Navigator ADCP/DVL
Maintenance Guide

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RD Instruments
Acoustic Doppler Solutions

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Navigator Maintenance Guide

1 Introduction

This guide explains how to prepare the WorkHorse Navigator for deployment, how to do certain maintenance, repair, and equipment modification procedures, and how to prepare the Navigator for storage or shipment.

Table 1, page 33 lists the items in the tools and spares parts kits. Use these kits when doing routine Navigator maintenance.

2 I/O Cable and Dummy Plug

The underwater connector (on the end-cap) and the I/O cable and dummy plug are molded underwater-matable connectors. The end-cap connector is a factory-installed item. We do not recommend removing it for any routine maintenance.

NOTE. The dummy plug should be installed any time the I/O cable is removed. Use the dummy plug when the Navigator is in storage or is being handled.

2.1 Disconnecting the I/O Cable or Dummy Plug

The cable should be disconnected with a straight outward motion only. Use the following procedure to disconnect the cable.

CAUTION. When disconnecting the Navigator I/O cable, do not apply any upward force on the connector as it is being pulled off. Applying an upward angle as the cable is disconnected puts stress on the end-cap connector. This may cause several serious problems: a) The end-cap connector or connector pins can crack. b) The O-ring on the bottom of the end-cap connector can be damaged. c) The molded urethane on the end-cap connector may separate from the brass insert. **If the end-cap connector is damaged in any of these ways, your ADCP/DVL will flood.**

a. Release the retaining strap by pulling it over the connector.

b. Grasp the cable close to the end-cap (see Figure 1). Your thumb should rest on top of the connector or against the edge of the end-cap. *Do not try to fit your hand under the cable as it passes over the end-cap*. This is what causes the upward force!

c. Pull the cable straight out away from the end-cap with a gentle side-to-side rocking motion. Do not apply any upward force on the connector as it is being disconnected.

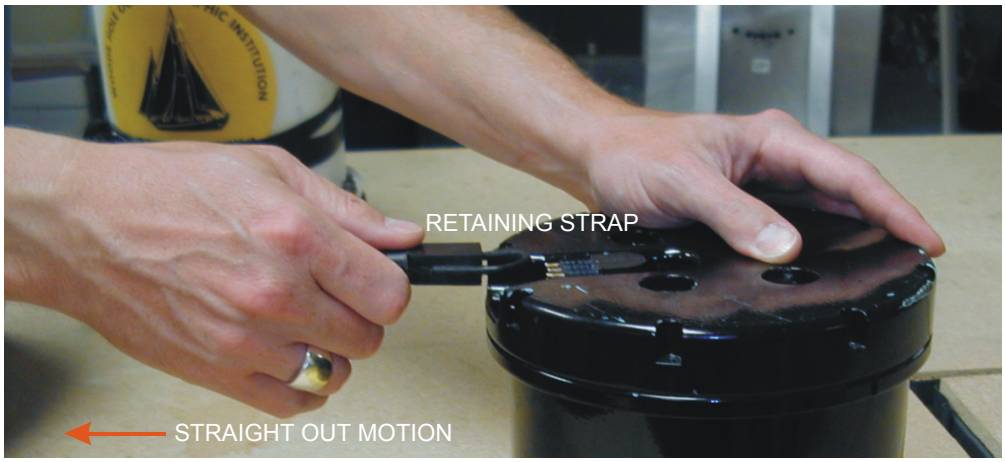

Figure 1. Removing the I/O Cable

2.2 Connecting the I/O Cable or Dummy Plug

The cable should be connected with a straight inward motion only. Use the following procedure to connect the cable.

> **CAUTION.** When connecting the Navigator I/O cable, do not apply any upward force on the connector as it is being pushed on. Applying an upward angle as the cable is connected puts stress on the end-cap connector. This may cause several serious problems: a) The end-cap connector or connector pins can crack. b) The O-ring on the bottom of the end-cap connector can be damaged. c) The molded urethane on the end-cap connector may separate from the brass insert. **If the end-cap connector is damaged in any of these ways, your ADCP/DVL will flood.**

a. Apply a light coat of DC-111 lubricant to the rubber portion of the end-cap connector pins. This will help seat the connector.

b. Gently push the cable straight in toward the end-cap connector. Do not apply any upward force on the connector as it is being connected.

c. Roll the retaining strap over the connector.

3 Navigator Disassembly

This section explains how to remove and replace the end-cap or housing to gain access to the ADCP/DVL's electronics, and optional internal recorder PC cards. Read all instructions before doing the required actions.

NOTE. RDI does not recommend opening the Navigator just to "look inside." Once opened, the O-rings and desiccant should be replaced.

3.1 End-Cap Removal (1200kHz Systems)

To remove the end-cap, do the following steps. Use "Parts Location Drawings," page 34 for parts identification.

a. Dry the outside of the Navigator.

b. Stand the Navigator on its transducer face on a soft pad.

c. Remove all power to the Navigator.

d. Remove the I/O cable and place the dummy plug on the I/O cable connector (see "I/O Cable and Dummy Plug," page 1).

e. Loosen and remove the eight end-cap bolts (4-mm).

NOTE. Make sure you save all hardware removed during this procedure for re-assembly.

f. Carefully pull the end-cap away from the housing until you can gain access to the connector jack on the common mode choke. Use care; the mating surfaces scratch easily. Do not damage the mating surface.

g. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the end-cap aside.

h. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage (see "O-ring Inspection and Replacement," page 7). Even small scratches can cause leakage around the O-ring seal.

3.2 Housing Removal (300/600kHz Systems)

a. Remove all power to the Navigator.

b. Remove the I/O cable and place the dummy plug on the I/O cable connector (see "I/O Cable and Dummy Plug," page 1).

c. Stand the Navigator on its end-cap.

d. Loosen and remove the four bolts (8-mm) that attach the housing flange to the transducer head assembly.

e. Carefully lift the transducer assembly straight up and away from the housing until you can gain access to the connector jack on the common mode choke. Use care; the mating surfaces scratch easily. Do not damage the mating surfaces.

NOTE. The cable attached to the end cap is only long enough to disconnect the internal I/O cable. There is NOT enough cable to set the transducer down next to the Housing Assembly.

f. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the end-cap assembly aside. Set the transducer assembly (transducer face down) on a soft pad.

g. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage (see "O-ring Inspection and Replacement," page 7).

h. When you are ready to re-assemble the Navigator, see "Navigator Re-assembly," page 7.

3.3 PC Board Removal

1200kHz systems require that the PC boards be removed in order to gain access to the fuse or PC Card recorder.

CAUTION. Before handling the PC Boards, always wear an earth-grounding static protection strap. The electronics in the Navigator are very sensitive to static discharge. Static discharge can cause damage that may not be seen immediately. This damage will result in early failure of electronic components.

We assume that a qualified technician or equivalent will perform all of the following work.

a. With your earth-ground static protection strap on, use a 3mm Allen wrench, to remove the four bolts that secure the three Navigator boards to the Transducer assembly.

b. Note the orientation of the transmit cable connector as it is plugged into the PIO board and to the Receiver board (see Figure 2, page 5).

This cable must be removed and it has a very tight fit. To remove this cable lift straight up on the three boards and tilt slightly toward the cable. This should allow you enough slack to unplug the cable from the PIO board. If this is not possible, you may unplug the cable from the Receiver board (this may not be accessible on 1200kHz systems). Be sure to note its orientation before unplugging.

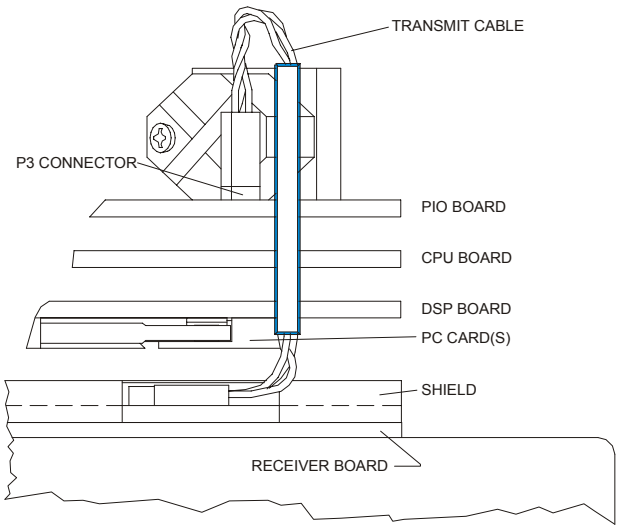

Figure 2. Transmit Cable

c. Once the transmit cable has been disconnected you may now remove the top three boards as a set by lifting the set straight up.

   These top three boards are connected to each other via connectors; they will remain as one piece. The DSP board connects to the Receiver board through a 26-pin header. The 26-pin header is a series of male pins. The 26-pin header may or may not stay connected to the DSP board when you remove the top three boards. If you see that there are male pins sticking out of the DSP board when you finish removing the board set, then the header has remained attached to the DSP board. If this happens remove it and place it into the Receiver board. To remove it, gently rock it back and forth while pulling it away from the DSP board. Once removed, align it with the connector on the Receiver board and press it into place.

3.4 Installing the PC Boards

a. Install all PC cards (if needed) into the PC card slots (see "PC Card Recorder," page 19). The PC card is keyed: it will only connect when it has been aligned correctly. The PC card is installed with the label side pointing away from the DSP board.

b. With your earth-ground static protection strap on, connect the PC Board set to the Receiver board. Align the board set to the 26-pin header connected to the Receiver board. As you connect the board set, connect the transmit cable. Be sure to connect the cable in the same orientation as was installed on the original board set.

c. Insert the four new bolts and tighten to four Newton-pounds. Do ***not*** change the position of any of the bolts. The bolt containing the felt washers and ground jumper must remain in the same position.

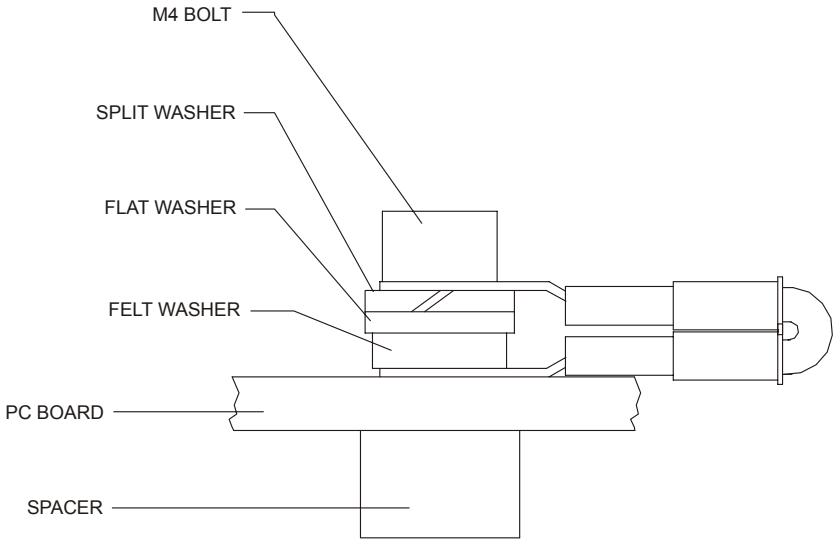

Figure 3. Ground Jumper

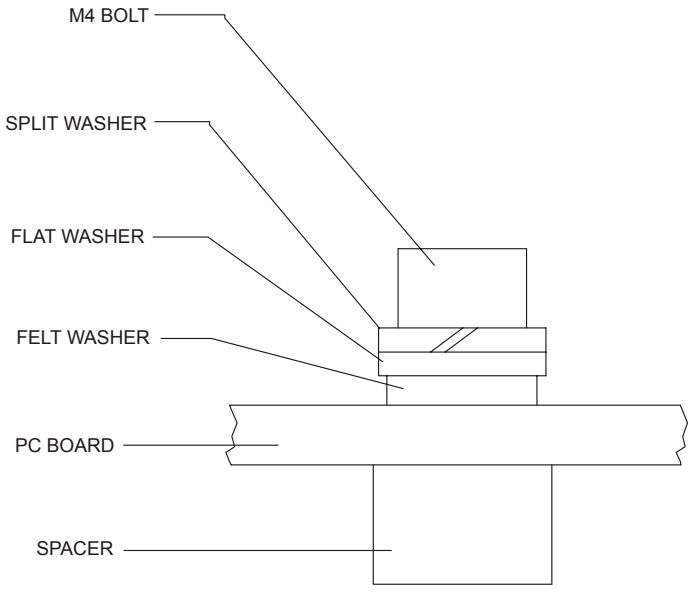

Figure 4. Mounting Hardware

4 Navigator Re-assembly

To replace the end-cap or housing, proceed as follows. Use "Parts Location Drawings," page 34 for parts identification.

a. If you are sealing the Navigator for a deployment, be sure you have done all appropriate maintenance items (see "Sealing the Navigator for a Deployment," page 23).

b. Make sure all printed circuit boards, spacers, cables, and screws have been installed.

c. Inspect/replace the O-rings before closing the Navigator (see "O-ring Inspection and Replacement," page 7).

d. Install two fresh bags of desiccant just before closing the Navigator (see "Desiccant Bags," page 20).

4.1 O-ring Inspection and Replacement

This section explains how to inspect/replace the Navigator O-rings. A successful deployment depends on the condition of the O-rings and their retaining grooves. See "Parts Location Drawings," page 34 for the locations of the following O-rings. Read all instructions before doing the required actions.

- Transducer and end-cap assembly, bore 2-258
- Transducer and end-cap assembly, face 2-260
- Transducer assembly, backup O-ring, 8-258 N300-90

NOTE. The backup O-ring is installed on 2000, 3000, and 6000 meter high pressure housing systems in addition to the 2-258 bore o-ring on the transducer/end cap assembly. Install the backup o-ring with the cupped side facing the 2-258 bore seal O-ring.

We strongly recommend replacing these O-rings whenever you disassemble the Navigator. Inspecting and replacing the O-rings should be the last maintenance task done before sealing the Navigator.

NOTE. We recommend you use new O-rings if you are preparing for a deployment.

a. Inspect the O-rings. When viewed with an unaided eye, the O-rings must be free of cuts, indentations, abrasions, foreign matter, and flow marks. The O-ring must be smooth and uniform in appearance. Defects must be less then 0.1 mm (0.004 in.).

CAUTION. If the O-ring appears compressed from prior use, replace it. **Weak or damaged O-rings will cause the ADCP/DVL to flood.**

b. Clean and inspect the O-ring grooves. Be sure the grooves are free of foreign matter, scratches, indentations, corrosion, and pitting. Run your fingernail across damaged areas. If you cannot feel the defect, the damage may be minor; otherwise, the damage may need repair.

CAUTION. Check the O-ring grooves thoroughly. **Any foreign matter in the O-ring grooves will cause the ADCP/DVL to flood.**

c. Lubricate the O-ring with a thin coat of DC-111 lubricant (Table 1, page 33, item 20). Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.

NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.

CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

d. The backup O-ring (see Figure 5) is installed in addition to the 2-258 bore O-ring on the transducer head assembly for 2000, 3000, and 6000-meter high-pressure systems only. Install the backup O-ring with the cupped side facing the 2-258 bore seal O-ring.

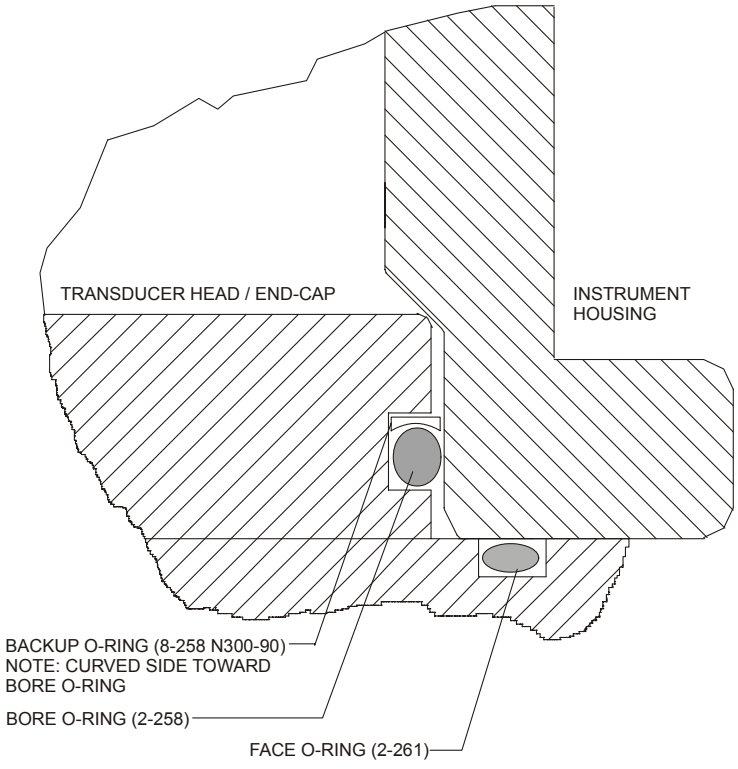

Figure 5. High Pressure O-Ring Detail View

4.2 End-cap Replacement

a. Stand the Navigator on its transducer face on a soft pad.

b. Inspect, clean, and lubricate the O-rings on the end-cap (see "O-ring Inspection and Replacement," page 7). Apply a very thin coat of silicone lube on the O-rings.

NOTE. We recommend you use new O-rings if you are preparing for a deployment.

NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.

CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

c. Connect the internal I/O connector to the plug on the common mode choke.

d. Place the end-cap on the housing, aligning the mating holes and the beam 3 mark on the end-cap with beam 3 mark on the housing. When mating the end-cap with the housing flange, try to apply equal pressure to all parts of the O-rings. Make sure the face and bore O-rings remain in their retaining grooves.

CAUTION. Check that no wires or any other object is pinched between the end-cap and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the ADCP/DVL will flood.**

e. Examine the end-cap assembly nuts, bolts, and washers (4-mm) for corrosion; replace if necessary. The "Parts Location Drawings," page 34 shows the assembly order of the end-cap mounting hardware. All the hardware items are needed to seal the Navigator properly.

f. Install all eight sets of hardware until "finger-tight."

g. Tighten the bolts in small increments in a "cross" pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 7.3 Newton-meters (65 pound-inches).

CAUTION. Apply equal pressure to the O-ring as you tighten the bolts. If one bolt is tightened more then the others, the O-ring can become pinched or torn. **A damaged O-ring will cause the system to flood.**

CAUTION. Do not over tighten the bolts that hold the transducer, housing, and end cap together. If you tighten too far, you can crack or break the housing. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**

NOTE. The recommended torque value for the end-cap 6-mm bolts is 7.3 Newton-meters (65 pound-inches).

4.3 Housing Assembly Replacement

a. Stand the Navigator on its end-cap.

b. Inspect, clean, and lubricate the O-rings on the housing (see "O-ring Inspection and Replacement," page 7). Apply a very thin coat of silicone lube on the O-rings.

NOTE. We recommend you use new O-rings if you are preparing for a deployment.

NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.

CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

c. Connect the internal I/O connector to the plug on the common mode choke.

d. Gently lower the transducer head/electronics assembly into the housing, aligning the mating holes and the beam 3 mark on the transducer head with the beam 3 mark on the end-cap. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-ring. Make sure the face and bore O-rings remain in their retaining grooves.

CAUTION. Check that no wires or any other object is pinched between the transducer head assembly and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the ADCP/DVL will flood.**

e. Examine the transducer assembly nuts, bolts, and washers (8-mm) for corrosion; replace if necessary. The "Parts Location Drawings," page 34 shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the Navigator properly.

f. Install all four sets of hardware until "finger tight."

g. Tighten the bolts in small increments in a "cross" pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 9.6 Newton-meters (85 pound-inches). Do not deform the plastic bushings.

CAUTION. Apply equal pressure to the O-ring as you tighten the bolts. If one bolt is tightened more then the others, the O-ring can become pinched or torn. **A damaged O-ring will cause the system to flood.**

CAUTION. Do not over tighten the bolts that hold the transducer, and housing together. If you tighten too far, you can crack or break the plastic bushing. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**

NOTE. The recommended torque value for the transducer head 8-mm bolts is 9.6 Newton-meters (85 pound-inches).

4.4 Optional External Battery Case Battery Replacement

The optional external battery case holds two battery packs to provide power. Batteries should be replaced when the voltage falls below +30 VDC (measured across the battery connector under no-load conditions). To replace the battery packs, do the following steps.

CAUTION. The external battery case should not be connected or disconnected underwater. The electrical output power will degrade the connector contacts and present a potential electrical shock hazard to installation personnel when the power connector is short-circuited in water. The external battery case output power cannot be enabled or disabled underwater.

a. Remove one end-cap from the external battery pack (see Figure 15, page 37).

b. Place the external battery case on its side and carefully pull out the battery pack (attached to the end-cap).

c. Disconnect the battery power cable from the wiring harness.

d. Remove the four wing nuts, lock washers, and washers holding the battery pack onto the posts (see "Parts Location Drawings," page 34).

e. Remove the support plate.

f. Slide out the used battery pack.

g. Slide a new battery pack onto the four posts. Make sure the wiring harness is not pinched by the battery pack. Use the large rubber bands (supplied with each new pack) to hold the cables in place.

h. Position the support plate over the four posts.

i. Place a flat washer, lock washer, and wing nut on each of the four posts. Tighten the nuts to hold the battery in place.

j. Test the battery pack voltage by measuring across the battery connector under no-load conditions. The voltage should be +42 VDC for a new battery pack.

CAUTION. Older Battery Packs may not contain permanent internal sleeves that protect the battery pack from any accidental shorting against the four End Cap studs. If the battery pack shorts out, it will blow a protective fuse inside the battery pack. **The battery pack is then open and will read as zero volts DC.**

k. Connect the battery power cable to the wiring harness.

l. Install the end-cap/battery pack assembly (see "End-cap Replacement," page 9).

m. Repeat steps "a" through "l" to replace the other battery pack.

n. Replace the desiccant bags on each battery just before sealing the external battery case (see "Desiccant Bags," page 20).

5 Compass Calibration

The main reason for compass calibration is battery replacement. Each new battery carries a different magnetic signature. The compass calibration algorithm corrects for the distortions caused by the battery to give you an accurate measurement. You should be aware of the following items:

- ***We recommend against calibrating the Navigator while on a vessel/ROV.*** The ship's motion and magnetic fields from the hull and engine will likely prevent successful calibration.
- If you think your mounting fixture or frame has some magnetic field or magnetic permeability, calibrate the Navigator inside the fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.

5.1 Preparing for Calibration

o. Place the Navigator on a piece of strong cardboard on top of a smooth wooden (non-magnetic) table. If a wooden table is not available, place the Navigator on the floor as far away from metal objects as possible. Use the cardboard to rotate the Navigator during calibration—this way you will not scratch the Navigator. Place the Navigator in the same orientation as it will be deployed.

NOTE. If you will deploy your Navigator looking up, calibrate it looking up. If you will deploy it looking down, calibrate it looking down.

CAUTION. If you calibrate the compass in one direction (up or down) and deploy the Navigator in the opposite direction (i.e. calibrate it in a downward position and deploy it in a upward position) the compass calibration will be invalid. Compass errors in excess of 5 degrees may occur.

p. Connect the Navigator as shown in the User's Guide.

q. Start *BBTalk*. See the RDI Tools User's Guide for assistance on using *BBTalk*.

5.2 Compass Calibration Verification

Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters at every 5º of rotation for a full 360º rotation. When it has collected data for all required directions, the Navigator computes and displays the results.

NOTE. Verify the compass if you have just replaced the memory module (optional for Navigators), or any ferrous metals is relocated inside or around the Navigator housing.

a. Start *BBTalk*. Send a Break to wake up the Navigator.

b. On the **Transfer** menu, click **Command History**. In the **Enter a Command** box, enter **AX** and click **OK**.

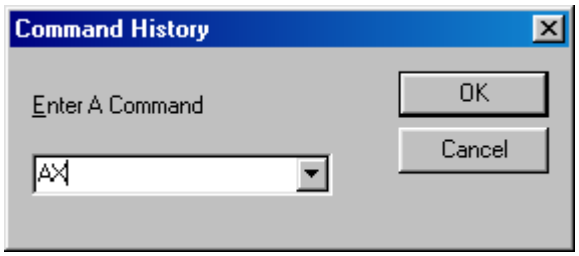

Figure 6. BBTalk Command History Box

c. **Place the ADCP/DVL in the same orientation as it will be deployed** on a piece of strong cardboard. The Navigator can be vertical (it can rest on its end cap), or it can be tilted (it could rest on a transducer face). Whatever its tilt, the tilt must remain constant as you rotate the ADCP/DVL.

d. When prompted, rotate the Navigator slowly 360 degrees using the cardboard to assist in rotating the ADCP/DVL. Rotate the Navigator smoothly and slowly. Pay particular attention to the Overall Error. For example;

```
HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:
   OVERALL ERROR:
      Peak Double + Single Cycle Error (should be < 5():   1.55
   DETAILED ERROR SUMMARY:
      Single Cycle Error:                                  1.54
      Double Cycle Error:                                  0.07
      Largest Double plus Single Cycle Error:              1.61
      RMS of 3rd Order and Higher + Random Error:          0.31
```

If the overall error is less than 5°, the compass does not require alignment. You can align the compass to reduce the overall error even more (if desired).

5.3 Compass Calibration Procedure

The built-in automated compass calibration procedure is similar to the alignment verification, but requires three rotations instead of one. The Navigator uses the first two rotations to compute a new calibration matrix and the third to verify the calibration. It will not accept the new matrix unless the calibration was carried out properly, and it asks you to verify that you want to use the new calibration if it is not as good as the previous calibration. While you are turning the Navigator for the two calibration rotations, the Navigator checks the quality of the previous calibration and displays the results. It compares these results with the results of the third calibration rotation.

There are two compass calibrations to choose from; one only corrects for hard iron while the other corrects for both hard and soft iron characteristics for materials rotating with the ADCP/DVL. Hard iron effects are related to residual magnetic fields and cause single cycle errors while soft iron effects are related to magnetic permeability that distorts the earth's magnetic field and causes double cycle errors. *In general, the hard iron calibration is recommended because the effect of hard iron dominates soft iron.* If a large double cycle error exists, then use the combined hard and soft iron calibration.

a. Prepare the Navigator for calibration (see "Preparing for Calibration," page 13).

b. Using *BBTalk,* send a Break to wake up the Navigator.

c. On the **Transfer** menu, click **Command History**. In the **Enter a Command** box, enter **AF** and click **OK**. When the calibration procedure starts, choose the calibration type.

d. Tilt the Navigator (see Figure 7, page 16). Tilt an upward-looking Navigator with a block under one side of the end-cap. A 35-mm block will give you an 11-degree tilt. Check the on-screen instructions to see if the orientation is OK. Adjust as necessary.

NOTE. The tilts must remain constant during the rotations. The transducer beam is the center point of the rotation.

e. When prompted, rotate the Navigator slowly 360 degrees (approximately 5 degrees per second).

f. The second rotation requires the Navigator to be tilted 15 degrees in another direction than from the first rotation (see Figure 7, page 16). Follow the on-screen instructions to orient the Navigator correctly. When prompted, rotate the Navigator slowly 360 degrees (approximately 5 degrees per second).

g. The third rotation requires the Navigator to be tilted 15 degrees in another direction than from the first and second rotations. Follow the on-screen instructions to orient the Navigator correctly.

h. If the calibration procedure is successful, it records the new calibration matrix to nonvolatile memory. The Navigator will not change its matrix unless the calibration is properly carried out.

i. If the calibration procedure is not successful, return your Navigator to the original factory calibration, by using the AR-command. Try using the AR-command if you have trouble calibrating your compass. In some circumstances, a defective compass calibration matrix can prevent proper calibration.

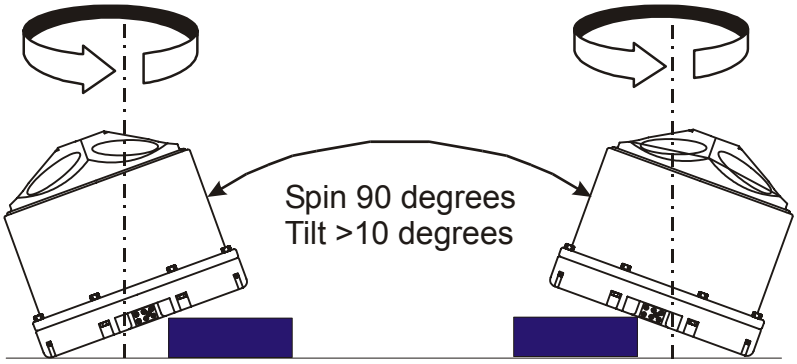

Figure 7. Compass Calibration

6 Fuse Replacement

PIO Board. There is one fuse on the PIO Board (see Figure 8, page 18) that protects the Navigator from excessive incoming power. If this fuse continues to blow, check your input power before applying power again.

a. Turn off the power.

b. Remove the end-cap or housing (see "Navigator Disassembly," page 3).

c. The PIO board fuse is located next to the internal I/O connector. Use a small flat-blade screwdriver to open the fuse housing. Turn the end 180° (counter-clockwise) to open the fuse housing.

d. Gently pull the fuse housing out. Turn the housing to remove the fuse.

e. Check the fuse using an ohmmeter. Replace the fuse if necessary with the correct voltage and amperage fuse (Table 1, page 33 item 21).

f. Install the transducer head or end-cap (see "Navigator Re-assembly," page 7).

g. Test the system (see the Test Guide).

External Battery Pack. One fuse in the optional external battery pack protects the Navigator from excessive incoming power. If this fuse continues to blow, check your battery packs before connecting the external battery case again.

a. Remove one end-cap from the external battery pack (see "End-Cap Removal ," page 3).

b. Carefully lift out the battery pack (attached to the end-cap).

c. Check the fuse using an ohmmeter. Replace the fuse if necessary with the correct voltage and amperage fuse (Table 1, page 33 item 21).

d. Install the end-cap (see "End-cap Replacement," page 9).

e. Measure the voltage output of the external battery case across pin 3 (+) and pin 7 (-) on the external connector. If both battery packs are fresh, you should measure approximately +42 VDC.

7 Communications Setting

A switch on the PIO board (see Figure 8) changes the communication settings between RS-232 and RS-422. Your computer and the Navigator must both be set to the same communication setting. Use the RS-232-to-RS-422 converter if the Navigator is using RS-422 communications and you computer only has an RS-232 COM port.

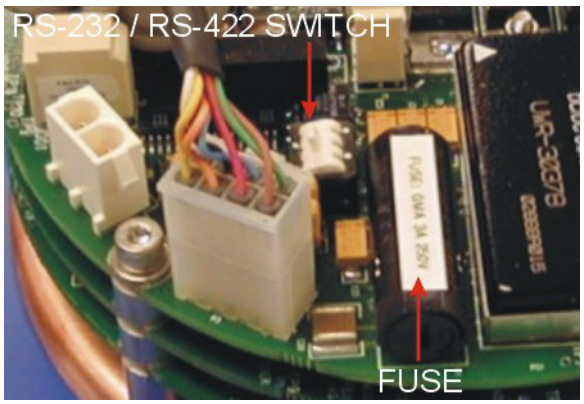

Figure 8. Communication Switch and Fuse

8 Firmware Upgrades

The firmware for Navigator ADCPs in located on flash RAM chips on the CPU board. Firmware must be downloaded. Use the following procedure to download firmware to the Navigator.

a. Connect your ADCP/DVL to the computer as shown in the Navigator User's Guide.

b. Start the program *DVLxx.exe* (where *xx* is the firmware number).

c. Click **Setup**. Click the **View README.TXT** button to view the Readme.txt file for details on what is new in this version of the firmware.

d. Click **Next** and follow the on-screen prompts.

e. If you are not able to install the new firmware, contact Customer Service.

f. After successfully upgrading the firmware, use *BBTalk* to test the ADCP/DVL (see the Test Guide).

9 PC Card Recorder

The PC Card recorder is located on the Digital Signal Processor (DSP) board inside the Navigator's electronics (see Figure 9). To recover data, the card can be removed and used in a personal computer (PC), or left in the Navigator, and accessed by using *BBTalk* (see the RDI Tools User's Guide). To remove or install a PC card, do the following.

a. Turn off power to the Navigator.

b. Remove the housing on 300/600kHz Navigators (see "Housing Removal," page 4). 1200kHz Navigators must remove the PC boards to gain access to the recorder (see "PC Board Removal," page 4).

c. Remove the PC cards by pushing the button on the side of the PC card slot. The card should "pop" out of the connector. If you cannot reach the release button with your finger, use a plastic pen or non-conductive tool to depress the button. Do not try to force the card in or out of the connector. PC cards slide easily in or out when properly oriented.

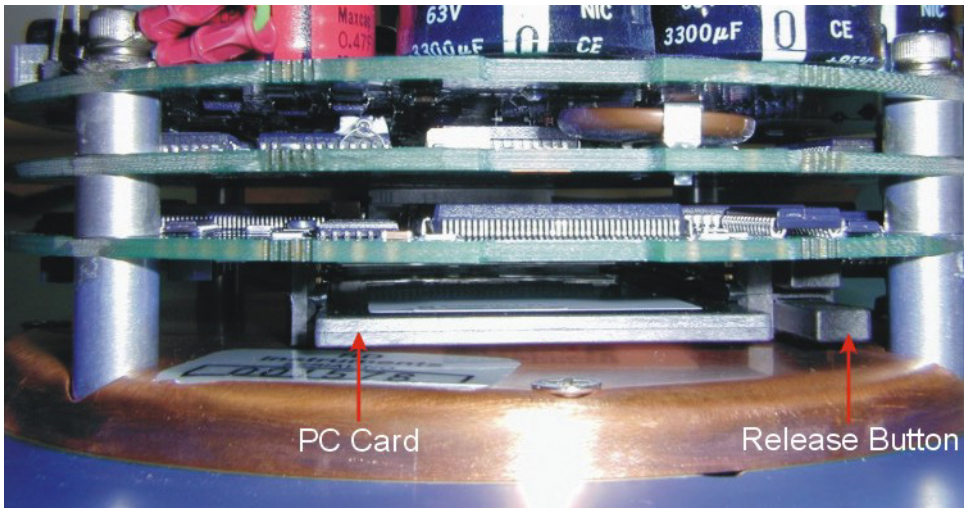

Figure 9. PC Card Recorder

d. When you are finished, install the PC card back into the DSP board. PC cards install with the label side toward the face of the transducer.

e. Install the housing or end-cap (see "Navigator Re-assembly," page 7).

NOTE. RDI uses true 16-bit PCMCIA/ATA, 5-volt, type 2 memory cards made by SANDISK (old name was SUNDISK). These cards must be formatted before using in the Navigator. Other cards may work but we have not had any success. You can use 10 to 220 MB cards (up to two cards).

The Navigator does not come with memory cards, but has the same capacity for memory cards as a WorkHorse Sentinel.

10 Desiccant Bags

Desiccant bags are used to dehumidify the housing interior. The factory-supplied desiccant lasts a year at specified Navigator deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air.

The average dry weight of a new desiccant bag is 7.2 grams ((5%). The weight increases to 8.4 to 9 grams for a "used" desiccant bag. Used desiccant bags may be dried at 250° for 14 hours. As a minimum, replace the desiccant bags (Table 1, page 33, item 19) whenever you are preparing to deploy or store the Navigator for an extended time.

CAUTION. Do not open the desiccant bag. Contact with the silica gel can cause nose, throat, and skin irritation.

NOTE. Desiccant bags are shipped in an airtight aluminum bag to ensure maximum effectiveness. There is a moisture indicator inside the bag. If the moisture indicator is pink, do not use the desiccant bag until it has been dried. RDI recommends replacing the desiccant bag just before the deployment.

a. Remove the housing or end-cap (see "Navigator Disassembly," page 3).

b. Remove the new desiccant bags from the airtight aluminum bag.

c. Remove the old desiccant bags and install two new ones. Place the desiccant bags (Table 1, page 33, item 19) on top of the PIO board.

d. Install the housing or end-cap (see "Navigator Re-assembly," page 7).

11 Zinc Anode Inspection and Replacement

Navigator systems have four sacrificial zinc anodes. If the ADCP/DVL does not have exposed bare metal, properly installed anodes help protect the ADCP/DVL from corrosion while deployed. Read all instructions before doing the required actions.

11.1 Zinc Anode Inspection

The life of a zinc anode is not predictable. An anode may last as long as one year, but dynamic sea conditions may reduce its life. Use a six-month period as a guide. If the total deployment time for the anodes has been six months or more, replace the anodes. If you expect the next deployment to last six months or more, replace the anodes. Inspect the anodes as follows.

a. Inspect the anodes on the end-cap for corrosion and pitting. If most of an anode still exists, you may not want to replace it.

b. Inspect the RTV-covered screws that fasten each anode. If the RTV has decayed enough to let water enter between the screws and the anode, replace the RTV.

c. If you have doubts about the condition of the anodes, remove and replace the anode.

11.2 Zinc Anode Electrical Continuity Check

Measure the resistance using a digital multimeter (DMM) between all four end-cap anodes. Scratch the surface of the anode with the DMM probe to make good contact if the anode is oxidized. The resistance should be less than five ohms. If not, reinstall the affected anode.

11.3 Zinc Anode Replacement

The following steps explain how to remove and replace the zinc anode/s.

a. Remove the RTV from the anode screw heads. Remove the screws.

b. The anode may stick to the ADCP/DVL because of the RTV used during assembly. To break this bond, first place a block of wood on the edge of the anode to protect the housing anodizing and paint. Carefully strike the block to loosen the anode.

c. Clean the bonding area under the anode. Remove all foreign matter and corrosion. Apply a continuous 1-2 mm bead (0.04-0.08 in.) of RTV around each screw hole.

d. Set a new anode in place and fasten with new screws.

e. Fill the counter bore above each screw head with RTV. The RTV protects the screw heads from water and prevents breaking the electrical continuity between the anode, screw, and housing.

f. Check electrical continuity. If any measurement is greater than one ohm, reinstall the affected anode.

CAUTION.

1. Do not use zinc anodes with an iron content of more than 0.0015%. The major factor controlling the electrical current output characteristics of zinc in seawater is the corrosion film that forms on the surface of the zinc. Corrosion product films containing iron have a high electrical resistance. As little as 0.002% iron in zinc anodes degrades the performance of the anode.

2. Do not use magnesium anodes. Magnesium rapidly corrodes the aluminum housing.

3. Do not connect other metal to the ADCP/DVL. Other metals may cause corrosion damage. Use isolating bushings when mounting the ADCP/DVL to a metal structure.

12 Protective Coating Inspection and Repair

RDI uses paint on the housing for identification and corrosion protection. For more protection, the case and the transducer assembly are first anodized. Do not damage the surface coatings when handling the ADCP/DVL. Inspect and repair the protective coating as follows. Read all instructions before doing the required actions.

NOTE. The procedures contained in this section apply to our standard aluminum systems. For systems made of other materials, contact RDI.

a. Inspect the end-cap, housing, and transducer assemblies for corrosion, scratches, cracks, abrasions, paint blisters, exposed metal (silver-colored aluminum), exposed anodize (black or dark green), and exposed primer (yellow). Be critical in your judgment; the useful life of the Navigator depends on it.

CAUTION. The chemicals used in the following steps can be hazardous to your health. Read all material safety data sheets and manufacturer's instructions before handling these chemicals.

b. If you are familiar with the repair of anodized coatings, proceed as follows; otherwise, send the Navigator to RDI for repair.

   1. Clean and prepare the damaged area using a fine-grade abrasive cloth or a fine-grade abrasive silicon carbide wheel. Remove all corrosion from the bare aluminum.
   2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
   3. Anodize per MIL-A-8625, Type 3, Class 1.
   4. Seal with sodium dichromate only.
   5. Paint repaired area as described in step c below.

c. Proceed as follows to repair or touch up the protective paint.

   1. Remove all loose paint without damaging the anodizing. Clean and prepare the damaged area using a fine-grade abrasive cloth. Feather the edges of the paint near the damaged area. Try to have a smooth transition between the paint and the damaged area. Do not sand the anodized area. If you damage the anodizing, see step b above for repair.
   2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
   3. Paint with one coat of epoxy primer (manufacturer's part number 4500; see note below).

4. Paint with one coat of orange or black paint (manufacturer's part number 4512-B (orange), 4511-B (black); see note below).

NOTE. RDI uses two-part epoxy type paint. This paint is manufactured by Pro-line Paint Manufacturing company, 2426 Main St., San Diego, CA, 92113, Telephone: (619) 231-2313; or 1168 Harbor, Long Beach, CA, 98813, Telephone: (213) 432-7961. Manufacturer's part numbers:
4500-A, Pro-thane Paint, Catalyst, Part A
4511-B, Pro-thane Paint, Black, Part B
4512-B, Pro-thane Paint, Orange, Part B

13 Sealing the Navigator for a Deployment

Use the "Parts Location Drawings," page 34 and the following steps to seal the Navigator for a deployment.

a. Check the Navigator electronics; there should be no loose screws or missing hardware.

b. Install the optional PC card(s) if needed (see "PC Card Recorder," page 19)

c. Add two fresh desiccant bags inside the Navigator housing (see "Desiccant Bags," page 20).

d. Install the housing assembly or end-cap (see "Navigator Re-assembly," page 7).

e. The Navigator is now ready for deployment unless you want to take steps to prevent biofouling (see "Prevention of Biofouling," page 23).

f. Use the Navigator User's Guide to connect the Navigator system. Use the Test Guide to test the Navigator before the deployment.

14 Prevention of Biofouling

This section explains how to prevent the buildup of organic sea life (biofouling) on the transducer faces. Objects deployed within about 100 meters (≈328 feet) of the surface are subject to biofouling, especially in warm, shallow water.

Deep Water Deployments. Biofouling is not usually a problem in deep water (more than 100 meters). Soft-bodied organisms usually cause no problems. Do not apply antifouling grease if deploying the Navigator in deep water.

Shallow Water Deployments. Soft-bodied organisms usually cause no problems, but barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the Navigator (see Figure 10, page 24).

In shallow-water applications, the use of antifouling grease may be appropriate if you cannot clean the transducer faces often (weekly), and if the antifouling grease meets all of your local safety and environmental laws.

14.1 Controlling Biofouling

The best-known way to control biofouling is cleaning the Navigator transducer faces often. However, in many cases this is not possible. The following options can help reduce biofouling.

- Coat the entire Navigator with the recommended antifouling paint. Make sure that the paint is applied in an even coat over the transducer faces.
- Apply a thin coat (≈4 mm; ≈0.16 in.) of either a 50:50 mix of chili powder and petroleum jelly or chili powder and silicone grease to the transducer faces. The chili powder should be the hottest that can be found. Water flowing across the transducers will wash this mix away over time. The silicone mixture tends to last longer.

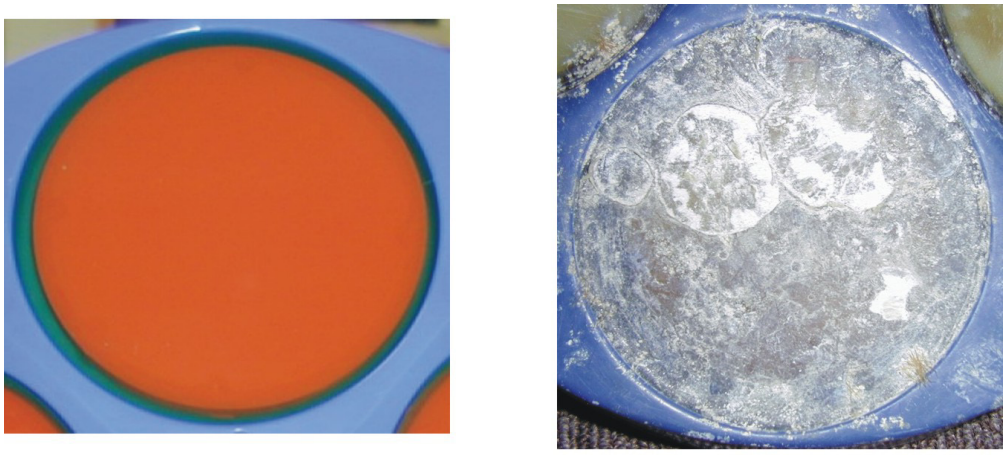

Figure 10. Barnacle Damage

CAUTION. Barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the Navigator.

If using antifouling grease, remove the grease immediately after recovering the Navigator from its deployment. Remove the grease with soapy water. Be sure to wear protective gloves and a face shield.

CAUTION.

1. Do not arbitrarily use antifouling grease for deep-water applications. For shallow-water applications, barnacles are a threat to the transducer faces; using antifouling grease may be appropriate if you cannot clean the Navigator regularly (weekly). If using antifouling grease, remove it immediately after recovering the Navigator.

2. Antifouling grease is toxic. Read the product safety data sheet before using the grease. Wear gloves and a face shield when applying the grease. If the skin comes in contact with the grease, immediately wash the affected area with warm, soapy water.

3. All U.S. coastal states prohibit the use of tributyl-tins on boat hulls. The European Economic Commission has released a draft directive that would prohibit the use of many organo-tins after July 1989. We strongly recommend you obey your local laws.

14.2 Recommended Antifouling Paints

You can use almost any EPA approved anti-fouling paint on the housing or the urethane transducer faces. You do have to be extra careful with the urethane faces. We recommend the TRILUX II paint from Interlux.

Manufacturer	Contact
Courtalds Finishes	Telephone: 908-686-1300
Interlux brand paints	Web Page: www.interlux.com

14.3 Applying Antifouling Paints

Follow the urethane faces application instructions for TRILUX II. One thin coat can last for several months.

NOTE. If you have an optional Navigator pressure sensor, and you want pressure (depth) data, you cannot protect the pressure sensor from biofouling. The pressure sensor is located near the center of the transducer array, between the urethane-covered transducers. The sensor port is a small hole drilled through a screw (see "Pressure Sensor Maintenance," page 26). You should tape off the screw during anti-fouling paint application.

This means that the sensor port is not fully protected from bio fouling. The sensor port is surrounded by the antifouling paint, but bio fouling may build up on the screw, and eventually clog the sensor port. However, most organisms do not seem to find the small amount of unpainted surface attractive. If it is logistically possible to periodically inspect/clean the pressure sensor screw, it is highly recommended. This tradeoff situation must be analyzed for individual deployments. Unfortunately, the location of the deployment site usually dictates action in this regard.

Transducer Faces (urethane surfaces)

a. Preparation - Lightly sand by hand with 120-grit paper.

b. Application - Apply one or two coats of Trilux-2 at four mil/coat. If applying a second coat, wait at least 12 hours to allow the first coat to dry. One coat lasts one season (3-4 months); two coats might last one year.

Metal Surfaces

a. Metal Surface Preparation

   1. On bare aluminum metal, use 353/354 Vinylux solvent wash (thin with 355). Perform the Metal Surface Application (Step (b), below) between 1 and 24 hours.

   2. On painted surfaces, use 120-grit sandpaper to remove gloss.

b. Metal Surface Application

   1. Mask as necessary.

   2. Apply one or two coats of Trilux-2 (active ingredient is copper thio-cyanate) at four mil/coat. If applying a second coat, wait at least 12 hours to allow the first coat to dry. One coat lasts one season (3-4 months); two coats might last one year.

NOTE. Do NOT use cuprous oxide on or near aluminum systems.

15 Pressure Sensor Maintenance

In order to read the water pressure, water must be able to flow through the copper screw on the pressure sensor. The tiny hole in the copper screw may at times be blocked. Use the following procedure and Figure 11, page 27 to clean the screw.

NOTE. The pressure sensor is optional. It may not be included on your system.

a. Place the ADCP/DVL on its' end-cap. Use a soft pad to protect the ADCP/DVL.

b. Use a straight-slot screwdriver to remove the copper screw.

c. Gently clean out the hole in the copper screw with a needle. If the hole becomes enlarged or the screw is corroded, replace the screw. A re-placement copper screw is included in the spare parts kit (part number 817-1067-00).

d. Install the copper screw. Tighten the screw "finger tight" (2 in/lbs). Do not over tighten the screw or you may strip the threads on the plastic cover disc. If this happens, return the ADCP/DVL to RDI for repair.

CAUTION.

The pressure sensor is filled with silicone oil. Never poke a needle or other object through the copper screw while the screw is installed over the pressure sensor. You will perforate the sensor, causing it to fail.

Do not remove the cover disc or attempt to clean the surface of the pressure sensor. The diaphragm is very thin and easy to damage.

Do not remove the pressure sensor. It is not field replaceable.

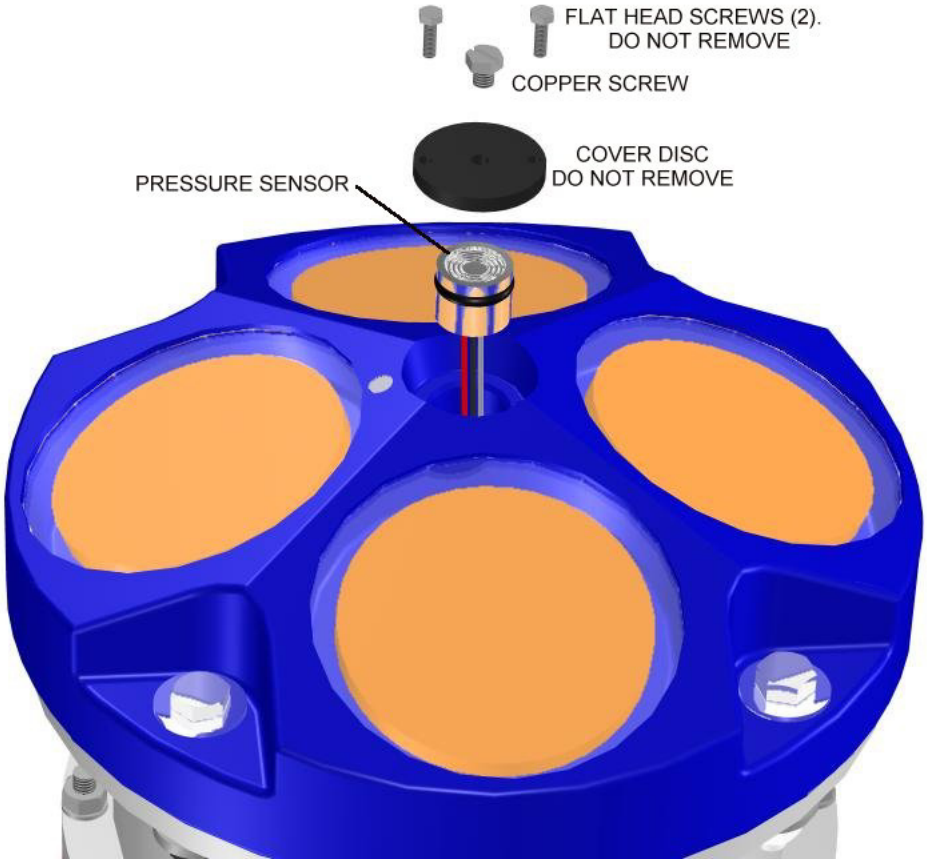

Figure 11. Pressure Sensor (Exploded View; WorkHorse Monitor/Sentinel Shown)

16 Storage and Shipping Maintenance

This section lists the maintenance items to do before storing the Navigator. These maintenance items include:

- Removing biofouling (see "Removal of Biofouling," page 28).
- Inspecting the transducer head (see "Transducer Head Inspection," page 28).
- Preparing the Navigator for final storage or shipping (see "Final Storage or Shipping Preparation," page 29).

16.1 Removal of Biofouling

Before storing or shipping the Navigator, remove all foreign matter and biofouling. Remove soft-bodied marine growth or foreign matter with soapy water. Waterless hand cleaners remove most petroleum-based fouling. Rinse with fresh water to remove soap residue. Dry the transducer faces with low-pressure compressed air or soft lint-free towels.

CAUTION. The soft, thin urethane coating on the transducer faces is easily damaged. Do not use power scrubbers, abrasive cleansers, scouring pads, high-pressure marine cleaning systems, or brushes stiffer than hand cleaning brushes on the transducer faces.

If there is heavy fouling or marine growth, the transducer faces may need a thorough cleaning to restore acoustic performance. Barnacles do not usually affect Navigator operation. We do however recommend removal of the barnacles to prevent water leakage through the transducer face. Lime dissolving liquids such as Lime-Away® break down the shell-like parts. Scrubbing with a medium stiffness brush usually removes the soft-bodied parts. Do NOT use a brush stiffer than a hand cleaning brush. Scrubbing, alternated with soaking in Lime-Away®, effectively removes large barnacles. After using Lime-Away®, rinse the Navigator with fresh water to remove all residues. If barnacles have entered more than 1.0 to 1.5 mm (0.00.06 in.) into the transducer face urethane, you should send the Navigator to RDI for repair (see Figure 10, page 24). If you do not think you can remove barnacles without damaging the transducer faces, contact RDI.

16.2 Transducer Head Inspection

The urethane coating on the transducer faces is important to Navigator watertight integrity. Mishandling, chemicals, abrasive cleaners, and excessive depth pressures can damage the transducer ceramics or urethane coating. Inspect the transducer faces for dents, chipping, peeling, urethane shrinkage, hairline cracks, and damage that may affect watertight integrity or

transducer operation. Repair of the transducer faces should only be done by RDI.

CAUTION. Never set the transducer on a rough surface; always use foam padding to protect the transducers.

16.3 Final Storage or Shipping Preparation

This section explains how to store or ship the Navigator. Clean and inspect the I/O connector for water or salt residue.

CAUTION. If you are shipping a Navigator to RDI for repair or upgrade, remove all customer-applied coatings or provide certification that the coating is nontoxic. This certification must include the name of a contact person who is knowledgeable about the coating, the name, and manufacturer of the coating, and the appropriate telephone numbers. If you return the equipment without meeting these conditions, we have instructed our employees not to handle the equipment and to leave it in the original shipping container pending certification. If you cannot provide certification, we will return the equipment to you or to a customer-specified cleaning facility. All costs associated with customer-applied coatings will be at the customer's expense.

When shipping the Navigator through a Customs facility, be sure to place the unit/s so identifying labels are not covered and can be seen easily by the Customs Inspector. Failure to do so could delay transit time.

NOTE. RDI strongly recommends using the original shipping crate whenever transporting the Navigator.

If you need to ship or store the Navigator, use the original shipping crate whenever possible. If the original packaging material is unavailable or un-serviceable, additional material is available through RDI.

For repackaging with commercially available materials, use the following procedure:

a. Use a strong shipping container made out of wood or plastic.

b. Install a layer of shock-absorbing static-shielding material, 70-mm to 100-mm thick, around all sides of the instrument to firmly cushion and prevent movement inside the container.

c. Seal the shipping container securely.

d. Mark the container FRAGILE to ensure careful handing.

e. In any correspondence, refer to the Navigator by model and serial number.

17 Returning Navigators to RDI for Service

When shipping the Navigator to RDI from either inside or outside the United States, the following instructions will help ensure the Navigator arrives with the minimum possible delay. Any deviation from these instructions increases the potential for delay.

17.1 Domestic Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material Authorizations are issued by Sales Administration or Customer Service and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Material Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What problem(s) need correction
- When you need the instrument returned

When the Return Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship via air freight, prepaid

Urgent Shipments should be shipped direct to RDI via any of several overnight or priority air services. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to three days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money. In addition, some truck lines may offer equivalent delivery service at a lower cost, depending on the distance to San Diego.

Mark the Package(s)

To: RD Instruments, Inc. (RMA Number)
9855 Businesspark Avenue
San Diego, CA 92131-1101

Step 3 - Urgent shipments

Send the following information by fax or telephone to RDI.

Attention: Sales Administration
Fax: (858) 695-1459
Phone: (858) 693-1178

- Detailed descriptions of what you are shipping (number of packages, sizes, weights, and contents).
- The name of the freight carrier
- Master Air bill number
- Carrier route and flight numbers for all flights the package will take

17.2 International Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material Authorizations are issued by Sales Administration or Customer Service and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Material Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What problem(s) need correction
- When you need the instrument returned

When the Return Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship Via Air Freight, Prepaid

Urgent Shipments should be shipped direct. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to five days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money.

Mark the package(s) as follows:

To: RD Instruments, Inc. (RMA Number)
9855 Businesspark Avenue
San Diego, CA 92131-1101 USA
C/O: Paxton, Shreve & Hays
Lindbergh Field, San Diego Airport
2361 Airlane Drive, #D
San Diego, CA 92101

Notify upon arrival
Phone: 858-692-3113
Fax:858-692-0539

Step 3 - Include Proper Customs Documentation

The Customs statement should be completed very carefully. It should accurately and truthfully contain the following information.

- Contents of the shipment
- Value
- Purpose of shipment (example: "American made goods returned for repair")
- Any discrepancy or inaccuracy in the Customs statement could cause the shipment to be delayed in Customs.

Step 4 - Send the Following Information by Fax or Telephone to RDI

Attention: Sales Administration
Fax: (858) 695-1459
Phone: (858) 693-1178

- Detailed descriptions of what you are shipping (number of packages, sizes, weights, and contents).
- The name of the freight carrier
- Master Air bill number
- Carrier route and flight numbers for all flights the package will take

18 Spare Parts

Table 1: Navigator Spare Parts

Item #	Qty	Part number	Description
1.	1	14800	Tool box, 14-1/2 H 7-1/2 H 5-1/2
2.	4	810-4004-00	Bushing, instrument housing
3.	2	2-260	O-ring, face
4.	2	2-258	O-ring, bore
5.		2-258, PARBAK	Backup O-ring
6.	1	M13COMBINATION	Wrench, 13 mm combination
7.	1	M10COMBINATION	Wrench, 10 mm combination
8.	1	M5ALLENDRIVER	Ball type, metric
9.	1	M6ALLENDRIVER	Ball type, metric
10.	1	5503A39	Wrench, 3 mm, ball end, L
11.	4	M8X1.25X70SH	Screw, socket head, stainless steel 316
12.	4	M8WASHSPL	Washer, split lock, stainless steel 316
13.	8	M8WASHSTD	Washer, flat, M8, 17 mm OD, stainless steel 316
14.	4	M8X1.25NUT	Nut, hex, stainless steel 316
15.	4	M6X1.0X45SH	Screw, socket head, stainless steel 316
16.	8	M6WASHSTD	Washer, flat, 12.5 mm OD, stainless steel
17.	4	M6WASHSPL	Washer, split lock, stainless steel 316
18.	4	M6X1.0NUT	Nut, hex, stainless steel 316
19.	1	DES3	Desiccant, sealed bag
20.	1	DC-111	Lubricant, silicone, 5.3 oz, Dow-Corning
21.	2	GMA-3A	Fuse, 3.0 Amp, 250V
22.	2	811-4007-00	Bushing, L
23.	2	Use local vendor	M8 Bushing, plastic isolation

19 Parts Location Drawings

Use the following figures to identify the parts used on your Navigator ADCP/DVL.

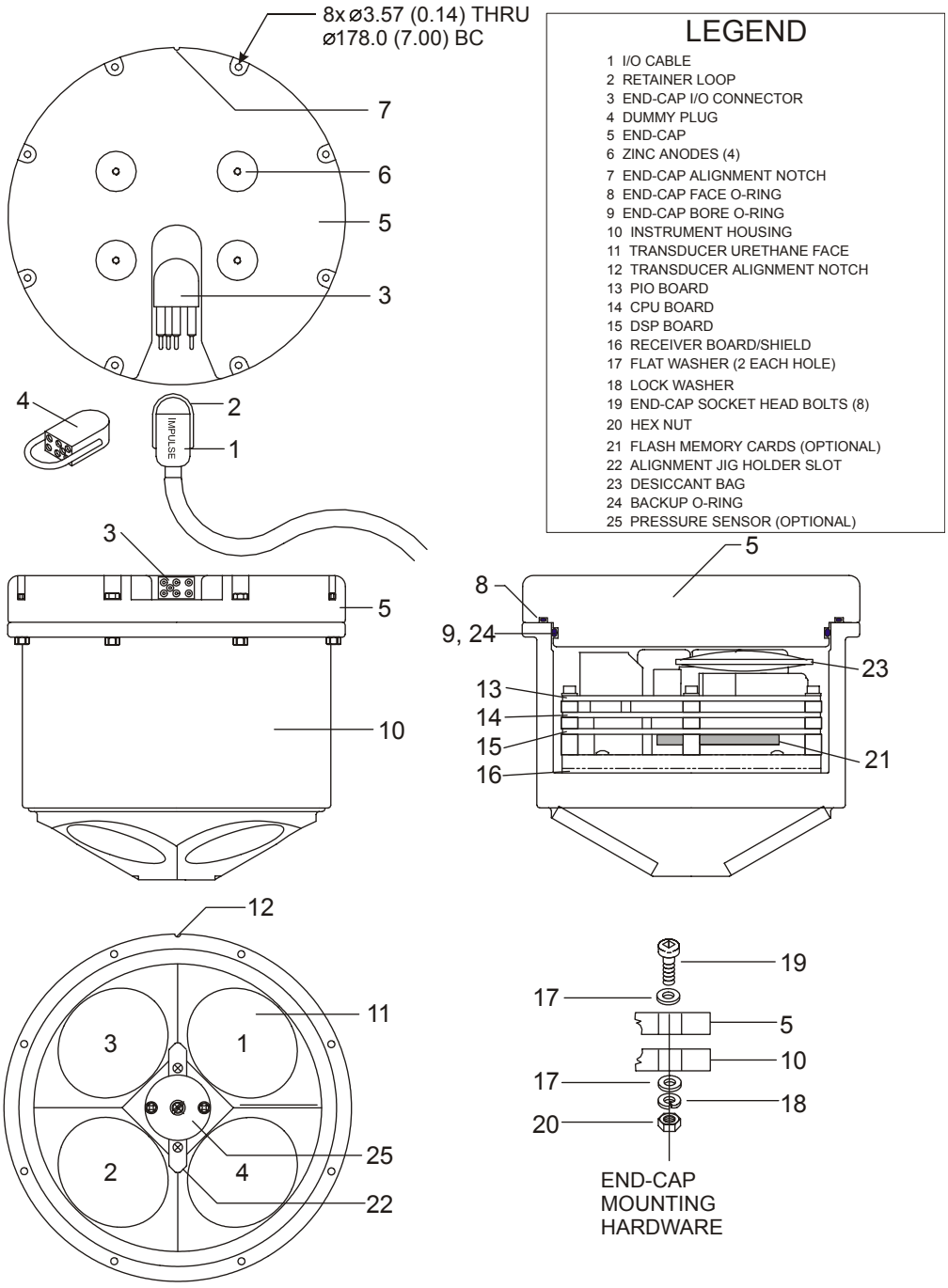

Figure 12. 1200kHz Navigator Parts Location

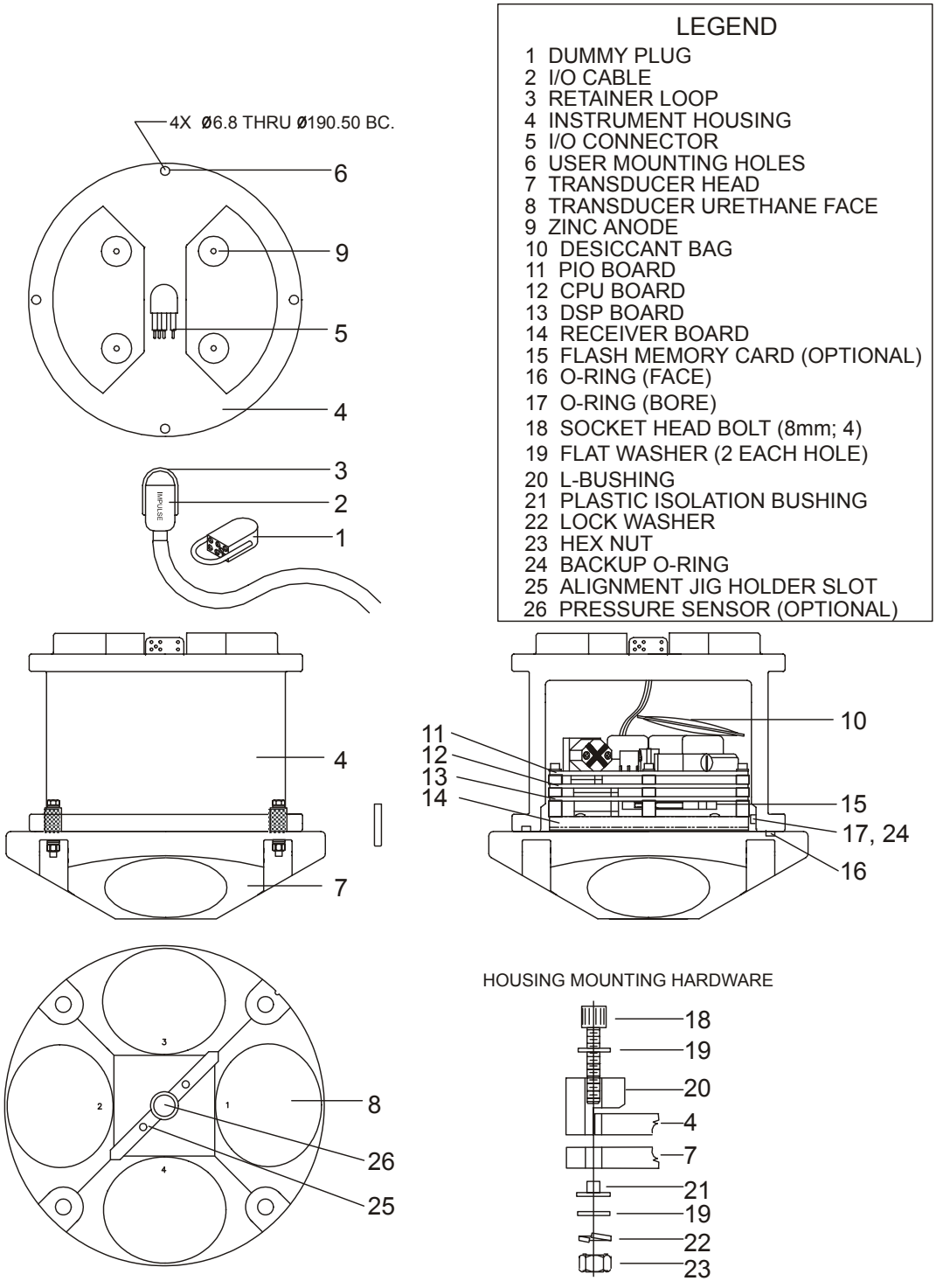

Figure 13. 300/600kHz Navigator Parts Location

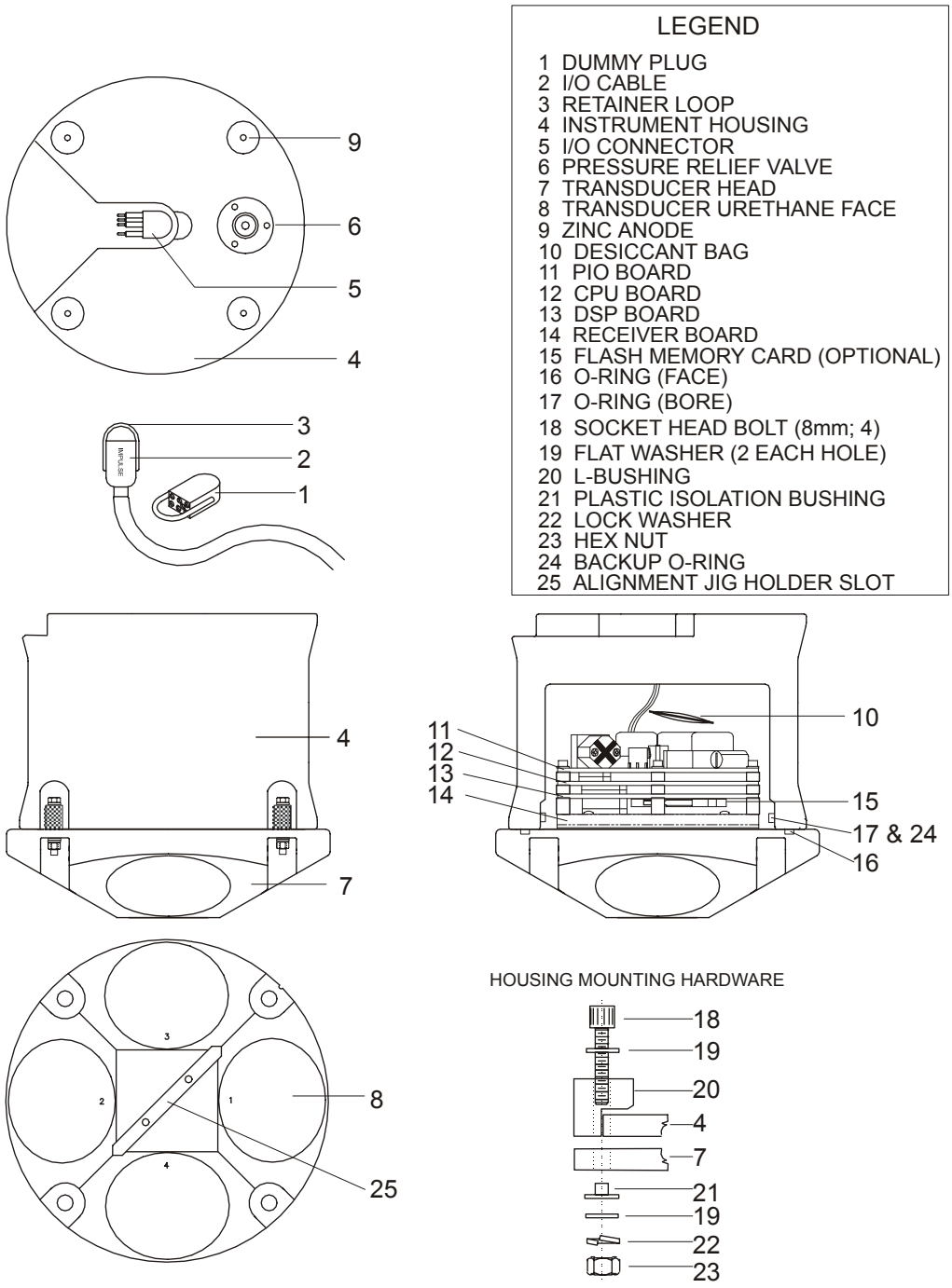

Figure 14. 300/600kHz Navigator Parts Location (3000/6000 meter Housing)

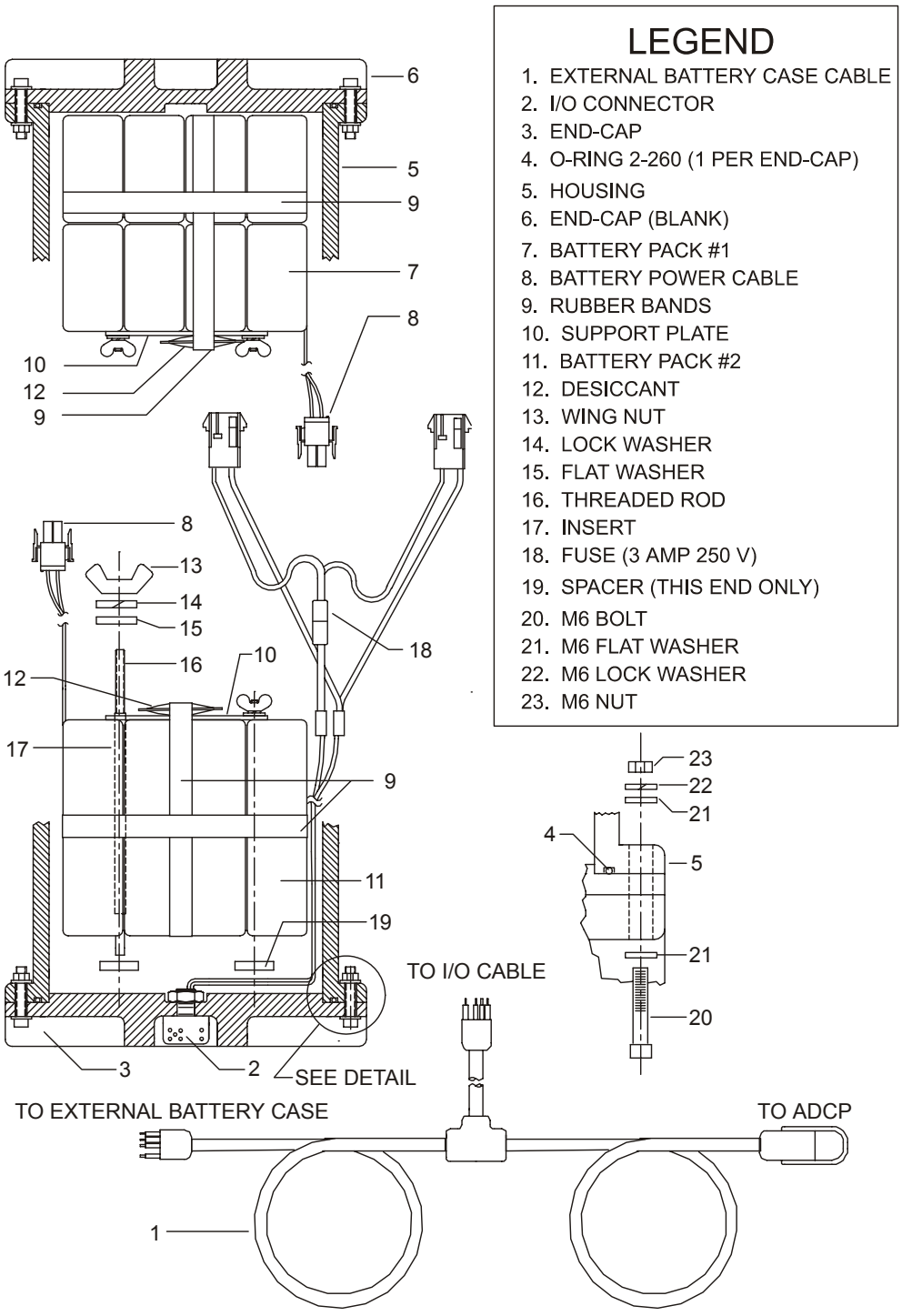

Figure 15. External Battery Pack Parts Location

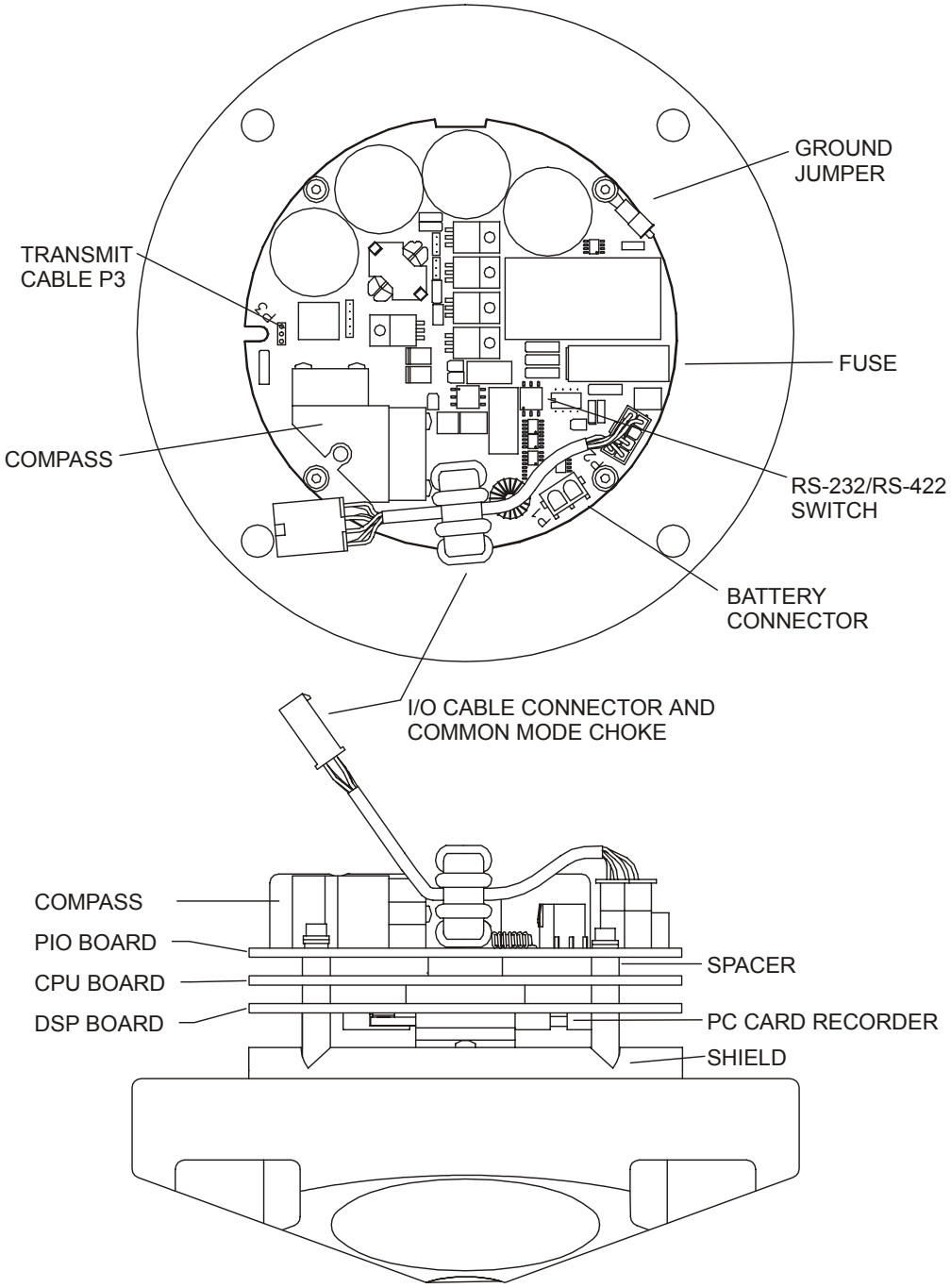

Figure 16. Navigator Board Locations