. Avoid eye contact with vapors, mists, or spray. Avoid skin contact. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Do not ingest. Avoid contact with oxidizing agents. Do not mix with oxidizers to avoid risk of explosion. Not intended for consumer sale or use.

7.2 STORAGE

Store away from acids. Keep container in well-ventilated area. Store away from oxidizing agents.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Not applicable.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact. Avoid eye contact with vapors, mists, or spray.
The following eye protection(s) are recommended: Safety Glasses with side shields.

8.2.2 Skin Protection

Avoid skin contact.

8.2.3 Respiratory Protection

Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

8.3 EXPOSURE GUIDELINES

None Established

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	GREASE
Odor, Color, Grade:	Light colored grease, no odor
General Physical Form:	Solid grease
Autoignition temperature	*No Data Available*
Flash Point	*Not Applicable*
Flammable Limits - LEL	*No Data Available*
Flammable Limits - UEL	*No Data Available*
Boiling point	*Not Applicable*
Density	*No Data Available*
Vapor Density	*Not Applicable*
Vapor Pressure	*Not Applicable*
Specific Gravity	1.02 - 1.6 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	*No Data Available*
Solubility in Water	Nil
Evaporation rate	*Not Applicable*
Volatile Organic Compounds	*No Data Available*
VOC Less H2O & Exempt Solvents	*No Data Available*

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong oxidizing agents; Strong acids; Strong bases; Reducing agents

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Formaldehyde	During Combustion
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Not determined.

CHEMICAL FATE INFORMATION

Not determined.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: For quantities <100 lbs. (50kg): dispose of waste product in a sanitary landfill. As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
80-6108-3463-4, 80-6109-3893-0

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.

CHEMICAL INVENTORIES
The components of this product are in compliance with the chemical notification requirements of TSCA.

All applicable chemical ingredients in this material are listed on the European Inventory of Existing Chemical Substances (EINECS), or are exempt polymers whose monomers are listed on EINECS.

The components of this product are listed on the Canadian Domestic Substances List.

Contact 3M for more information.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 1 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification

Health: 1 **Flammability:** 1 **Reactivity:** 0 **Protection:** A

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Reason for Reissue: The MSDS has been revised because 3M has adopted the 16-section ANSI/ISO format. The potential hazards of the product have not changed. We encourage you to reread the MSDS and review the information.

Revision Changes:
Copyright was modified.
Section 3: Potential effects from skin contact information was modified.
Section 3: Potential effects from ingestion information was modified.
Section 6: Release measures information was modified.
Section 7: Handling information was modified.
Section 7: Storage information was modified.
Section 8: Engineering controls information was modified.
Section 8: Eye/face protection phrase was modified.
Section 8: Skin protection phrase was modified.
Section 8: Prevention of swallowing information was modified.
Section 10: Hazardous decomposition or by-products table was modified.
Section 13: Waste disposal method information was modified.
Sections 3 and 9: Specific physical form information was modified.
Section 9: Specific gravity information was modified.
Section 2: Ingredient table was modified.
Section 4: First aid for ingestion (swallowing) - decontamination - was added.

Section 4: First aid for ingestion (swallowing) - intervention - was added.
Section 4: First aid for ingestion (swallowing) - medical assistance - was added.
Section 9: Density information was added.
Section 9: Solubility in water text was added.
Section 14: ID Number Heading Template 1 was added.
Section 14: ID Number(s) Template 1 was added.
Section 4: First aid for ingestion (swallowing) - none - was deleted.
Section 14: ID Number(s) and/or UPC(s) Template 1 was deleted.

MSDS

Print

Material Safety Data Sheet

TEF-GEL

Date of Preparation: 2/20/99

Revision Date: 09/27/2013

Section 1 – Chemical Product and Company Identification

Product/Chemical Name: Tef-Gel
General Use: Anti-sieze Lubricant
Manufacturer:
Ultra Safety Systems
1601 Hill Avenue, Suite C
Mangonia Park Fl 33407
Telephone: (561) 845-1086 (8:00AM – 5:00PM)
Nights and Weekends: (561) 584-0504

Section 2 – Composition / Information on Ingredients

Ingredient Name	CAS Number	% wt or % volume
Polytetrafluoroethylene, PTFE*	9002-84-0	40.0

Product formulation is Proprietary

No Ingredients are known to be hazardous under normal usage.
*Not a hazardous material under normal usage, but PTFE can produce toxic fumes if pyrolized.

Ingredients	OSHA PEL		ACGIH TLV		NIOSH REL		NIOSH IDLH
	TWA	STEL	TWA	STEL	TWA	STEL	TWA
Oil Mist	5 mg/m3	None Established	5 mg/m3	None Established	5 mg/m3	None Established	2500 mg/m3

Section 3 – Hazards Identification
*****EMERGENCY OVERVIEW*****

Summary of Risks: May irritate eyes. Prolonged or repeated skin contact may cause irritation. Inhalation of Oil mist or vapors from material at high temperatures may irritate respiratory passages.

Polytetrafluoroethylene (PTFE), when thermally decomposed (over 290^{o}C) , may cause polymer fume fever. Thermal decomposition of PTFE (over 290^{o}C) will generate hydrogen fluoride.

HMIS	
H	1
F	1
R	0
PPE	
Sec.8	

POTENTIAL HEALTH EFFECTS

Eye Contact: May cause irritation.
Skin Contact: Repeated or prolonged skin contact may cause irritation. Thermal decomposition of PTFE (over 290^{o}C) will generate hydrogen fluoride, which is corrosive, causing burns on contact with skin and other tissue.
Inhilation: Oil Mist and vapors at high temperatures may irritate respiratory passages. Inhalation of decomposition products of PTFE (over 290^{o}C) may cause polymer fume fever, a temporary flu-like illness accompanied by fever, chills, and sometimes

cough, of approximately 24 hours duration. Repeated episodes of polymer fume fever may cause lung damage. Inhalation of fluorine compounds as decomposition products of PTFE (over 290^{o}C) may cuse lung irritation and pulmonary edema.
Ingestion: May cause gastrointestinal irritation.
Primary Route(s) of Entry: Inhalation at high temperatures, eye contact, skin contact.
Target Organs: Respiratory passages at high temperatures, eyes, skin.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with pre-existing diseases of the lungs may have increases susceptibility to the toxicity of excessive exposures from thermal decomposition products.
Carcinogenicity: IARC, NTP, and OSHA do not list TEF-GEL or its ingredients as carcinogens.

Section 4 – First Aid Measures

Eye Contact: Flush thoroughly with water for at least 15 minutes. Get immediate medical attention.
Skin Contact: Remove contaminated clothing. Wash exposed area with soap and water. Get medical attention if symptoms persists.
Inhalation: If symptoms develop, remove affected person from source of exposure into fresh air. Get immediate medical attention. If person is not breathing, give artificial respiration. If breathing is difficult, administer oxygen if available.
Ingestion: Get immediate medical attention. Do not induce vomiting unless instructed to do so by a physician.

Section 5 – Fire – Fighting Measures

Flash Point: over 400^{o}F (204^{o}C)
Flash Point Method: CC, ASTMD93
Lower Flammable Limit (LFL): N/A
Upper Flammable Limit (UFL): N/A
Extinguishing Media: CO2, Foam, Dry Chemical, Water Spray
Unusual Fire or Explosion Hazards: None
Hazardous Combustion Products: Hydrogen fluoride, carbonyl fluoride, carbon monoxide and small amount of other toxic fumes
Fire-Fighting Instructions: Wear a NIOSH approved positive pressure self-contained breathing apparatus with full protective clothing. Do not release runoff from fire control methods to sewers or waterways.

Section 6 – Accidental Release Measures

Spill Response: Observe precautions from other sections. Contain any spill with dikes or absorbents to prevent migration and entry into drains, sewers or bodies of water. Wipe or scrape up grease and place it in a proper container for disposal. Wash walking surfaces thoroughly to reduce slipping hazard. Follow applicable OSHA (29 CFR 1910.120), state and local regulations.

Section 7 – Handling and Storage

Handling Precautions: Exercise ordinary care in handling industrial lubricants. Avoid contamination of cigarettes or other tobacco products. Wash hands thoroughly before eating or smoking. Remove contaminated clothing and clean before reuse. Users should be alert to the possibility that very small percentages of the population may display unexpected allergic reactions to otherwise innocuous industrial lubricants and raw materials.
Storage Requirements: Do not store in open or unlabeled containers. Store away from incompatibles.

Section 8 – Exposure Controls / Personal Protection

Eye Protection: Avoid eye contact. Wear safety glasses or chemical goggles in accordance with OSHA 29 CFR 1910.133.
Skin Protection: Avoid skin contact. Wear chemical protective gloves. Depending upon conditions of use, additional protection may be necessary such as a face shield, apron, etc.
Ventilation: Local ventilation is generally not necessary under normal conditions of use with adequate general ventilation. Ventilation and other forms of engineering controls are preferred means for controlling chemical exposures.
Respiratory Protection: Avoid breathing oil mist. Respiratory protection is generally not necessary under normal condition of use with adequate general ventilation.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Other Precautionary Information: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, using the toilet, or applying cosmetics.

Section 9 – Physical and Chemical Properties

Appearance and Odor: Smooth, white grease with slight odor
Vapor Pressure: Negligible
Vapor Density: Not Determined
Formula Weight: Not Calculated
Specific Gravity (H2O=1, at 4^{o}C): Not Determined
Water Solubility: Insoluble
Boiling Point: Not Volatile
Dropping Point: Non-melting
% Volatile: None
pH: Not Determined

Section 10 – Stability and Reactivity

Stability: Tef-Gel is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: This product will not undergo hazardous polymerization.
Chemical Incompatibilities: Strong oxidizing materials.
Conditions to Avoid: Pyrolysis
Hazardous Decomposition Products: Thermal oxidative decomposition of Tef-Gel can produce hydrogen fluoride, carbonyl fluoride, carbon monoxide as well as small amounts of other toxic fumes.

Section 11 – Toxicological Information

Toxicity Data: None Available

Section 12 – Ecological Information

Environmental Fate and Effects: No data has been established for this product.

Section 13 – Disposal Considerations

Disposal: Contact a licensed waste-disposal contractor for detailed recommendations.
Disposal Regulatory Requirements: Many states classify waste lubricants as “hazardous”, which means disposal only by a licensed firm. Follow applicable Federal, state, and local regulations.

Section 14 – Transport Information

DOT Transportation Data (49 CFR 172.101): Not Regulated.

Section 15 – Regulatory Information

TSCA: All components of this product are listed on the TSCA inventory.
EPA Regulations:

SARA 311/312 Hazard Class (40 CFR 370)

Immediate (Acute) Health Hazard No	Sudden Release of Pressure Hazard No	Reactive Hazard No
Delayed (Chronic) Health Hazard No	Fire Hazard No	

SARA 313 Toxic Chemicals (40 CFR 372)	CAS Number	%	Reactive Hazard No
No Ingredients Listed			

SARA Extremely Hazardous Subtances (40 CFR 355)	CAS Number	%	Threshold Planning Quantity (TPO)
No Ingredients Listed			

CERCLA Hazardous Substances (40 CFR 302)	CAS Number	%	Reportable Quantity (RO)
No Ingredients Listed			

COSHH Hazardous Subtances	IATA
No Ingredients are Hazardous	Not Regulated

REACH and Safety Data Sheet	IMDG
No Ingredients are Hazardous	Not Regulated

Section 16 – Other Information

SHELF LIFE: INDEFINITE or UNLIMITED

Disclaimer: While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Ultra Safety Systems, Inc. makes no warranty with respect thereto and disclaims all liability with respect thereon.

Appendix F: Seaglider Warranty

SEAGLIDER™ ONE (1) YEAR WARRANTY TO ORIGINAL PURCHASER

1. Warranty, Exclusive Remedies and Warranty Disclaimers.

1.1 Warranty. Kongsberg warrants that devices sold hereunder shall be free from defects in materials and workmanship under normal use and service when correctly operated in accordance with the Kongsberg instructions and training for a period of one (1) year from date of acceptance ("Warranty"). Kongsberg reserves the right and sole discretion to modify this Warranty at any time with written notice. Customer's receipt of any device delivered hereunder shall be an unqualified acceptance of and a waiver by Customer of the Customer's right to make a claim with respect to such device unless Customer gives Kongsberg written notice of any claim within one (1) year after acceptance of such device.

1.2 Exclusive Remedy. The sole obligation of Kongsberg, and Customer's sole and exclusive remedy for a breach of the Warranty in Section 1.1, shall be that Kongsberg shall use commercially reasonable efforts to repair and correct, or, at Kongsberg's option, replace the device which shall have been promptly reported in writing as not operating in accordance with the Warranty and, upon inspection by Kongsberg shall be determined to not have met the Warranty, provided the device was not abused or operated other than in accordance with the Kongsberg instructions.

1.3 Assignment. Kongsberg hereby assigns to Customer all of the manufacturers' warranties relating to the equipment which Kongsberg is permitted by the equipment manufacturer(s) to assign to Customer. Such assignment is subject to all of the terms and conditions imposed by the equipment manufacturer(s) with respect thereto. Kongsberg will use commercially reasonable efforts to promptly apprise Customer of such warranties following Customer's purchase of the equipment.

1.4 Disclaimers. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY SPECIFIED ABOVE, KONGSBERG GRANTS NO WARRANTIES, EITHER EXPRESS OR IMPLIED. KONGSBERG EXPRESSLY DISCLAIMS THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT FOR THE DEVICE(S), IN WHOLE AND IN PART. KONGSBERG DOES NOT ASSUME LIABILITY FOR LOSS, DAMAGE, OR OTHER RESULTS OF OPERATING THE DEVICE IN WATER, OR DUE TO LEAKAGE, IMPLOSION, OR EXPLOSION. THE WARRANTY WILL NOT APPLY TO THE DEVICE IF THERE IS A FAILURE OF THE DEVICE OR ANY PART THEREOF WHICH IS ATTRIBUTABLE TO: (A) INAPPROPRIATE OR UNAUTHORIZED USE OF THE DEVICE; (B) ACCIDENT, NEGLECT, MISUSE OR ABUSE OF THE DEVICE;

(C) EXPOSURE OF THE DEVICE TO POTENTIALLY HARMFUL ENVIRONMENTAL, POWER, AND OPERATING CONDITIONS; (D) CUSTOMER SPECIFIC MODIFICATIONS NOT PERFORMED BY KONGSBERG WITHOUT RECEIPT OF APPLICABLE TRAINING. KONGSBERG DOES NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE DEVICE WILL MEET CUSTOMER'S

REQUIREMENTS, THE OPERATION OF THE DEVICE WILL BE UNINTERRUPTED OR ERROR-FREE OR THAT ALL DEFECTS WILL BE CORRECTED.

2. Limitations of Liability and Disclaimer of Damages.

2.1 **Liability for Use or Loss at Sea.** CUSTOMER SHALL BE SOLEY RESPONSIBLE FOR ANY LIABILITY RESULTING FROM THE USE OR LOSS OF THE DEVICE AT SEA INCLUDING, BUT NOT LIMITED TO, USE OR LOSS RESULTING FROM THE APPLICATION OF THE REGULATIONS OR RESTRICTIONS OF THE MARINE POLLUTION ACT (MARPOL), THE ENVIRONMENTAL PROTECTION AGENCY, THE UNITED STATES COAST GUARD, ANY ACT THAT ENABLES THE EXISTENCE OF MARINE PROTECTED AREAS (BOTH U.S. AND OTHER), AND ANY OTHER STATE, REGIONAL, COUNTY, OR LOCAL REGULATIONS OR OF ANY THIRD PARTY STATE OR NATION**.**

2.2 Disclaimer of Damages. NOTWITHSTANDING ANYTHING TO THE CONTRARY IN THIS AGREEMENT, IT IS EXPRESSLY AGREED THAT KONGSBERG AND ITS SUPPLIERS SHALL IN NO EVENT BE LIABLE FOR TORTIOUS CONDUCT (INCLUDING BUT NOT LIMITED TO NEGLIGENCE OR STRICT LIABILITY) OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES RELATING TO OR ARISING OUT OF THE AGREEMENT, EVEN IF KONGSBERG IS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF GOODWILL, INTERRUPTION OF BUSINESS, DEVICES NOT BEING AVAILABLE FOR USE, LOST OR CORRUPTED DATA, LOSS OF BUSINESS, LOSS OF PROFITS, LOSS OF USE OF THE DEVICE OR ANY ASSOCIATED EQUIP- MENT, COST OF CAPITAL, COST OF SUBSTITUTE OR REPLACEMENT PRODUCT, FACILITIES OR SERVICES, DOWN-TIME, CHARGES FOR CUSTOMER'S TIME AND EFFORT, THE CLAIMS OF THIRD PARTIES, INJURY TO PROPERTY, OR ANY OTHER DIRECT, INDIRECT, SPECIAL, RELIANCE, INCIDENTAL OR CONSEQUENTIAL DAMAGES, REGARDLESS OF THE NATURE OF THE CLAIM AND WHETHER OR NOT FORESEEABLE, AND WHETHER OR NOT BASED ON BREACH OF WARRANTY, CONTRACT OR TORT OR STRICT LIABILITY, OR FOR ANY CLAIM BY ANY THIRD PARTY EXCEPT AS EXPRESSLY PROVIDED HEREIN**.**

For the sale of devices made to Customers within the United States, note that some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This Warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

2.3 **Limitation of Liability.** ANY DAMAGES THAT KONGSBERG SHALL BE REQUIRED TO PAY SHALL BE LIMITED TO THE TOTAL FEES AND CHARGES RECEIVED FROM CUSTOMER UNDER THIS AGREEMENT**.**

2.4 **No Liability for Delays.** Kongsberg and its suppliers shall not be liable for any damages caused by delay in delivery, installation or operation of the software or equipment under this Agreement.

2.5 **U.N. Convention on Contracts.** Kongsberg and Customer expressly agree that the United Nations Convention on Contracts for the

International Sale of Goods (or its successor) shall not apply to this Warranty.

Problems within the Warranty Period

To make a Warranty claim, contact Kongsberg Underwater Technologies, Inc. by sending an email to km.support.seaglider@Kongsberg.com or call +1 425-712-1107 for technical support. Provide the technical support representative with the Seaglider serial number and obtain a return merchandise authorization number (RMA#) and instructions for shipping to a designated repair facility.

Non-Warranty Repairs / Refurbishments

When non-warranty repairs, such as damage, or a refurbishment are requested, contact Kongsberg and an RMA Number will be issued to the Customer. The Customer is responsible for all shipping associated with non-warranty repairs. Upon receipt of the equipment, an evaluation will be performed and a Repair/Refurbishment Estimate will be forwarded to the Customer for review/approval. Prior to non- warranty repair work being initiated, a Purchase Order or other means of payment will need to be provided by the Customer. The limited warranty on repairs or refurbishments is sixty (60) days for labor and parts.