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Neptune® 2

Waste Management System

Service and Installation Manual

REF 0702-002-620

120 V Rover - ULTRA
REF 0702-001-000

120 V Docking Station
REF 0702-014-000

Neptune® 2
Waste Management System
Service and Installation Manual
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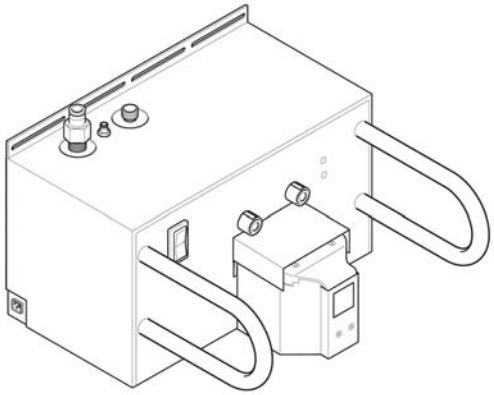
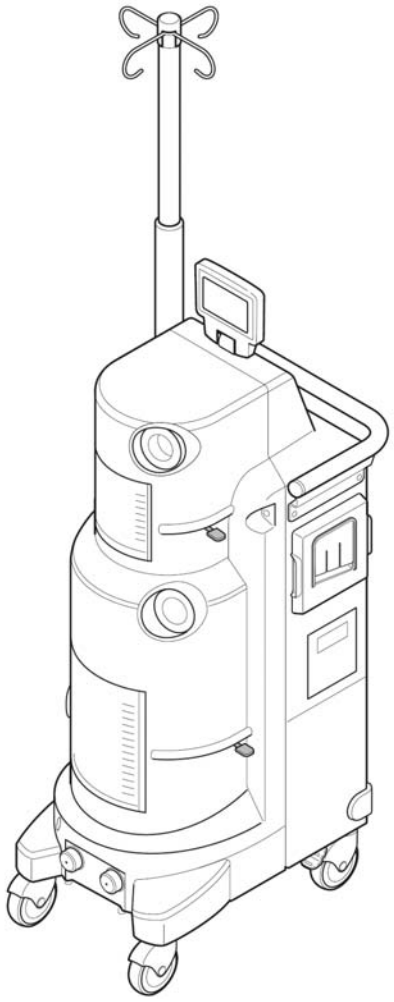
120 V Docking Station
REF 0702-014-000





How to Use the Neptune 2 Service Manual

The Neptune 2 service and installation manual is comprised of 8 chapters that each covers a separate service topic. While a table of contents is provided to aid in quickly locating the desired material, the contents of each chapter are outlined below.

Chapter 1 – Operational Description

Here you will find a brief overview of how the Neptune 2 Waste Management System works. Included topics are:

- The components in each subsystem (i.e. vacuum subsystem, or fresh water subsystem)
- The specific function of those components and how they operate in the system.
- Illustration of the user interface panel to familiarize the technician with the indicators and controls of the Neptune 2 Ultra rover.

Chapter 2 – Ultra Rover Disassembly

The Neptune 2 Waste Management System is comprised of a docking station (a stationary device; also referred to as a docker) to remove waste fluid, and a mobile device called a rover to collect surgical fluid. The Neptune Ultra is Stryker's two canister model rover, which also provides a motorized IV Pole and smoke evacuation in the same compact footprint. Chapter 2 outlines the procedures necessary to remove and replace components in the Ultra rover. Reference the disassembly examples for a detailed description of how the procedures are structured.

Chapter 3 – Solo Rover Disassembly

The Solo rover provides the user with the safety, environmental, and cost savings benefits of the Neptune Waste Management system with fewer functions than the Ultra model. The solo model has only one canister and is not equipped with smoke evacuation or an IV pole. This product has not been introduced for sale yet. Chapter 3 will outline procedures for the solo rover when it is released. Reference the disassembly examples for a detailed description of how the procedures are structured.

Chapter 4 – Docker Disassembly

The docking station, or docker, is a stationary unit centrally located to a power source (standard wall outlet), a fresh water source, and a drain. It is responsible for removing the surgical fluid from the rover through an automated sequence that requires little interaction from the user, as well as rinse the rover with detergent after use. The procedures to remove and replace components for the docker are outlined in chapter 4. Reference the disassembly examples for a detailed description of how the procedures are structured.

Warning Indicators and Disassembly Procedure Example

The following examples illustrate how the disassembly procedures are structured as well as the warning indicators used when performing maintenance in the field. The disassembly procedures apply to chapters 2, 3, and 4, although each chapter will cover the steps necessary to perform maintenance on a specific product.

Warning Indicators

First and foremost, it is crucial that the technician be familiar with the indicators used when performing maintenance on the Neptune Waste Management System. The words WARNING, CAUTION, and NOTE each carry a special meaning.

WARNING: Disregarding WARNING information may compromise the safety of the patient and/or health care staff and may result in injury.

CAUTION: Disregarding CAUTION information may compromise product reliability and may result in damage.

NOTE: NOTE information supplements and/or clarifies procedural information.

A triangle with an exclamation point alerts the technician to read and understand the accompanying instructions, especially the operating, maintenance, and safety information.

A triangle with water droplets alerts the technician that the associated repair step may potentially expose the technician to fluids. (fresh water or surgical waste) A fluid warning poses a potential hazard to both personnel and equipment.

Disassembly Basics

The disassembly procedures provide a step-by-step illustration of how the Neptune Waste Management system is disassembled. As a general rule, each product's disassembly section begins with the steps required to remove the covers. It is important for the technician to understand that the subsequent procedures begin with the assumption that the covers have been removed to gain access to the system. Certain procedures are longer than others and therefore include the steps to remove the necessary covers. The disassembly procedures outline the steps necessary to remove all of the subsystems and circuit boards in each product.

For the most part the process starts with the covers and proceeds through removing each component, one at a time. **The technician should ensure that the equipment is unplugged and turned off during disassembly!!** Power should not be applied when removing components or subassemblies. Components are assembled in reverse order of assembly and therefore reassembly of the equipment is not covered.

Disassembly Diagram

Assembly Title

The assembly title consists of the name and the part number of the component to be removed. If an assembly has additional parts that can be removed, the technician should refer to the procedure for that part. For example, page 2-7 outlines the steps to remove the top cover assembly. There are also removal procedures for two components *on* the top cover assembly. (These are the main control board on page 2-12 and the volume display assembly on page 2-19) Each of the two subassemblies of the top cover begins with taking off the top cover. Always verify that the procedure being followed is for the part you intend to replace. The number of steps involved and the order they are performed may vary depending on which part is being replaced.

Assembly Name	Assembly Part Number
Front Panel Assembly	**P/N 0702-001-070**

ASSEMBLY TITLE

Front Panel Assembly P/N 0702-001-070

Note: Make sure to dock the rover before removing the front cover. To prevent accidental leaks, the canisters must be empty *prior* to removing them!

1. Slide **IV pole grommet** (p/n 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.
2. Remove two **strikeplates** (p/n 0702-001-323) (BN) on the bottom of front cover assembly using 3/16"" allen wrench.
3. Remove two **socket head button cap screws** (p/n 0004-651-000) (CE) on upper front cover assembly using 3/16"" allen wrench.

Warning Indicators

Certain steps in the disassembly process will require the technician to take special precaution. In this case the step, or sometimes even the whole procedure, will be preceded by a warning indicator. The message contains an indicator, a warning level, and the message.

Indicator: Used to identify a warning message. (water or precautionary)

Warning Level: Used to indicate the severity of the message. (Note, Caution, or Warning)

Message: Communicates a potential hazard or clarifies the disassembly step.

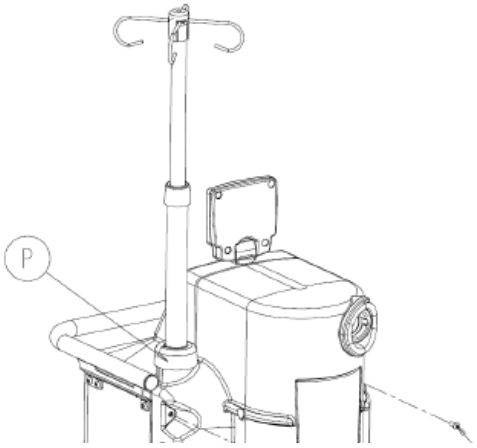
Indicator	Warning Level	Message
	**Note**	Make sure to dock the rover before removing the front cover. To prevent accidental leaks, the canisters must be empty *prior* to removing them!

WARNING INDICATOR

Front Panel Assembly P/N 0702-001-070

Note: Make sure to dock the rover before removing the front cover. To prevent accidental leaks, the canisters must be empty *prior* to removing them!

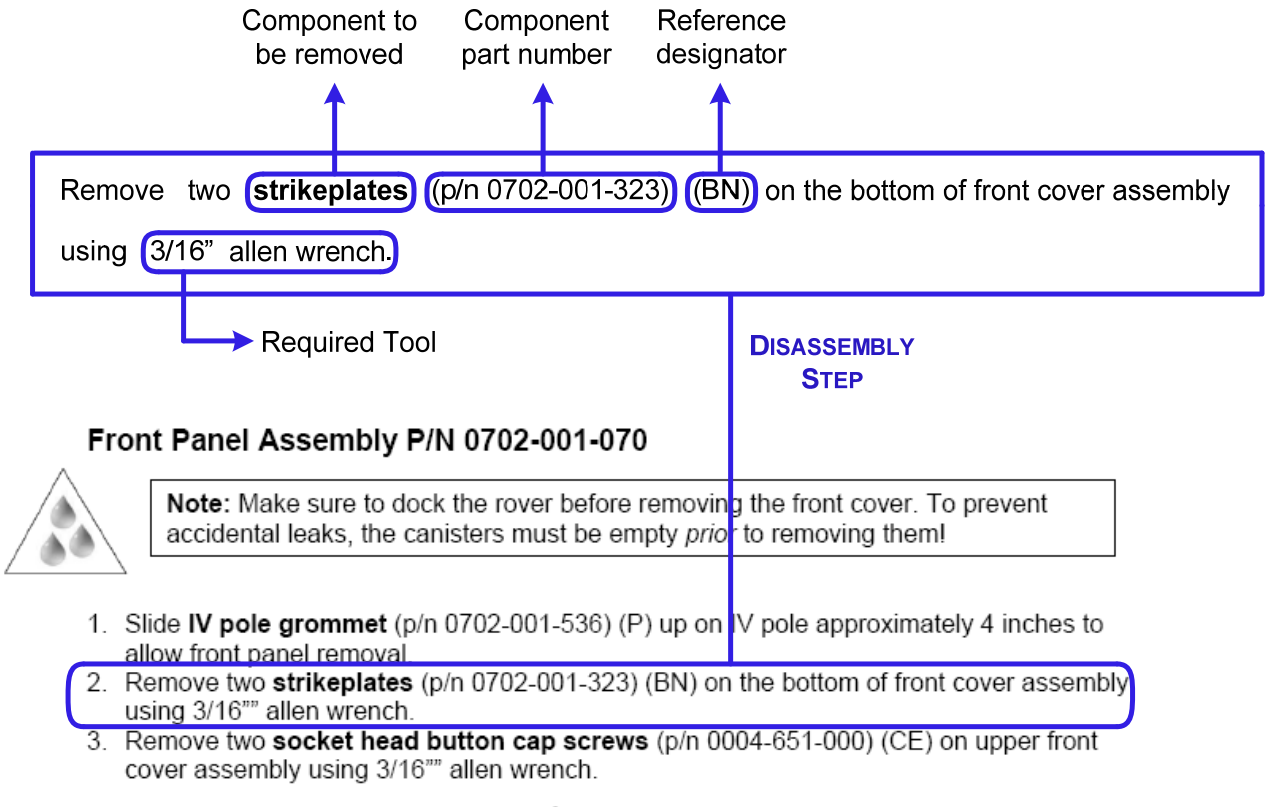
1. Slide **IV pole grommet** (p/n 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.
2. Remove two **strikeplates** (p/n 0702-001-323) (BN) on the bottom of front cover assembly using 3/16"" allen wrench.
3. Remove two **socket head button cap screws** (p/n 0004-651-000) (CE) on upper front cover assembly using 3/16"" allen wrench.



Disassembly Step

Each step in the removal process outlines the following:

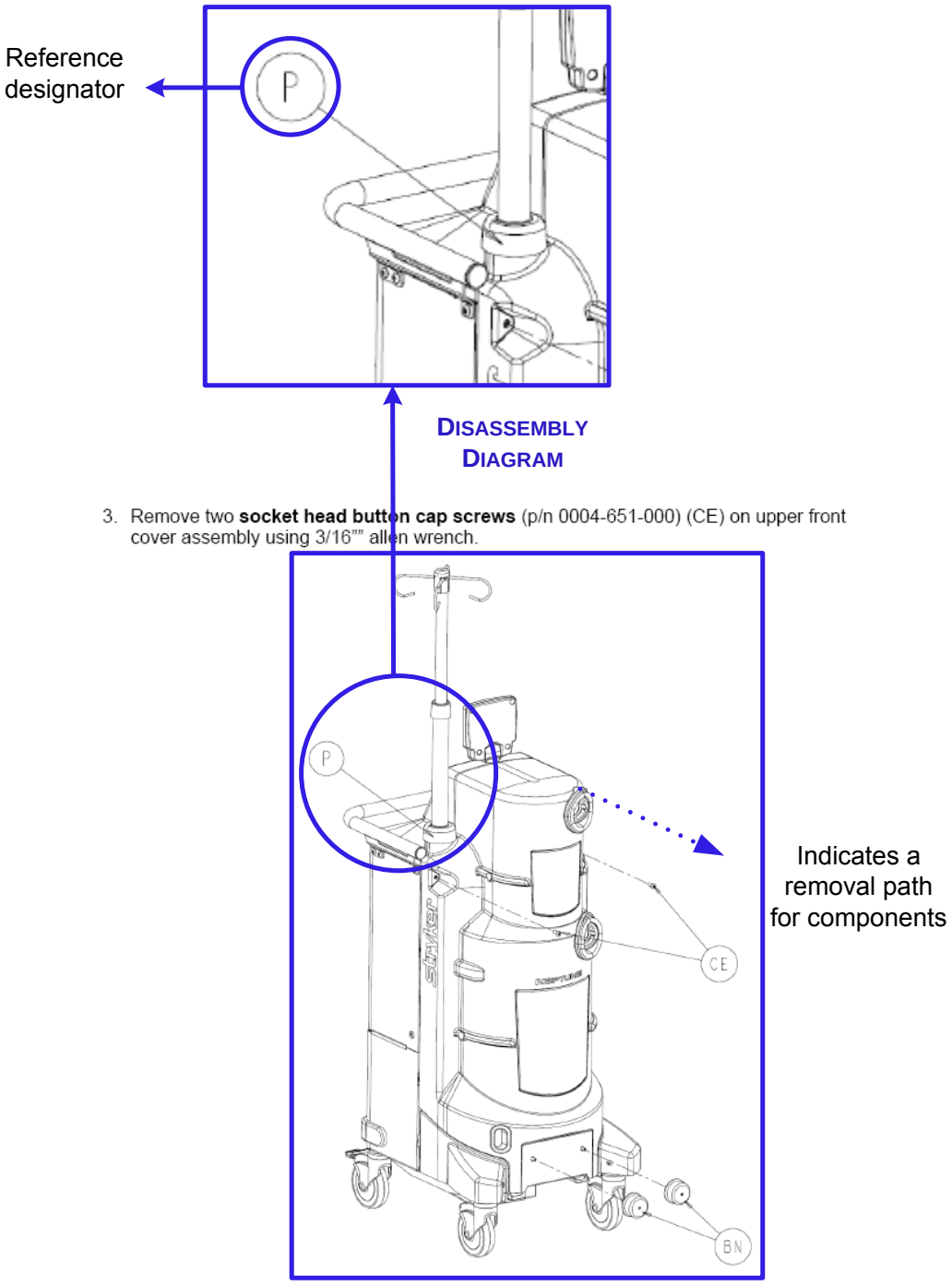
Component:	The component name is always in bold.
Part Number:	The part number for the component being removed.
Reference Designator:	A visual reference to the component to remove.
Required Tool:	Lists the tool needed to perform the listed action



Sometimes a component may be listed in a procedure without a part number. For example, the technician may be directed to remove the connector labeled **main control board**. In this case there will not be an accompanying reference designator or illustration. Items such as connectors (and some wire harnesses) are referenced as plugs (i.e. P2) and do not have a part number other than that of the physical connector. These types of items are simply referred to by the label near the connector end.

Disassembly Diagram

The diagram provides the technician with a visual reference of the components to be removed. The reference designators shown help the technician to correspond each part in the diagram to the one listed in the disassembly step. Dashed lines indicate a motion path for parts to be removed. It is important to understand that any parts mentioned in the removal step will be shown in bold, immediately followed by the part number and reference designator. However, ***only*** the part being removed in each step will have a corresponding reference designator *in the diagram*. This allows the technician to clearly indentify which part is being removed while also still providing the part number information for all parts in the Neptune system.



Chapter 5 – Troubleshooting

This chapter provides the technician with the information required to troubleshoot the Neptune 2 Waste management system. Chapter 5 provides:

- Troubleshooting Overview
- Ultra Rover Block Diagrams
- Docking Station Block Diagrams
- System Troubleshooting Chart
- System Settings Overview
- Technician Menu Overview
- Error Codes

Troubleshooting Overview

This section outlines how troubleshooting is accomplished using the half-split bracketing method. A complete example is provided which guides the technician through a troubleshooting example from start to finish. Included here are how to diagnose a symptom, where to initiate troubleshooting, how to determine if a check is good or bad, and where to proceed once that decision has been made. Ultimately the troubleshooting process will lead a technician to the faulty assembly or component.

Ultra Rover Block Diagrams

This section builds on the knowledge gained in the troubleshooting overview. It provides a block diagram for each of the subassemblies in the Ultra rover. (The Solo rover will be included after it has been released.) Since the IV pole was used in the overview example, it has not been included in the block diagram listing. The example for the IV pole used actual data. The example can be used as a real-life troubleshooting aid.

Docking Station Block Diagrams

Similar to the Ultra Rover block diagrams section, here the technician can find a troubleshooting aid for the docking station.

System Troubleshooting Chart

This section provides data for each subsystem in the Ultra rover. Proper troubleshooting requires the technician to be able to determine whether the equipment is performing as it should. The chart provides voltage and resistance measurements for the subassemblies in the rover. This should enable the technician to check the resistance between points to verify continuity, measure for the correct voltage at a connector, and ultimately to check for proper operation at each subassembly.

System Setting Menu

The system settings menu lists what options the user can change, and explains how to access those options. This information is also provided to the user in the Instructions for Use.

Technician Menu Overview

The technician menu is provided exclusively to the technician. Here the technician will find information on how to manually control the docking sequence, perform calibrations, reprogram software, and more. **It is important to note that the information listed here is meant for a Stryker certified trained technician only.** This information should be considered sensitive material. It is possible for someone to adversely affect the operation of the Neptune Waste Management System if they are unaware. The technician should understand how their menu choices in the technician menu will affect the system.

Neptune Error Codes

The error messages in the Neptune Waste Management System are categorized into 17 different groups. Each category relates to a specific subsystem in either the rover or the docker. Messages are displayed on the suction display on the rover user interface panel and can be identified by a specific number. Each error code is generated for a specific failure.

This should aid the technician in narrowing the search for a faulty component or assembly. In some cases, a fault will generate multiple error codes. For instance, if a wire harness fails, it may prevent a circuit board from communicating with several subassemblies. This would result in multiple communication errors. This section describes what each fault means, what components could generate that fault, and what the initial troubleshooting steps should be.

Chapter 6 – Technical Procedures

The disassembly procedures listed in chapters 2, 3, and 4 provide a step-by-step process to remove components in the Neptune Waste Management System. The procedures in chapter 6 are provided to outline the steps necessary in a process *other than* removal. Each process guides the technician from start to finish through procedures that mostly require navigation through the rover's software menus. Included in this chapter are:

- Field calibration
- Electrical safety and testing
- Detailed description of how to manually control the docking station
- Multiple procedures designed to help the technician troubleshoot

Chapter 7 – Installation

This section provides the technician with the information required to install a Neptune 2 Waste Management System.

Chapter 8 – Appendices

The appendices section provides information for the technician that falls outside of the information provided in each of the previous chapters. Appendix A is a list of materials. This provides the technician with a list of tools and test equipment that are required to perform maintenance. The materials given in the list of disposables are things that the technician may need to have on hand to perform maintenance. They include things such as cable ties, which will need to be replaced if they are cut while performing maintenance. The list of chemicals contains the bonding chemicals used in manufacturing such as Loctite®, as well as any lubricants used.

Chapter 1 - Operational Description

The Neptune Ultra is Stryker Instruments' second generation waste management system. The system is comprised of a docking station (or docker) and a rover. The rover offers mobile fluid waste management with fluid volume sensing, smoke evacuation, and an IV Pole in a single, compact footprint. The docker provides a fixed connection to the hospital's waste drain and water supply. The rover connects to the docker to off-load the contents and clean each canister.

General Description

The rover consists of two fluid collection canisters, and utilizes hoses, pumps, and valves to provide suction for surgical waste fluid. Once the fluid has been removed, the rover stores it in one of the two canisters. This fluid is off-loaded later through the docker. While docked, the rover receives fresh water as well as Stryker detergent for pre-fill and self-cleaning purposes. The Rover also has a smoke evacuation system and ULPA filter for the purpose of evacuating smoke. Also, a powered height-adjustable IV Pole capable of holding four IV bags is provided on the same compact footprint. All operations of the rover are controlled by software running on several microprocessors, but always initiated through a user interface consisting of multiple LCDs, LEDs, switches, and dials. Each of the sections below provides an overview of subsystem functions.

Small Canister

The small canister receives body waste fluids fluids from an input manifold, pre-fill (after a tank dump) from the pre-fill tank, or the fresh water from the fluid diverter system to rinse during docking. The fluid capacity for the small canister is 4 liters. A float sensor determines how much fluid is in the small canister, with an accuracy of +/-50 ml. The pre-fill for the small canister is at least 375 ml. This is necessary to establish a starting level for accurate fluid measurement. The small canister is plumbed to the cap of the large canister which contains a drain valve to allow the fluid to empty via gravity flow.

Large Canister

The large canister receives body waste fluids from either an input manifold or the small canister, and fresh water from the fluid diverter system to rinse during docking. The fluid capacity for the large canister is 20 liters. A float sensor determines how much fluid is in the large canister, with an accuracy of +/-150 ml. The pre-fill for the large canister is at least 1070 ml. This is necessary to establish a starting level for fluid accurate measurement. The large canister is plumbed to the waste fluid coupling which connects to the docker to off-load the contents of the canisters. The fluid is extracted by the off-load pump in the docker which is routed to the facility drainage system.

Vacuum

A vacuum system is comprised of a pump, regulator, valves, and filters. The pump is connected in parallel to both canisters to provide the negative pressure necessary for suction of surgical fluids. The manifolds provide the interface from the surgical site to each canister. The maximum vacuum level of each canister can be set and the actual vacuum level is displayed to the user on the user interface panel. Redundant vacuum level sensors are provided for each canister. This provides a duplicate monitoring system in case one sensor fails. A separate line receptacle is provided at the vacuum regulator to provide connection to the hospital vacuum system. When using the hospital vacuum system, the rover will not regulate vacuum but will display vacuum levels.

Pre-Fill

The pre-fill pump transfers water from the pre-fill tank to the small canister after the user has activated the empty tank function. (Only the small canister receives a prefill after a tank dump) The pre-fill tank holds 1200 ml of clean water, which allows for at least 3 pre-fills after a tank dump. To ensure that the prefill tank is full, the pre-fill is directed through the inlet fluid coupling during each docking cycle. The large canister is pre-filled directly from the fresh water system during docking. (The large canister does not use the prefill tank, but a separate water connection)

Smoke Evacuator

A smoke evacuator system provides removal and diffusion of smoke caused by cauterizing and other procedures. The surgical plume is filtered through the ULPA filter. The smoke blower is activated and speed controlled through the user interface. The smoke evacuator can also be operated in auto mode which, once activated, will engage automatically when surgical plume is detected.

Docking Mechanism

The docker coupling mechanism is comprised of hose couplings, a stepper motor and electronics. Two hose couplings are provided for liquid transfer of both the fresh water input (to the pre-fill tank or large canister), and output of waste fluid from the large canister. A stepper motor is used to control the fresh water and waste fluid couplings. Magnets are used to keep the rover stationary while connected to the docker. While the rover is docked, data transfer between the rover and docker is accomplished through an IR link.

When the rover is docked it receives power through the docker power coupler and does not need to be plugged into the wall outlet. All docking functions including off-load, pre-fill, and washing are automatically activated when docked. The rover will not dock if the rover is plugged in and turned on. The rover power switch must be off or the rover must be unplugged to successfully dock. A hall sensor in the docker is used to determine when the rover is present.

Docking Functions

The docker functions are activated automatically when the rover is connected to the docking station. There are three different docking modes selected by the user: quick drain, normal wash, and extended wash. (Extended wash will be released in the near future) If no wash cycle is selected then the default cycle, normal wash, will be initiated. The docking station is responsible for emptying waste fluid from the rover, rinsing the canister with fresh water and detergent, and filling each canister with a fluid prefill.

IV Pole

A motor-powered IV pole is provided on the rover. It has four hooks and each is capable of holding a 3L IV bag for a total of 12 liters. The IV Pole can be adjusted between 5’9” and 8’6” through the user interface. The IV pole will automatically descend to 5’9” upon loss of power to the Rover.

User Interface

The user interface consists of an LCD, two rotary dials, two LEDs, and a membrane switch. (See figure 1 for a representation these components.) The rotary dials are used to adjust the vacuum level for each canister. The membrane switch provides user functions to control the smoke evacuator on/off, volume reset, empty tank, vacuum system on/off, IV pole up, and IV pole down. Four additional variable controls are located adjacent to the LCD. These functions change based on the screen which is being shown at the time. Two LEDs are provided to indicate when either the smoke evacuator or vacuum systems are active. The fluid volume level in each canister is display on a monochrome LCD, which is positioned on a 360 deg swivel mounted above the user interface panel. A speaker is provided to give audio feedback to the user.

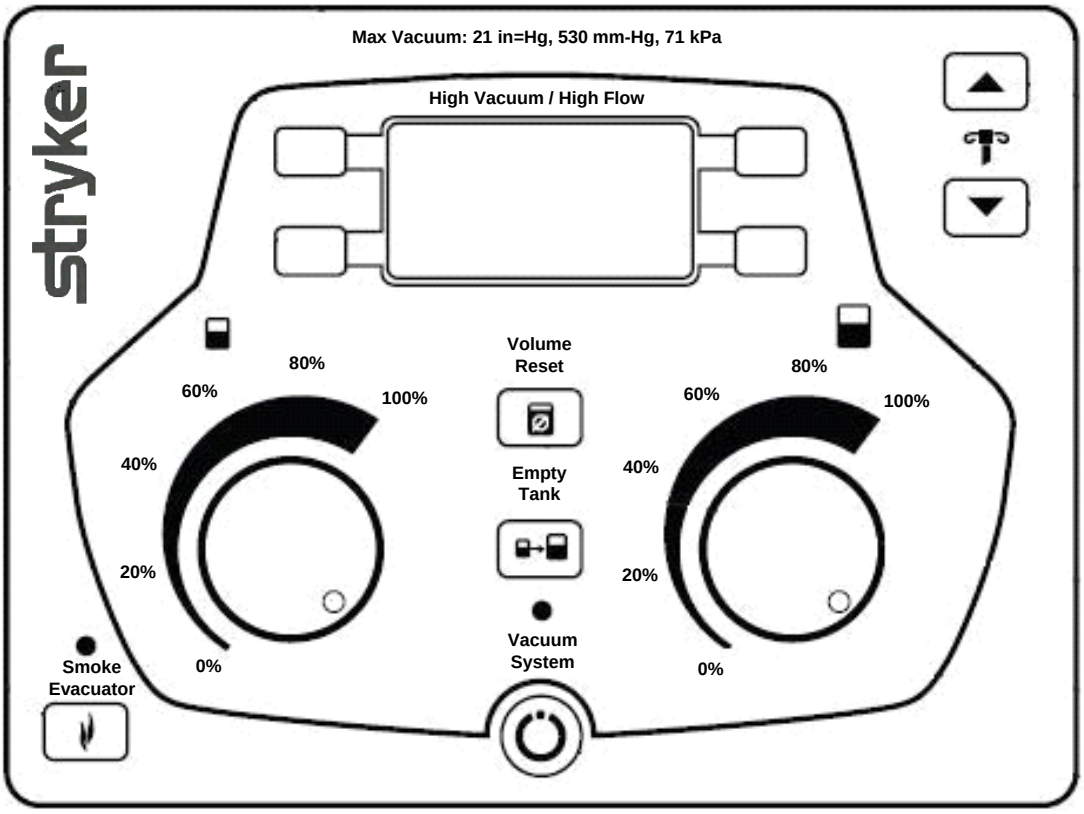


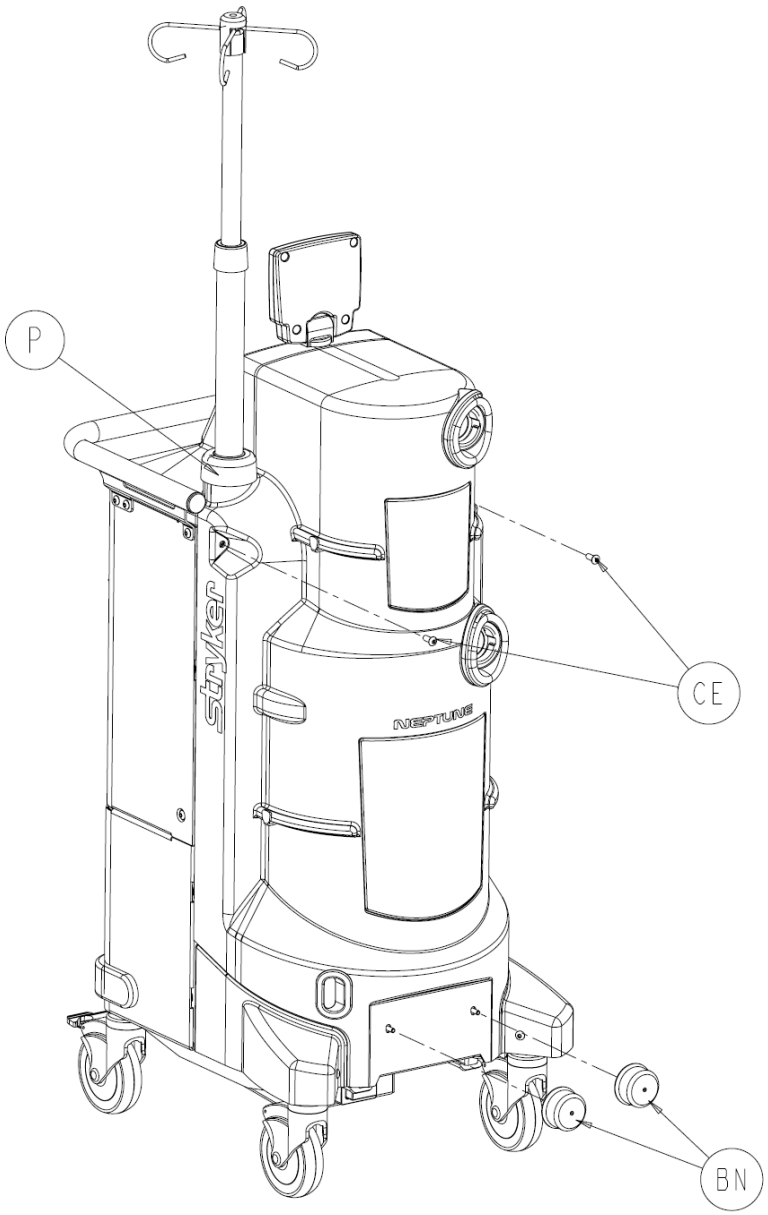
Figure 1

Chapter 2 – Ultra Rover Disassembly

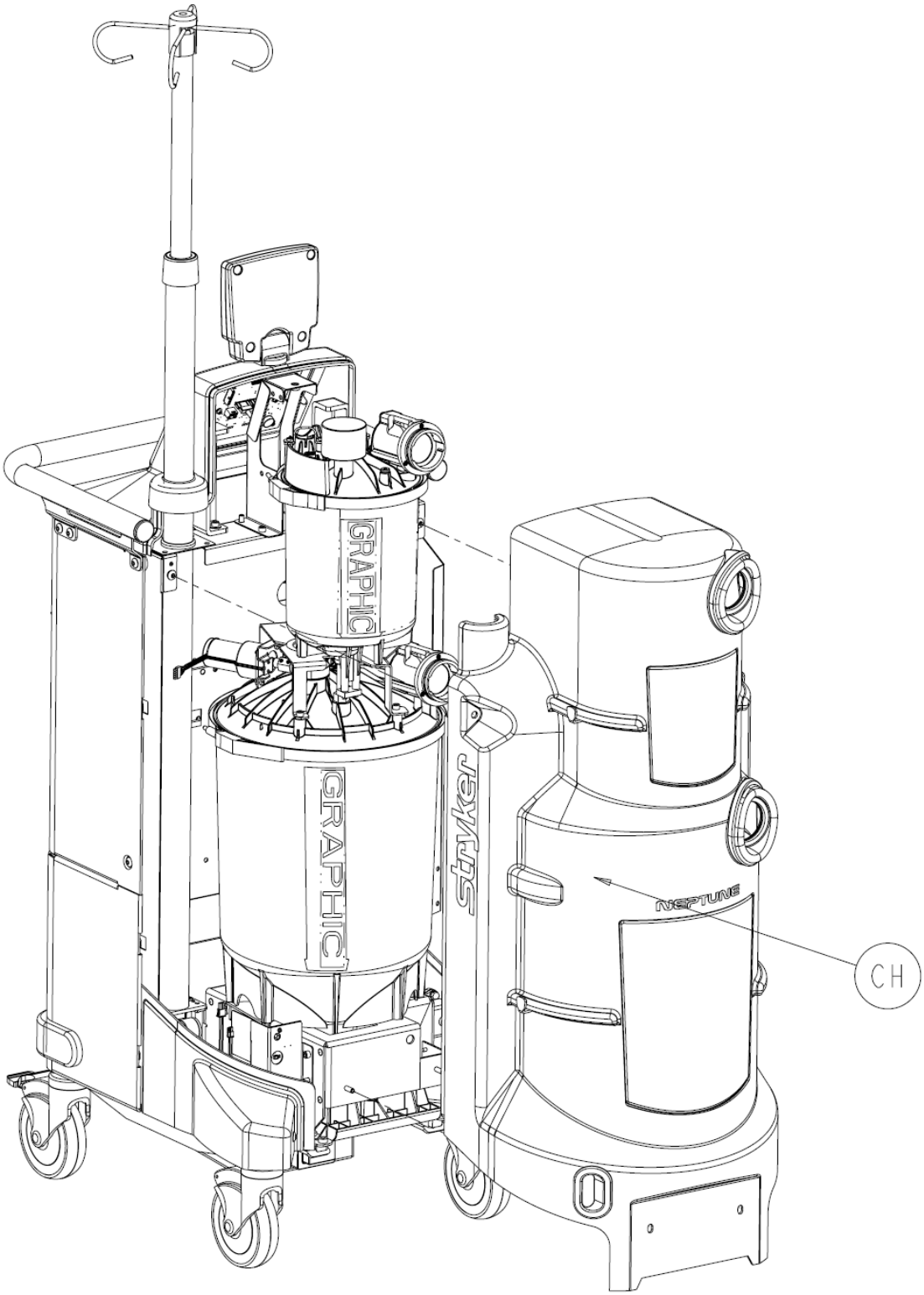
Front Panel Assembly P/N 0702-001-070

Note: Make sure to dock the rover before removing the front cover. To prevent accidental leaks, the canisters must be empty *prior* to removing them!

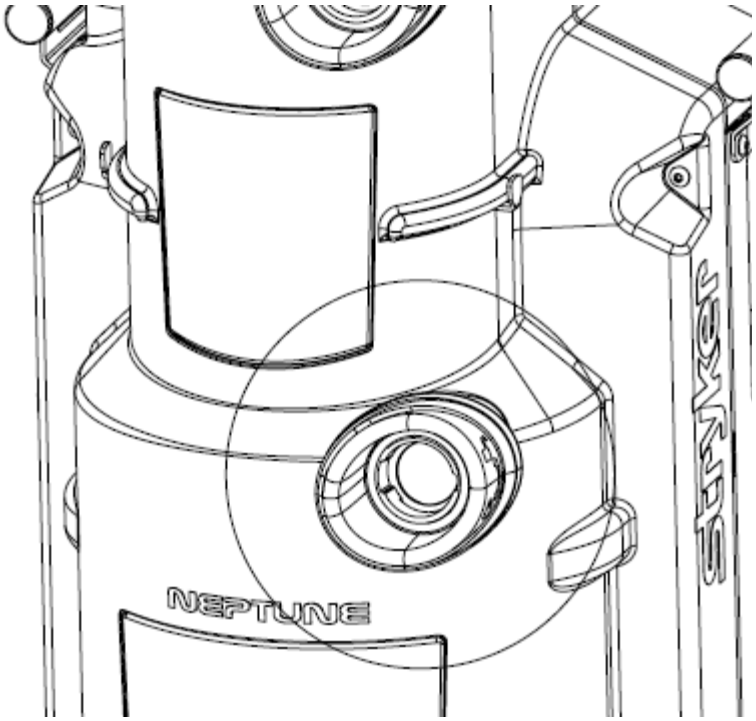
1. Slide **IV pole grommet** (P/N 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.
2. Remove two **strikeplates** (P/N 0702-001-323) (BN) on the bottom of front cover assembly using 3/16” allen wrench.
3. Remove two **socket head button cap screws** (P/N 0004-651-000) (CE) on upper front cover assembly using 3/16” allen wrench.



4. Remove **front cover assembly** (P/N 0702-001-070) (CH) and place aside.



5. When reinstalling the front cover assembly, make sure that the manifold receptacle opening is lined up properly. Failure to do so may cause the grey manifold boot to come loose. To allow sufficient clearance when reinstalling the front cover, follow the procedure on p. 2-5 for removing the ***Rear Panel Assembly.*** The technician should remove the rear panel, reinstall the front cover, and finally reinstall the rear panel assembly.

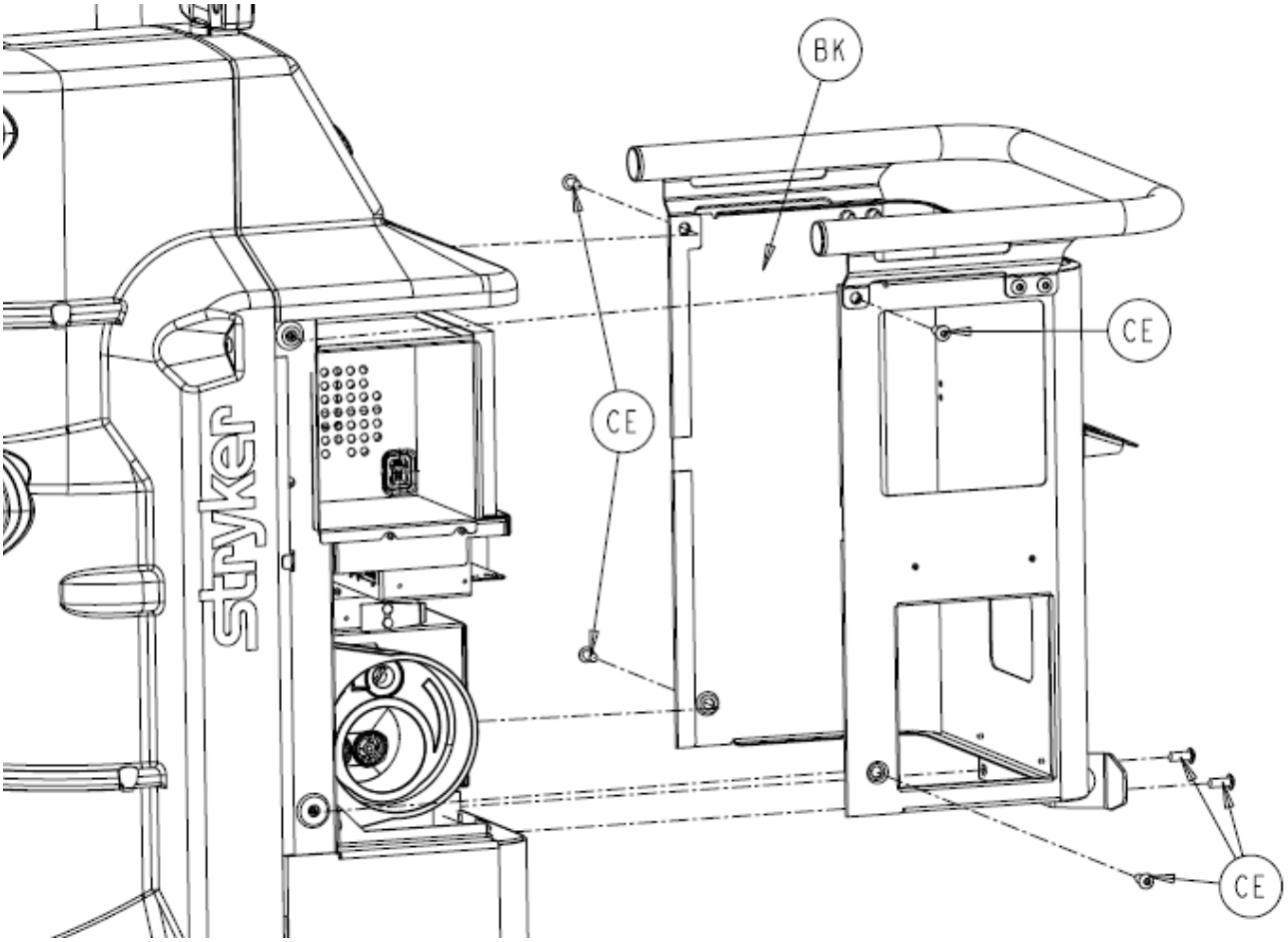


Rear Panel Assembly P/N 0702-001-060

Caution: The illustration below shows the rear panel assembly ***without*** the HEPA filter, HEPA filter door, and the smoke filter installed. The technician must remove the HEPA filter door on the lower left side of the rear panel and then remove the HEPA filter ***prior*** to removing the rear panel. Also, ensure the smoke evacuator filter is not installed. Failure to do so will prevent the technician from removing the cover properly and may cause damage to the equipment.

1. Using a 3/16” allen wrench, remove 6 **socket head button cap screws** (P/N 0004-651-000) (CE) from **rear panel assembly** (P/N 0702-001-060) (BK).

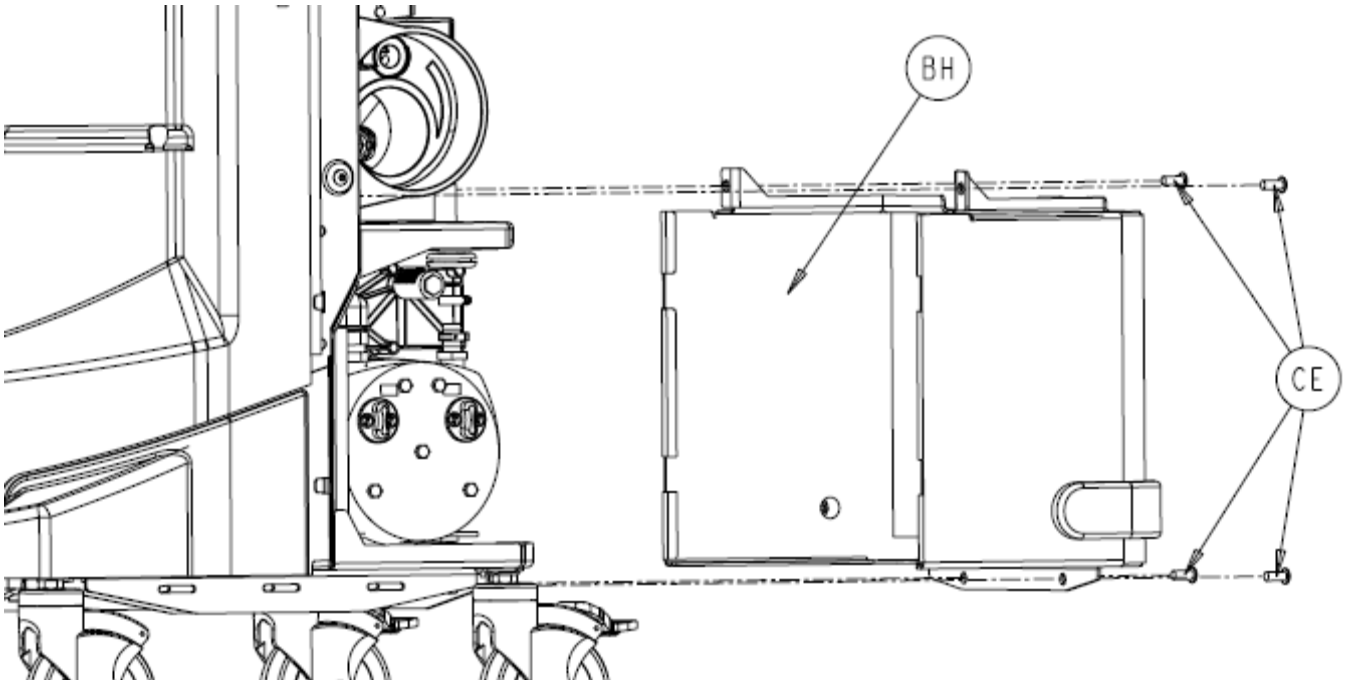
2. Remove **rear panel assembly** (P/N 0702-001-060) (BK) and place aside.



Lower Panel Assembly P/N 0702-001-030

Note: The rear panel assembly must be removed prior to removing the lower panel assembly. Follow the steps in the ***rear panel assembly*** instructions on page.2-5

1. Remove the 4 **socket head button cap screws** (P/N 0004-651-000) (CE) from **lower panel assembly** (P/N 0702-001-030) (BH).
2. Remove **lower panel assembly** (P/N 0702-001-030) (BH) and place aside.

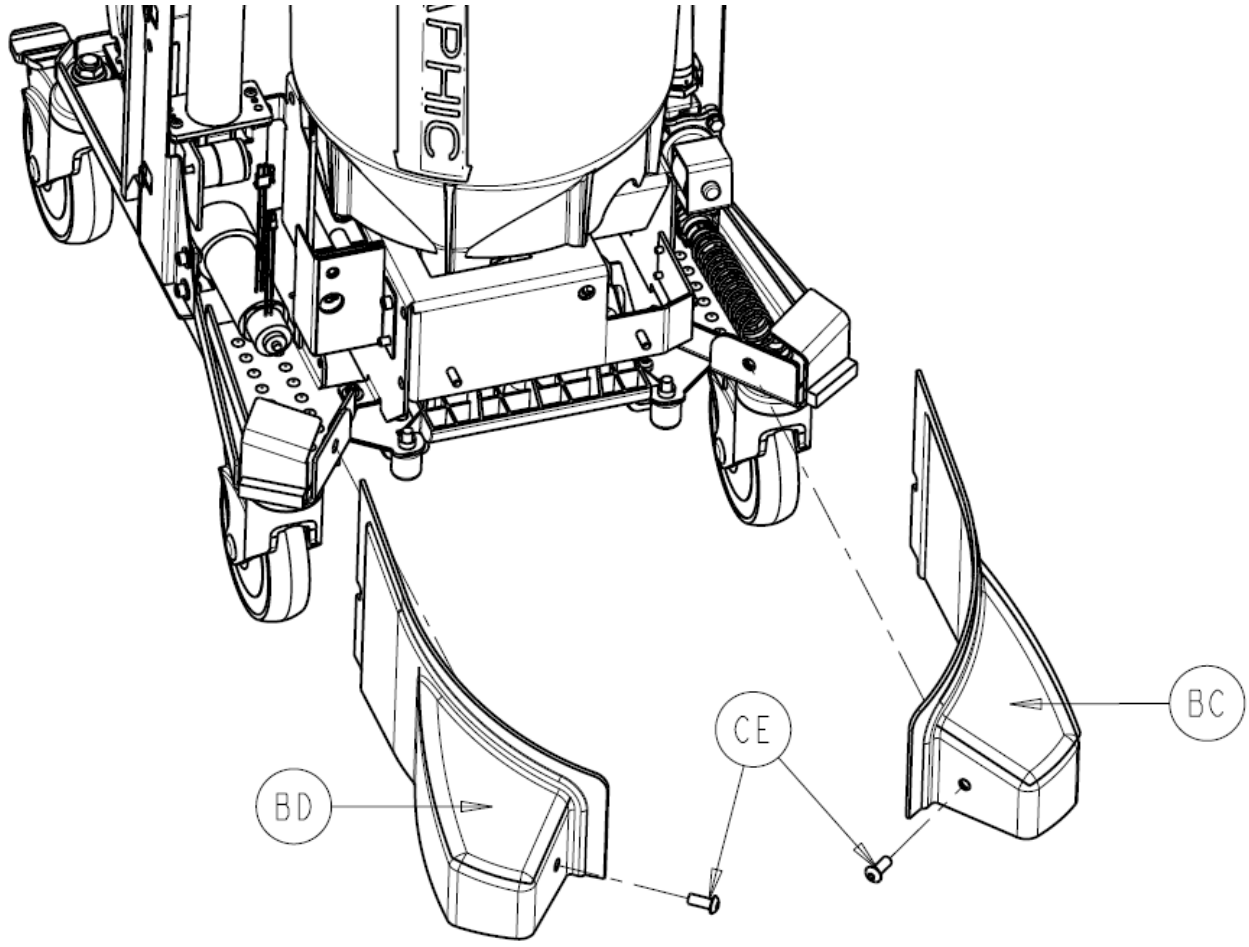


Bumper Assembly P/N 0702-001-940; 0702-001-950

Note: The front cover assembly must be removed prior to removing the bumper assembly. Follow the steps in the ***front cover assembly*** instructions on page.2-2.

1. Remove the **socket head button cap screws** (P/N 0004-651-000) (CE) from the **left bumper** (P/N 702-1-940) (BC) and **right bumper** (702-1-950) (BD).

2. Remove the **left bumper** and **right bumper** by pulling directly towards the front of the rover and place aside. (note: do not pull off bumper at an angle)

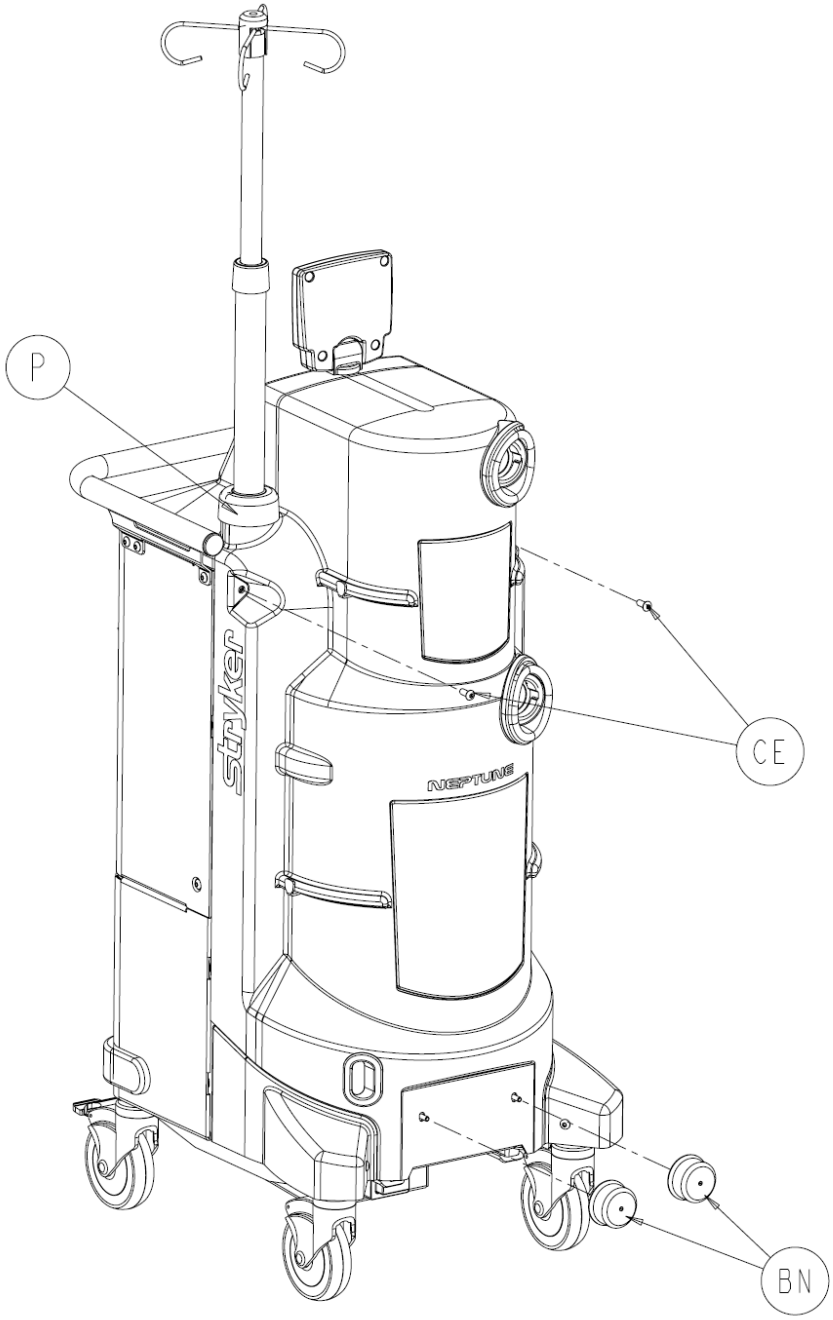


Top Cover Assembly P/N 0702-001-090

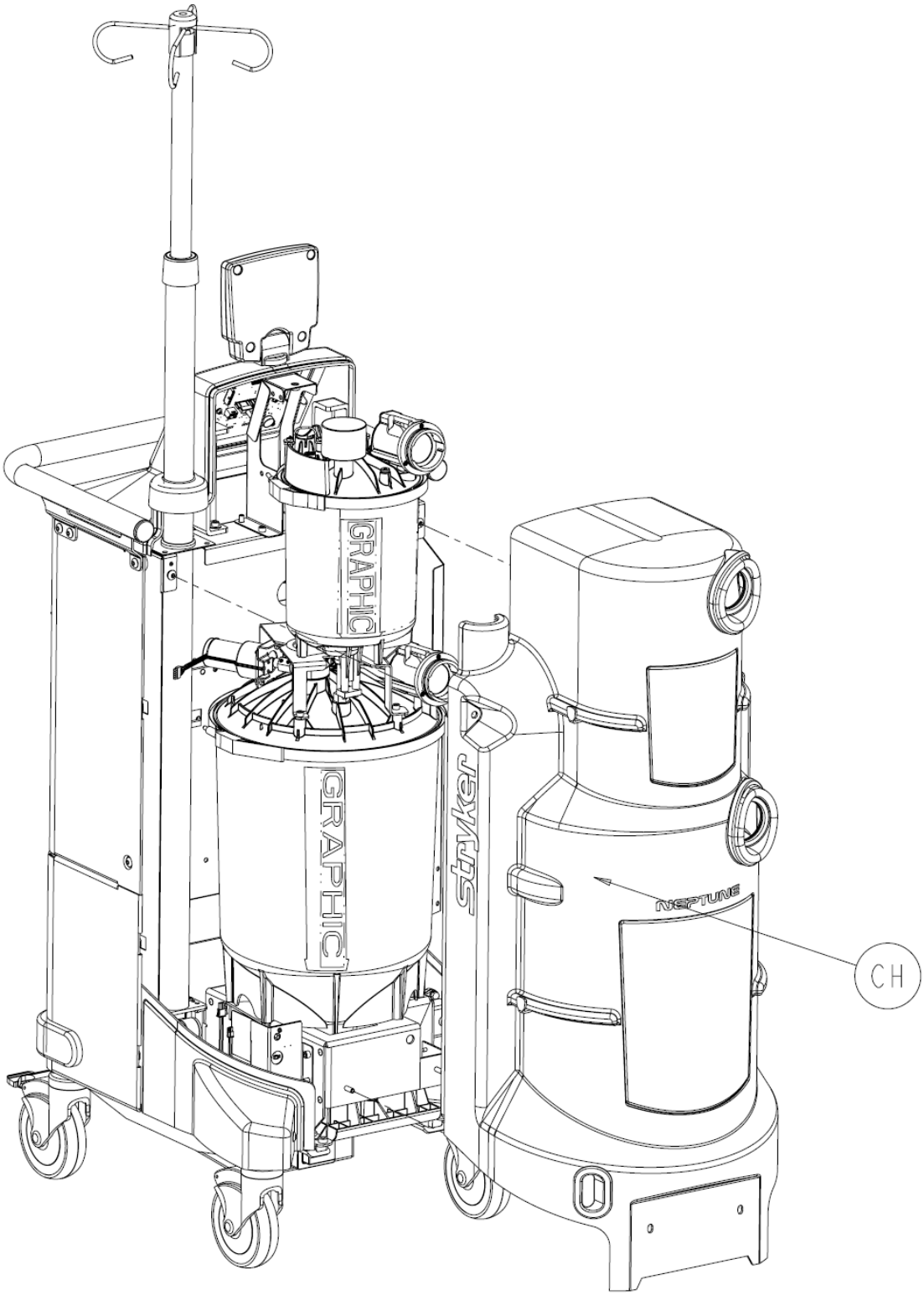
1. Slide **IV pole grommet** (P/N 0702-001-536) (P) up on pole approximately 4 inches to allow front panel removal.

2. Remove two **strikeplates** (P/N 0702-001-323) (BN) on the bottom of front cover assembly using 3/16” allen wrench.

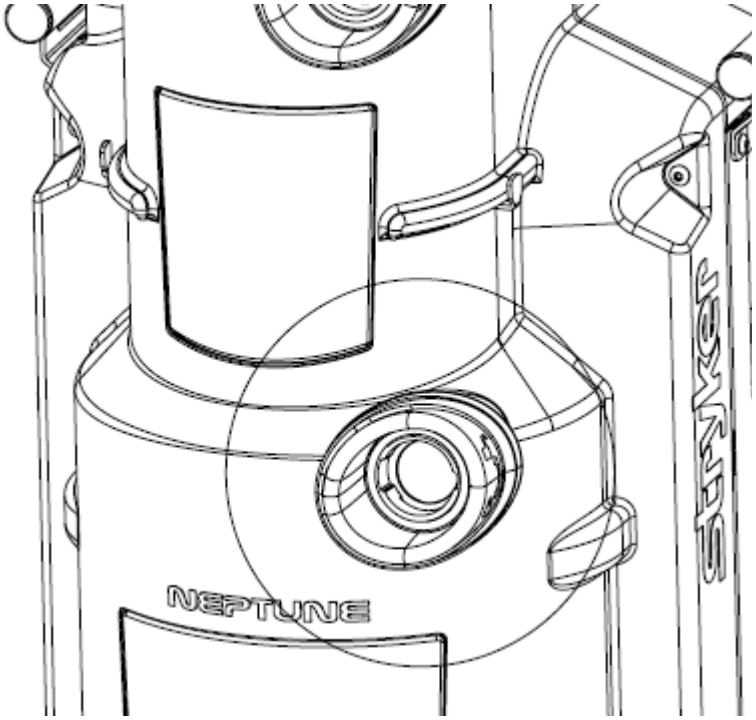
3. Remove two **socket head button cap screws** (P/N 0004-651-000) (CE) on upper front cover assembly using 3/16” allen wrench.



4. Remove **front cover assembly** (P/N 0702-001-070) (CH) and place aside.



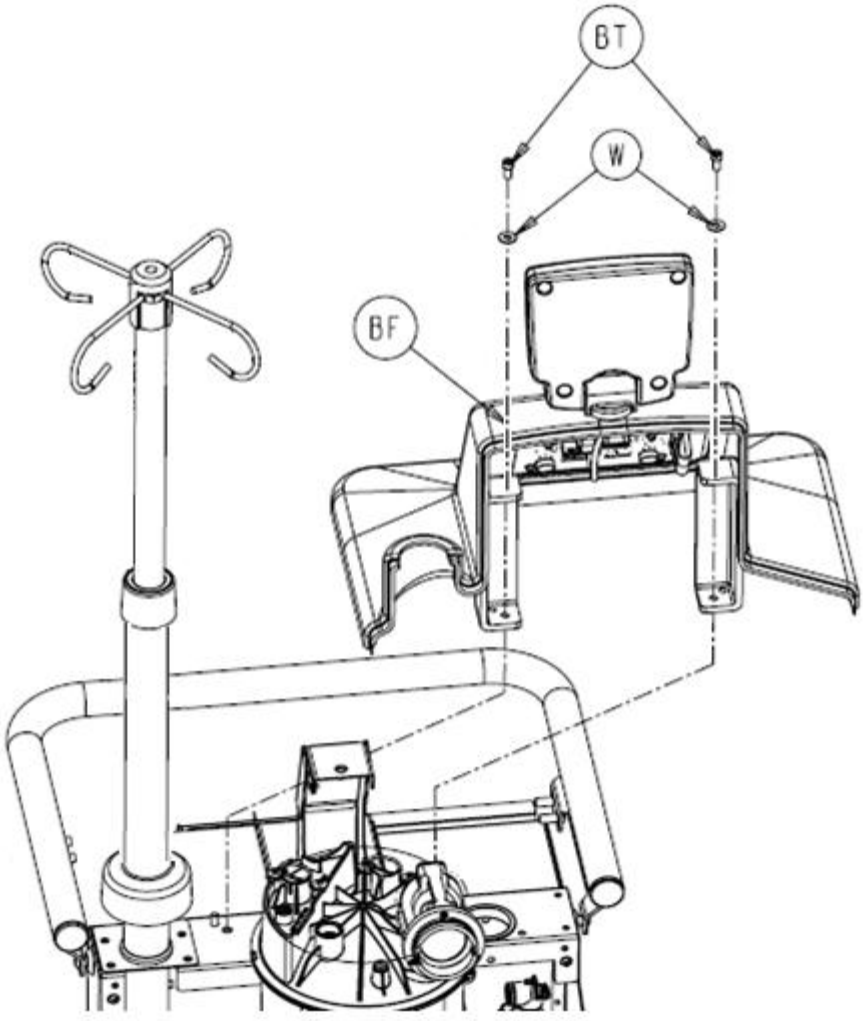
5. When reinstalling the front cover assembly, make sure that the manifold receptacle opening is lined up properly. Failure to do so may cause the grey manifold boot to come loose.



6. Remove two **socket head cap screws** (P/N 0004-645-000) (BT) and two **flat washers** (P/N 0011-507-000) (W) from **top cover assembly** (P/N 0702-001-090) (BF).

Caution: Do not remove any connector by pulling on the wires. Doing so may damage the equipment.

7. On the **main control board** (P/N 702-1-800), disconnect the cable labeled **main controller** from the P2 connector and the cable labeled **rover controller** from the P4 connector. Unplug the serial number board from connector labeled J6 on the main control board. (This connector is attached to the wire harness with a cable tie)



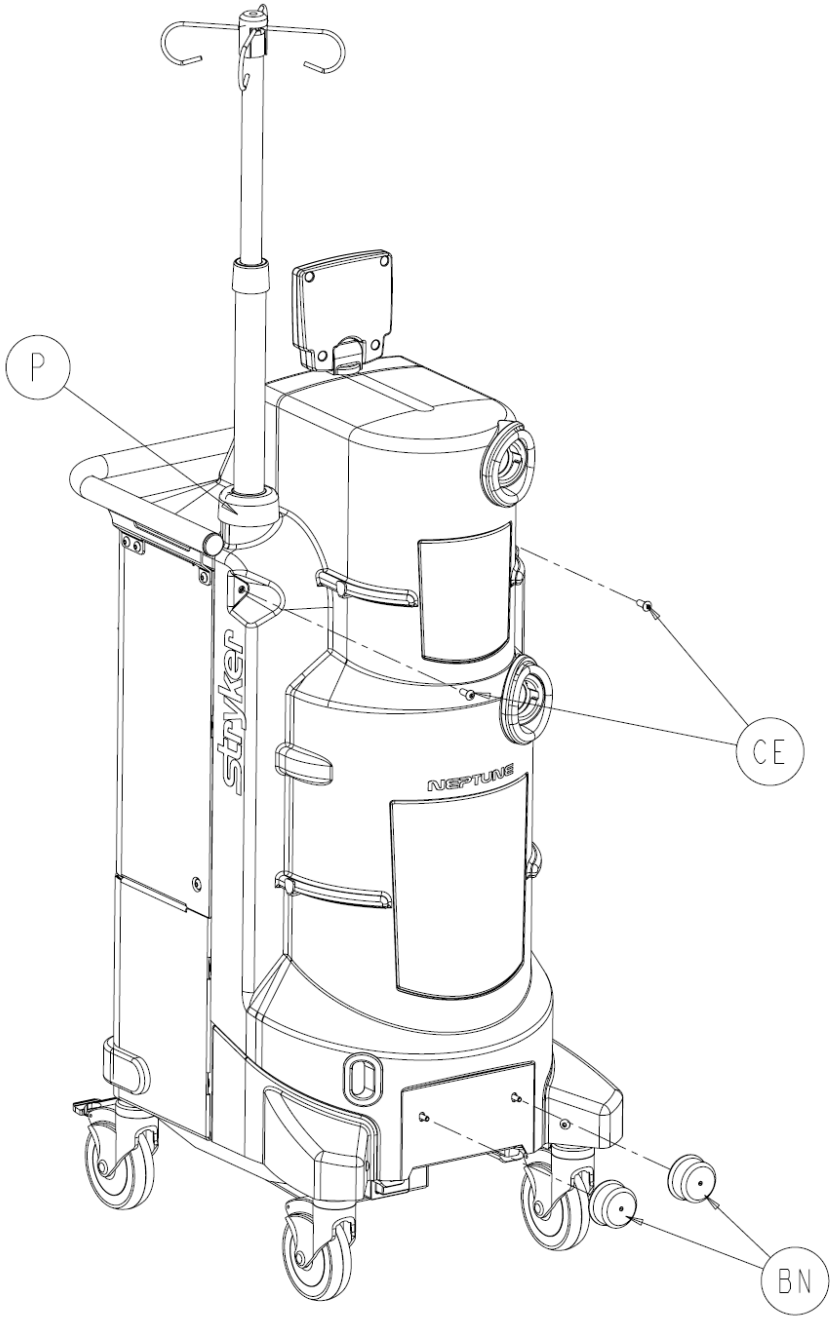
8. If replacing the top cover assembly, make sure to follow procedure 6.3 ***Reprogramming Rover Software*** on p. 6-6 when finished. If the technician is only removing the top cover to gain access to another part of the system, then you ***do not*** need to complete procedure 6.3 afterwards.

Main Control PCBA P/N 0702-001-800

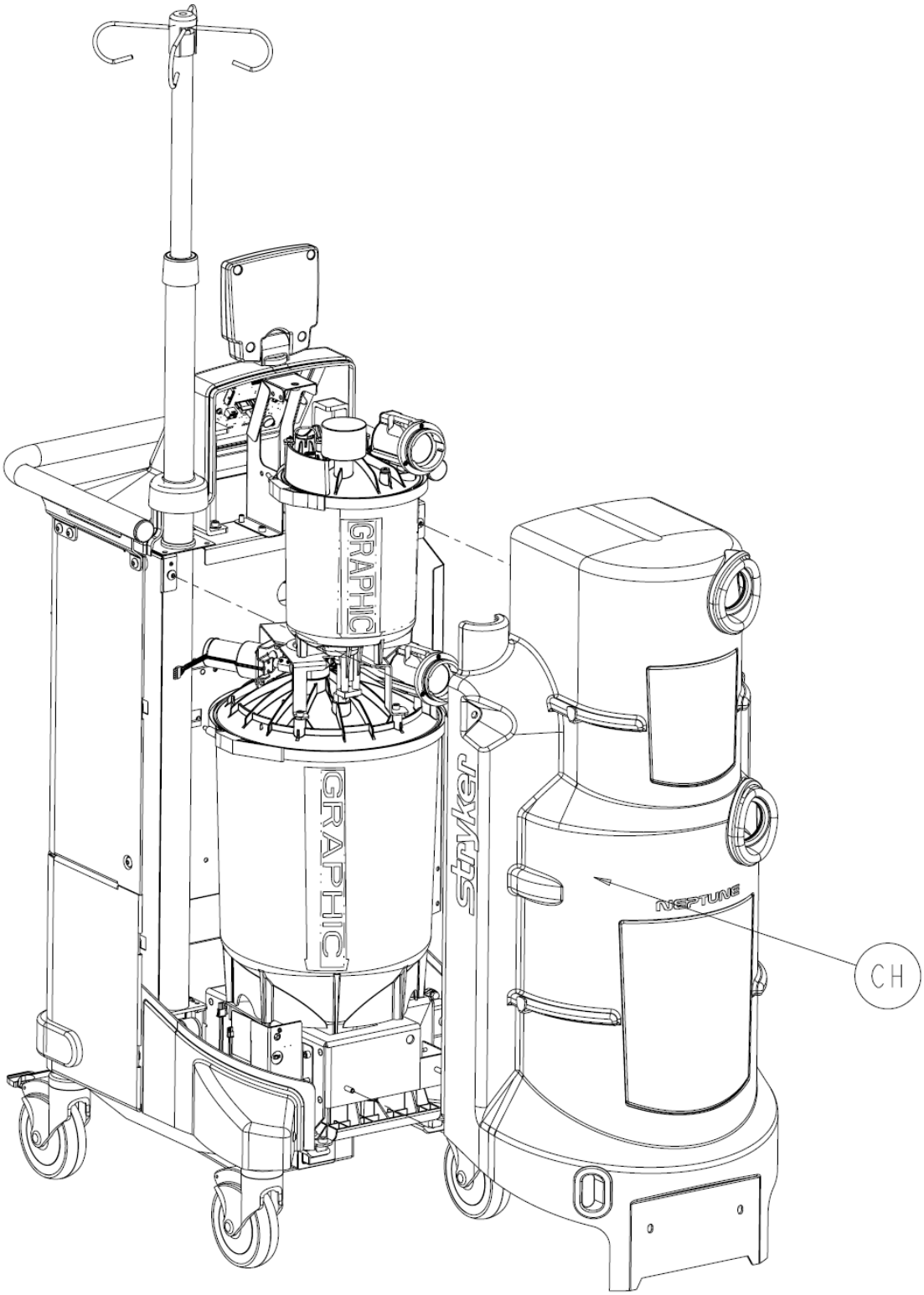
1. Slide **IV pole grommet** (P/N 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.

2. Remove two **strikeplates** (P/N 0702-001-323) (BN) on the bottom of front cover assembly using 3/16” allen wrench.

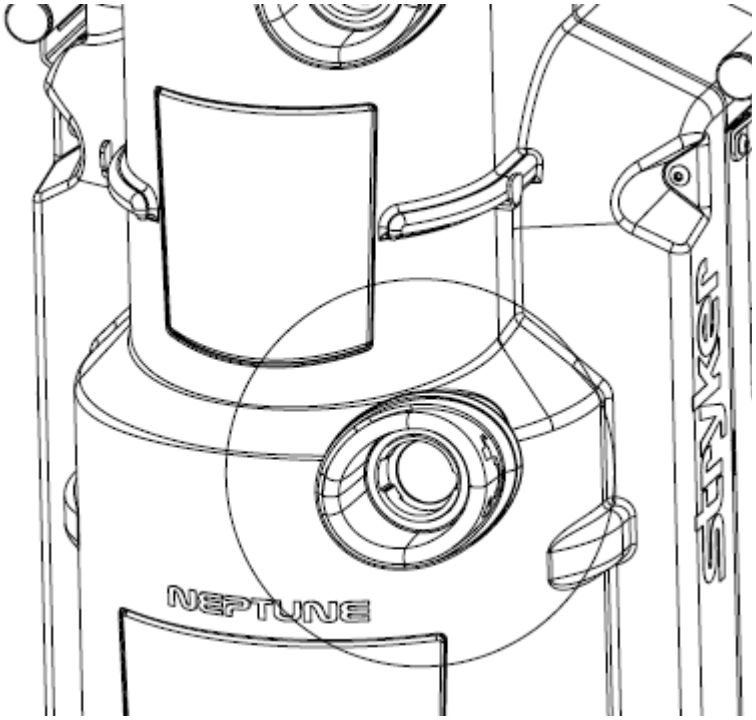
3. Remove two **socket head button cap screws** (P/N 0004-651-000) (CE) on upper front cover assembly using 3/16” allen wrench.



4. Remove **front cover assembly** (P/N 0702-001-070) (CH) and place aside.



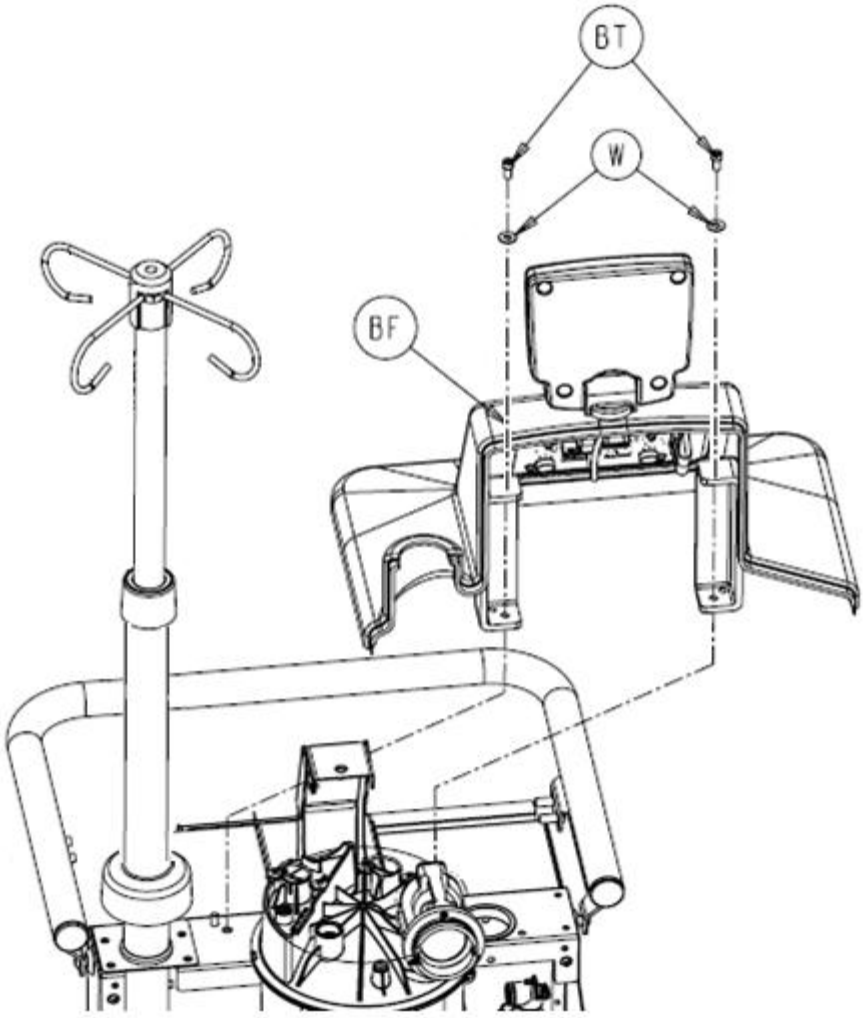
5. When reinstalling the front cover assembly, make sure that the manifold receptacle opening is lined up properly. Failure to do so may cause the grey manifold boot to come loose.



6. Remove two **socket head cap screws** (P/N 0004-645-000) (BT) and two **flat washers** (P/N 0011-507-000) (W) from **top cover assembly** (P/N 0702-001-090) (BF).

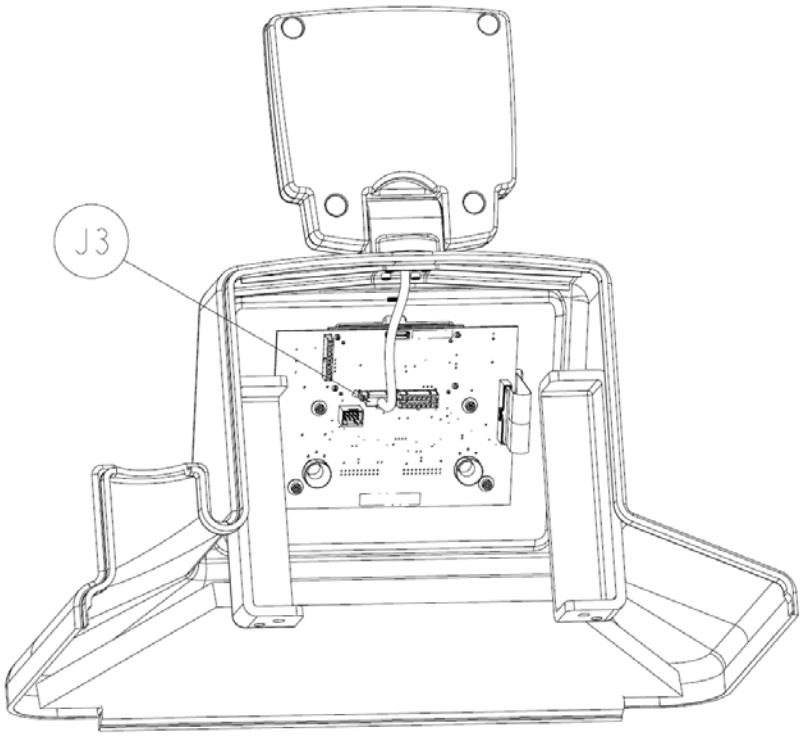
Caution: Do not remove any connector by pulling on the wires. Doing so may damage the equipment.

7. On the **main control board** (P/N 702-1-800), disconnect the cable labeled **main controller** from the P2 connector and the cable labeled **rover controller** from the P4 connector. Unplug the serial number board from connector labeled J6 on the main control board. (This connector is attached to the wire harness with a cable tie)

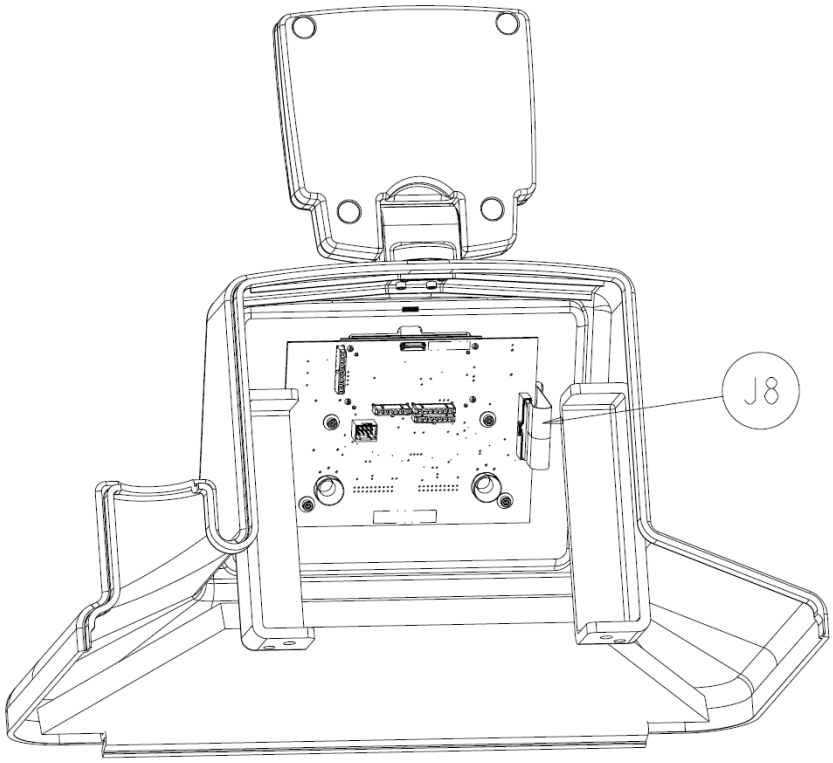


Caution: Make sure to take proper measures to prevent Electro-Static Discharge (ESD) from damaging any circuit boards in the rover. Connect a protective wrist strap to exposed metal chassis *prior* to removing the hardware and touching the board.

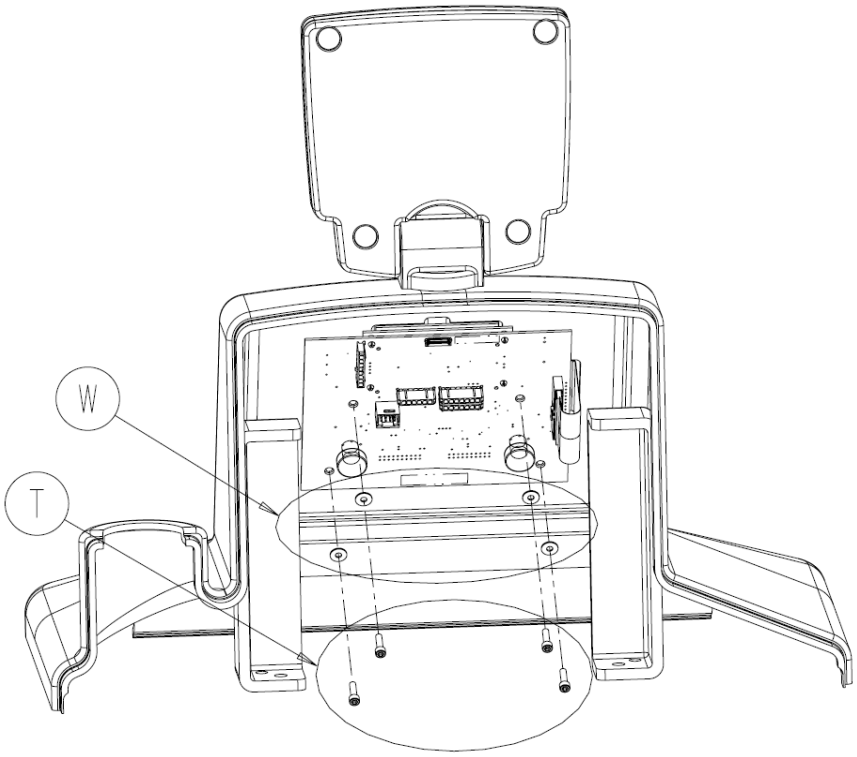
8. Disconnect the cable from the volume display assembly connected to **J3** on main control board.



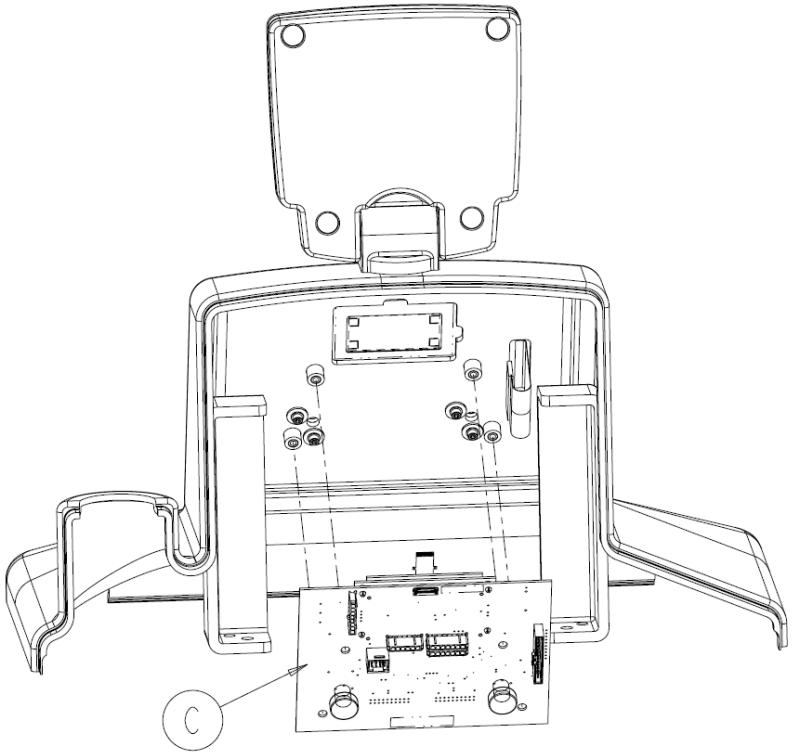
9. Disconnect ribbon cable from **J8** on main control board.



10. Remove four **socket head cap screws** (P/N 0004-523-000) (T) and four **stainless flat washers** (P/N 0011-491-000) (W) from main control board.



11. Remove the **main control PCBA** (P/N 0702-001-800) (C) and set aside.



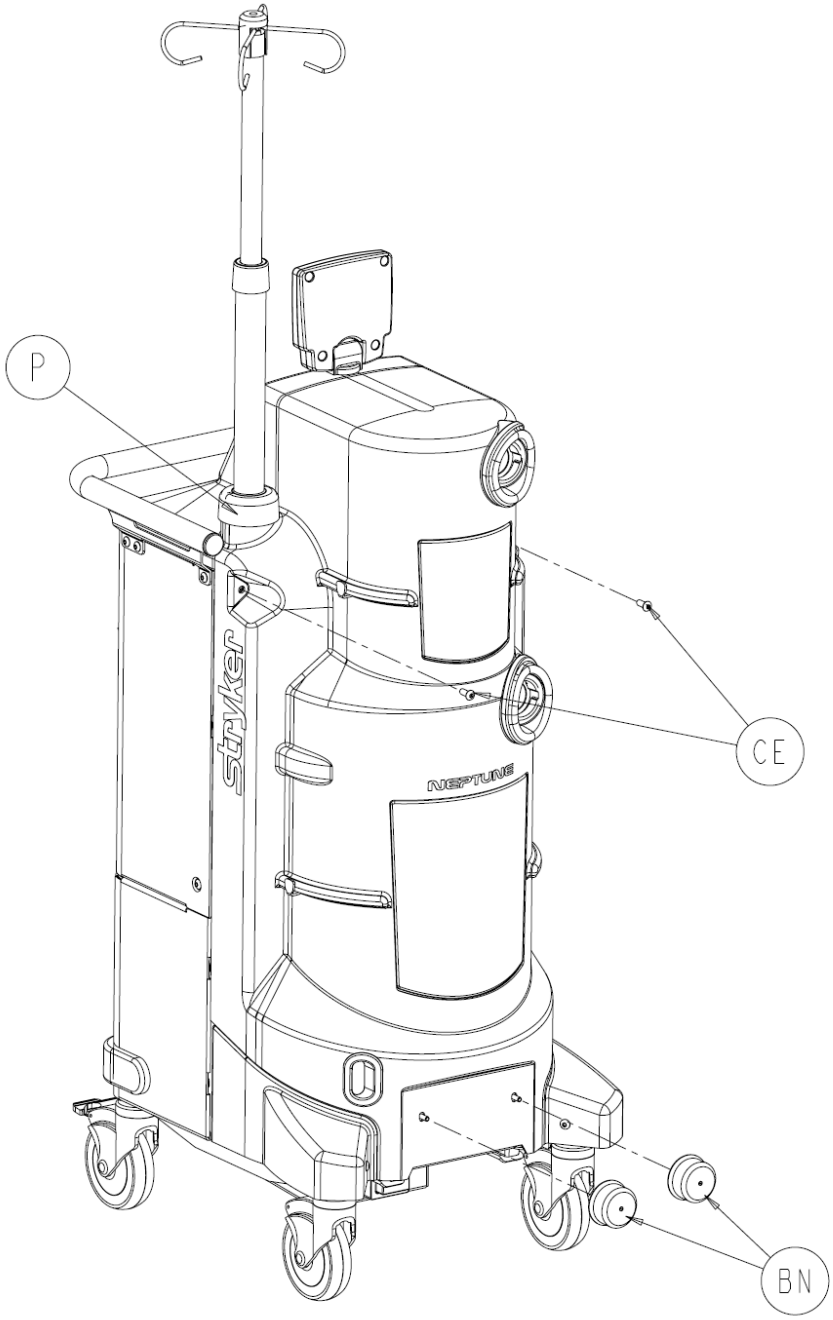
11. If replacing the main control board, make sure to follow procedure 6.3 ***Reprogramming Rover Software*** on p. 6-6 when finished. If the technician is only removing the main control board and not replacing it, then you ***do not*** need to complete procedure 6.3 afterwards.

Volume Display Assembly P/N 0702-001-840

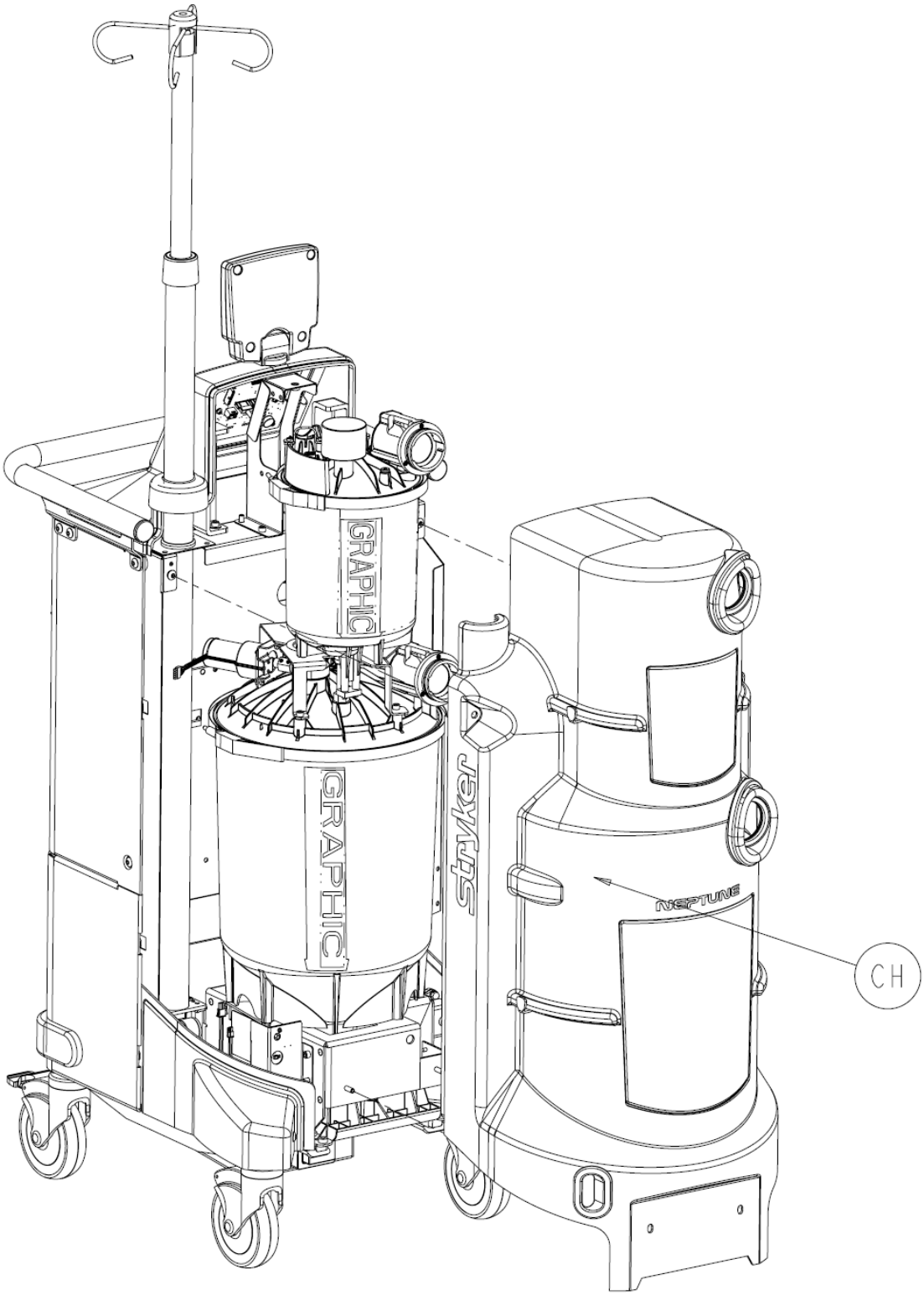
1. Slide **IV pole grommet** (P/N 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.

2. Remove two **strikeplates** (P/N 0702-001-323) (BN) on the bottom of front cover assembly using 3/16” allen wrench.

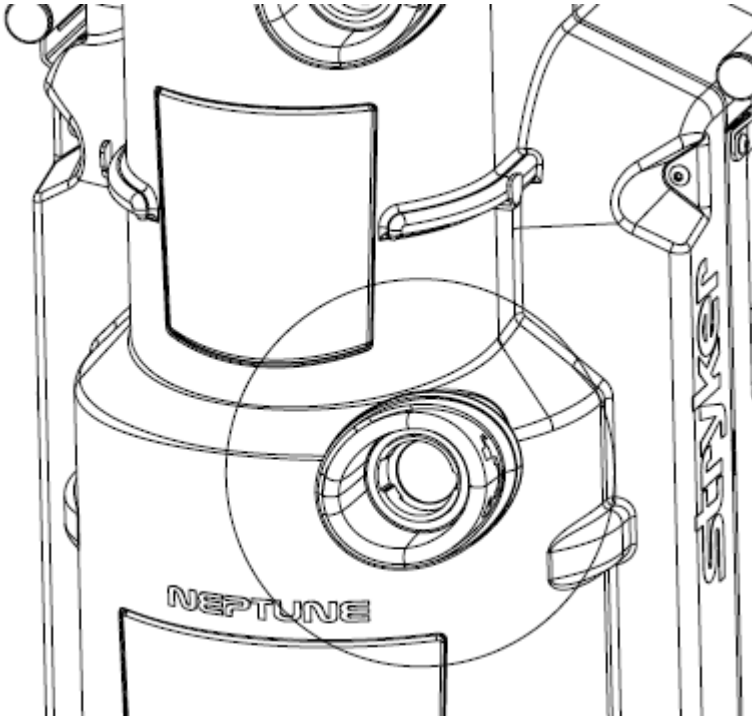
3. Remove two **socket head button cap screws** (P/N 0004-651-000) (CE) on upper front cover assembly using 3/16” allen wrench.



4. Remove **front cover assembly** (P/N 0702-001-070) (CH) and place aside.



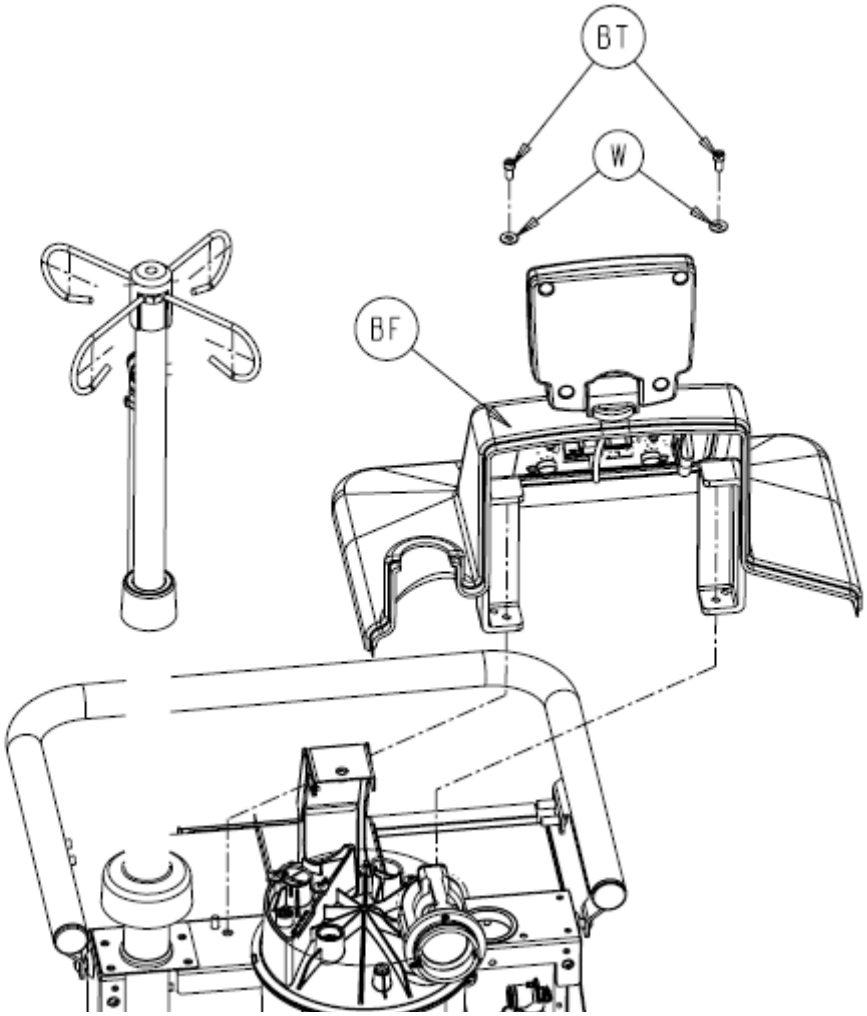
5. When reinstalling the front cover assembly, make sure that the manifold receptacle opening is lined up properly. Failure to do so may cause the grey manifold boot to come loose.



6. Remove two **socket head cap screws** (P/N 0004-645-000) (BT) and two **flat washers** (P/N 0011-507-000) (W) from **top cover assembly** (P/N 0702-001-090) (BF).

Caution: Do not remove any connector by pulling on the wires. Doing so may damage the equipment.

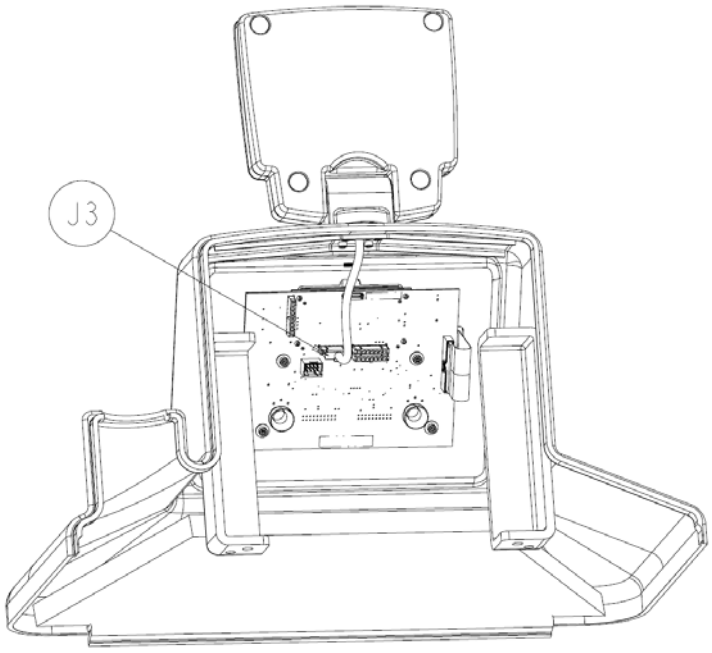
7. On the **main control board** (P/N 702-1-800), disconnect the cable labeled **main controller** from the P2 connector and the cable labeled **rover controller** from the P4 connector.



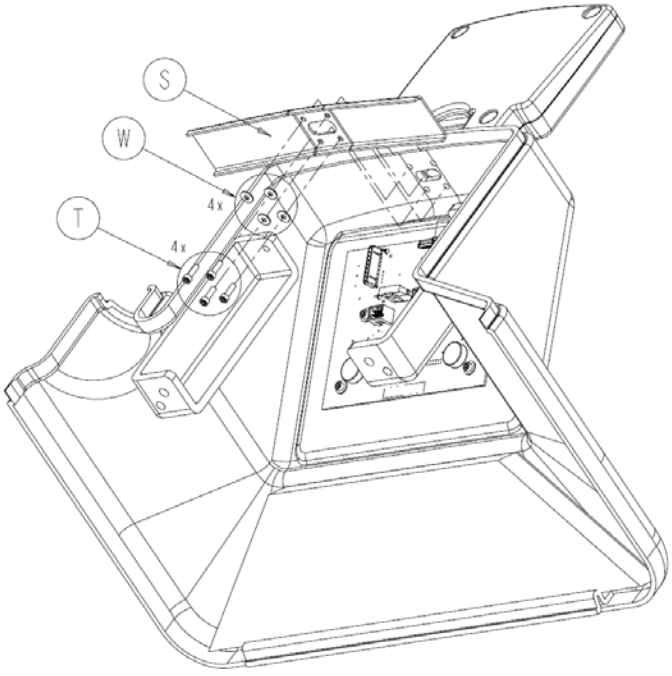
Caution: Make sure to take proper measures to prevent Electro-Static Discharge (ESD) from damaging any circuit boards in the rover. Connect a protective wrist strap to exposed metal chassis *prior* to removing the hardware and touching the board.

8. Disconnect the cable from the volume display assembly connected to **J3** on main control board.

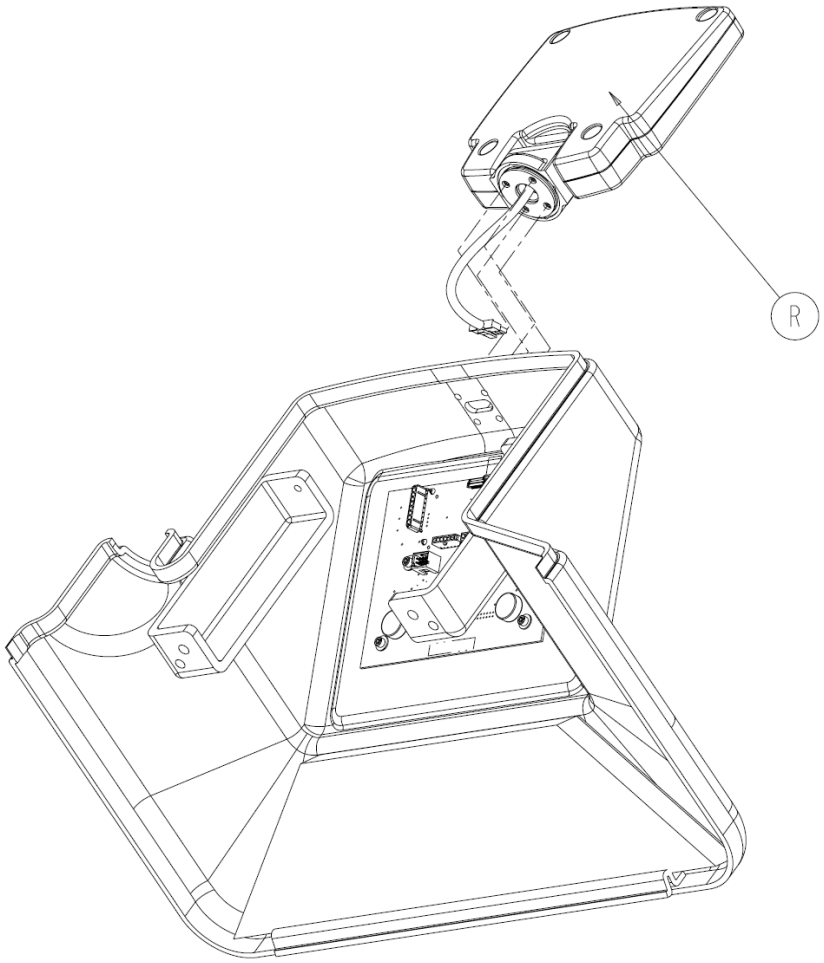
Note: The wire harness connected to J3 is shown here in a previous configuration. The new installation method secures the harness with a cable tie that must be cut when removing the connector. If the wire harness is in the new configuration, be careful not to cut the wire harness when removing the cable tie. Always be sure to replace the cable tie when reinstalling the connector.



9. Remove four **socket head cap screws** (P/N 0004-523-000) (T), four **flat washers** (P/N 0011-491-000) (W), and **stiffener** (P/N 0702-001-856) (S) and set aside.



10. Remove **volume display assembly** (P/N 0702-001-840) (R) from top cover assembly and set aside.



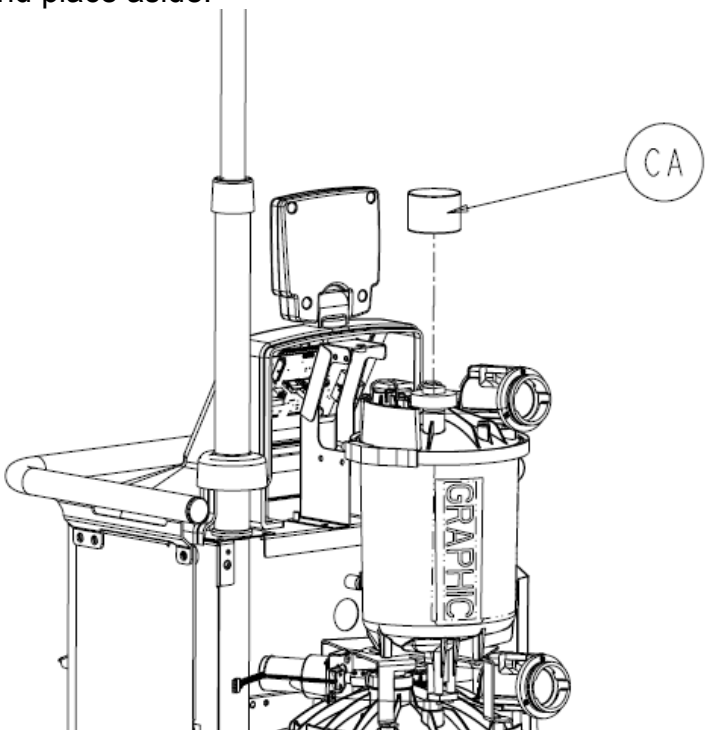
11. If replacing the volume display assembly, make sure to follow procedure 6.3 ***Reprogramming Rover Software*** on p. 6-6 when finished. If the technician is only removing the volume display assembly and not replacing it, you ***do not*** need to complete procedure 6.3 afterwards.

Removing Large and Small Canisters P/N 0702-001-320 & 0702-001-300

When accessing components behind the fluid collection canisters it is best to remove both canister assemblies together as one. It is not necessary to remove each canister individually. The same applies when accessing hardware located behind the canister assemblies. Use this procedure, followed by ***Separation of Large & Small Canister Assemblies*** (p. 2-31) to remove the large canister. If only the small canister needs to be replaced, proceed to ***Small Canister Assembly*** (p. 2-35).

Caution: This procedure begins with the front cover already removed. If the rover canister(s) contain fluid, you will need to manually dock the unit using the technician menu before proceeding!

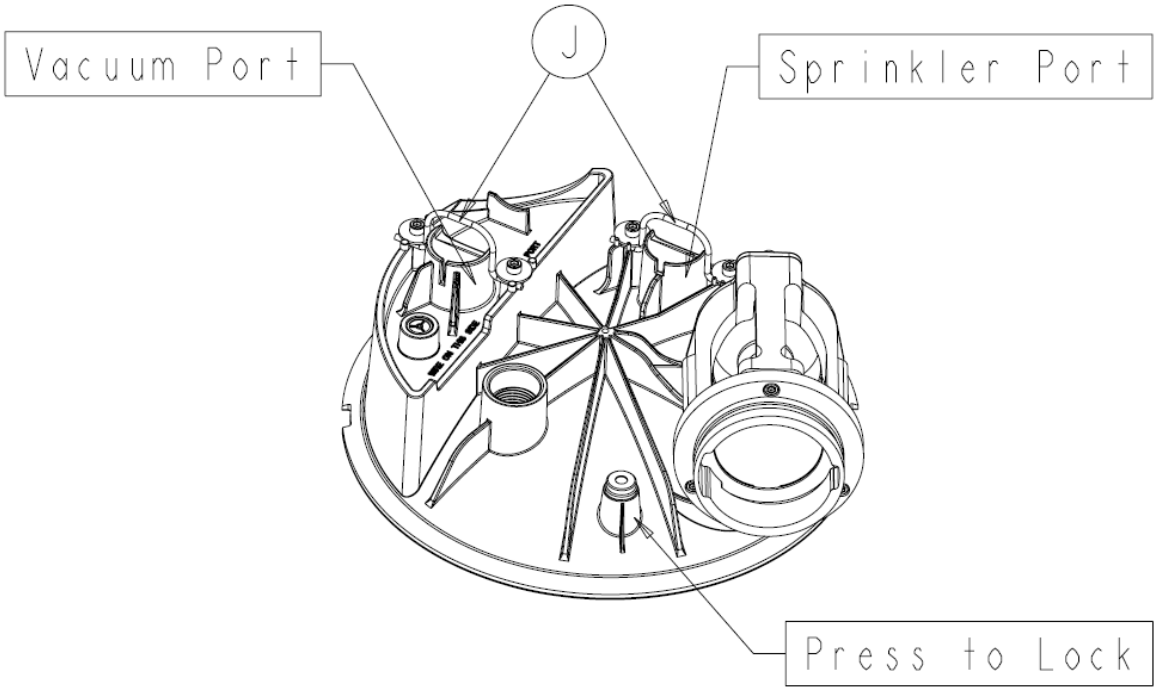
1. Remove **level sensor cover** (P/N 702-1-882) (CA) from **fluid level transducer** (P/N 702-1-880) (AN) and place aside.



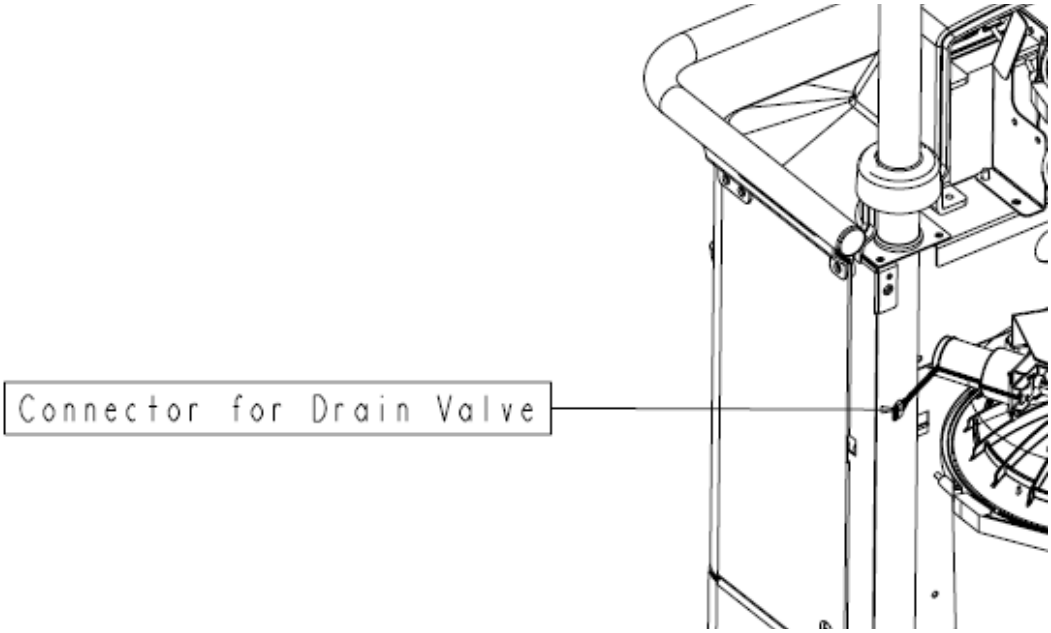
Caution: Do not remove any connector by pulling on the wires. Doing so may damage the equipment.

2. Disconnect the grey cable labeled level sensor from the **fluid level transducer** (P/N 702-1-880) (AN).
3. Remove the two **coupling clips** (P/N 702-1-204) (J) on **small canister cap assembly** (P/N 702-1-200) (AM)
4. Remove elbow from ports marked vacuum port and sprinkler port from the **small canister cap assembly** (P/N 702-1-200) (AM)

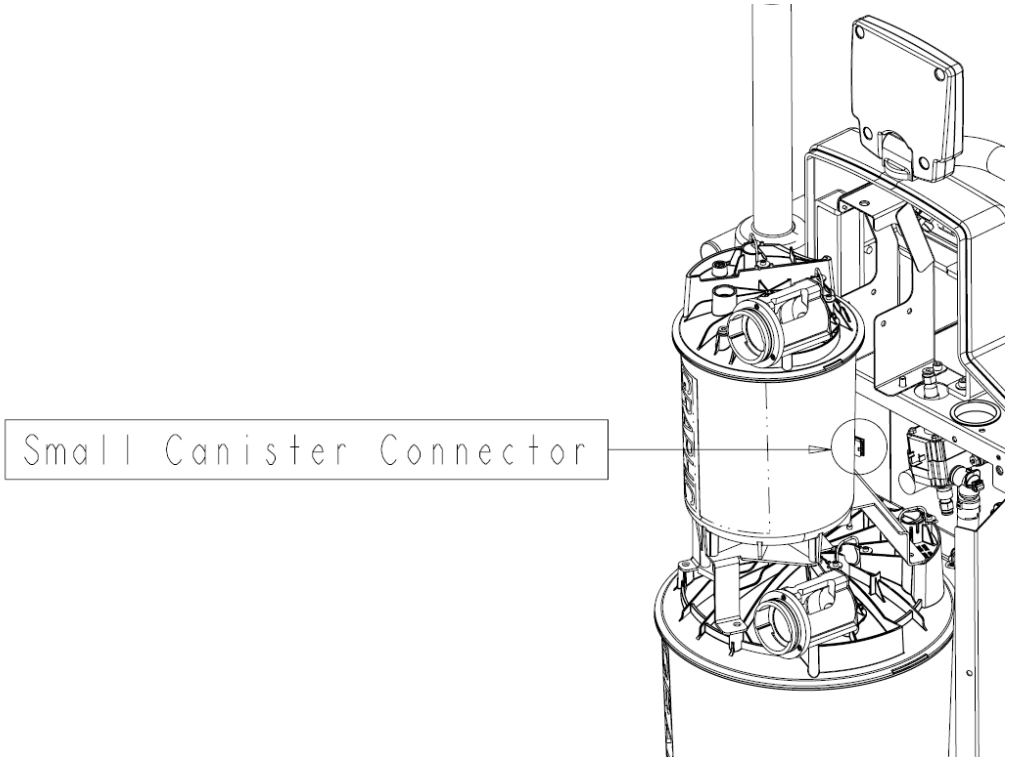
5. Remove the nylon tubing coming from the injector pump assembly going to the green press-to-lock fitting on the **small canister cap assembly** (P/N 702-1-200) (AM).



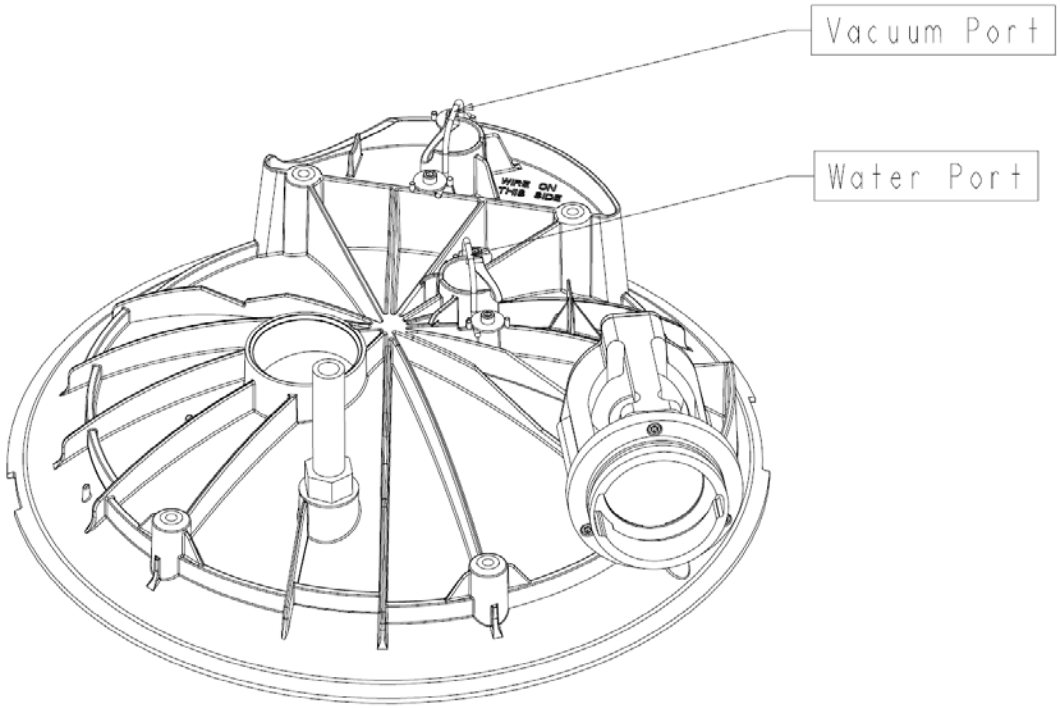
6. Remove the connector going from the cable labeled drain valve to the **drain valve assembly** (P/N 702-1-360) (D).



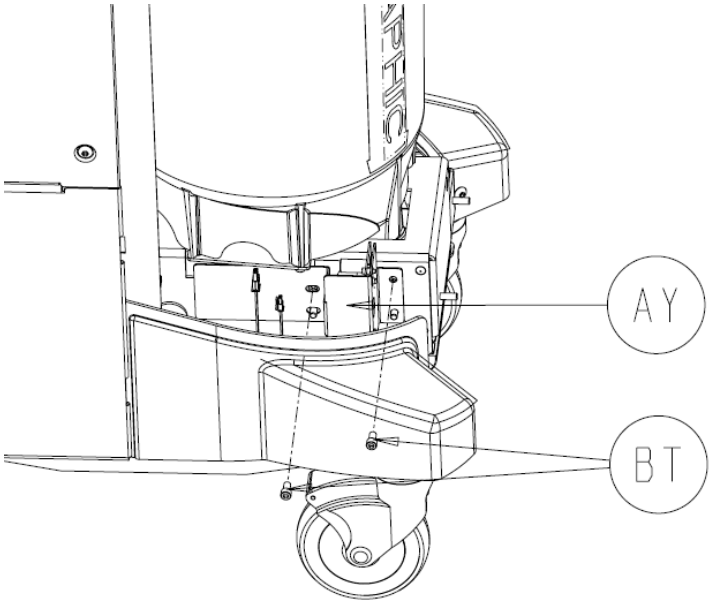
7. Remove the grey cable labeled **small canister PCBA** from the connector on the **canister calibration PCBA** (P/N 0702-001-803) (Behind Canister).



8. Remove the coupling clips on the large canister at the water and vacuum ports.

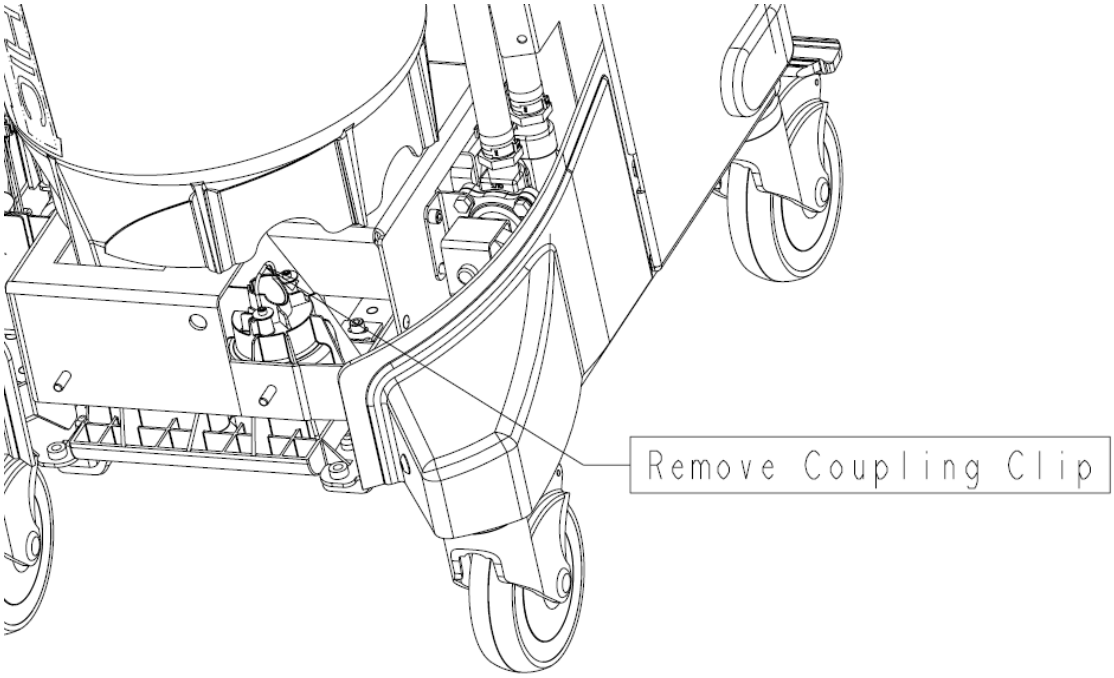


9. Remove the two **socket head cap screws** (P/N 0004-645-000) (BT) that hold the **IR board bracket** (0702-001-326) (AY) to the rover chassis using a 3/16" allen wrench. The IR board bracket assembly can remain connected while removing the canister.

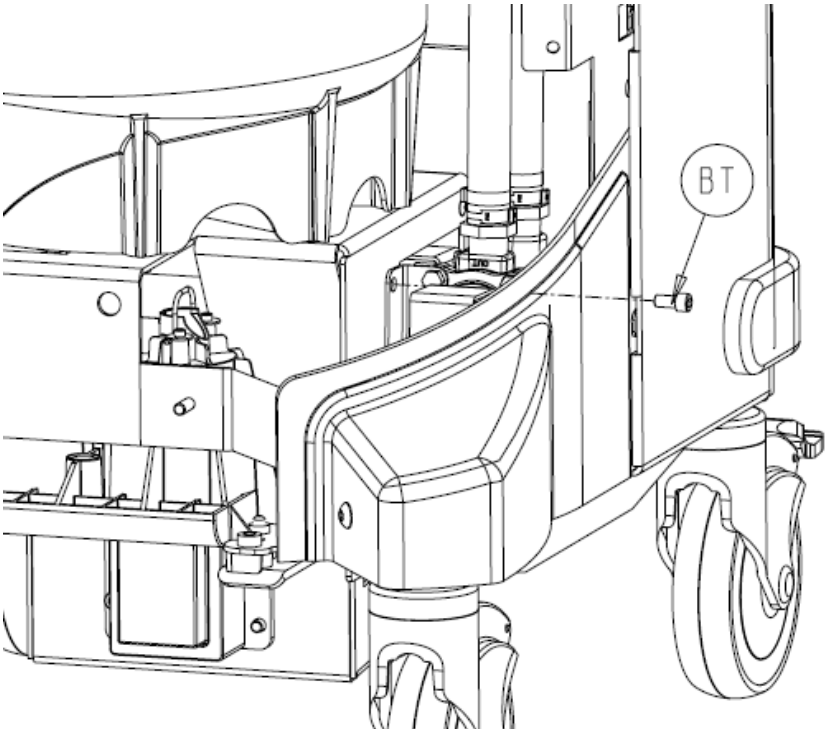


Caution: When removing the inlet hose in **step 10,** be aware that water and detergent may be present in the hose!

10. Remove the **coupling clip** (P/N 702-1-204) (C) from the **coupling block** (P/N 702-1-600) that holds the **diverter inlet water hose assembly** (P/N 702-1-341) (B) and remove the hose from the block.



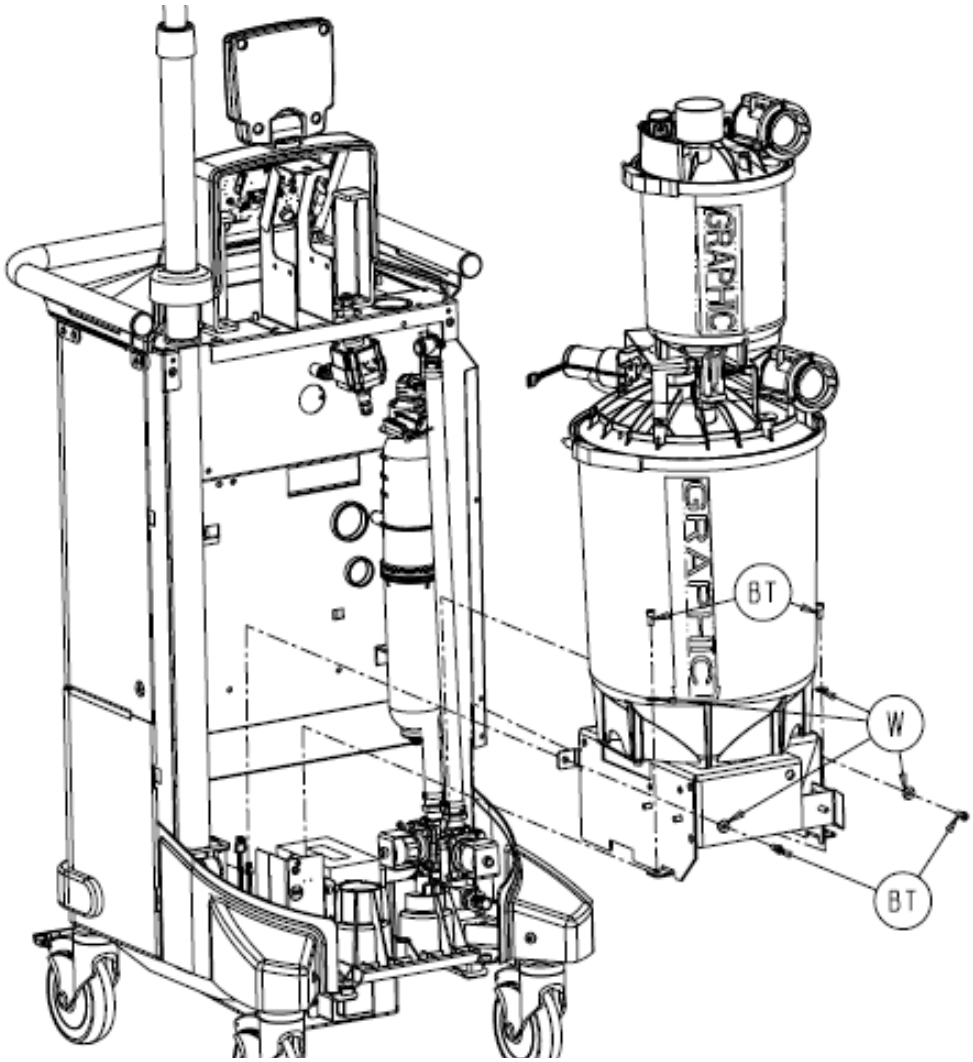
11. Using a 3/16” allen wrench, remove the **socket head cap screw** (P/N 0004-645-000) (BT) that holds the **rover inlet fluid diverter assembly** (0702-001-350) (AS) to the rover chassis.



Caution: Ensure that both canisters are empty prior to removing them. Removing the canisters with fluid inside will cause the fluid to leak into the chassis area.

Caution: DO NOT lift the **large canister assembly** completely out of the chassis once the hardware has been removed! On some models, the connection behind the canister is inaccessible until after the canister hardware is removed, and the canister rotated slightly. Proceed with caution!

12. Remove the four **socket head cap screws** (P/N 0004-645-000) (BT) and four **flat washers** (P/N 0011-507-000) (W) that hold the **large canister assembly** (P/N 702-1-320) (AD) to the rover chassis. (Note that the small canister will still be attached.)



13. Unplug the connector labeled large can PCBA from the **canister calibration PCBA** (P/N 702-1-803) (D). If the connector is behind the canister, slowly lift the **large canister assembly** (P/N 702-1-320) (AD) up until the bottom bracket clears the **coupling block** (P/N 702-1-600). Then rotate the **large canister assembly** (P/N 702-1-320) (AD) clockwise approximately 10° and remove the connector.

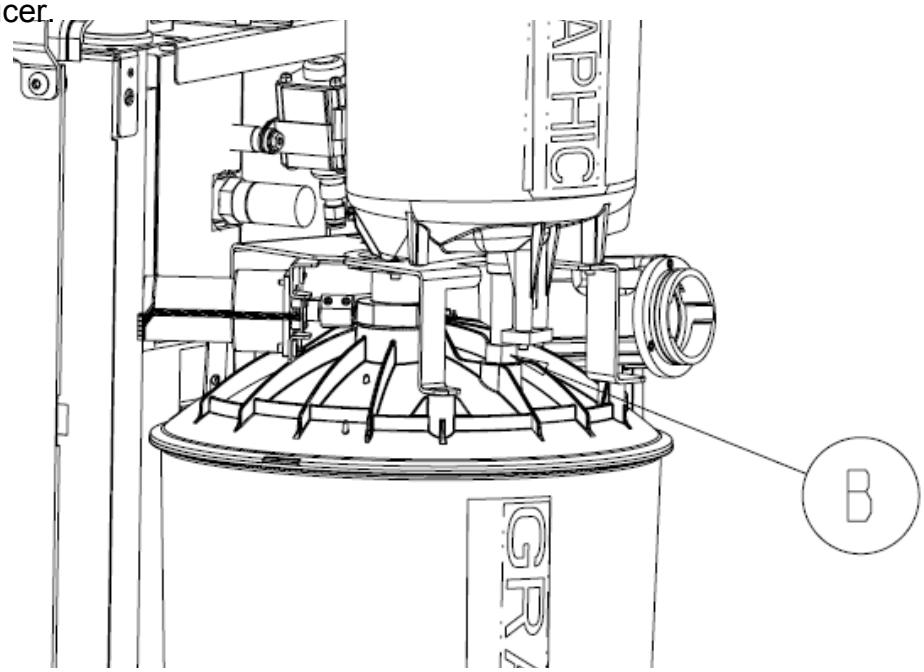
14. Continue to remove the **large canister assembly** (P/N 702-1-320) (AD) out of the chassis assembly and set aside.

Separation of Large & Small Canister Assemblies

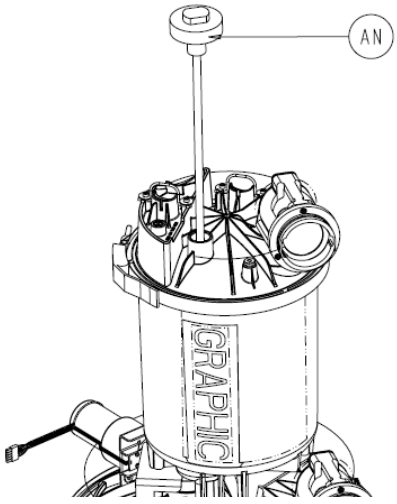
This procedure outlines how to separate the large and small canister assemblies. It should be followed only after removing both assemblies together as described in the preceding section. If you are only replacing the small canister, proceed to ***Small Canister Assembly (p. 2-35)***.

Caution: Ensure that the small canister is empty prior to **step 1!** Loosening the seal nut and removing the fluid level transducer may cause fluid to leak from the small canister if it is not empty.

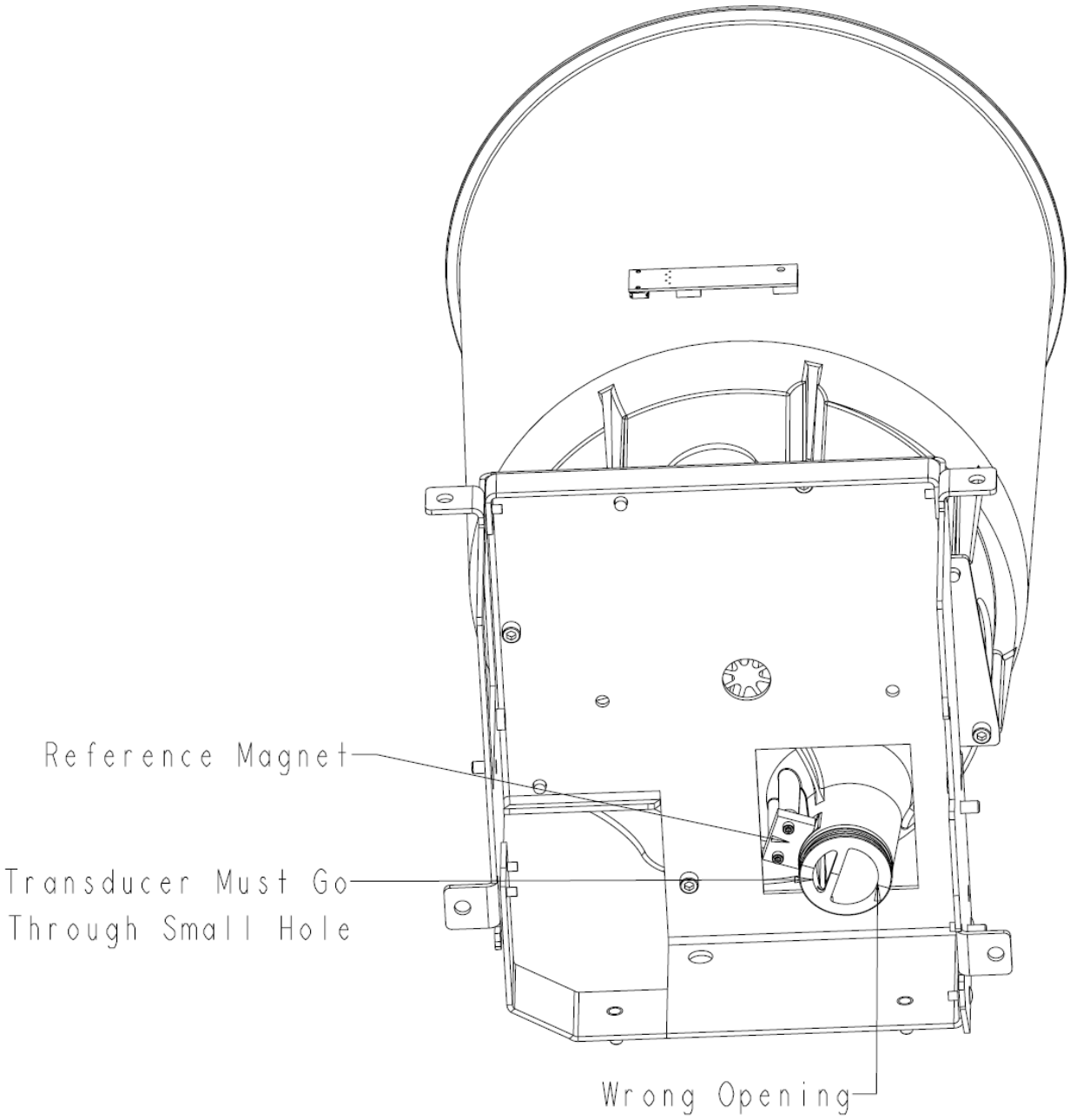
1. Using an adjustable wrench, loosen the **transducer seal nut** (P/N 0702-001-225) (B) on the large canister cap. This provides the tension relief required to remove the fluid level transducer.



2. Carefully unthread and remove the **fluid level transducer** (P/N 702-1-880) (AN) from the **small canister cap assembly** (P/N 702-1-200) (AM).

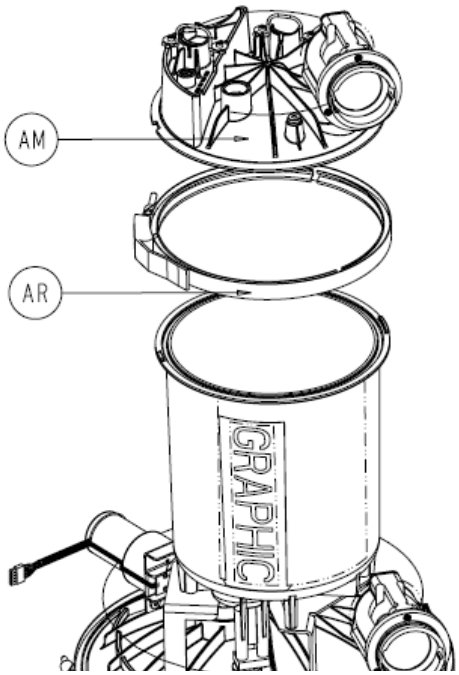


3. Be especially careful when reinstalling the fluid level transducer. There are two compartmented sides at the opening in the bottom of the large canister. The transducer must be routed through the small opening. The reference magnet for the volume sensing subsystem is adjacent to the small opening. If the transducer rod is not routed correctly, the rover will not read fluid volume in the large canister.



4. Remove the **small v-clamp** (P/N 702-001-304) (AR) that holds the **small canister cap assembly** (P/N 702-1-200) (AM) to the **small canister assembly** (P/N 702-001-300) (AK) and set the v-clamp aside.

5. Remove the **small canister cap assembly** (P/N 702-001-200) (AM) from the **small canister assembly** (P/N 702-001-300) (AK) and set aside.

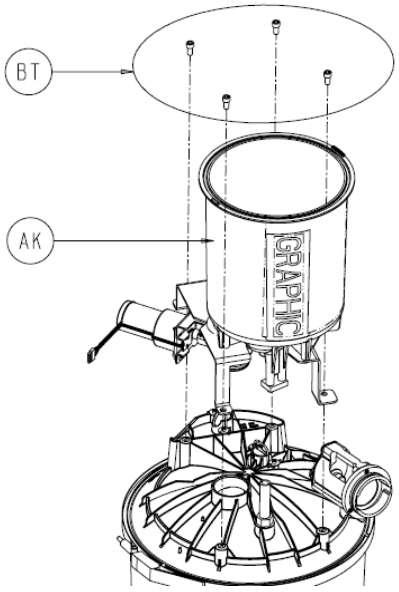


Caution: There is a small amount of water that remains in the **drain valve assembly** after the prefill has been emptied. After all the bolts have been removed, make sure to lift the **small canister assembly** *slowly* to allow the fluid to drain into the large canister assembly.

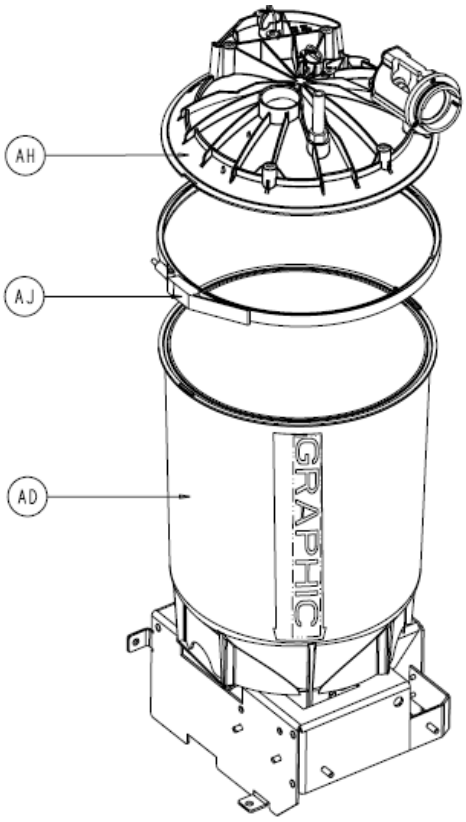
6. Remove the four **socket head cap screws** (P/N 0004-645-000) (BT) located on the front left side, and the front and back right sides using a 3/16” allen wrench. (Do not remove the screw closest to the drain valve at this time.)

7. Remove the last **socket head cap screw** (P/N 0004-645-000) (BT) from the back left side. (Screw closest to the drain valve.)

8. Carefully lift the **small canister assembly** (P/N 702-1-300) (AK) out and set aside. Be mindful of any fluid that may remain in the drain valve assembly.



9. The large canister can be accessed by removing the **large v-clamp** (P/N 0702-001-324) (AJ) and then removing the **large canister cap assembly** (P/N 0702-001-220) (AH) from the **large canister assembly** (P/N 0702-001-320) (AD).

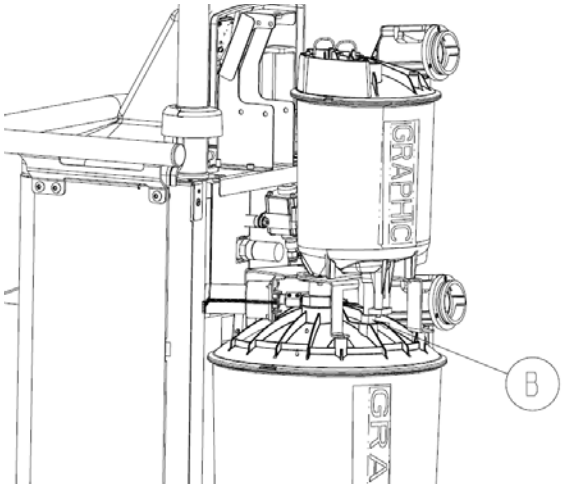


Small Canister Assembly P/N 0702-001-300

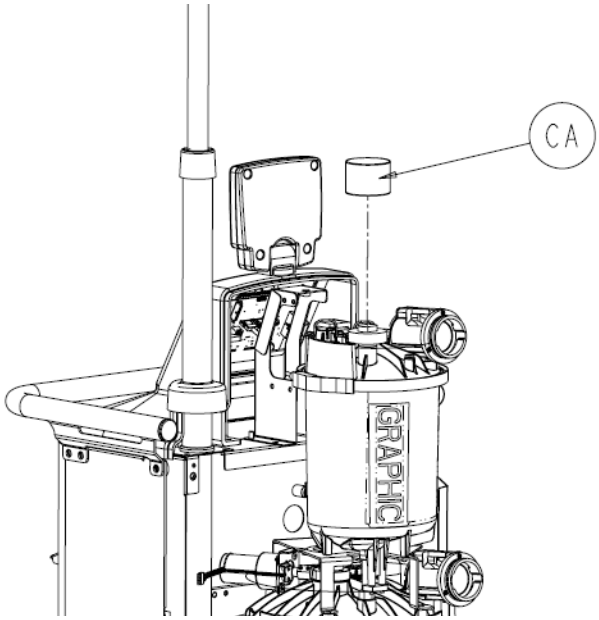
The following procedure outlines the removal of the small canister only. The small canister can be removed while leaving the rest of the fluid collection assembly intact in the system. To remove the large canister assembly it is best to follow the procedure ***Removing Large and Small Canisters*** (p.2-25) followed by ***Separation of Large & Small Canister Assemblies*** (p.2-31)

Caution: Ensure that the small canister is empty prior to **step 1!** Loosening the seal nut and removing the fluid level transducer may cause fluid to leak from the small canister if it is not empty.

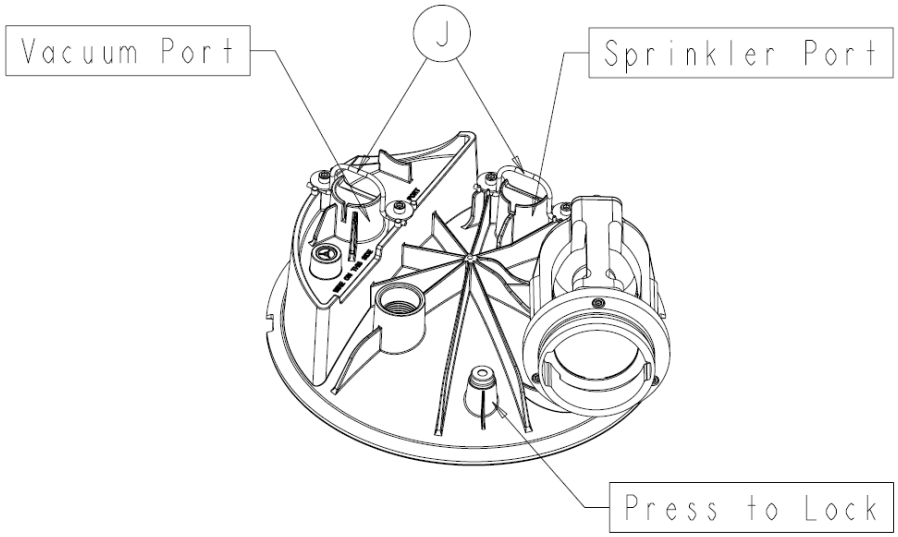
1. Using an adjustable wrench, loosen the **transducer seal nut** (P/N 0702-001-225) (B) on the large canister cap. This provides the slack required to remove the fluid level transducer.

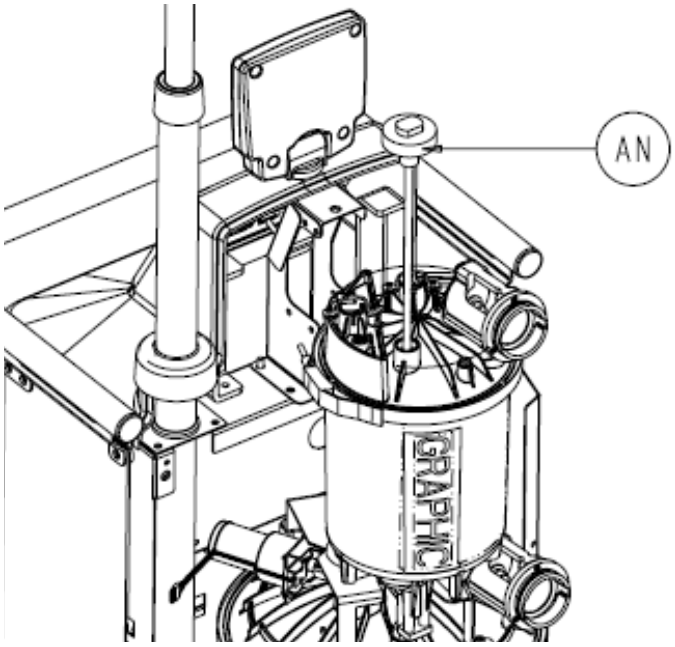


2. Remove **level sensor cover** (P/N 702-1-882) (CA) from **fluid level transducer** (P/N 702-1-880) (AN) and place aside.



3. Disconnect the grey cable labeled level sensor from the **fluid level transducer** (P/N 702-1-880) (AN).
4. Remove the two **coupling clips** (P/N 702-1-204) (J) on **small canister cap assembly** (P/N 702-1-200) (AM)
5. Remove elbow from ports marked vacuum port and sprinkler port from the **small canister cap assembly** (P/N 702-1-200) (AM)
6. Remove the nylon tubing coming from the injector pump assembly going to the green press-to-lock fitting on the **small canister cap assembly** (P/N 702-1-200) (AM).



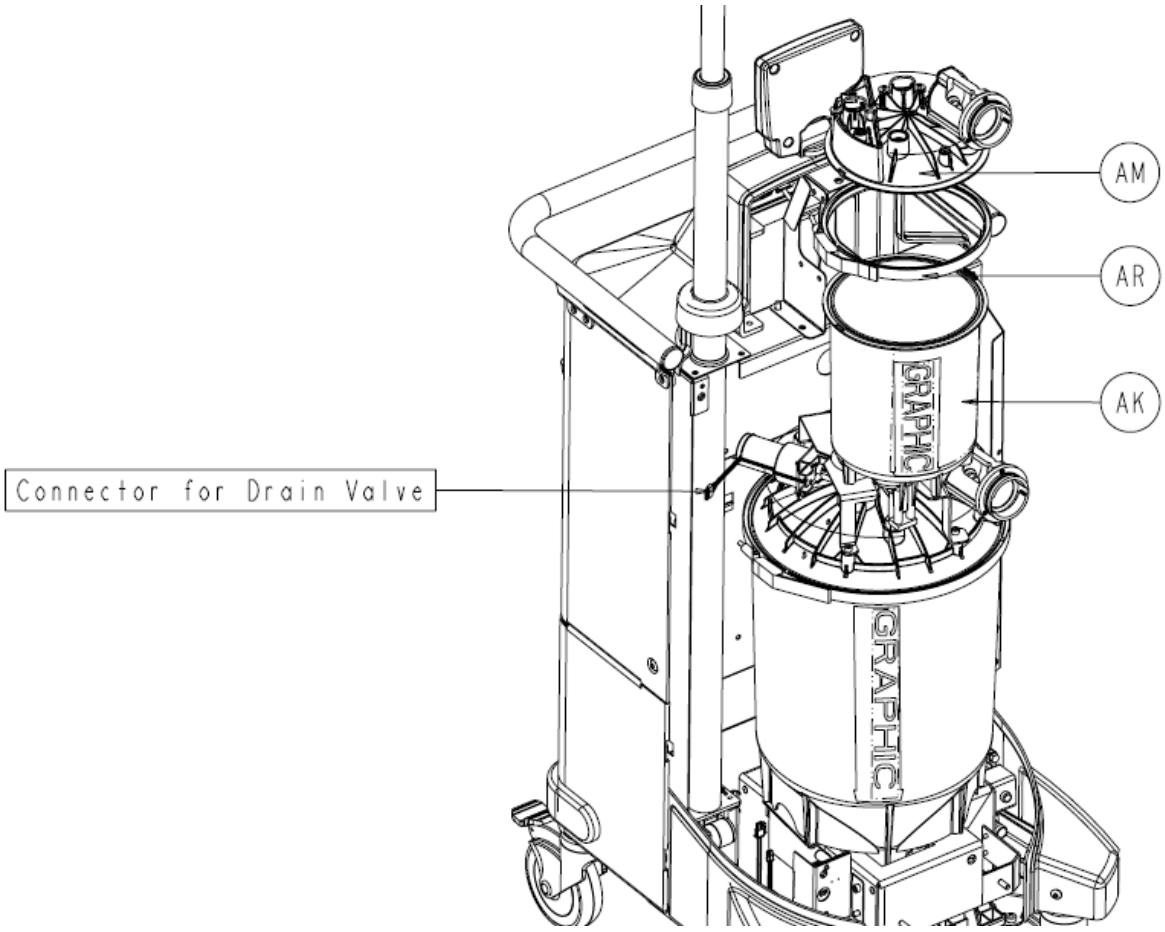


7. Carefully unthread the **fluid level transducer** (P/N 702-1-880) (AN) from the **small canister cap assembly** (P/N 702-1-200) (AM) and set aside.

8. Remove the **small v-clamp** (P/N 702-1-304) (AR) that holds the **small canister cap assembly** (P/N 702-1-200) (AM) to the **small canister assembly** (P/N 702-1-300) (AK) and set the v-clamp aside.

9. Remove the **small canister cap assembly** (P/N 702-1-200) (AM) from the **small canister assembly** (P/N 702-1-300) (AK) and set aside.

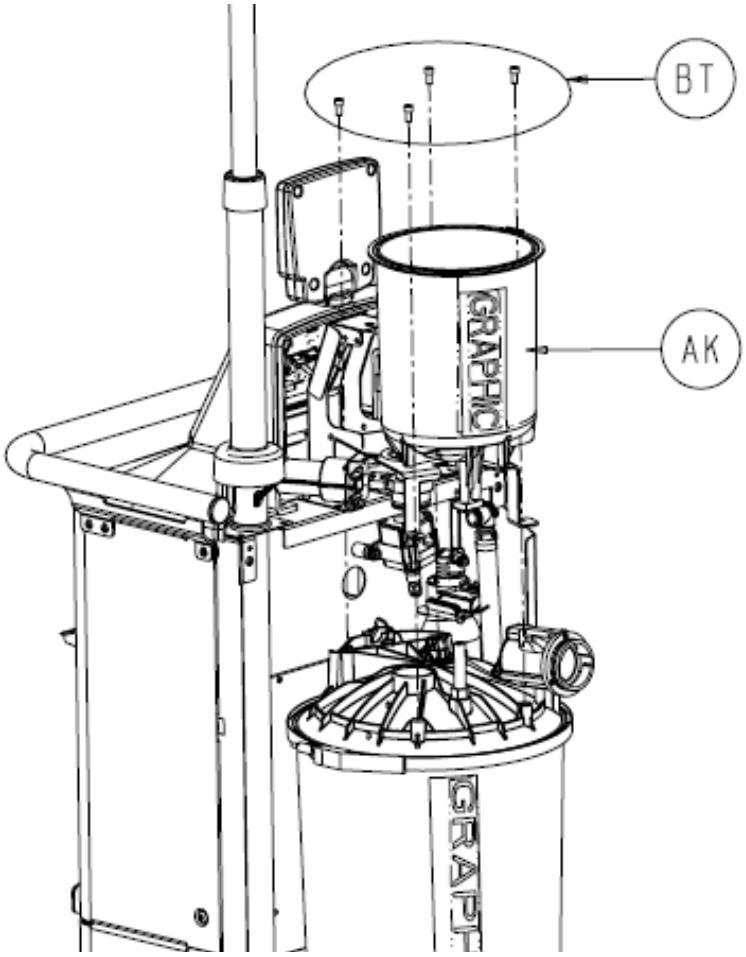
10. Remove the grey cable labeled **small canister PCBA** from the **canister calibration PCBA** (P/N 702-1-803) (F).



11. Remove the connector going from the cable labeled drain valve to the **drain valve assembly** (P/N 702-1-360) (D).

Caution: There is a small amount of water that remains in the **drain valve assembly** after the prefill has been emptied. After all the bolts have been removed, make sure to lift the **small canister assembly** *slowly* to allow the fluid to drain into the large canister assembly.

12. Remove the three **socket head cap screws** (P/N 0004-645-000) (BT) located on the front left side, and the front and back right sides using a 3/16" allen wrench.
13. Remove the last **socket head cap screw** (P/N 0004-645-000) (BT) from the back left side.
14. Carefully lift the **small canister assembly** (P/N 702-1-300) (AK) out and set aside. Be mindful of any fluid that may remain in the drain valve assembly.

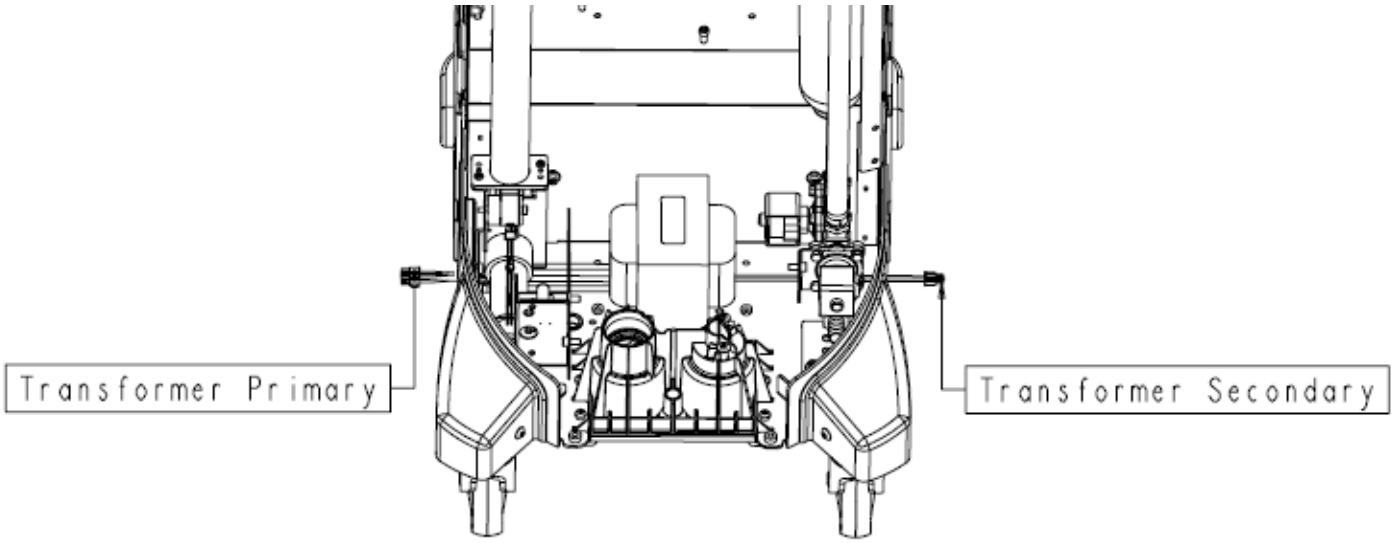


Caution: If replacing the canister, be sure to follow procedure 6.4 ***Performing the Canister Calibration*** on page 6-11.

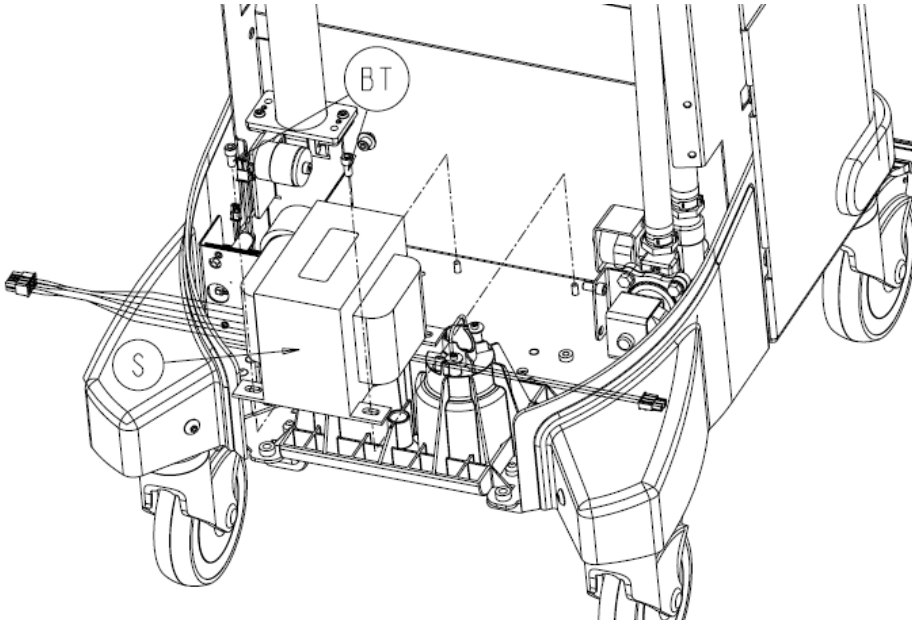
Power Transformer Assembly P/N 0702-001-830

Note: This procedure begins with the both fluid collection canisters removed. The technician must complete ***Removing Large and Small Canisters*** on page 2.25 before proceeding.

1. Disconnect cables labeled **transformer primary** and **transformer secondary**. Note that the cables coming directly from the transformer are not labeled. The label is on the main wire harness side of the connection.



2. Remove two **socket head cap screws** (P/N 0004-645-000) (BT) using a 3/16” allen wrench.

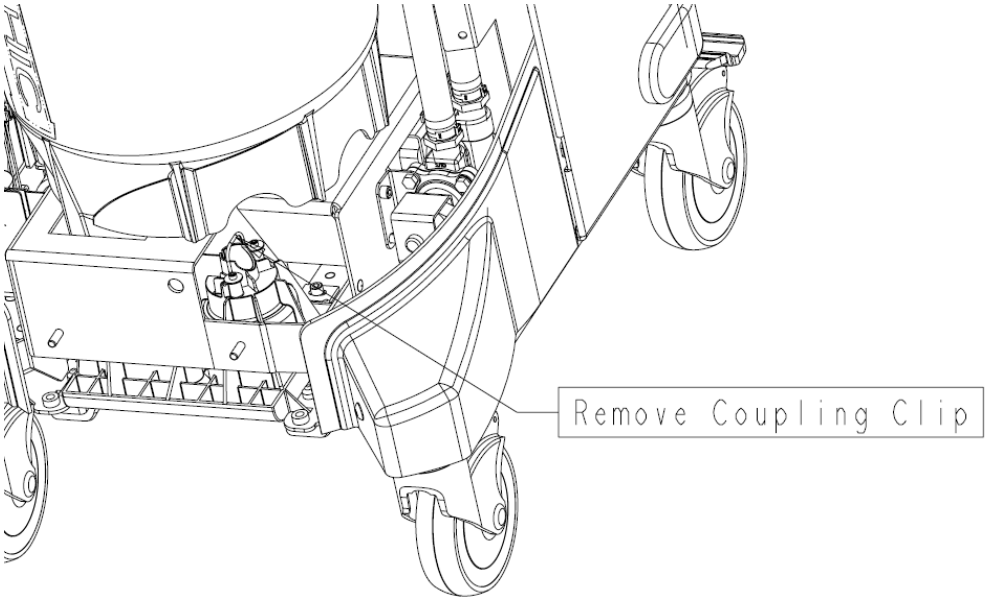


3. Remove **power transformer assembly** (P/N 0702-001-830) (S) and set aside.

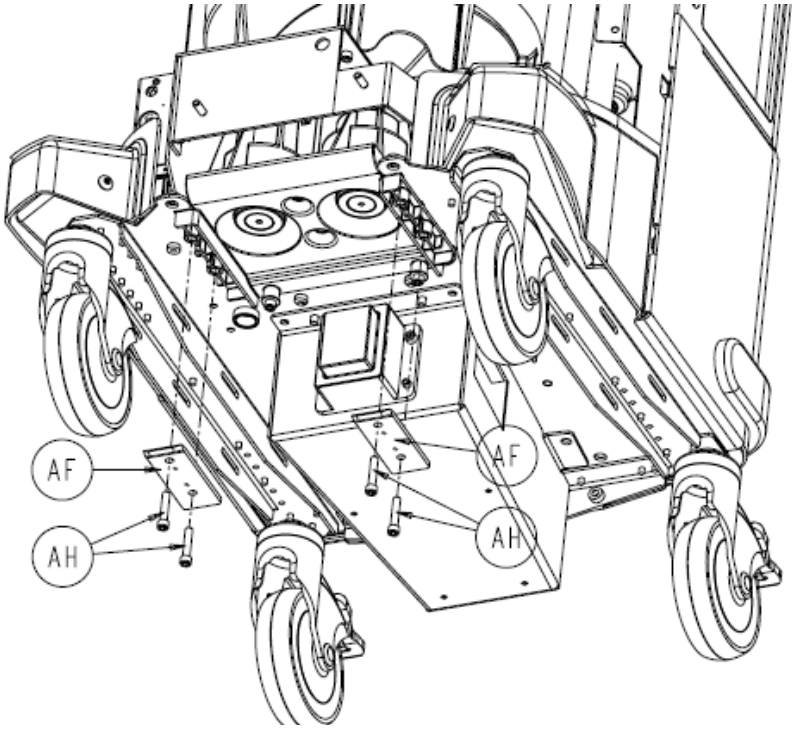
Coupling Block Assembly P/N 0702-001-600

Caution: This procedure begins with the front cover already removed. If the rover canister(s) contain fluid, you will need to manually dock the unit using the technician menu before proceeding!

1. Remove the **coupling clip** (P/N 702-1-204) (C) from the **coupling block** (P/N 702-1-600) that holds the **diverter inlet water hose assembly** (P/N 702-1-341) (B) and remove the hose from the block.



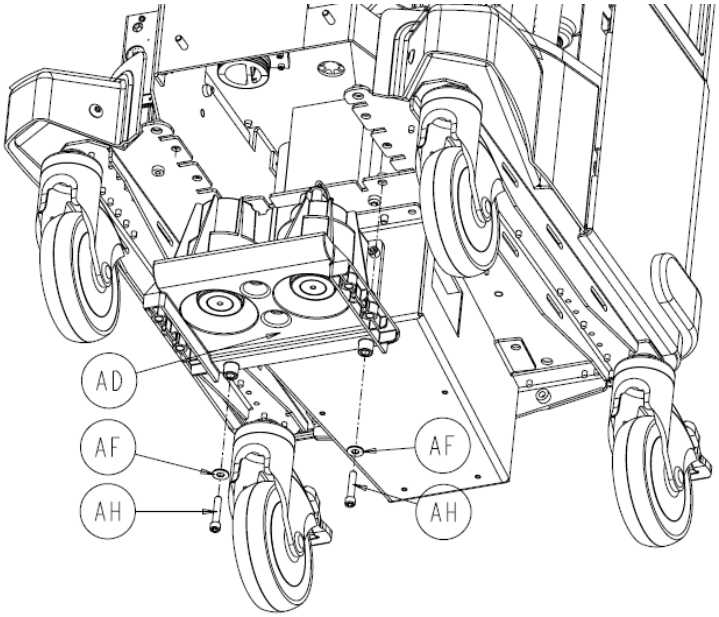
2. Remove four **socket head cap screws** (P/N 0004-542-000) (AH) from underside of **coupling block assembly** (P/N 702-1-600) (AD) using a 3/16" allen wrench.



3. Once the four screws have been removed, remove the two **coupling block rails** (P/N 702-1-603) (AF) and set aside.

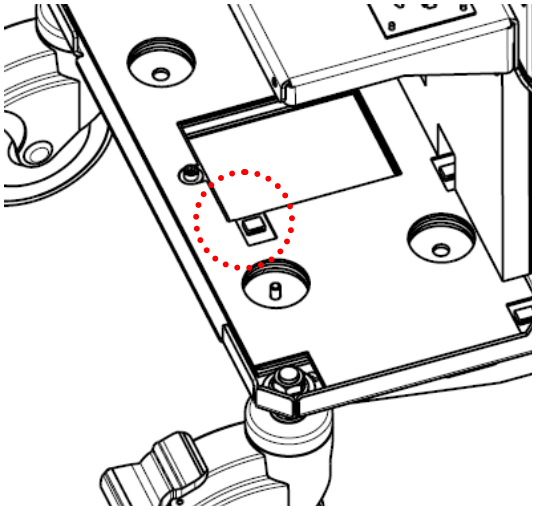
Note: Be aware of the orientation of the coupling block rails. There are guide pins to keep the rail aligned, but it can be installed backwards as well as upside down. The sloped portion of the rail should point away from the vacuum pump and towards the floor.

4. Remove the remaining two **socket head cap screws** (P/N 0004-542-000) (AH) and two **¼" flat washers** (P/N 0011-507-000) (AE) using a 3/16" allen wrench.
5. Remove the **coupling block assembly** (P/N 702-1-600) (AD) by forcing it downward and set aside.



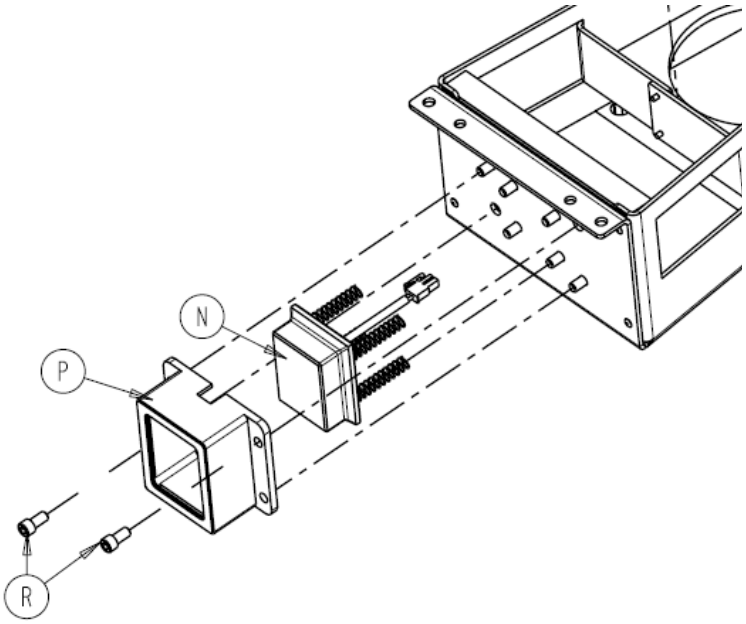
Exhaust Plenum Assembly P/N 702-901-930

1. There is a cable tie underneath the vacuum pump holding the fan cable to the chassis. Prior to removing the exhaust plenum, be sure to cut the cable tie to allow sufficient slack in the cable assembly.



Note: Prior to lowering the exhaust plenum assembly you must remove the rover power coupler assembly. Do not disconnect the grey cable attached to the assembly. Instead, leave the cable connected.

2. Remove the two **socket head cap screws** (P/N 0004-645-000) (R) using a 3/16” allen wrench.

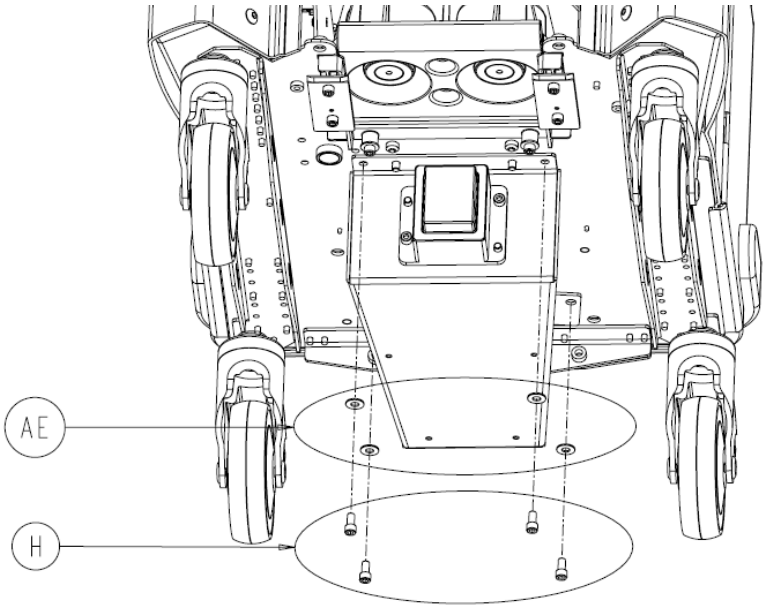


3. Remove the **rover power coupler cover** (P/N 702-1-944) (P) and place aside.

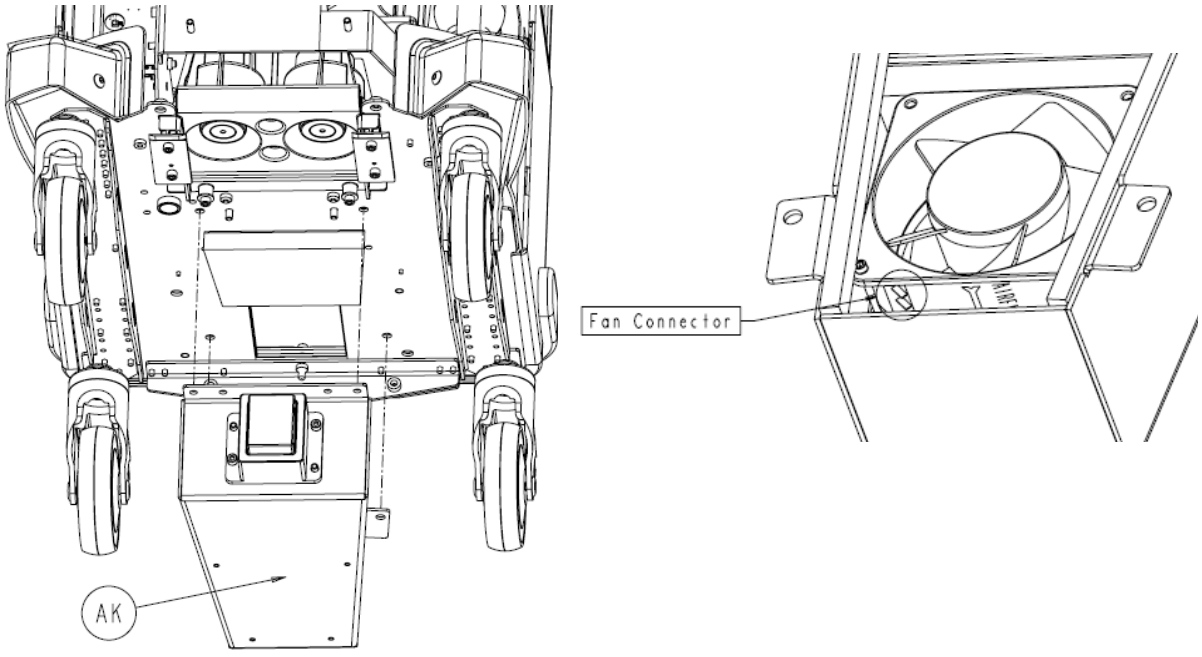
4. Set the **rover power coupler assembly** (P/N 702-1-945) (N) inside the chassis. Take caution not to put too much stress on the gray cable or bend the springs on the assembly.

Note: The exhaust plenum assembly is heavy! When removing the hardware, be prepared to support the weight of the plenum. Make sure to keep clear of the underside of the plenum to avoid bodily injury.

5. Remove four **socket head cap screws** (P/N 0004-645-000) (H) and four **¼" flat washers** (P/N 0011-507-000) (AE) using a 3/16" allen wrench.



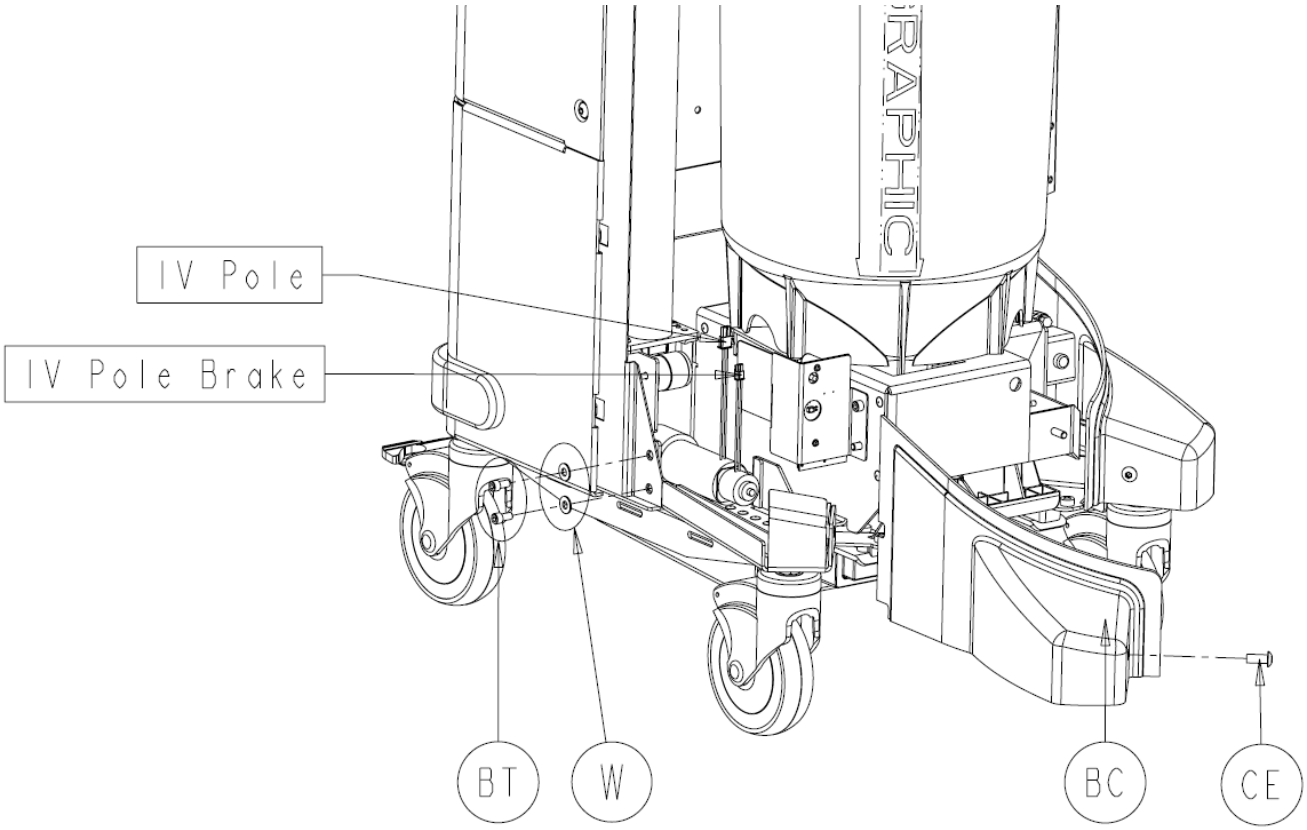
6. The **exhaust plenum assembly** (P/N 702-901-930) (AK) has a fan with a cable connected to it. Disconnect the fan connector and set the assembly aside.



IV Pole Assembly P/N 0702-001-500

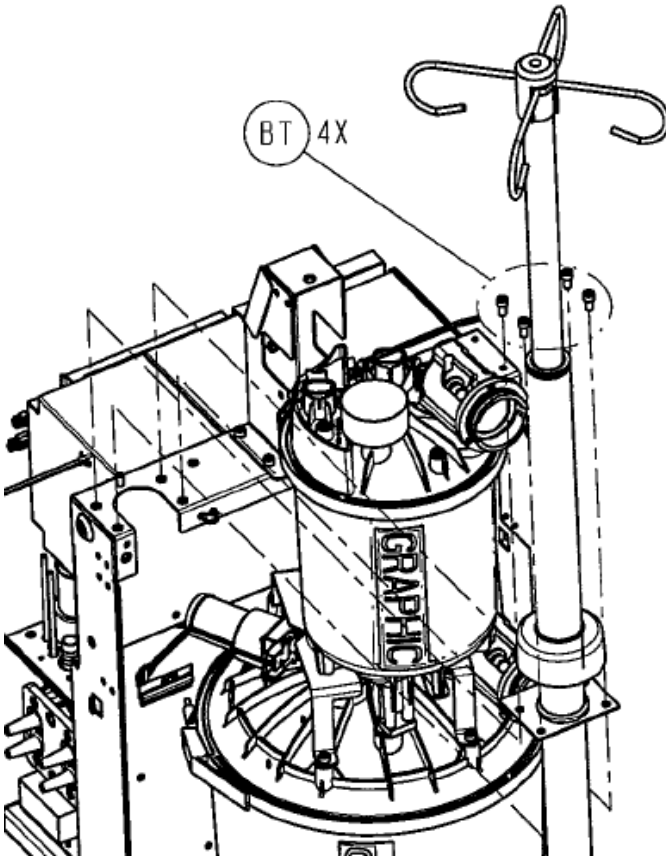
1. Using a 3/16” allen wrench, remove the **socket head button cap screw** (P/N 0004-651-000) (CE) and remove the **left bumper** (P/N 702-1-940) (BC).

2. Disconnect the cables labeled **IV Pole** and **IV pole Brake** from the two connectors on the motor of the **IV Pole assembly** (P/N 702-1-500) (AW).



3. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 0004-645-000) (BT) and two **¼” flat washers** (P/N 0011-507-000) (W) that hold the IV pole’s motor mount to the large canister mount.

4. Using a 3/16” allen wrench, remove the four **socket head cap screws** (P/N 0004-645-000) (BT) that hold the chassis support plate to the rover chassis.



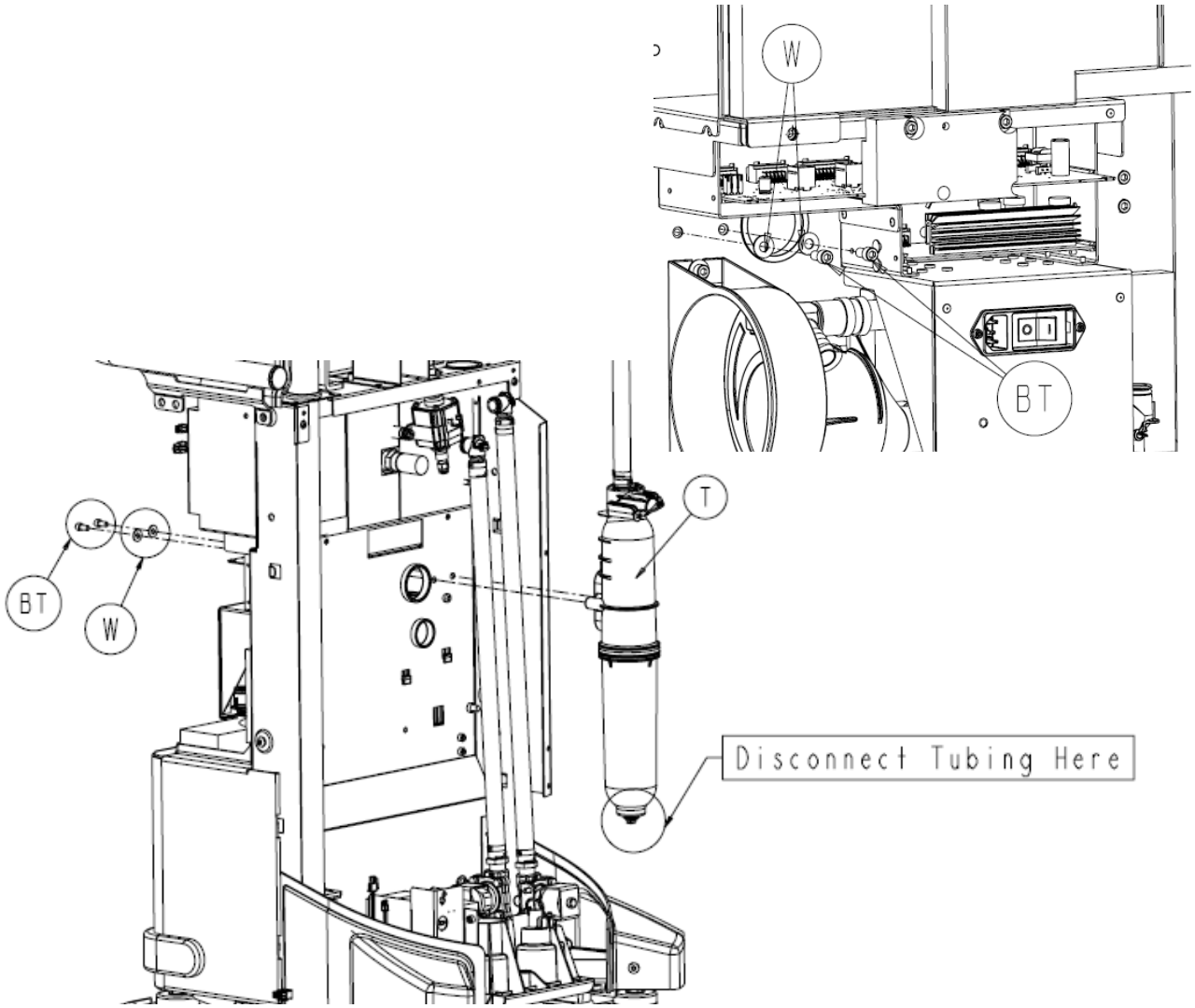
5. Remove the **IV Pole assembly** (P/N 702-1-500) (AW) and set aside.

Prefill Tank P/N 702-007-370

Removing the prefill tank can only be accomplished once the fluid collection assemblies have been removed. The removal procedure for the fluid collection assemblies is detailed in ***Removal of Large and Small Canisters*** on page 2.25. Make sure to manually run the prefill pump to drain the fluid from the prefill tank prior to removing the canister assemblies.

Note: When disconnecting tubing for the prefill tank and prefill pump, be aware of water and detergent that may be present the tubing.

1. Disconnect the nylon tubing from the bottom of the **prefill tank assembly** (P/N 702-007-370) (T). The prefill tank outlet hose assembly will already be disconnected at this point.
2. Using a 3/16" allen wrench, remove the two **socket head cap screws** (P/N 0004-645-000) (BT) and two **¼" flat washers** (P/N 0011-507-000) (W) that secure the prefill tank to the rover chassis. Note that the hardware for the prefill tank is on the opposite side of the chassis.
3. Remove the **prefill tank assembly** (P/N 702-007-370) (T) and set aside.



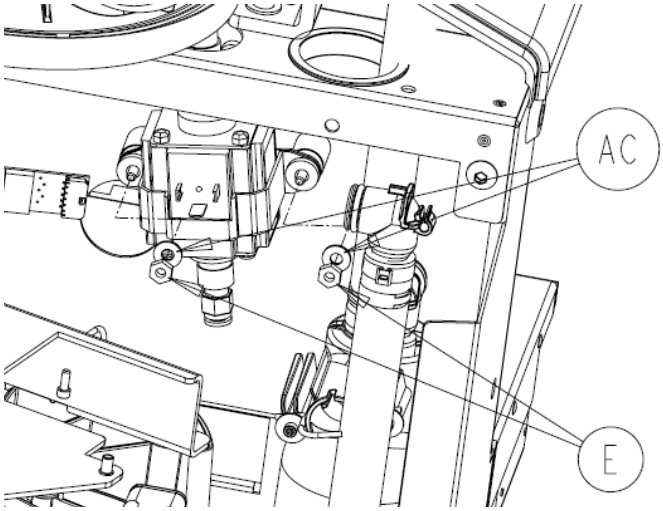
Prefill Pump Assembly 0702-001-380

Caution: Make sure to manually run the prefill pump to drain the fluid from the prefill tank prior to removing the prefill pump. Failure to do so will cause fluid to leak when removing the tubing in step 2.

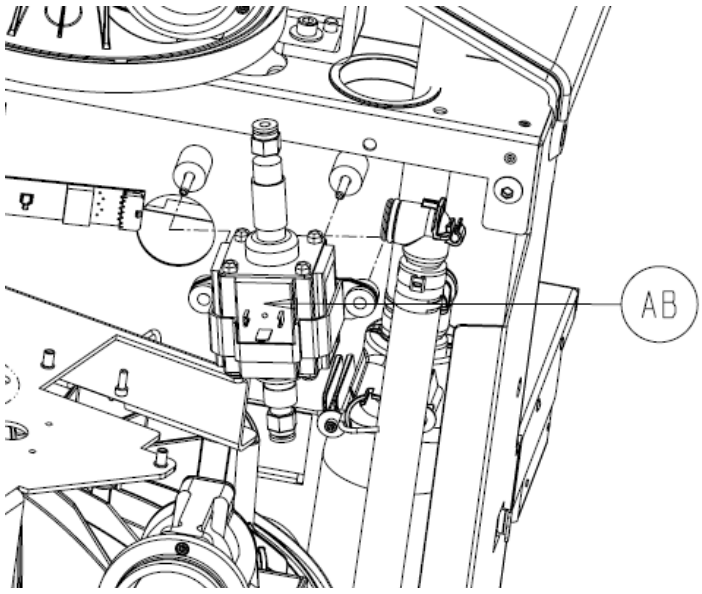
1. Using a #2 phillips screwdriver, unscrew the fastener holding the power connector to the **injector pump assembly** (P/N 0702-001-380) (AB).

2. Unplug the tubing from the top and bottom fittings on the prefill pump.

3. Using a 3/8" socket remove the two **10-32 hex nuts** (0015-004-000) (E) and two **flat washers, #10** (P/N 0011-512-000) (AC).



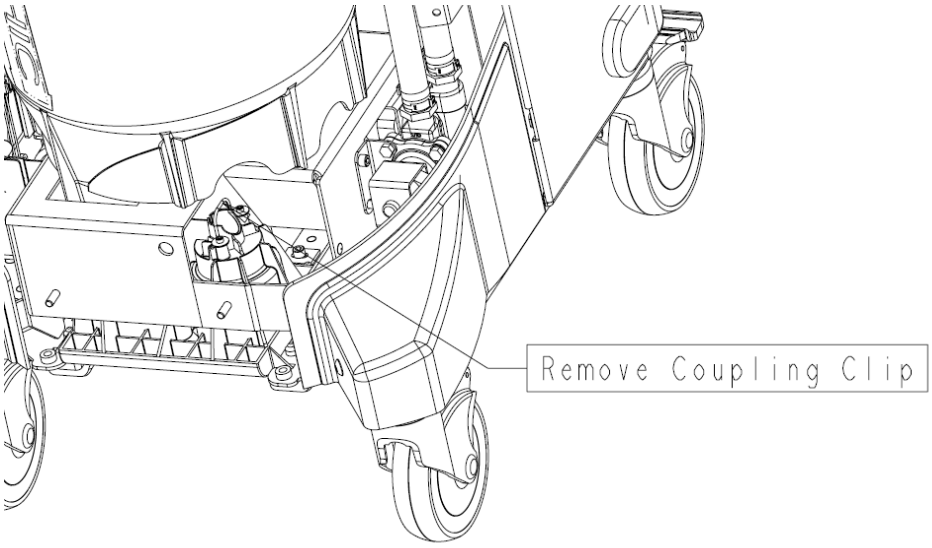
4. Remove the **injector pump assembly** (0702-001-380) (AB) from the chassis and set aside. The spacers behind the injector pump do not need to be removed. Make sure they are in place when reinstalling the pump.



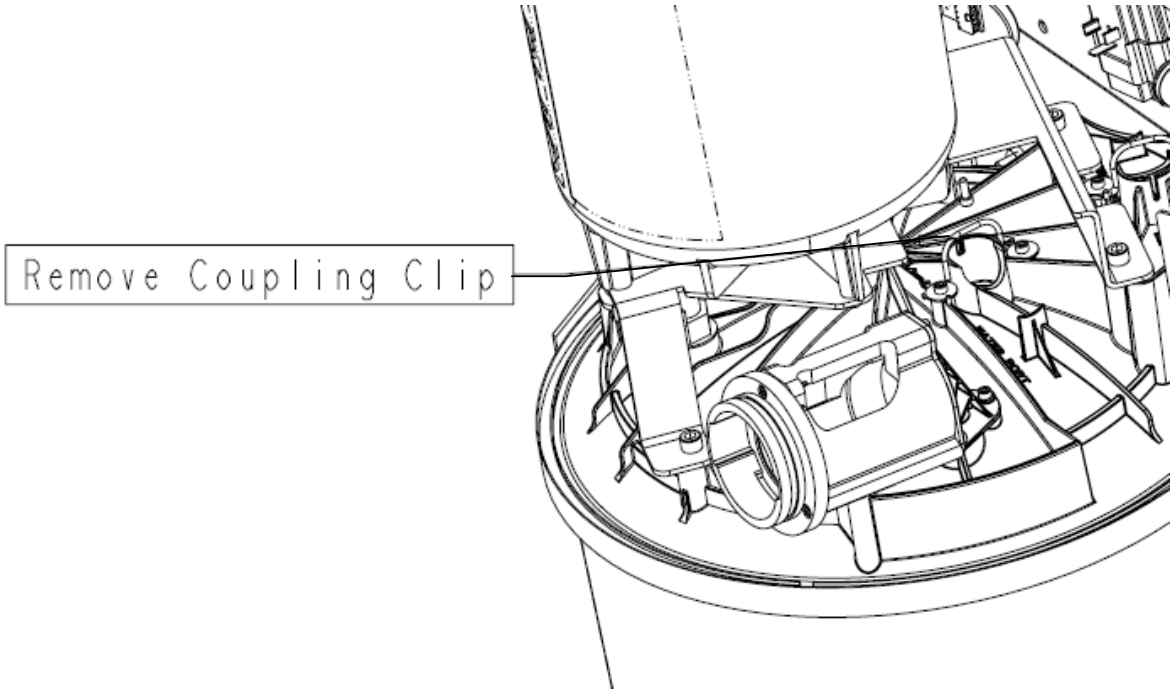
Fluid Diverter Assembly P/N 0702-001-350

Caution: When removing elbow connectors be aware of any water and detergent that may be present!

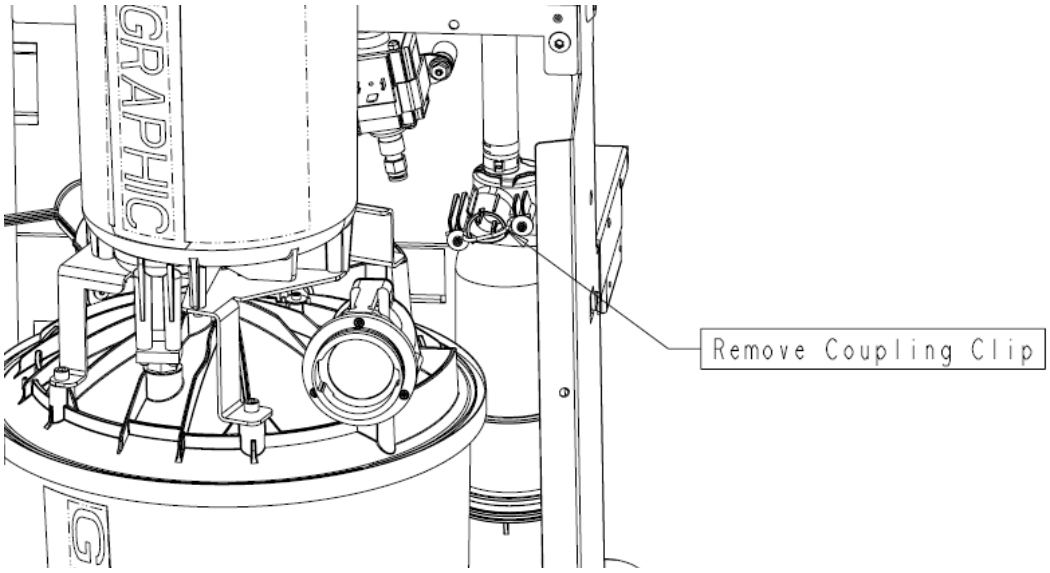
1. Remove the **coupling clip** (P/N 702-1-204) (C) from the **coupling block** (P/N 702-1-600) that holds the **diverter inlet water hose assembly** (P/N 702-1-341) (B) and remove the hose from the block.



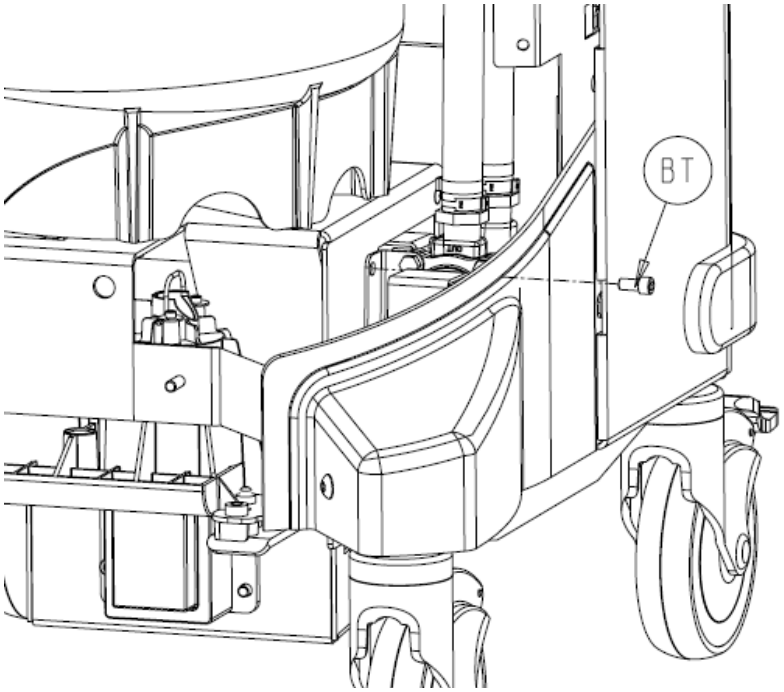
2. Remove the **coupling clip** (P/N 702-1-204) that holds the **large tank inlet water hose assembly** (0702-001-340) (C) to the **large canister cap assembly** (0702-001-220) (AH) and remove the hose from the cap. (Cap will be labeled **Water Port**)



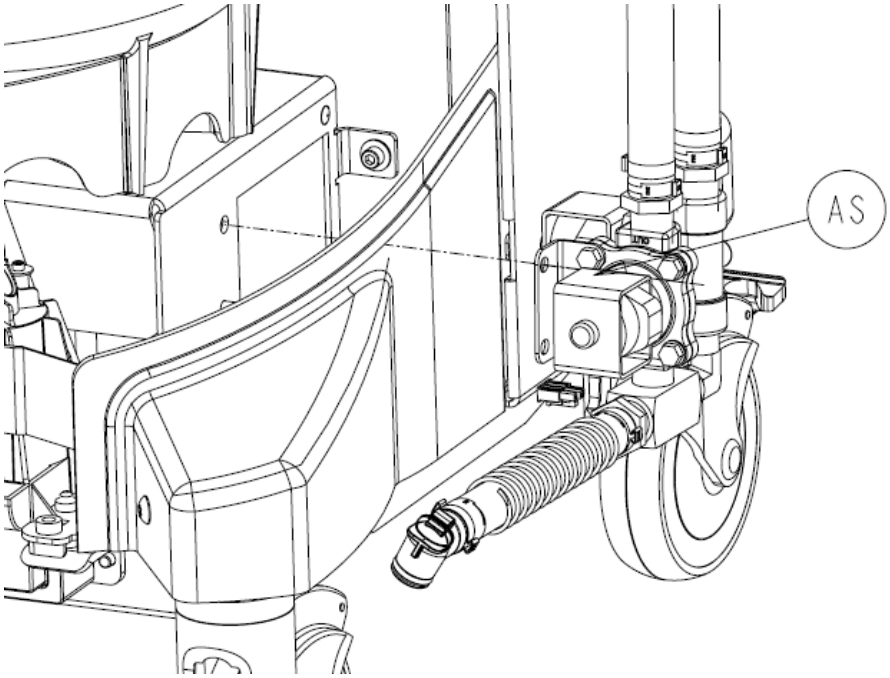
3. Remove the **coupling clip** (0702-001-204) (D) that holds the **prefill tank inlet water hose assembly** (0702-001-343) to the prefill tank.



4. Using a 3/16” allen wrench, remove the **socket head cap screw** (P/N 0004-645-000) (BT) that holds the **rover inlet fluid diverter assembly** (0702-001-350) (AS) to the rover chassis.



5. Disconnect the power connector labeled **diverter valve** from the diverter.
6. Remove the **rover inlet fluid diverter assembly** (P/N 0702-001-350) (AS) and set aside.

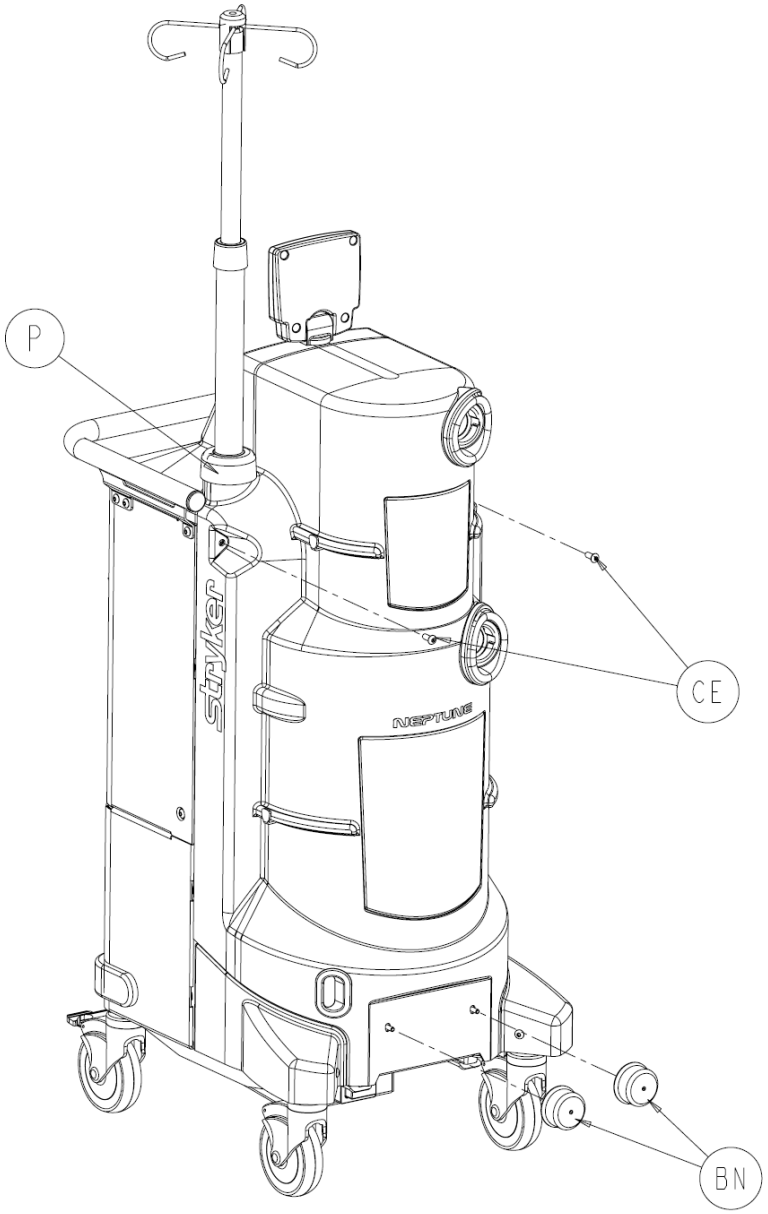


Smoke Evacuator Assembly Removal P/N 0702-001-400

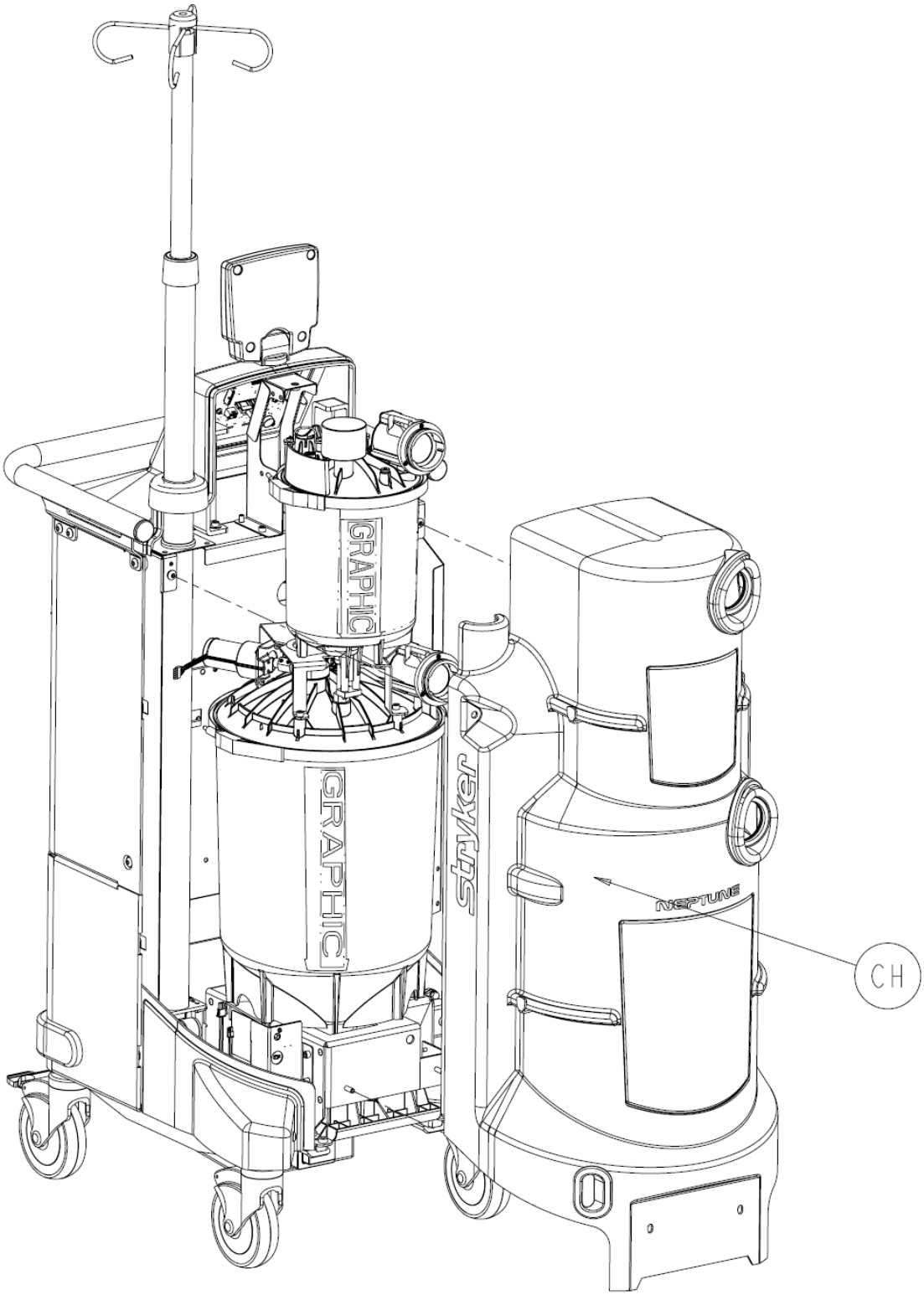
1. Slide **IV pole grommet** (P/N 0702-001-536) (P) up on IV pole approximately 4 inches to allow front panel removal.

2. Remove two **strikeplates** (P/N 0702-001-323) (BN) on the bottom of front cover assembly using 3/16” allen wrench.

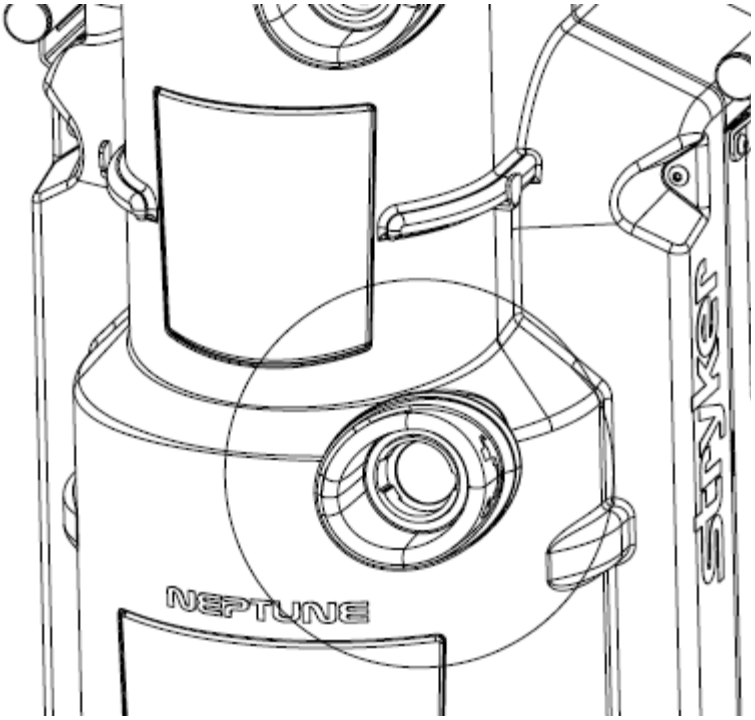
3. Remove two **socket head button cap screws** (P/N 0004-651-000) (CE) on upper front cover assembly using 3/16” allen wrench.



4. Remove **front cover assembly** (P/N 0702-001-070) (CH) and place aside.



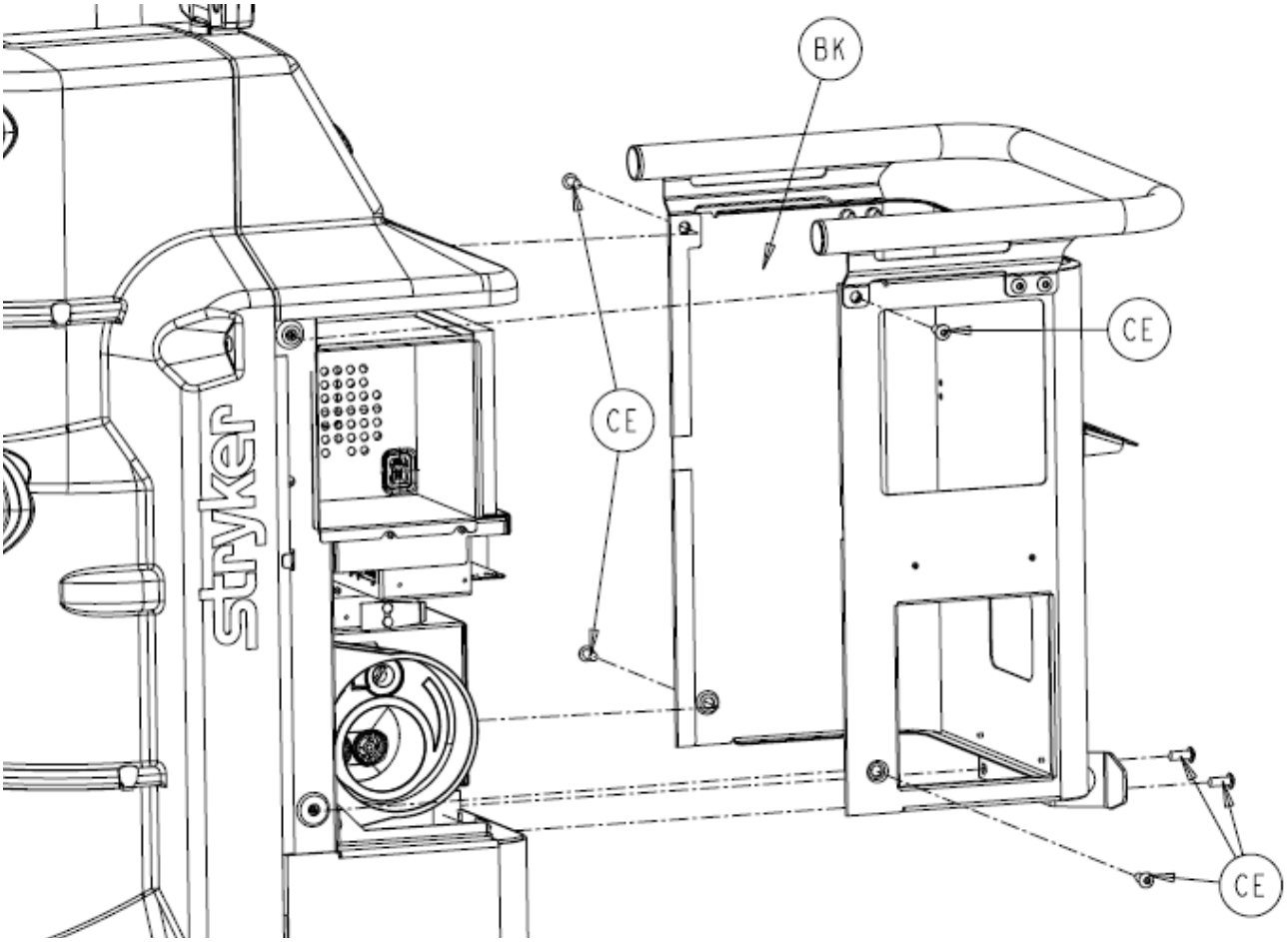
5. When reinstalling the front cover assembly, make sure that the manifold receptacle opening is lined up properly. Failure to do so may cause the grey manifold boot to come loose. To allow sufficient clearance when reinstalling the front cover, follow the procedure on p. 2-5 for removing the ***Rear Panel Assembly.*** The technician should remove the rear panel, reinstall the front cover, and finally reinstall the rear panel assembly.



Caution: The rear panel illustration shows the rear panel assembly ***without*** the HEPA filter, HEPA filter door, and the smoke filter installed. The technician must remove the HEPA filter door on the lower left side of the rear panel and then remove the HEPA filter ***prior*** to removing the rear panel. Also, ensure the smoke evacuator filter is not installed. Failure to do so will prevent the technician from removing the cover properly and may cause damage to the equipment.

6. Using a 3/16” allen wrench, remove 6 **socket head button cap screws** (P/N 0004-651-000) (CE) from **rear panel assembly** (P/N 0702-001-060) (BK).

7. Remove **rear panel assembly** (P/N 0702-001-060) (BK) and place aside.



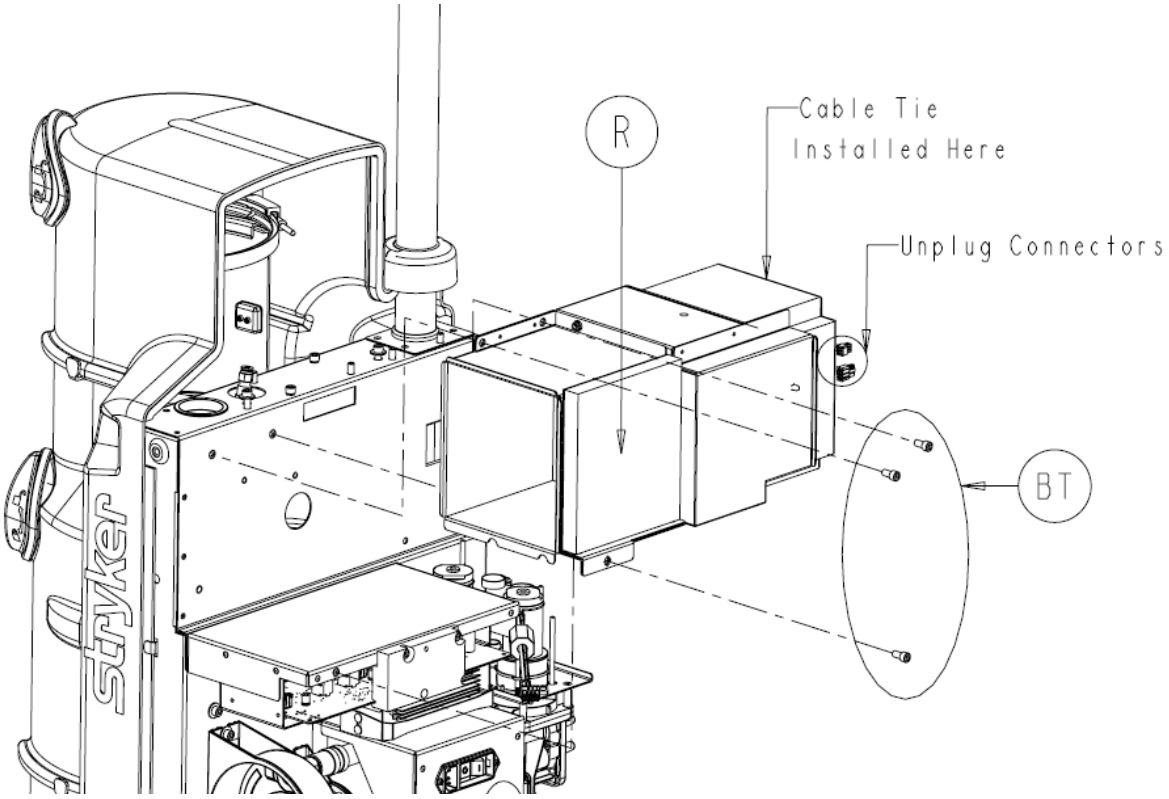
Caution: Be careful not to cut the wire harness or any tubing when cutting cable ties.

8. Cut the **cable tie** (P/N 0058-099-000) that holds the tubing coming from the **vacuum manifold assembly** (P/N 702-001-110) (N). (Leave the cable tie in the chassis of the assembly.)

9. Disconnect the **smoke blower wiring harness** labeled **702-001-872**. (white connector with purple wires)
10. Disconnect the grey cable labeled **smoke sensor**. (grey cable with black connector)

11. Remove the three **socket head cap screws** (P/N 0004-645-000) (BT) that hold the **smoke evacuator assembly** (P/N 0702-001-400) (R) to the rover chassis.

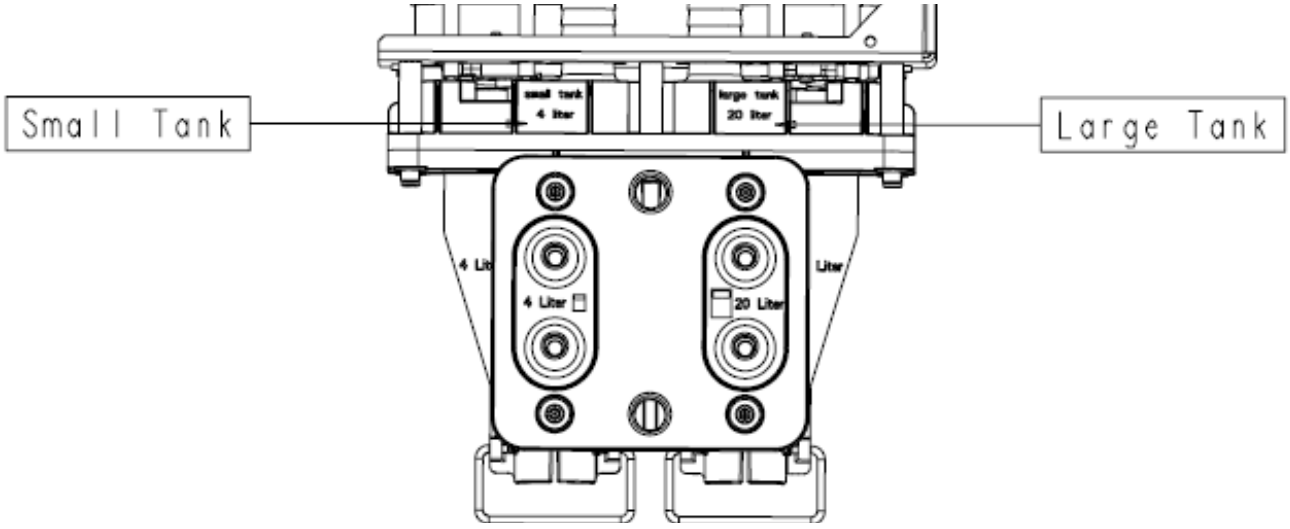
12. Remove the smoke evacuator and set aside.



Vacuum Manifold Assembly P/N 0702-001-110

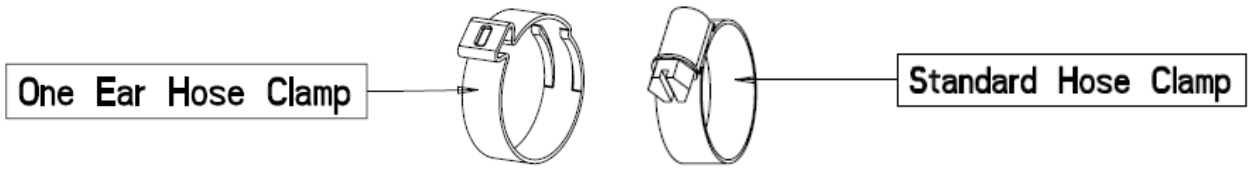
Note: Observe how the four norprene sensor lines are routed behind the board block. When reinstalling the vacuum manifold assembly, make sure to properly place the sensor lines behind the block to avoid pinching a sensor line.

1. Remove the four norprene tubes (two white and two black) from the **power distribution PCBA** (P/N 0702-001-035) (J) that are coming from the **vacuum manifold assembly** (P/N 0702-001-110) (N). The motor, power connector, and tubing are specific to the large or small tank. When removing components for each system, note that the regulators are labeled **small tank 4 liter** and **large tank 20 liter** to distinguish the two controlling subsystems.

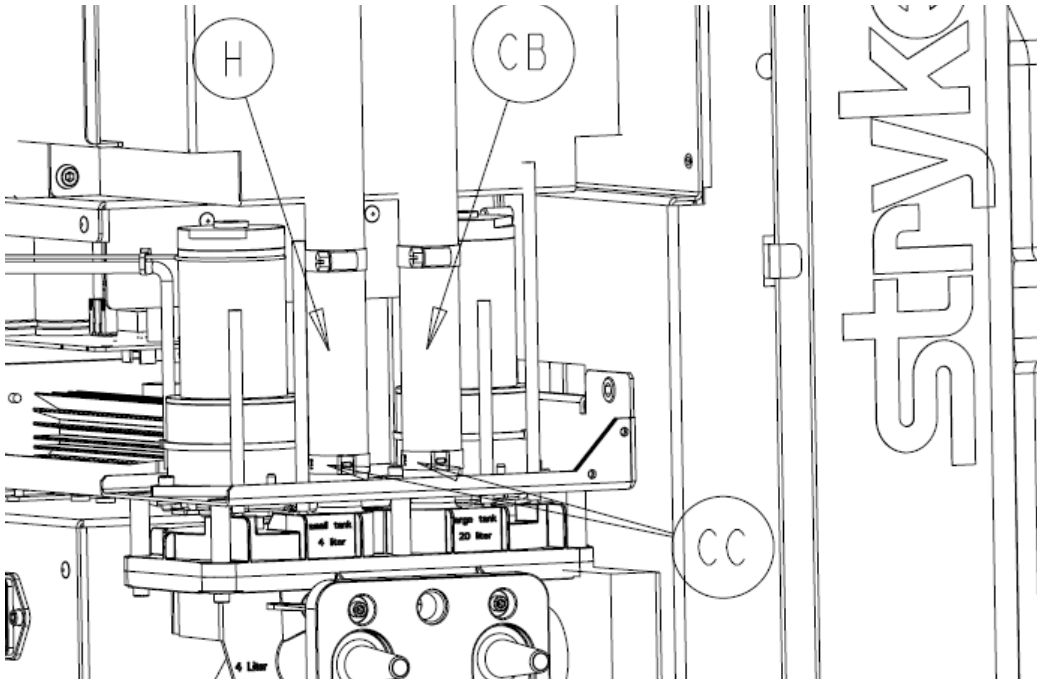


2. Disconnect the two power connectors labeled **small can regulator** and **large can regulator** from each of the encoder motors.

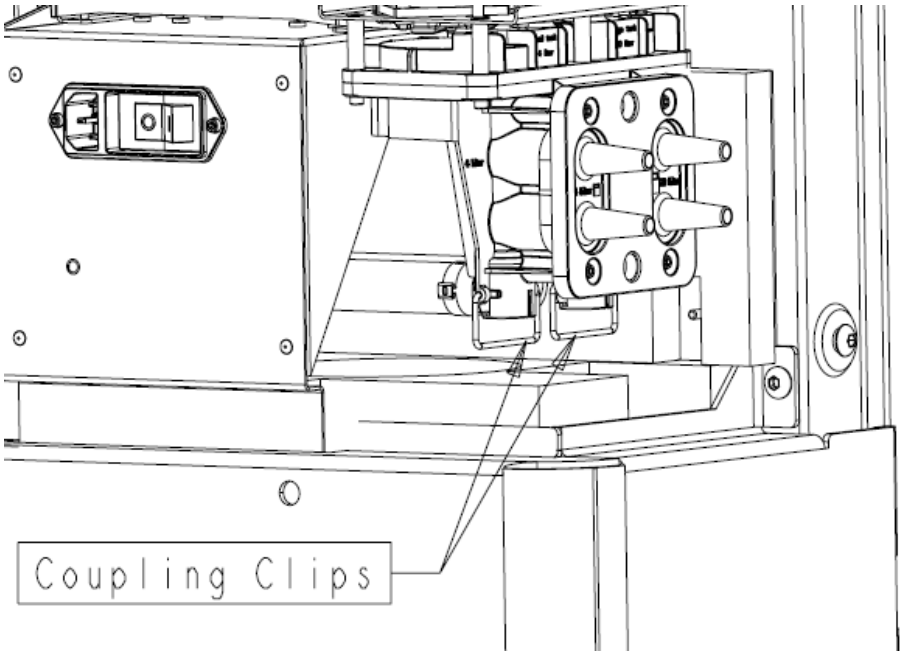
Note: There are two clamps on the **canister vacuum hose assembly** (P/N 0702-001-127) (CB). One style is a **hose clamp** (P/N 0058-328-000) (CK), while the other is a **one ear hose clamp** (P/N 0058-098-000) (CC). The one ear hose clamp is used during assembly. The traditional hose clamp should be used once the one ear clamp is removed. The two clamps are depicted below.



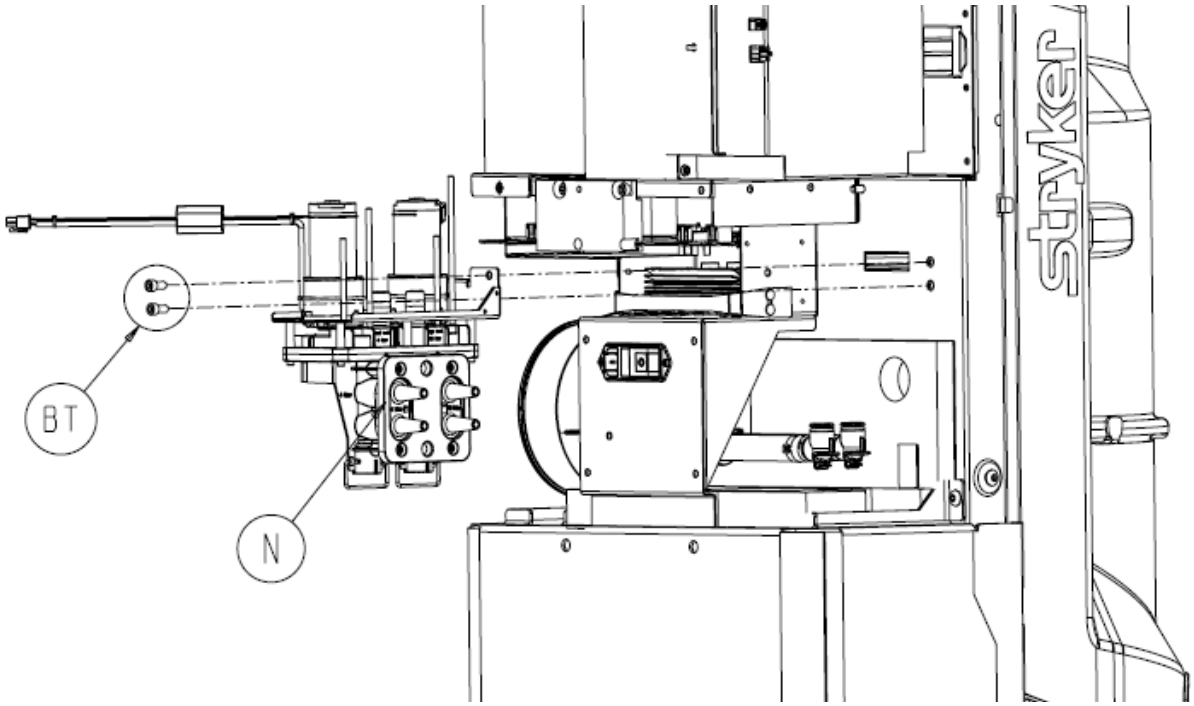
3. Using a pair of wire cutters, cut the **one ear hose clamp** (P/N 0058-098-000) (CC) that hold the **canister vacuum hose assemblies** (P/N 0702-001-127) (CB) and the **small canister vacuum hose assy** (P/N 0702-001-038) (H) to the **vacuum manifold assembly** (P/N 0702-001-110) (N) and remove the hoses. Be careful not to cut the vacuum hose. If the standard hose clamp is used instead of the one ear clamp, use a screwdriver to loosen the clamp and remove the hose.



4. Remove the coupling clips that secure the two vacuum hoses from the HEPA filter housing to the vacuum manifold assembly.



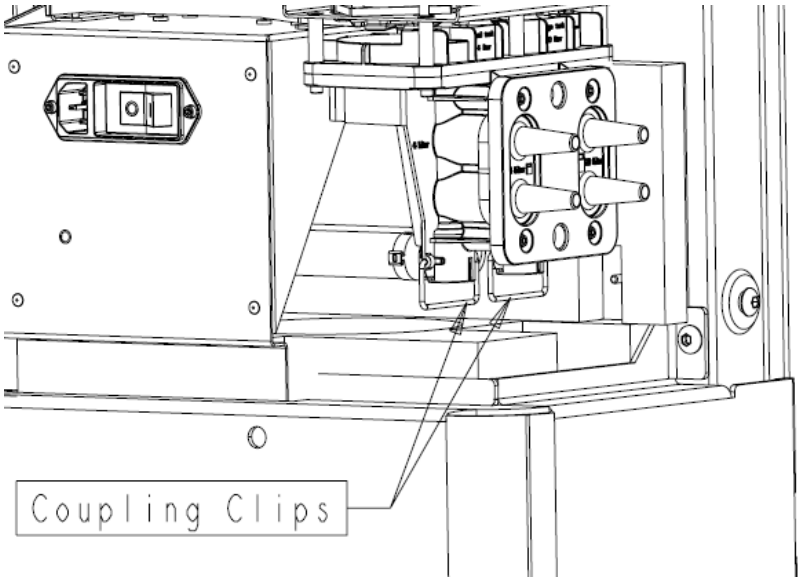
5. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 0004-645-000) (BT) that hold the vacuum manifold assembly to the rover chassis.



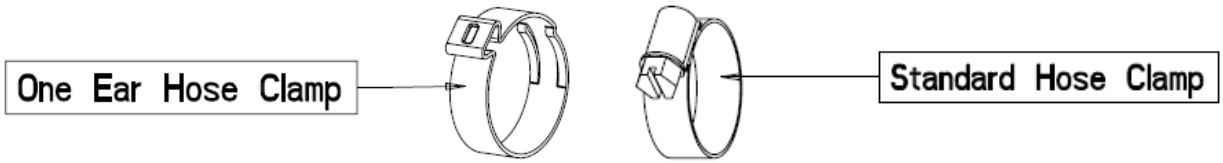
6. Remove the vacuum manifold assembly and set aside.

Fluid Suction HEPA Housing Assembly P/N 0702-001-110

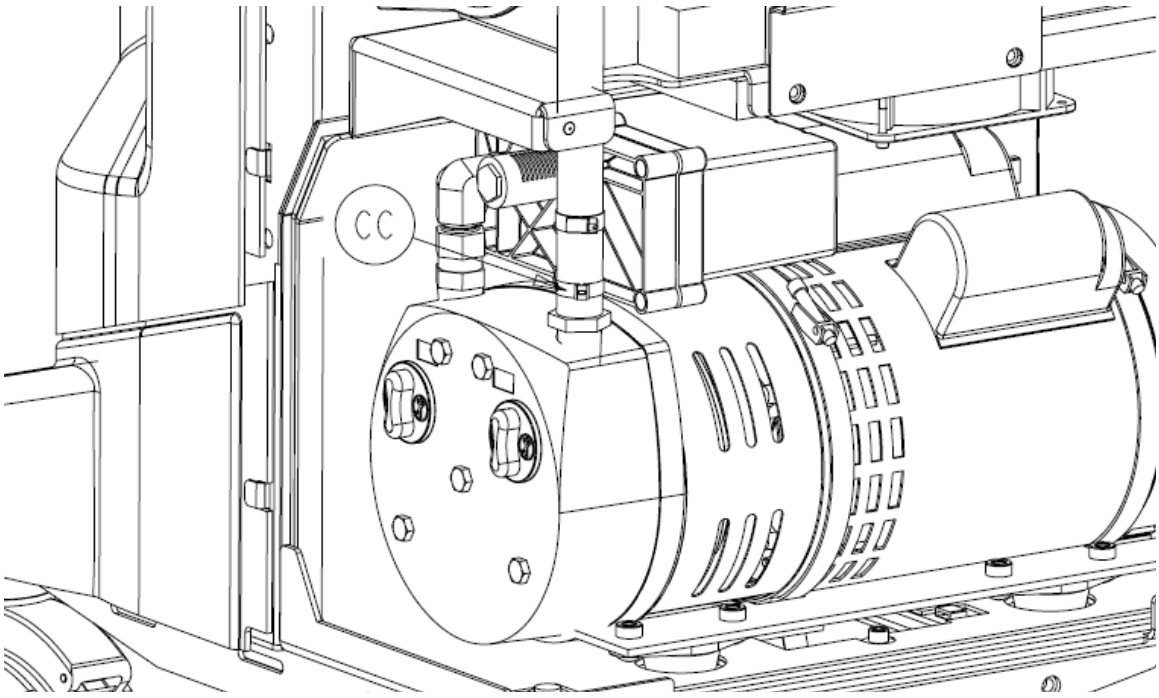
1. Remove the vacuum manifold clips that secure the two vacuum hoses from the HEPA filter housing to the vacuum manifold assembly.



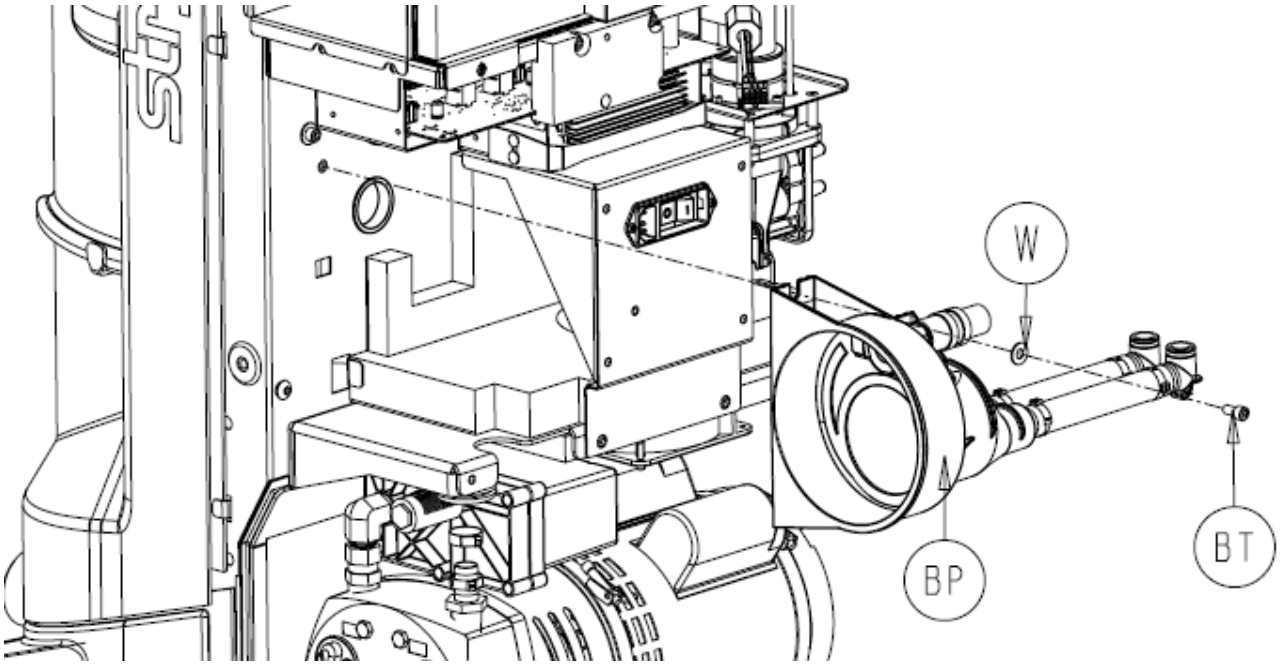
Note: There are two clamps on the **canister vacuum hose assembly** (P/N 0702-001-127) (CB). One style is a **hose clamp** (P/N 0058-328-000) (CK), while the other is a **one ear hose clamp** (P/N 0058-098-000) (CC). The one ear hose clamp is used during assembly. The traditional hose clamp should be used once the one ear clamp is removed. The two clamps are depicted below.



2. Using a pair of wire cutters, cut the **one ear hose clamp** (P/N 0058-328-000) (CC) that holds the **HEPA outlet tubing** (P/N 0702-001-196) (K) to the **vacuum pump** (P/N 0702-001-101) (A) and remove the hose from the barbed fitting on the vacuum pump. Be careful not to cut the vacuum hose. If the standard hose clamp is used instead of the one ear clamp, use a screwdriver to loosen the clamp and remove the hose.



3. Remove the **socket head cap screw** (P/N 0004-645-000) (BT) and **flat washer** (P/N 0011-507-000) (W) that hold the HEPA filter assembly to the rover chassis.

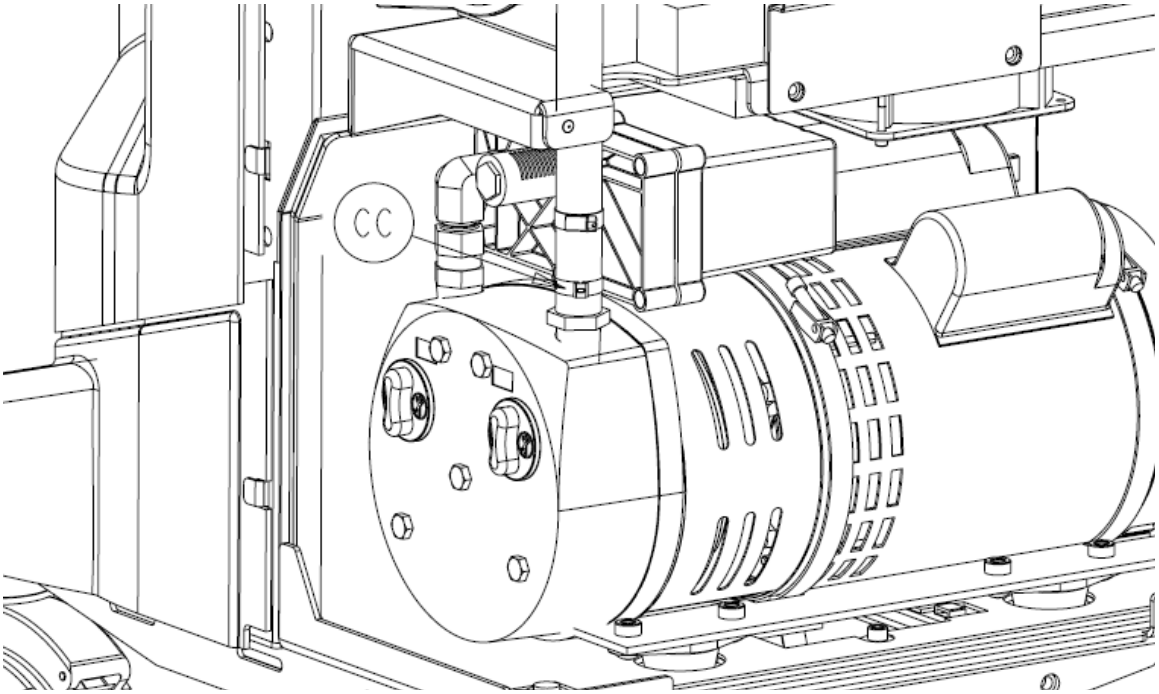


4. Slide the **fluid suction HEPA housing** (P/N 0702-001-190) (BP) up and out to remove, and then set aside.

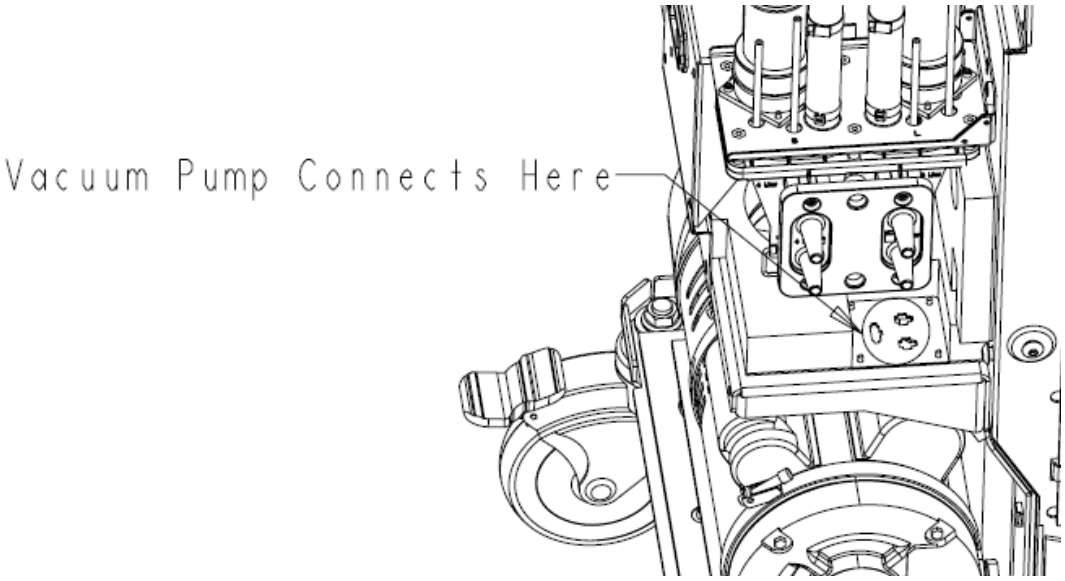
Vacuum Pump Assembly P/N 0702-001-100

Note: There are two clamps on the **canister vacuum hose assembly** (P/N 0702-001-127) (CB). One style is a **hose clamp** (P/N 0058-328-000) (CK), while the other is a **one ear hose clamp** (P/N 0058-098-000) (CC). The one ear hose clamp is used during assembly. The traditional hose clamp should be used once the one ear clamp is removed. The two clamps are depicted below.

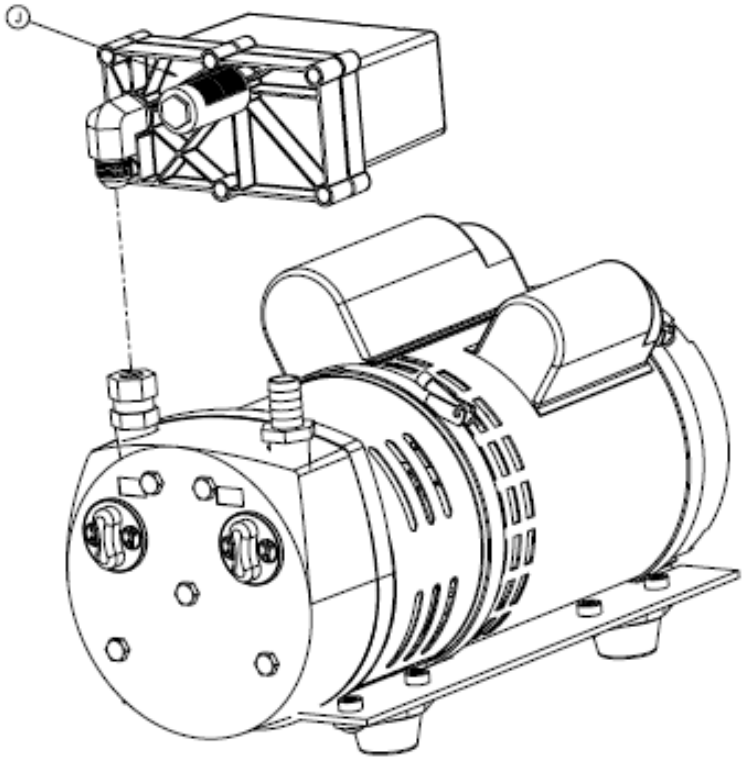
1. Using a pair of wire cutters, cut the **one ear hose clamp** (P/N 0058-328-000) (CC) that holds the **HEPA outlet tubing** (P/N 0702-001-196) (K) to the **vacuum pump** (P/N 0702-001-101) (A) and remove the hose from the barbed fitting on the vacuum pump. Be careful not to cut the vacuum hose. If the standard hose clamp is used instead of the one ear clamp, use a screwdriver to loosen the clamp and remove the hose.



2. Disconnect the **vacuum pump wire harness** (P/N 0702-001-819) from the right side of the vacuum pump.

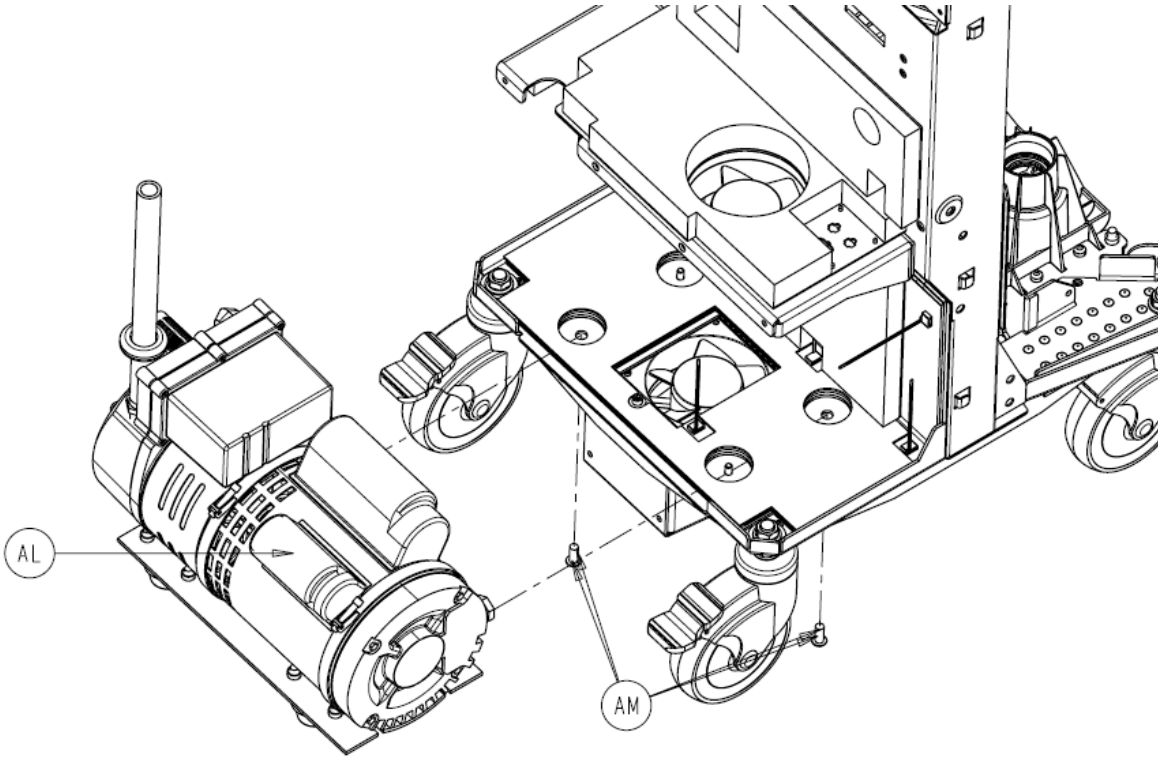


3. In order to allow enough clearance for the vacuum pump to be removed, you may have to remove the **silencer manifold assembly** (P/N 0702-001-160) (J). If this is required, loosen the flare swivel adapter that connects the silencer to the vacuum pump using a 7/8” open-ended wrench.



4. If the silencer manifold was removed in step 3, set the manifold aside. If not then proceed to step 5.

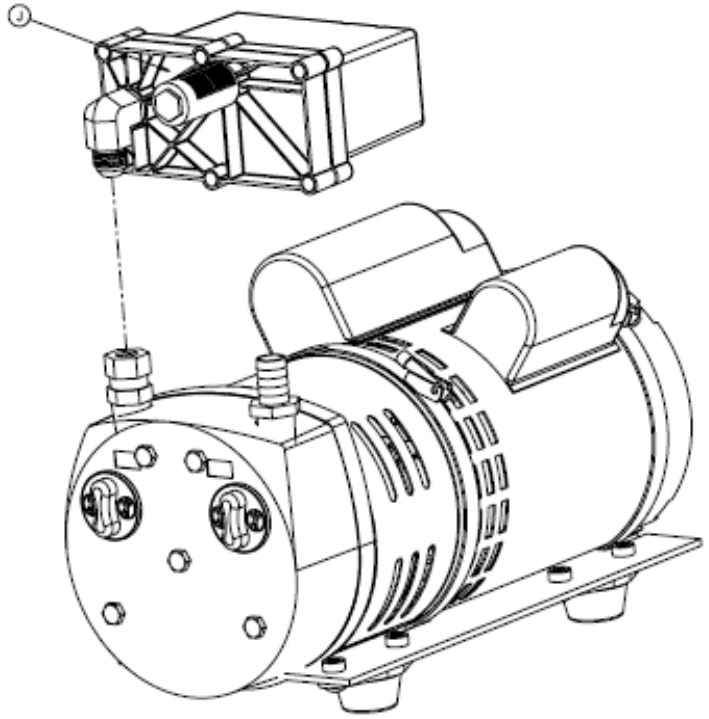
5. Using a 3/16” allen wrench, remove the two **socket button head cap screws** (P/N 0004-651-000) (AM) from underneath the rover.



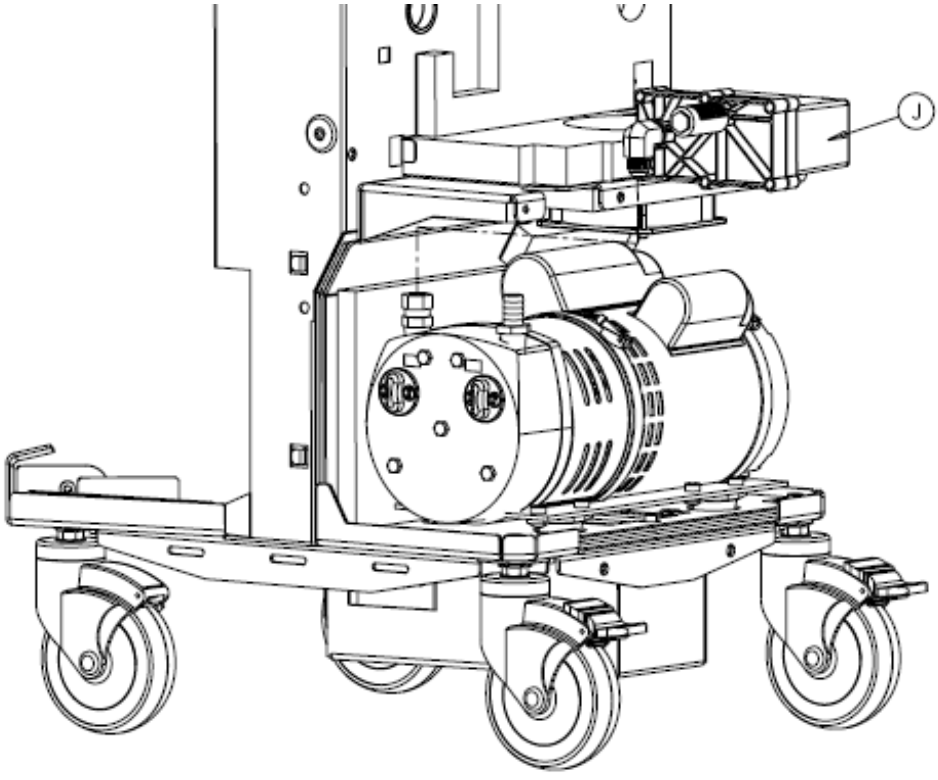
6. Lift the **vacuum pump assembly** (P/N 0702-001-100) (AL) far enough to clear the recessed holes the in the chassis and remove.

Silencer Manifold Assembly P/N 0702-001-160

1. Using a 7/8” open-ended wrench, loosen the flare swivel adapter that connects the **silencer manifold assembly** (P/N 0702-001-160) (J) to the vacuum pump.



2. Remove the silencer manifold and set aside.



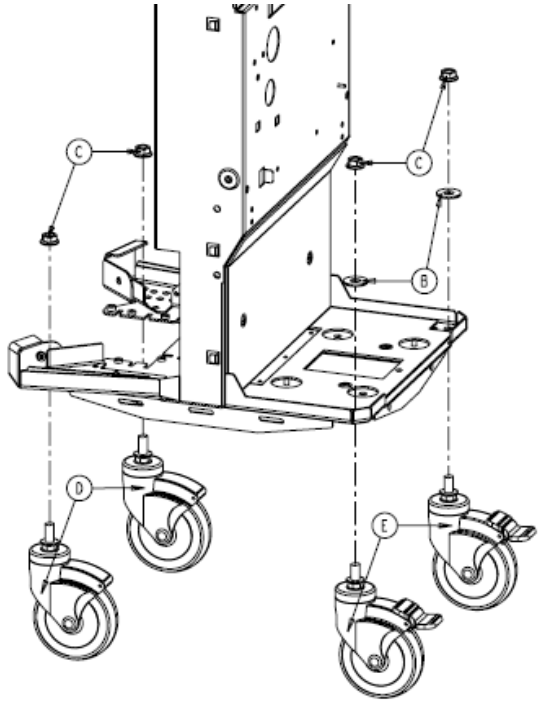
Caster Assembly P/N 0702-001-012; 0702-001-013

Note: When installing the caster make sure you are certain which style needs replacement. The casters in the front are different from those in the back. Also note that the casters with a brake require a washer.

Caution: If you are installing two or more casters be sure to replace them one at a time!! To avoid the risk of bodily injury **DO NOT** remove more than one caster at a time!

1. Using a ¾" open ended wrench, remove the **flange nut** (P/N 0015-079-000) (C).

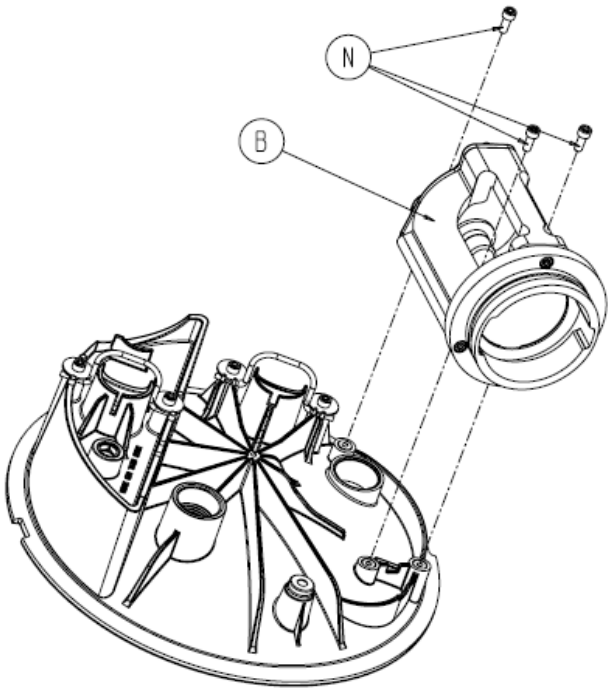
2. If replacing **caster assembly with brake** (P/N 0702-001-013) (E), remove the **½" washer** (P/N 0011-004-004) (B) and set aside. If caster does not have a brake, proceed to step 3.



3. Remove either the **caster assembly without brake** (P/N 0702-001-012) (D) or the **caster assembly with brake** (P/N 0702-001-013) (E) and set aside.

Manifold Receptacle Assembly P/N 0702-001-230

1. Using a 7/64 allen wrench, remove the three **socket head cap screws** (0004-529-000) (N).

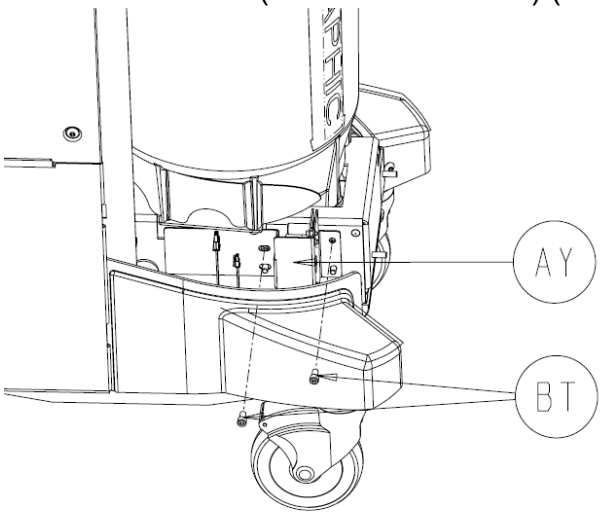


2. Remove the **manifold receptacle assembly** (P/N 0702-001-230) (B) and set aside.

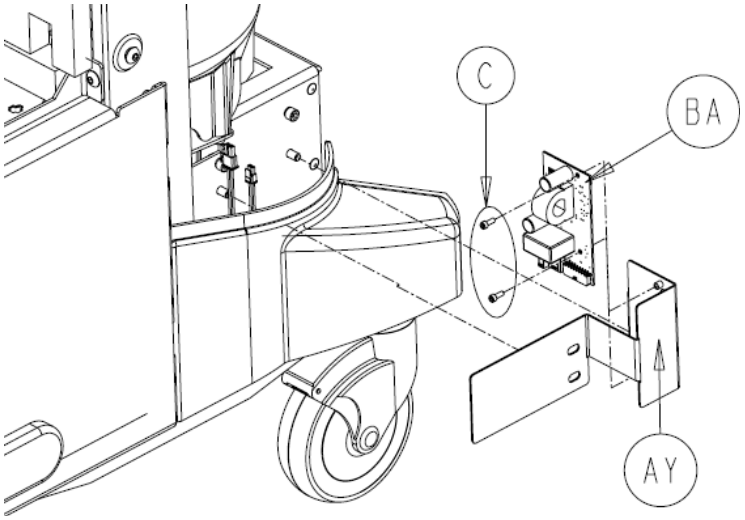
Rover Power Coupler Circuit Board Assembly P/N 0702-001-086

Note: There are two cables labeled **power coupler PCBA** that connect to the circuit board assembly. One is grey with a black connector, the other cable has one red and one black wire going to a white connector. The two connectors are of different size and can only be connected one way. Take note of the cable orientation when removing the circuit board assembly.

1. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 0004-645-000) (BT) that hold the **IR board bracket** (P/N 0702-001-326) (AY) to the rover chassis.



2. Disconnect the two cables labeled **power coupler PCBA** going to the **rover power coupler PCBA** (P/N 0702-001-806) (BA).
3. Using a 7/64” allen wrench, remove the two **socket head cap screws** (P/N 0004-529-000) (C) that hold the **rover power coupler PCBA** (P/N 0702-001-806) (BA) to the **IR board bracket** (P/N 0702-001-326) (AY).



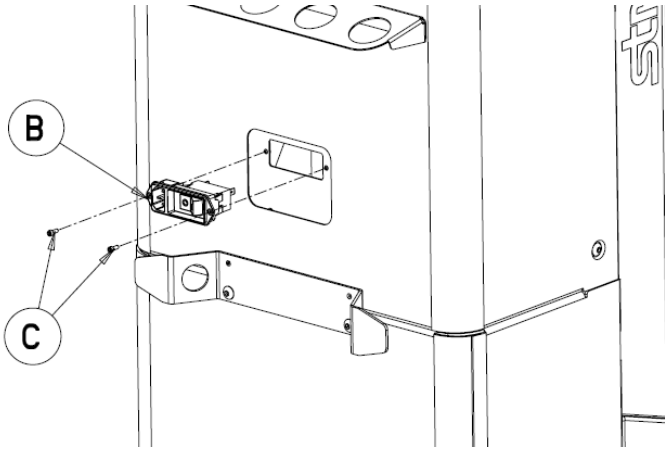
4. Remove the circuit board and set aside.

Power Entry Module P/N 0702-001-862

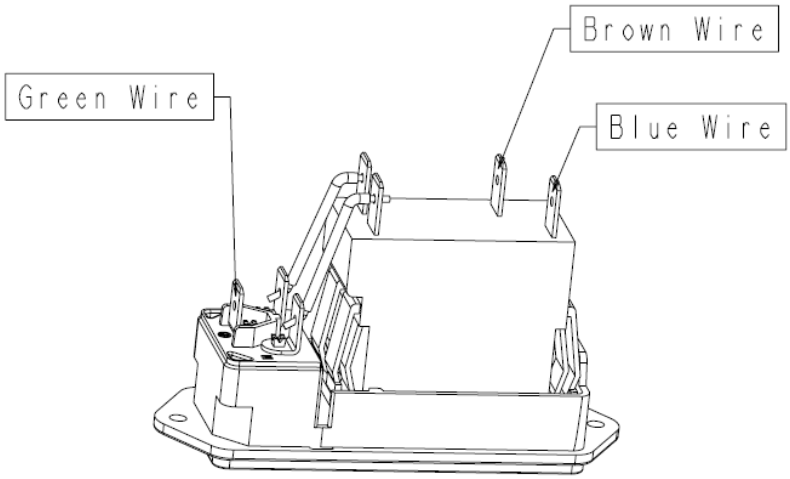
1. Using a 7/64” allen wrench, remove the two **socket head cap screws** (P/N 0004-529-000) (C).

Warning: The wires connected to the power module have limited slack. Be careful not to pull the power entry module out too far. Doing so may place excess stress on the wiring and connectors.

2. Pull the **power entry module** (P/N 0702-001-862) (C) out about two inches from the rover and disconnect the green, blue, and brown wires from the back.



Note: When removing the wires on the back of the power entry module, pay attention to the proper configuration. Extra prongs may exist that are not used for this application. The wires should be connected as depicted below. The diagram represents removing the power entry module and rotating it down 90°.

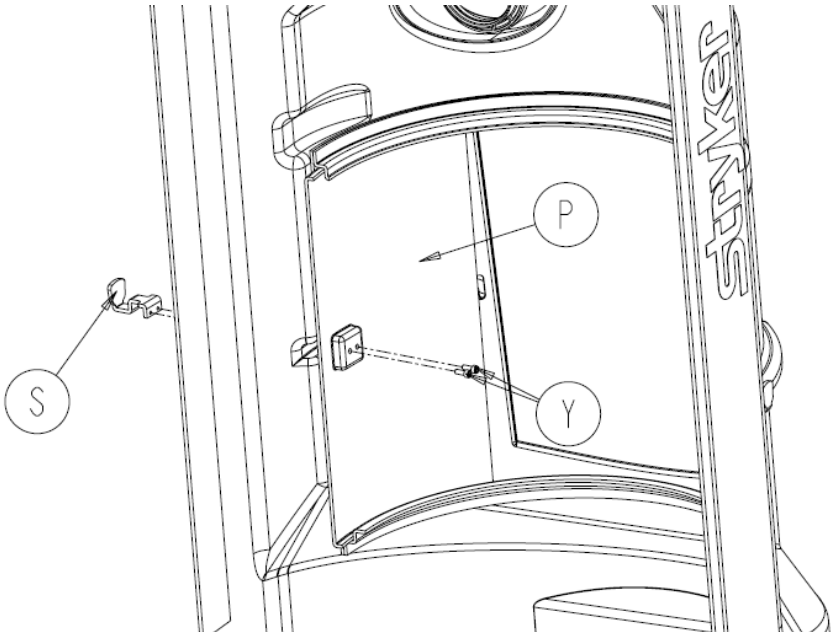


3. Remove the **power entry module** (P/N 0702-001-862) (C) and set aside.

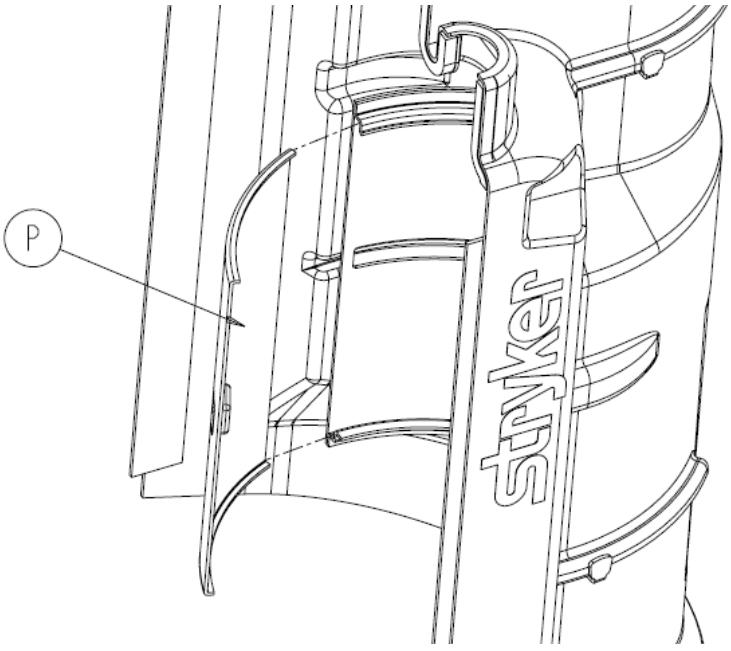
Canister Door Removal P/N 0702-001-070P; 0702-001-070R

Note: This removal procedure covers removal for both canister door covers. The procedure is the same for each size door on both sides of the front cover.

1. Remove the two **socket head cap screws** (P/N 0702-001-070Y) (Y) that hold the **door slider** (P/N 0702-001-070S) (S) to the **large canister door** (P/N 0702-001-070P) (P).
2. Remove the **door slider** (P/N 0702-001-070S) (S) and set aside.



3. Slide the **large canister door** (P/N 0702-001-070P) (P) out of the track on the front cover assembly and set aside.

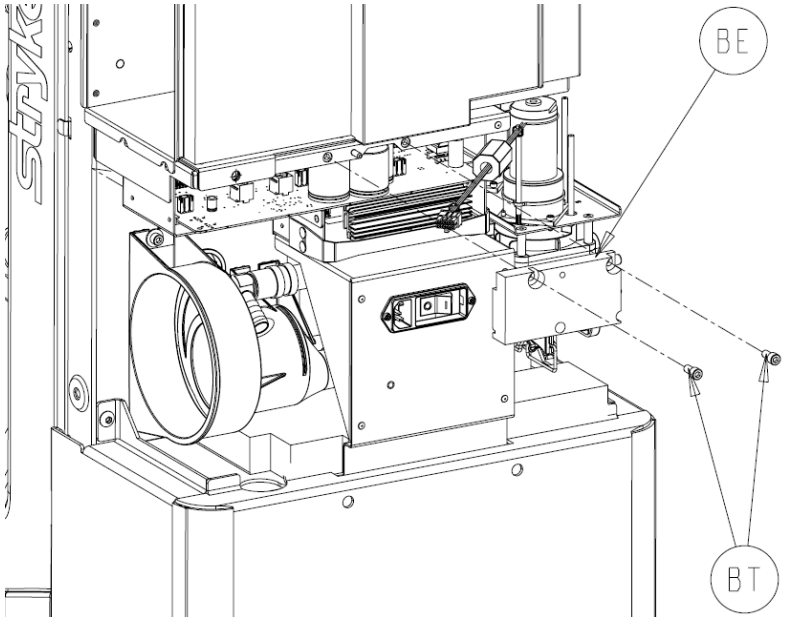


Power Distribution PCBA P/N 0702-001-035

Caution: Make sure proper Electro Static Discharge (ESD) measures are observed when removing and replacing circuit boards. Failing to properly handle sensitive components can cause damage to the circuits.

Warning: Make sure the rover is powered off before removing any circuit boards! Failure to do so may cause serious personal injury and may severely damage the equipment.

1. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 0004-645-000) (BT) that secure the **board block** (P/N 0702-001-812) (BE) to the rover chassis.

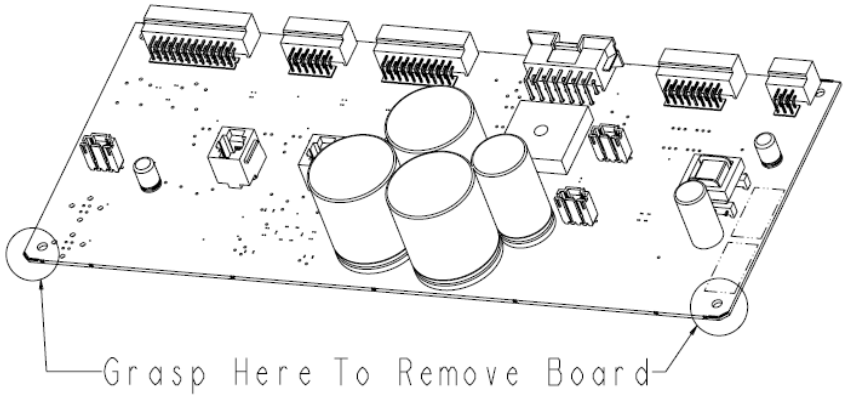


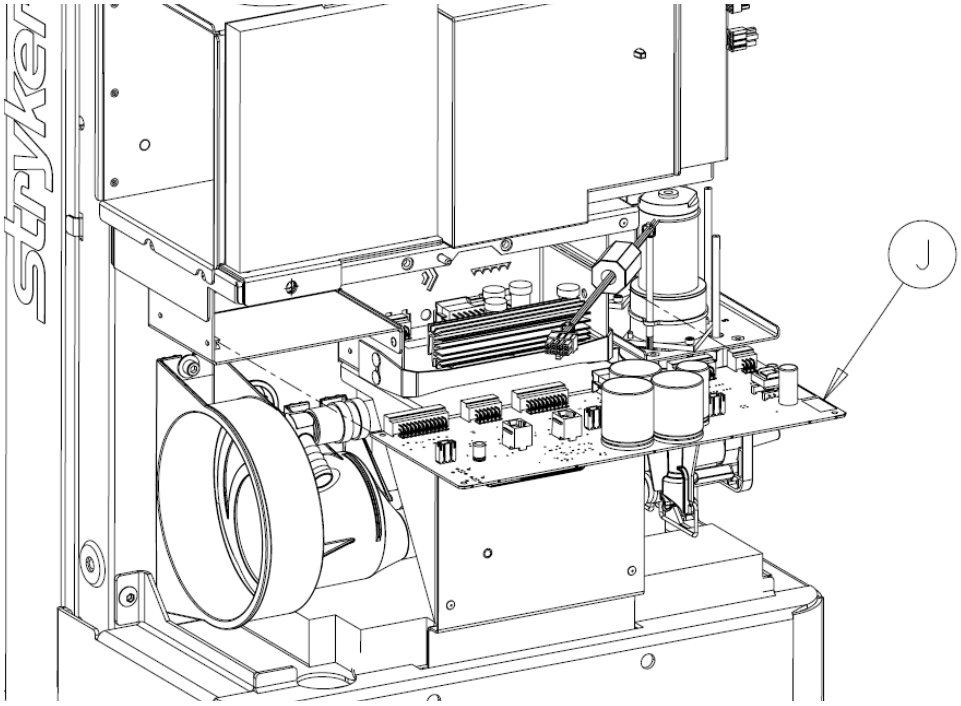
2. Remove the **board block** (P/N 0702-001-812) (BE) and set aside.

3. Disconnect the four norprene vacuum sensor lines (two black and two white) going from the vacuum manifold assembly going to the power distribution board.

Warning: The power distribution circuit board and the AC power circuit board interface with the subsystems of the rover by mating connectors on the board with a series of backplane connectors on the rover chassis. When removing these components, be sure to grasp the board at both ends to ensure even distribution of pressure. **Ensure ALL connectors are lined up correctly before reinserting circuit boards!!** DO NOT force the circuit board into place when reinstalling.

4. Remove the **power distribution PCBA** (P/N 0702-001-035) (J) by grasping at each end and pulling the board out.





5. Place the circuit board aside.

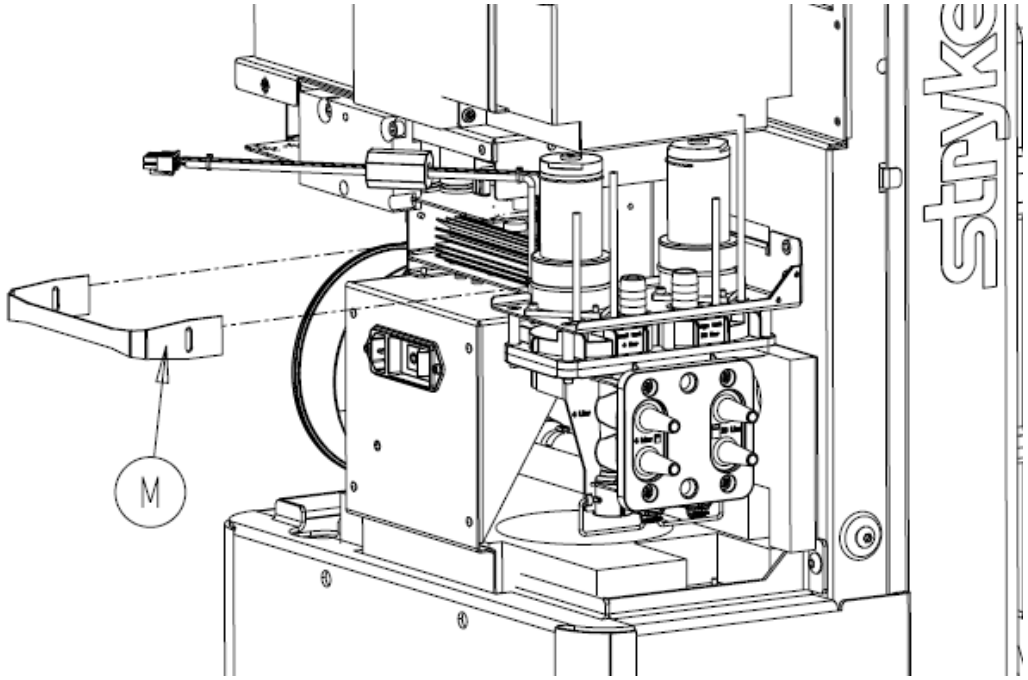
6. Make sure to follow procedure 6.3 ***Reprogramming Rover Software*** on p. 6-6 after replacing the circuit board.

AC Power PCBA P/N 0702-001-802

Caution: Make sure proper Electro Static Discharge (ESD) measures are observed when removing and replacing circuit boards. Failing to properly handle sensitive components can cause damage to the circuits.

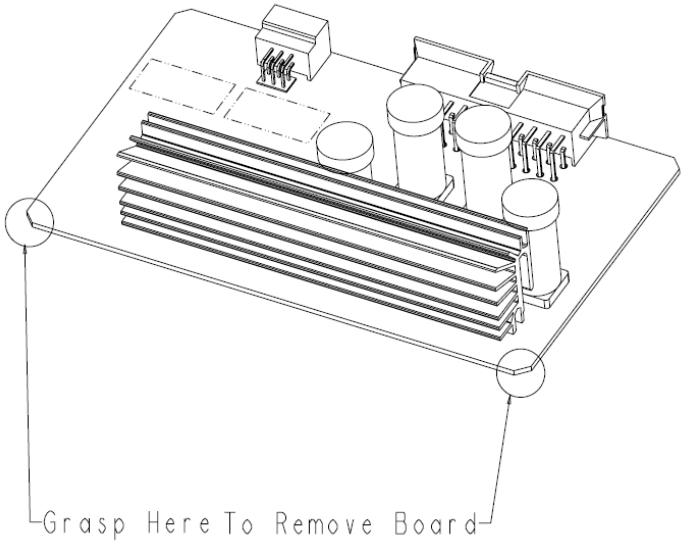
Warning: Make sure the rover is powered off before removing any circuit boards! Failure to do so may cause serious personal injury and may severely damage the equipment.

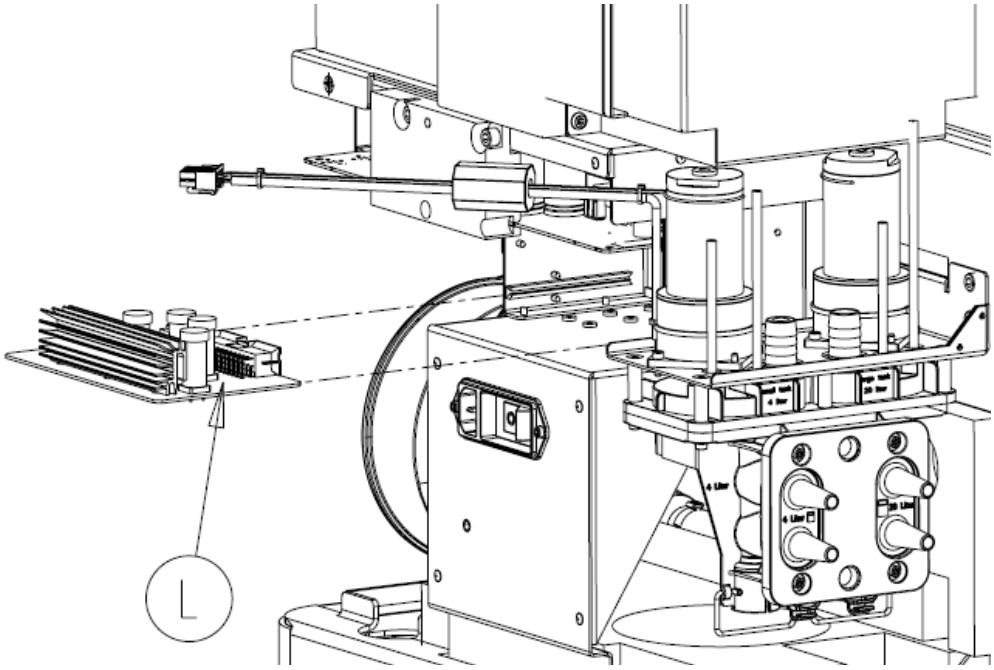
1. Remove the **AC power board retainer** (P/N 0702-001-804) (M) and set aside.



Caution: The power distribution circuit board and the AC power circuit board interface with the subsystems of the rover by mating connectors on the board with a series of backplane connectors on the rover chassis. When removing these components, be sure to grasp the board at both ends to ensure even distribution of pressure. **Ensure <u>ALL</u> connectors are lined up correctly before reinserting circuit boards!!** <u>DO</u> <u>NOT</u> force the circuit board into place when reinstalling.

2. Remove the **AC power PCBA** P/N 0702-001-802 (L) by grasping at each end and pulling the board out.





3. Place the circuit board aside.

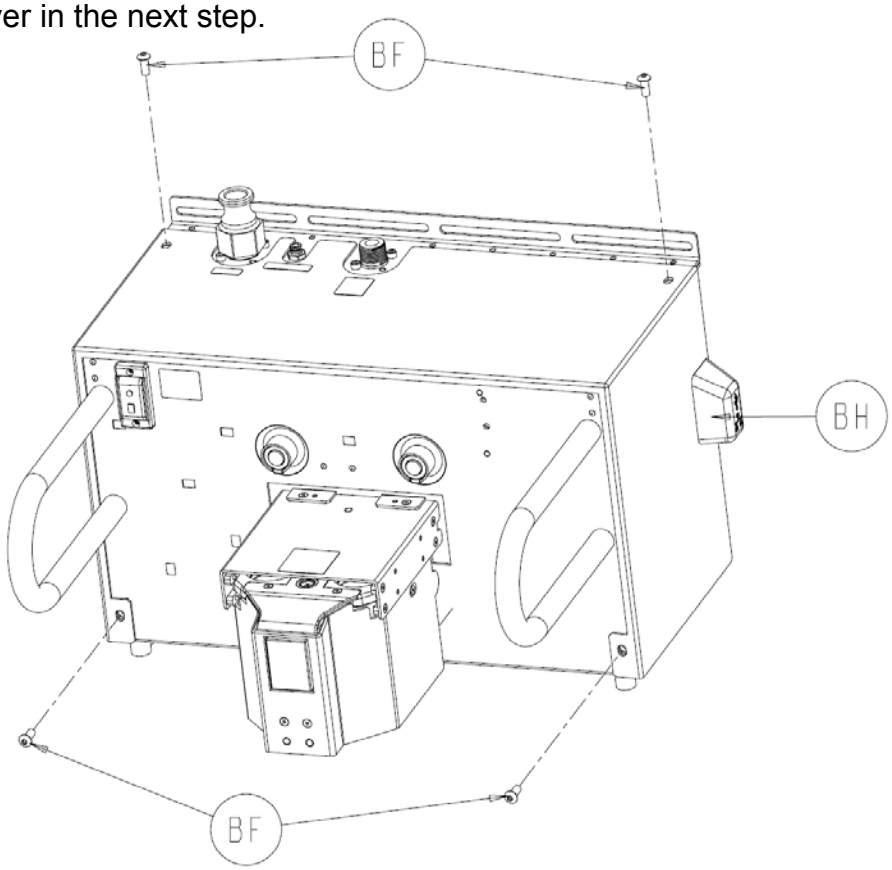
Chapter 3 – Solo Rover Disassembly

The Neptune Solo will be the second release in the Neptune 2 waste management system. Chapter 3 will outline the disassembly procedures once the product has been released.

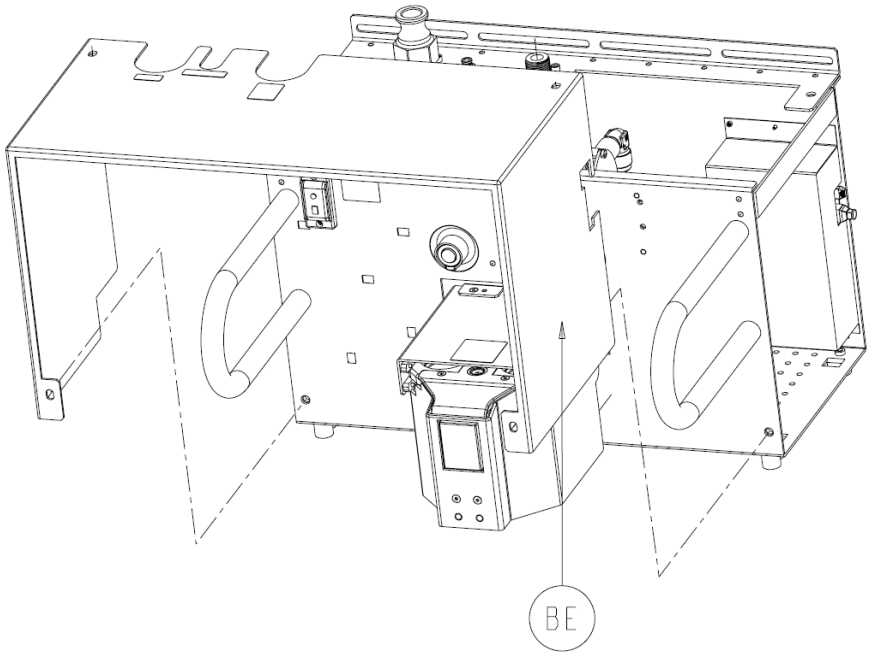
Chapter 4 – Docker Disassembly

Chassis Top Cover Removal P/N 0702-014-011

1. Using a 3/16” allen wrench, remove four **socket head cap screws** (P/N 0004-638-000). Make sure to remove the **electronic ports cover** (P/N 0702-014-027) (BH) before removing top cover in the next step.

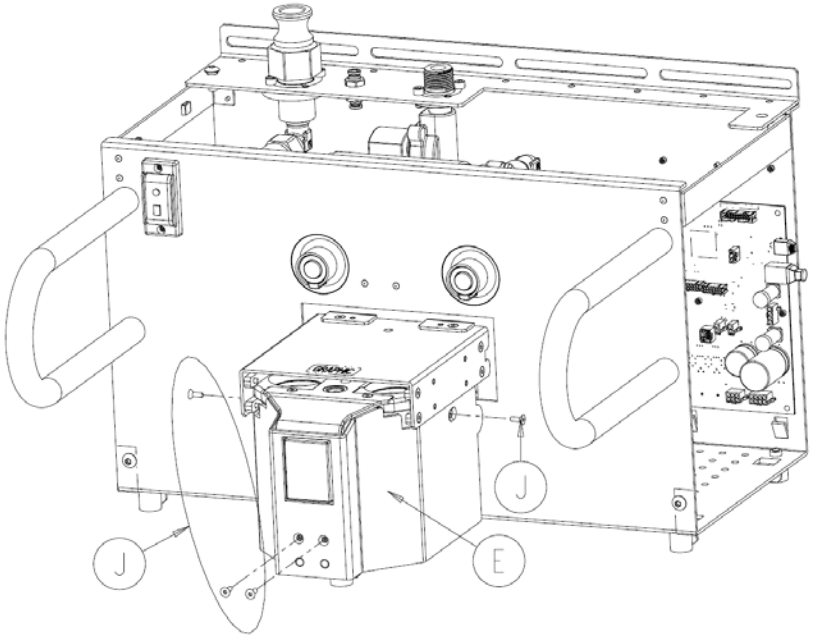


2. Slide **chassis top cover** (P/N 0702-014-011) (BE) forward and remove from chassis assembly.

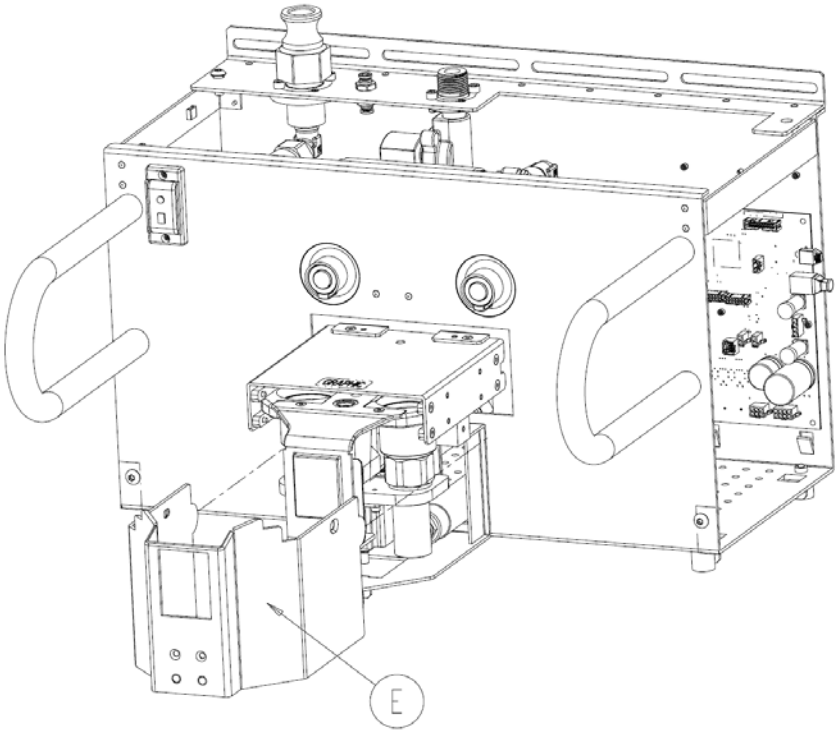


Actuator Assembly P/N 0702-014-100

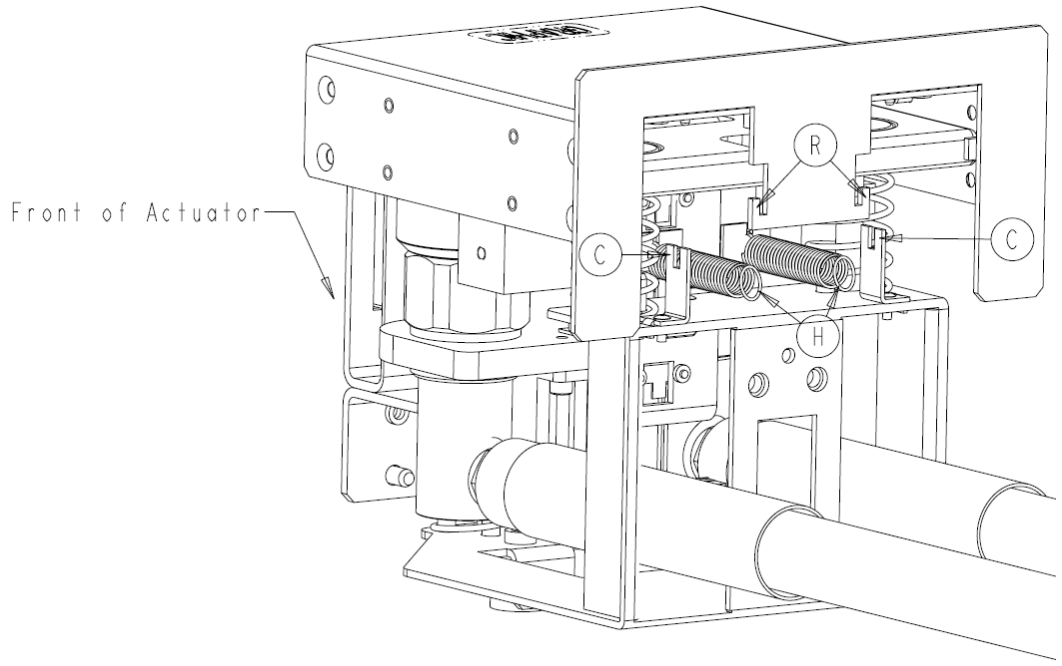
1. Using a 1/8” allen wrench, remove four **socket flat countersunk head cap screws** (P/N 0004-346-000) (J) from the **actuator strike skirt** (P/N 0702-014-117) (E).



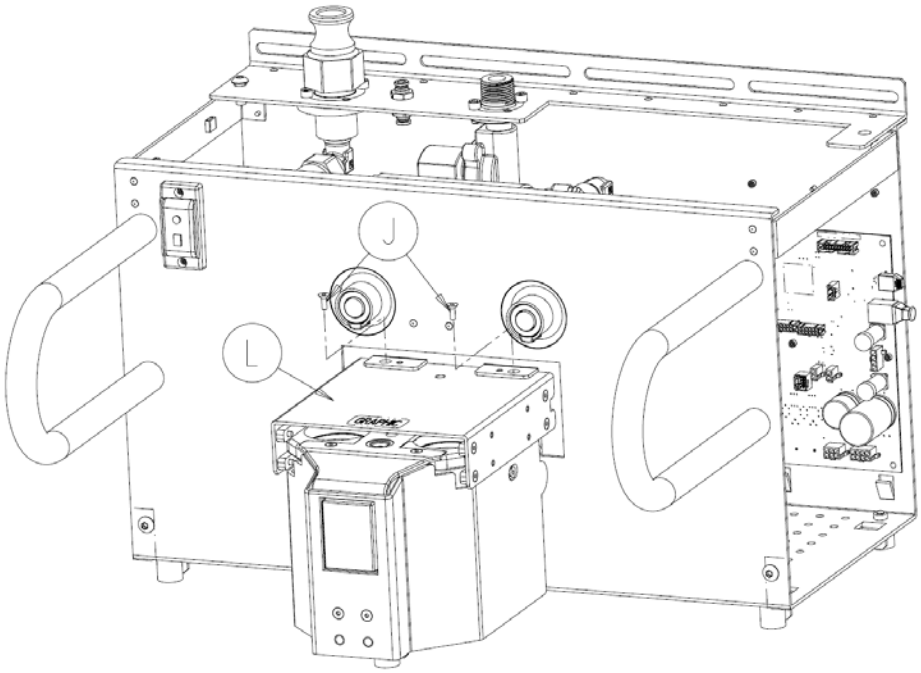
2. Remove the **actuator strike skirt** (P/N 0702-014-117) (E) and set aside.



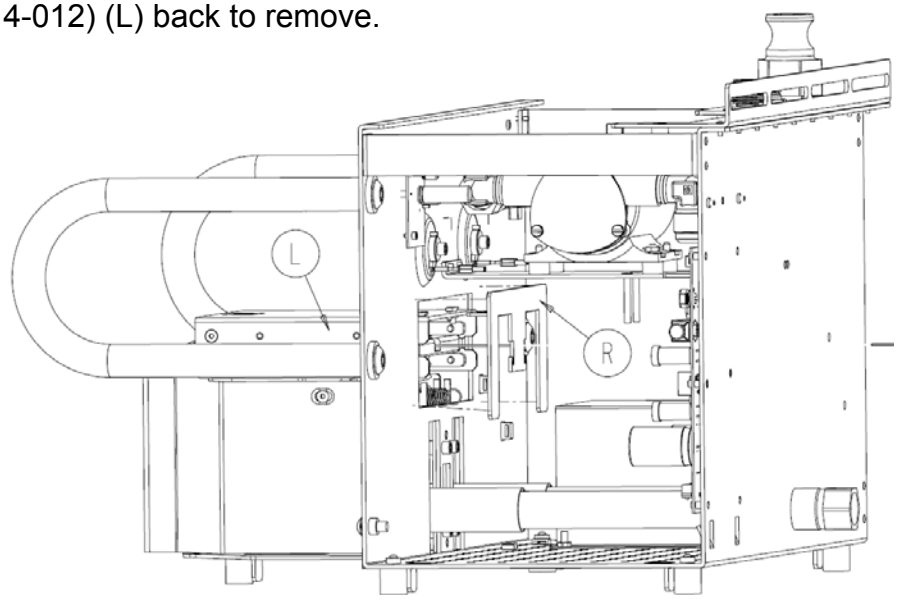
3. The **extension springs** (P/N 0038-586-000) (H) are normally connected to the **actuator cover back** (P/N 0702-014-014) (R) and serve to keep the actuator cover closed. Remove the looped end of the **extension springs** (P/N 0038-586-000) (H) and place them on the **actuator cover spring tab** (P/N 0702-014-101) (C).



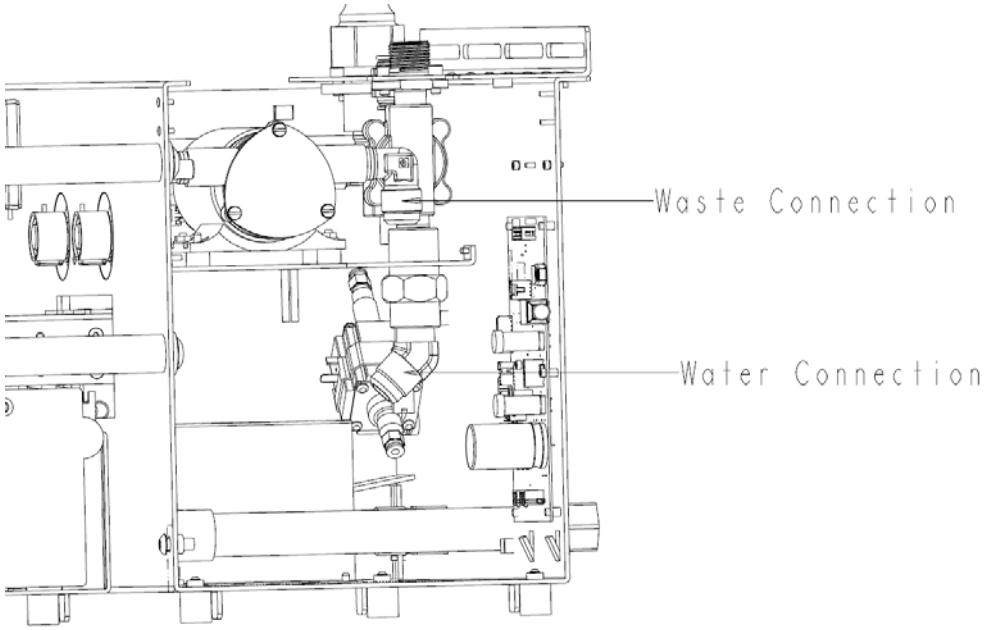
4. Using a 1/8” allen wrench, remove two **socket flat countersunk head cap screws** (P/N 0004-346-000) (J) from the **actuator cover** (P/N 0702-014-012) (L).



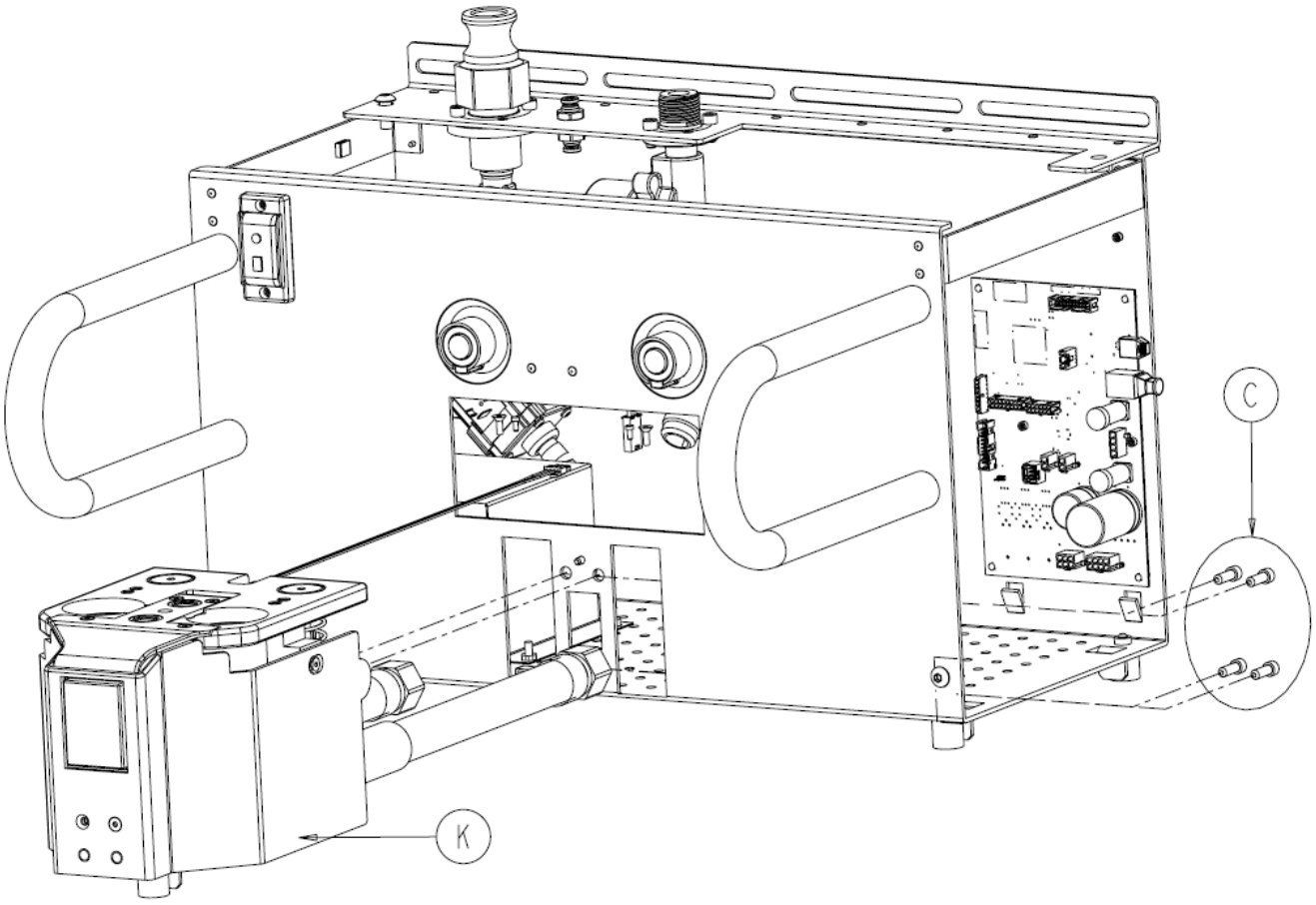
5. Push **actuator cover** (P/N 0702-014-012) (L) inside chassis enough to remove **actuator cover back** (P/N 0702-014-014) (R). Continue to push **actuator cover** (P/N 0702-014-012) (L) back to remove.



6. Unplug the connector from **docker power coupler assembly** (P/N 0702-014-114) at J1 of the **docker power coupler PCBA** (P/N 0702-014-510) (H). *Carefully* cut all wire ties used to secure this cable.
7. Unplug the connector from **stepper motor assembly** (P/N 0702-014-123) at the point where it connects to the **docker main wire harness** (P/N 0702-014-021).
8. Disconnect three connectors from **hall sensor wire harness** (P/N 0702-014-021F). Each connector is different to prevent from reinstalling incorrectly.
9. Using an adjustable wrench, disconnect **coupling offload hose** (P/N 0702-014-129) (D) at the connection to the **offload pump** (P/N 0702-014-201). Next, remove the **coupling inlet hose** (P/N 0702-014-128) (C) at the connection to the **water inlet assembly** (P/N 0702-014-400) (AF)

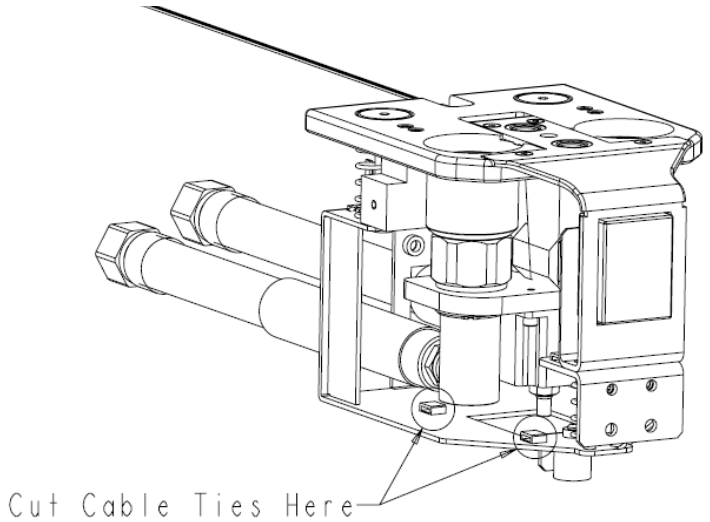


10. Using a 3/16” allen wrench, remove the four **socket head cap screws** (P/N 0004-518-000) (C) from inside chassis assembly from the **actuator assembly** (P/N 0702-014-100) (K). Remove the **actuator assembly** (P/N 0702-014-100) (K) and carefully guide the wiring harnesses through the opening in the chassis. Ensure the connectors do not get caught on the docker chassis on the way out.

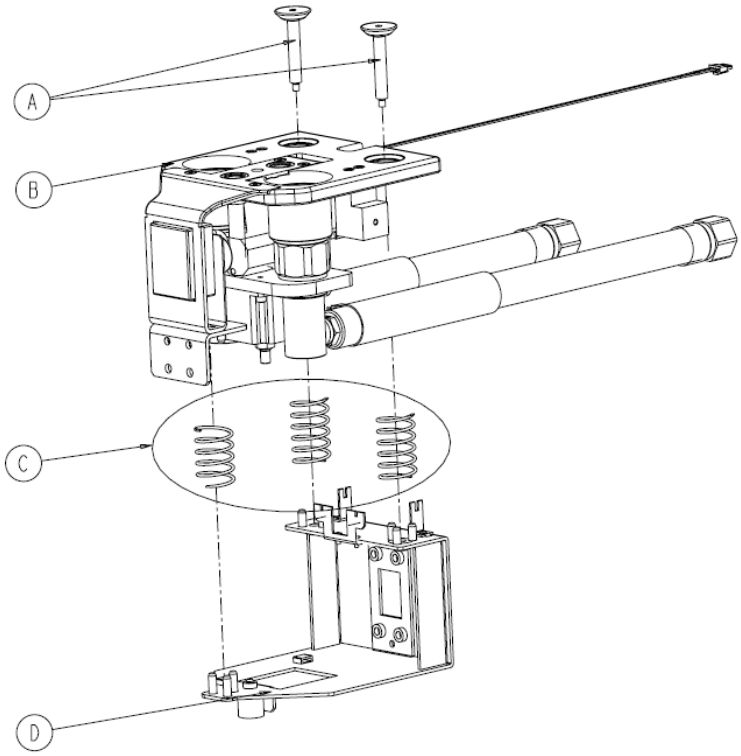


Docker Power Coupler Assembly P/N 0702-014-114

1. The wire harness attached to the **docker power coupler assembly** (P/N 0702-014-114) (F) is secured by two cable ties to the **actuator base frame** (P/N 0702-014-101) (D). *Carefully* cut the cable ties to remove the wire harness.



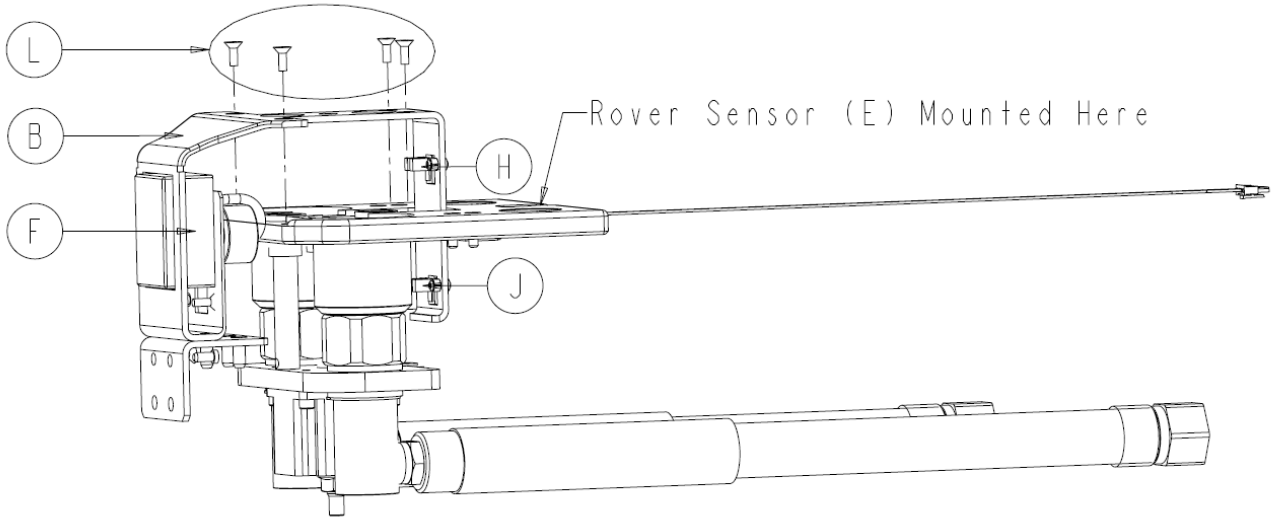
2. Using a 3/16” allen wrench, remove two **actuator alignment rods** (P/N 0702-014-104) (A) from **actuator interface** (P/N 0702-014-110) (B).



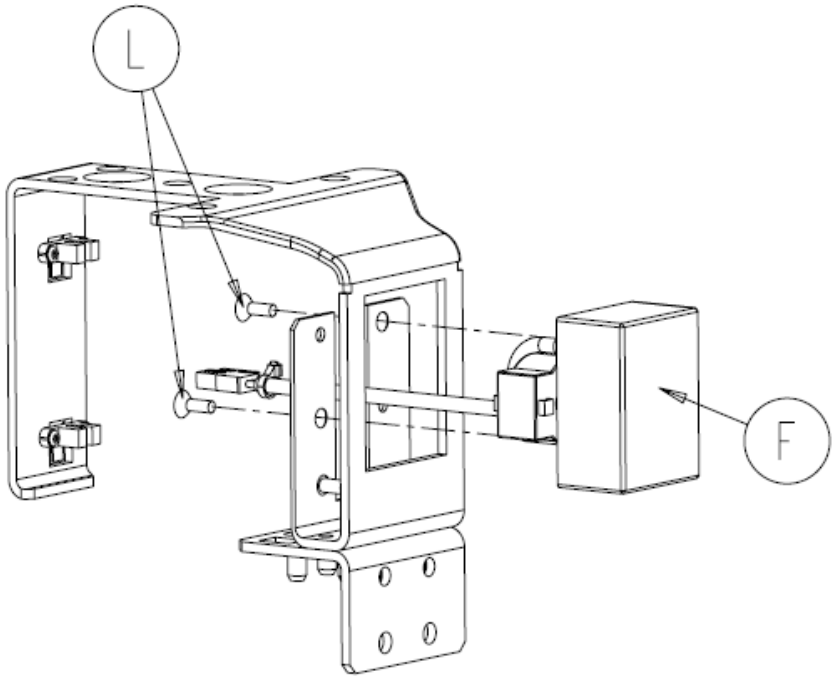
3. Separate the **actuator interface** (P/N 0702-014-110) (B) from the **actuator base frame** (P/N 0702-014-101) (D) and set aside the three **compression springs** (P/N 0038-585-000) (C).

4. Using a 1/8” allen wrench remove four **socket flat countersunk head cap screws** (P/N 0004-346-000) (L) and separate the **actuator strike plate** (P/N 0702-014-111) (B) by lifting it upwards.

Caution: the **extended hall sensor** (P/N 0702-014-119) (H), the **rover hall sensor** (P/N 0702-014-106) (E), the **hall sensor** (P/N 0702-014-906) (J), and the **docker power coupler assembly** (P/N 0702-014-114) (F) are all mounted to the strike plate. Each component has a wiring harness attached to it. Be careful not to get the connectors caught on anything when the removing the **actuator strike plate** (P/N 0702-014-111) (B).

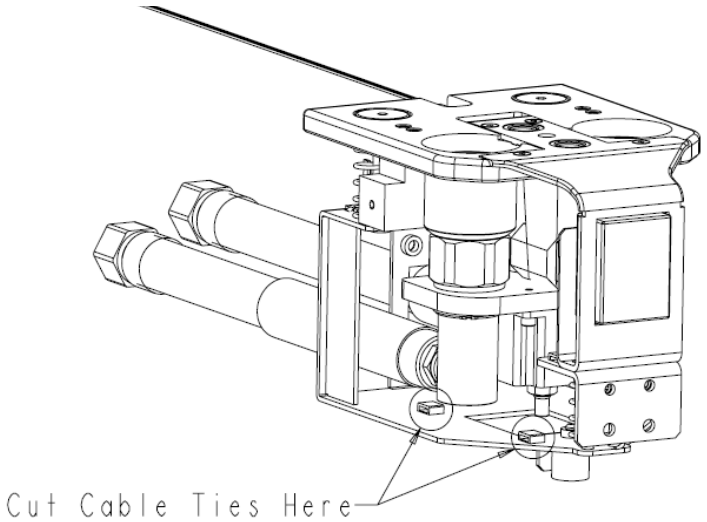


5. Using a 1/8” allen wrench, remove two **socket flat countersunk head cap screws** (P/N 0004-346-000) (L).
6. Remove the **docker power coupler assembly** (P/N 0702-014-114) (F) and set aside.

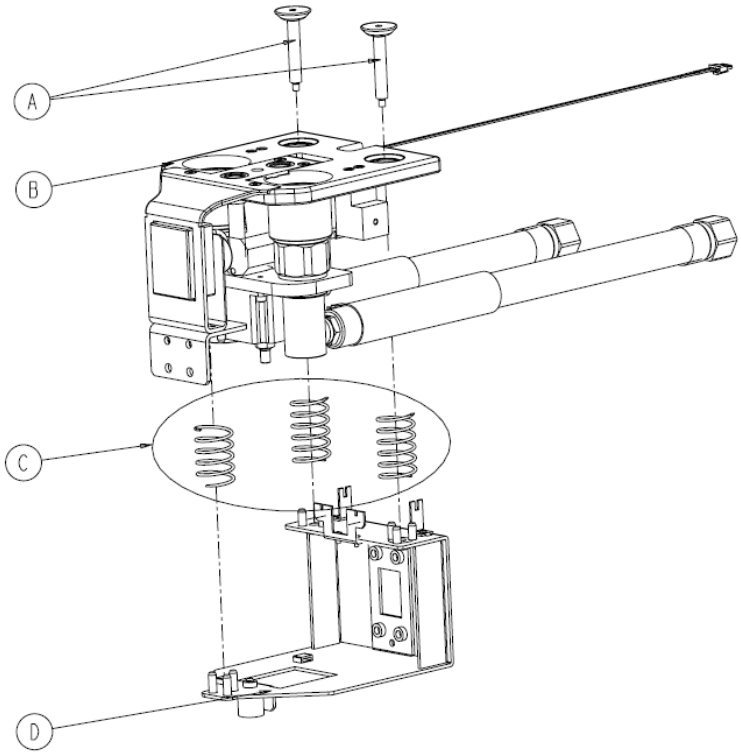


Extend Hall Sensor P/N 0702-014-119
(Retract) Hall Sensor P/N 0702-014-906

1. The wire harness attached to the **docker power coupler assembly** (P/N 0702-014-114) (F) is secured by two cable ties to the **actuator base frame** (P/N 0702-014-101) (D). *Carefully* cut the cable ties to remove the wire harness.



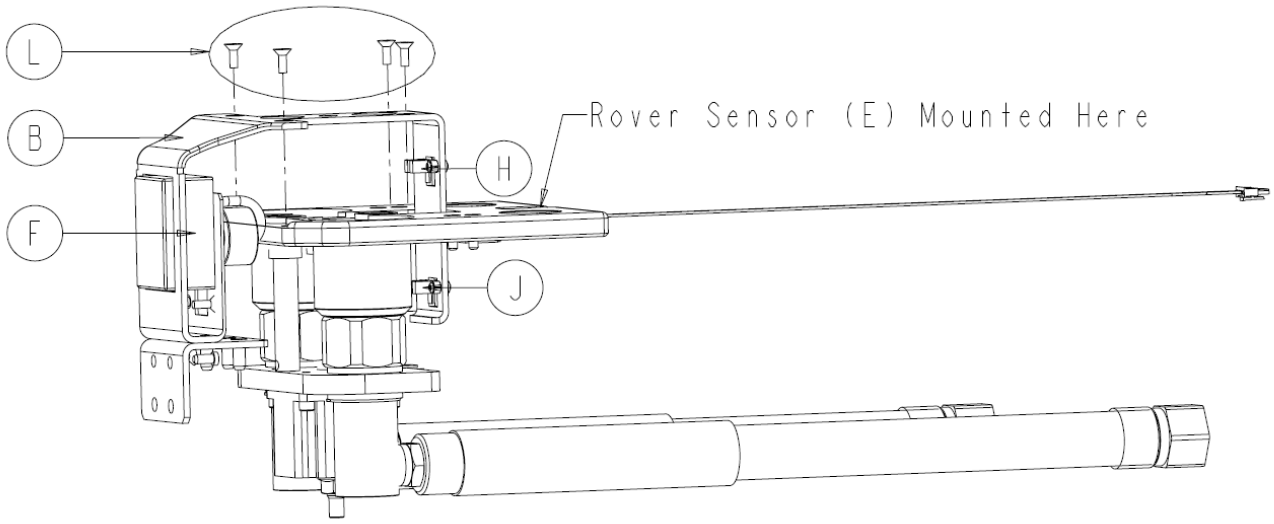
2. Using a 3/16” allen wrench, remove two **actuator alignment rods** (P/N 0702-014-104) (A) from **actuator interface** (P/N 0702-014-110) (B).



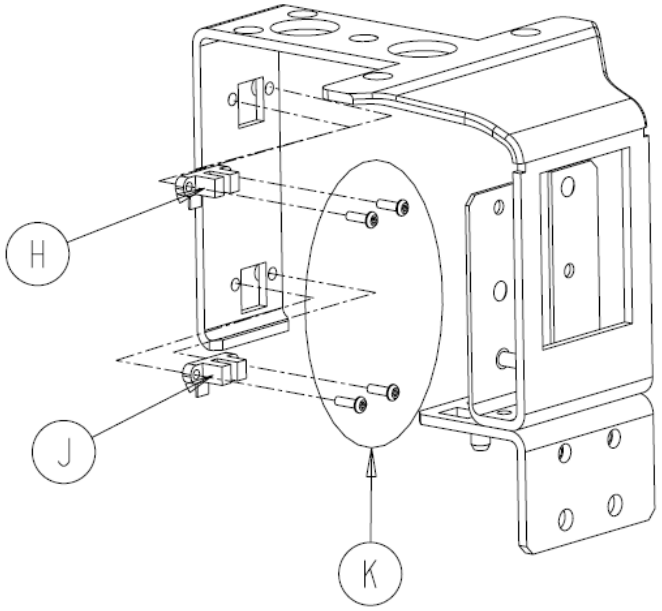
3. Separate the **actuator interface** (P/N 0702-014-110) (B) from the **actuator base frame** (P/N 0702-014-101) (D) and set aside the three **compression springs** (P/N 0038-585-000) (C).

4. Using a 1/8” allen wrench remove four **socket flat countersunk head cap screws** (P/N 0004-346-000) (L) and separate the **actuator strike plate** (P/N 0702-014-111) (B) by lifting it upwards.

Caution: the **extended hall sensor** (P/N 0702-014-119) (H), the **rover hall sensor** (P/N 0702-014-106) (E), the **hall sensor** (P/N 0702-014-906) (J), and the **docker power coupler assembly** (P/N 0702-014-114) (F) are all mounted to the strike plate. Each component has a wiring harness attached to it. Be careful not to get the connectors caught on anything when the removing the **actuator strike plate** (P/N 0702-014-111) (B).

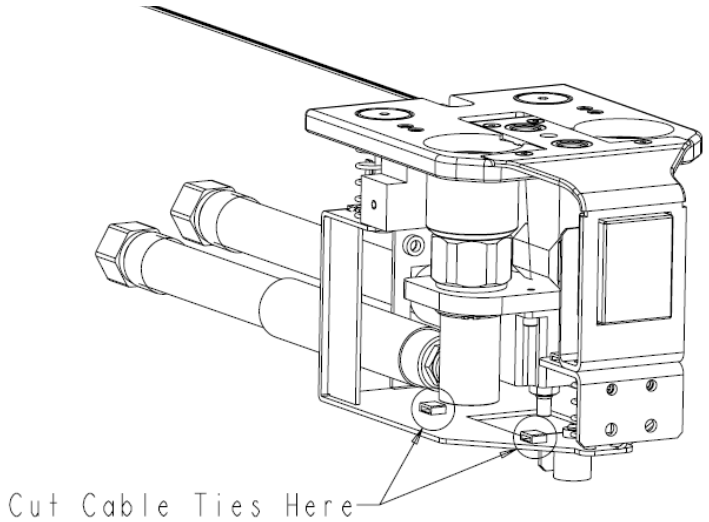


5. Using a T8 torx bit, remove two **button head socket cap screws** (P/N 0004-639-000) (K) for either the **extended hall sensor** (P/N 0702-014-119) (H) or the **[retracted] hall sensor** (P/N 0702-014-906) (J). Remove sensor and set aside.

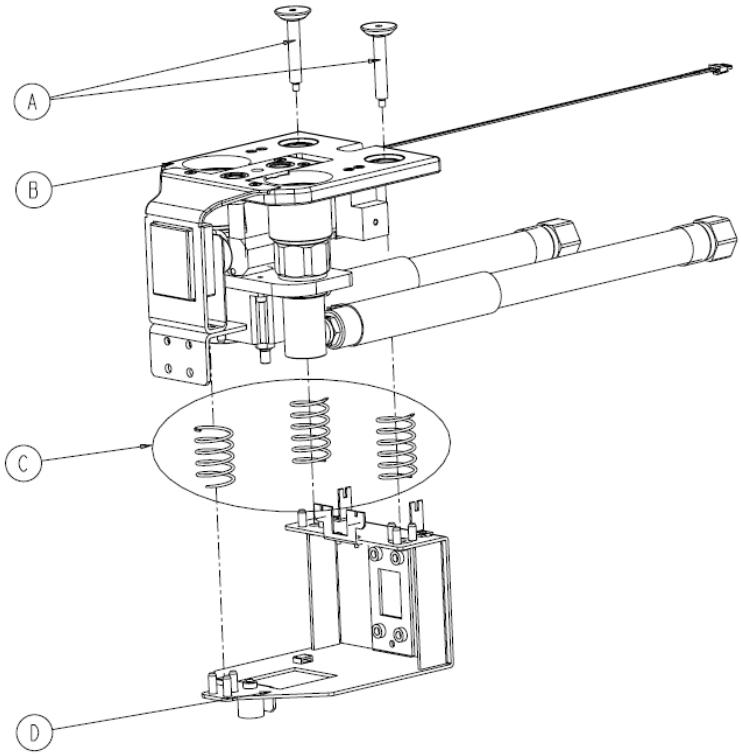


Stepper Motor P/N 0702-014-123

1. The wire harness attached to the **docker power coupler assembly** (P/N 0702-014-114) (F) is secured by two cable ties to the **actuator base frame** (P/N 0702-014-101) (D). *Carefully* cut the cable ties to remove the wire harness.



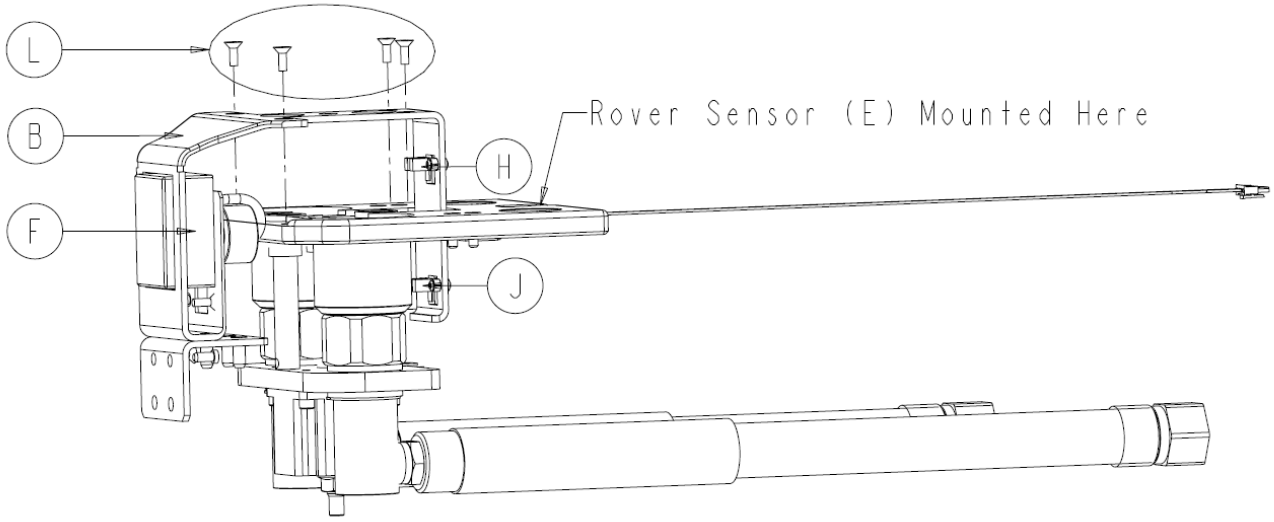
2. Using a 3/16” allen wrench, remove two **actuator alignment rods** (P/N 0702-014-104) (A) from **actuator interface** (P/N 0702-014-110) (B).



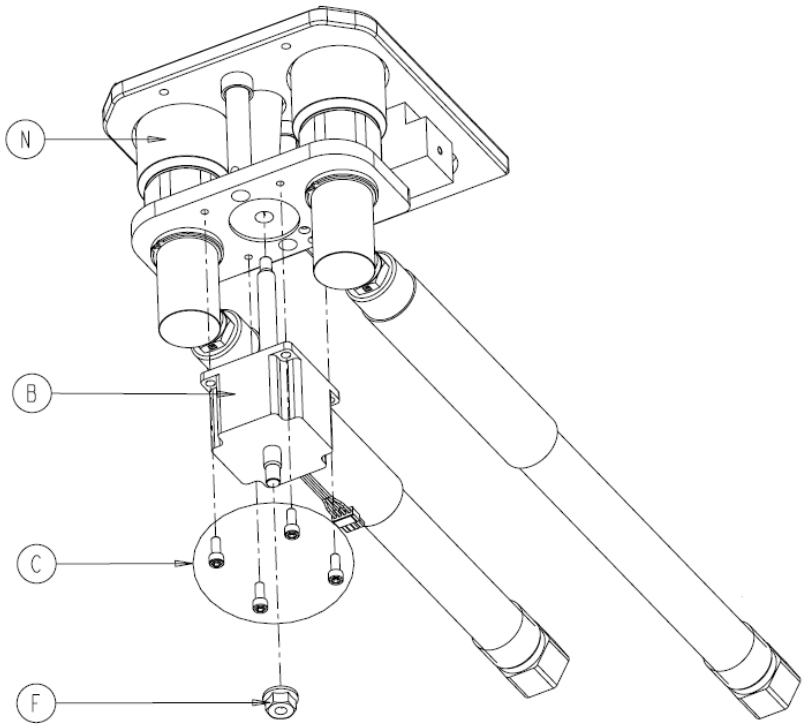
3. Separate the **actuator interface** (P/N 0702-014-110) (B) from the **actuator base frame** (P/N 0702-014-101) (D) and set aside the three **compression springs** (P/N 0038-585-000) (C).

4. Using a 1/8” allen wrench remove four **socket flat countersunk head cap screws** (P/N 0004-346-000) (L) and separate the **actuator strike plate** (P/N 0702-014-111) (B) by lifting it upwards.

Caution: the **extended hall sensor** (P/N 0702-014-119) (H), the **rover hall sensor** (P/N 0702-014-106) (E), the **hall sensor** (P/N 0702-014-906) (J), and the **docker power coupler assembly** (P/N 0702-014-114) (F) are all mounted to the strike plate. Each component has a wiring harness attached to it. Be careful not to get the connectors caught on anything when the removing the **actuator strike plate** (P/N 0702-014-111) (B).

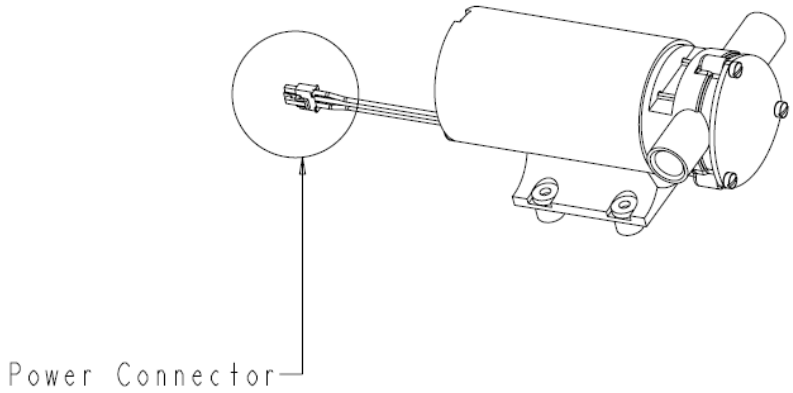


5. Using a ½” socket, unthread and remove the **flange nut** (P/N 0015-007-000) (F) on the **stepper motor** (P/N 0702-014-123) (B). Remove four **socket head cap screws** (P/N 0004-526-000) (C) to separate the **stepper motor** (P/N 0702-014-123) (B) from the **coupling assembly** (P/N 0702-014-120) (N).



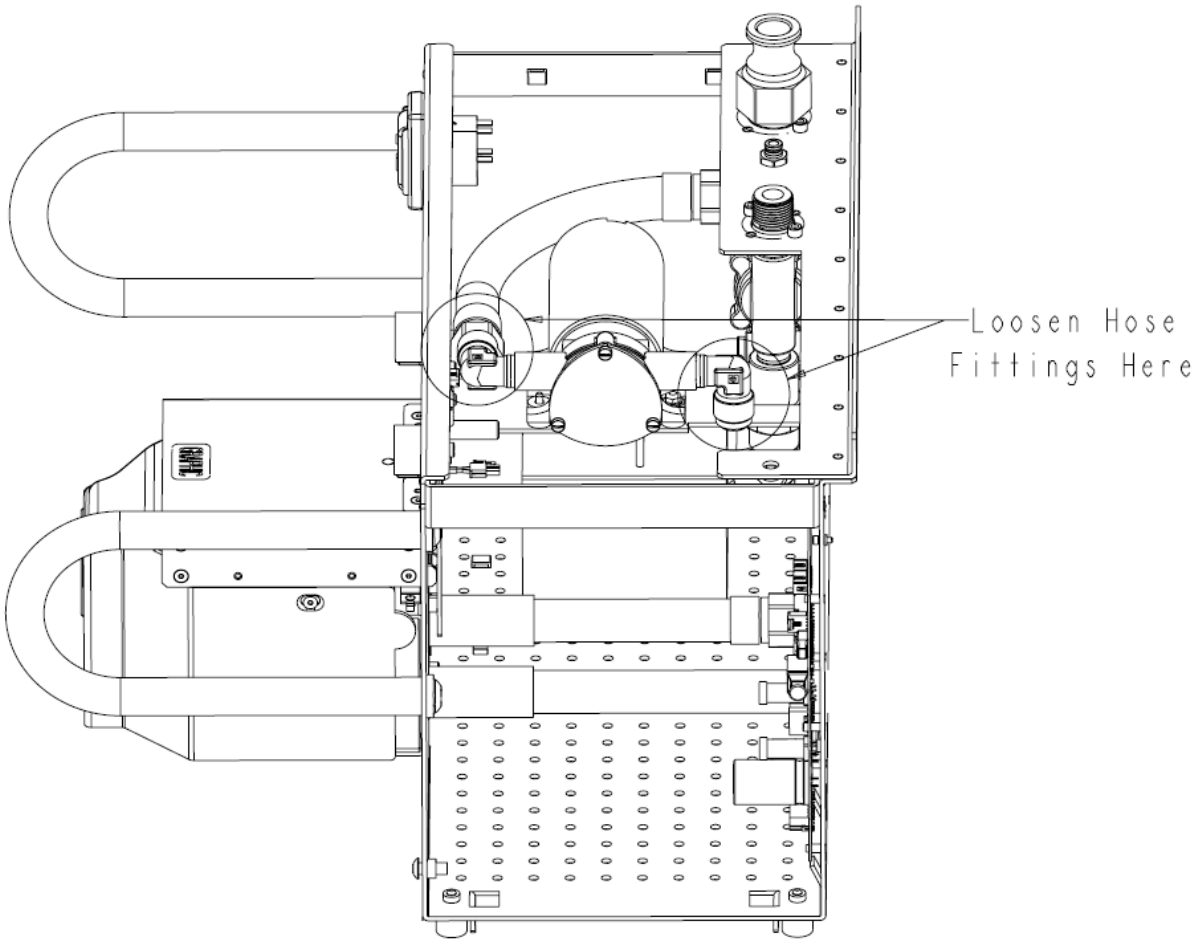
Offload Pump P/N 0702-014-201

1. Unplug the power connector to **offload pump** (P/N 0702-014-201) (AP).



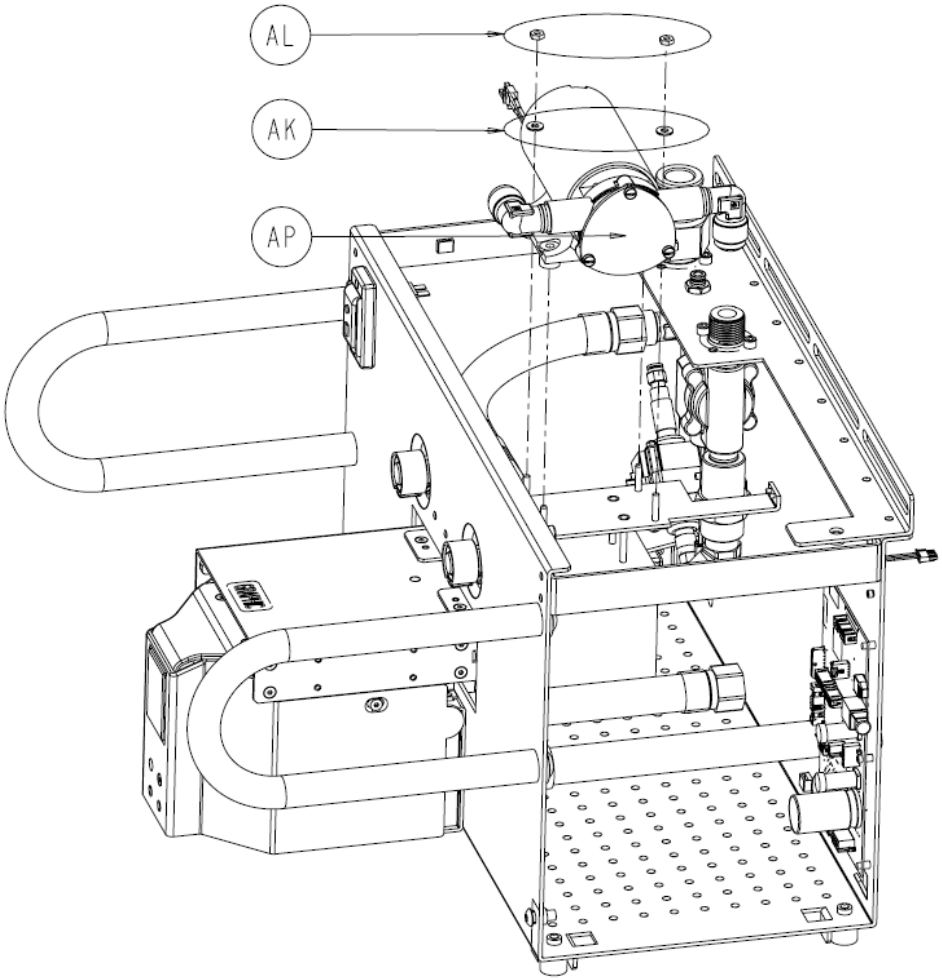
Caution: Be aware that fluids may be present when removing the waste offload hose!

2. Using an adjustable wrench, loosen and remove the fittings for the **waste offload hose** (P/N 0702-014-015) (BJ) from **½" npt x ¾" swivel elbow** (P/N 0048-325-000) (AT).



3. Remove two **hex nuts** (P/N 0015-004-000) (AL) and two **flat washers** (P/N 0011-512-000) (AK).

4. Remove **offload pump** (P/N 0702-014-201) (AP) and set aside.

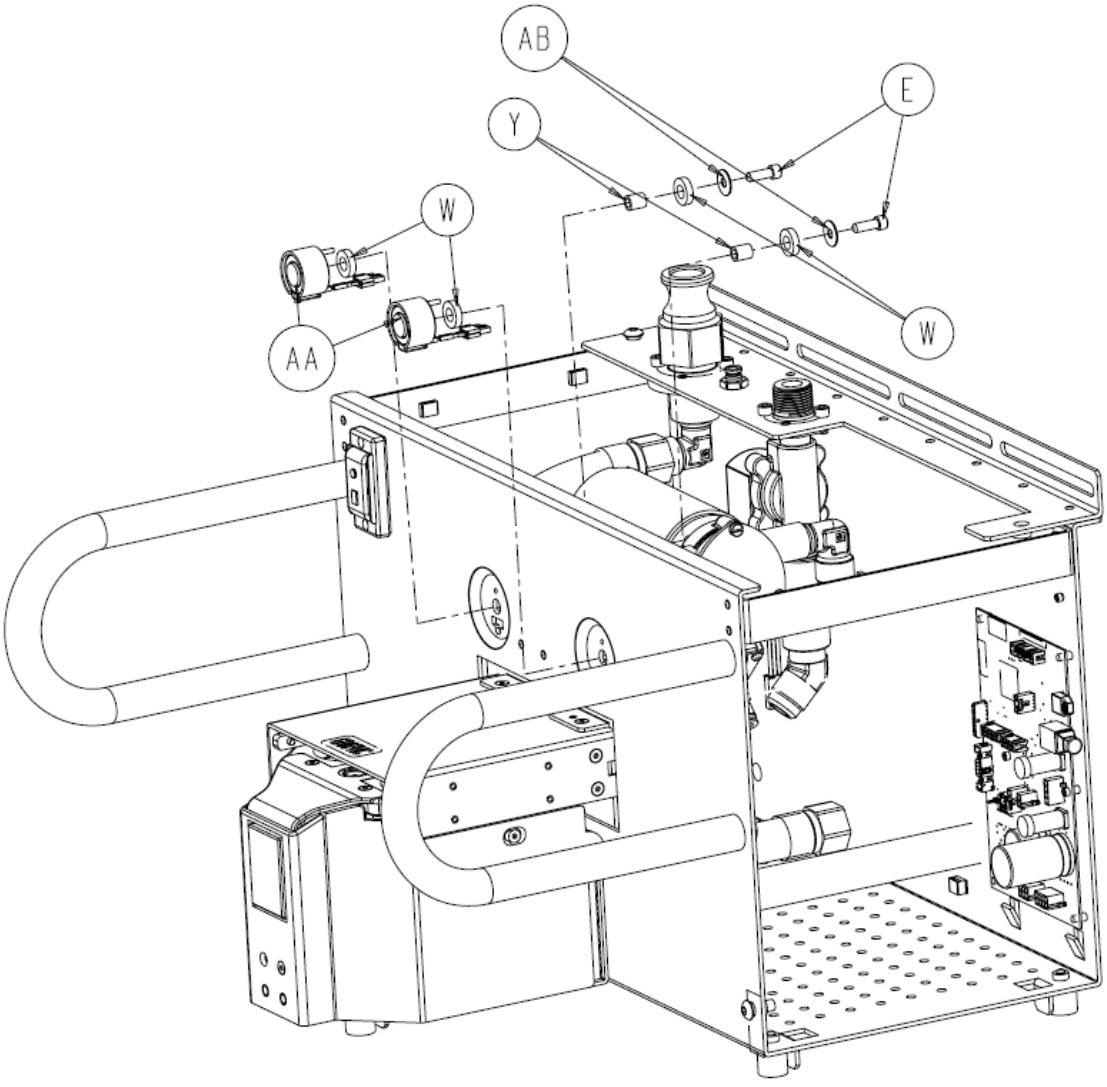


Electromagnet P/N 0702-014-920

1. Unplug the two power connectors from the **electromagnets** (P/N 0702-014-920) (AA).
2. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 0004-529-000) (E) from the back of the **electromagnets** (P/N 0702-014-920) (AA).
3. Remove the **electromagnets** (P/N 0702-014-920) (AA) and set aside.

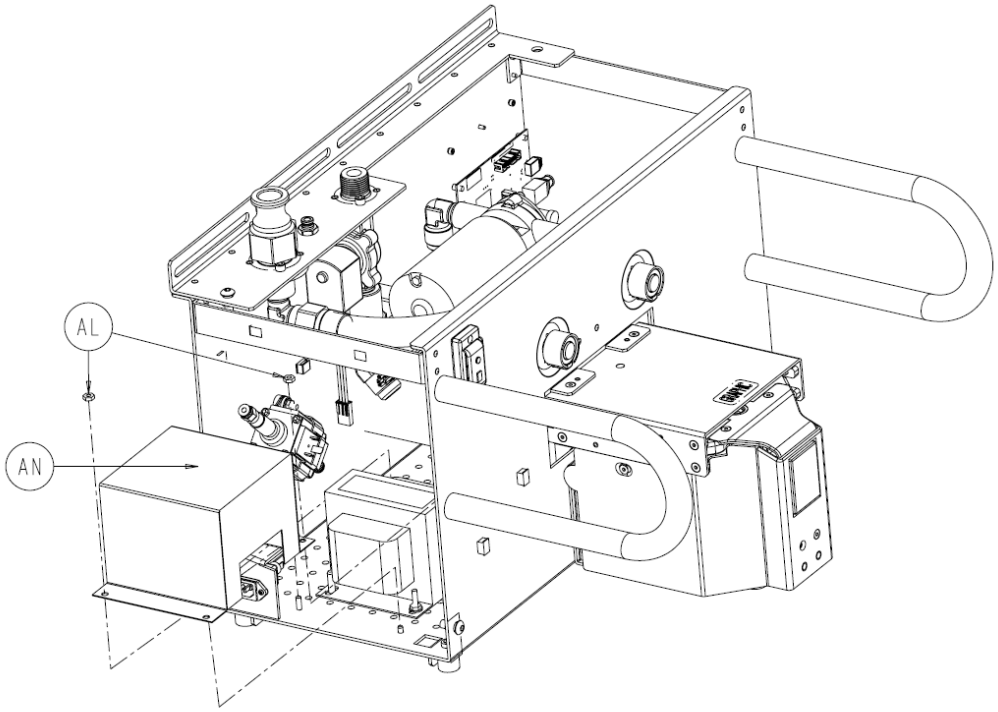
Note: It is important to keep the hardware in the same configuration when reinstalling the magnets. The technician should be familiar with how the magnets are installed in the diagram below. The following components must be installed in the same order:

1. **electromagnets** (P/N 0702-014-920) (AA)
2. **electromagnet bushing** (P/N 0702-014-922) (W)
3. **electromagnet spacer** (P/N 0702-014-921) (Y)
4. **electromagnet bushing** (P/N 0702-014-922) (W)
5. **flat washer** (P/N 0011-188-000) (AB)
6. **socket head cap screw, ¼-20 x .750** (P/N 0004-518-000) (E)

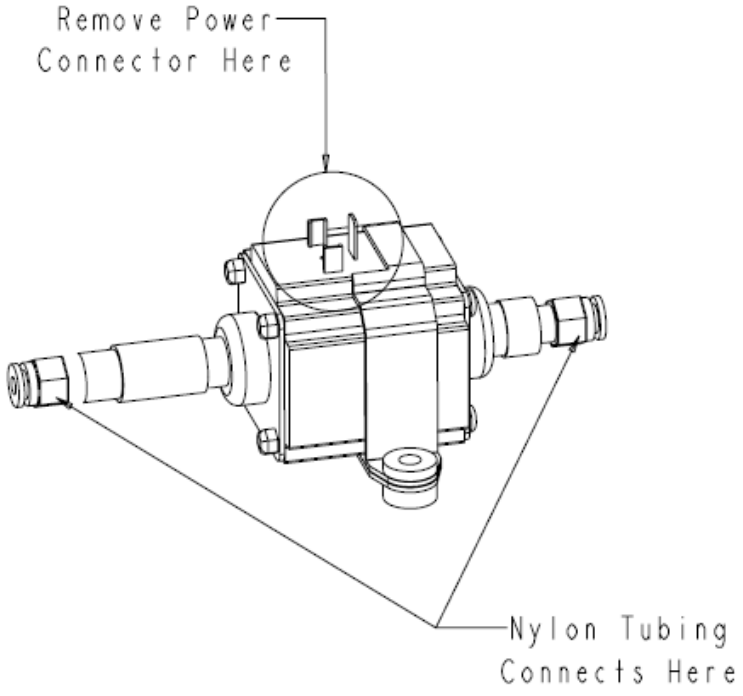


Injector Pump Assembly P/N 0702-001-380

1. Remove two **hex nuts** (P/N 0015-004-000) (AL).
2. Remove **transformer cover** (P/N 0702-014-025) (AN) and set aside.



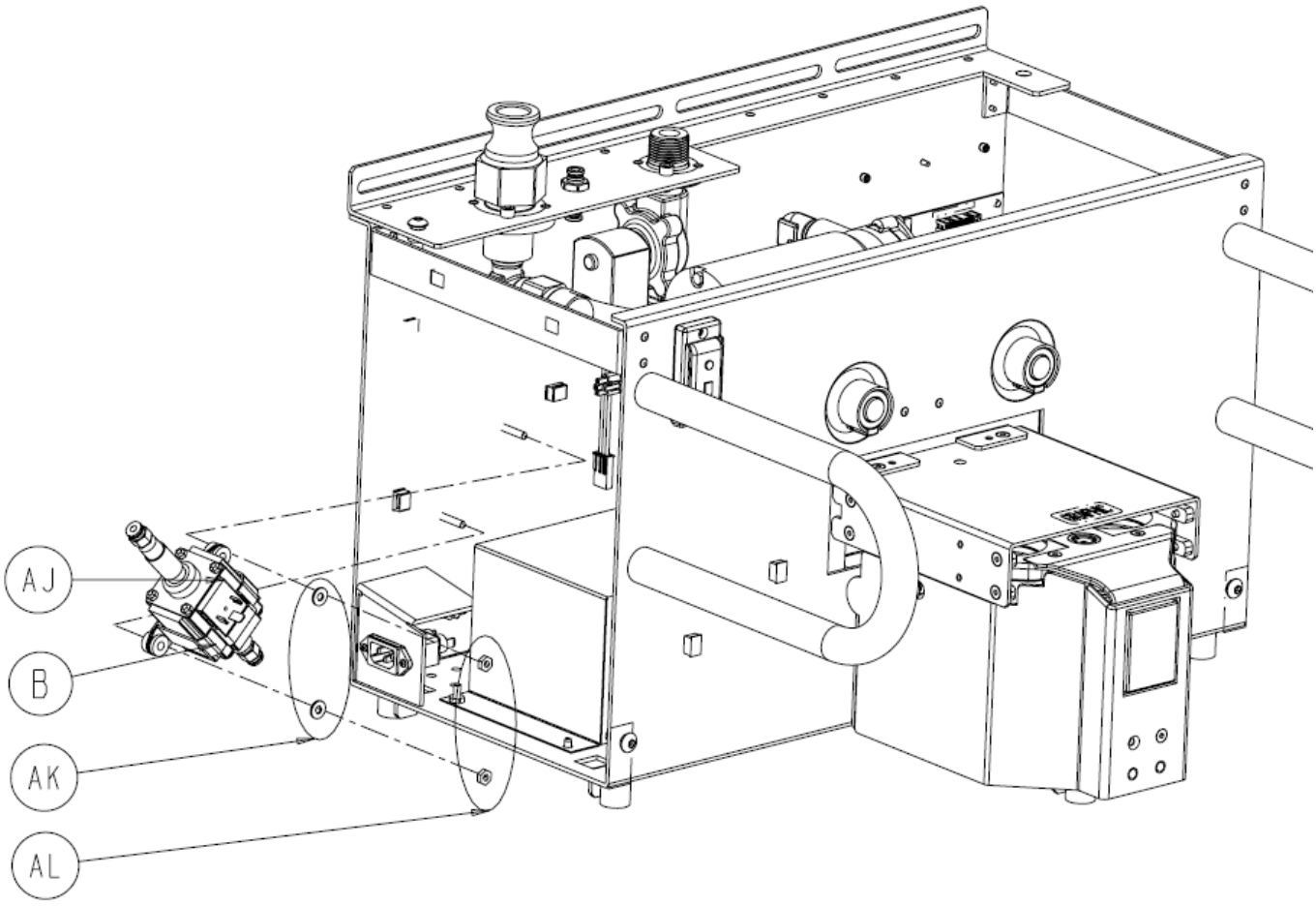
3. Using a #2 phillips screwdriver, unscrew the fastener holding the power connector to the **injector pump assembly** (P/N 0702-001-380) (AJ) and pull connector off.



4. Disconnect nylon tubing from both ends of **injector pump assembly** (P/N 0702-001-380) (AJ).

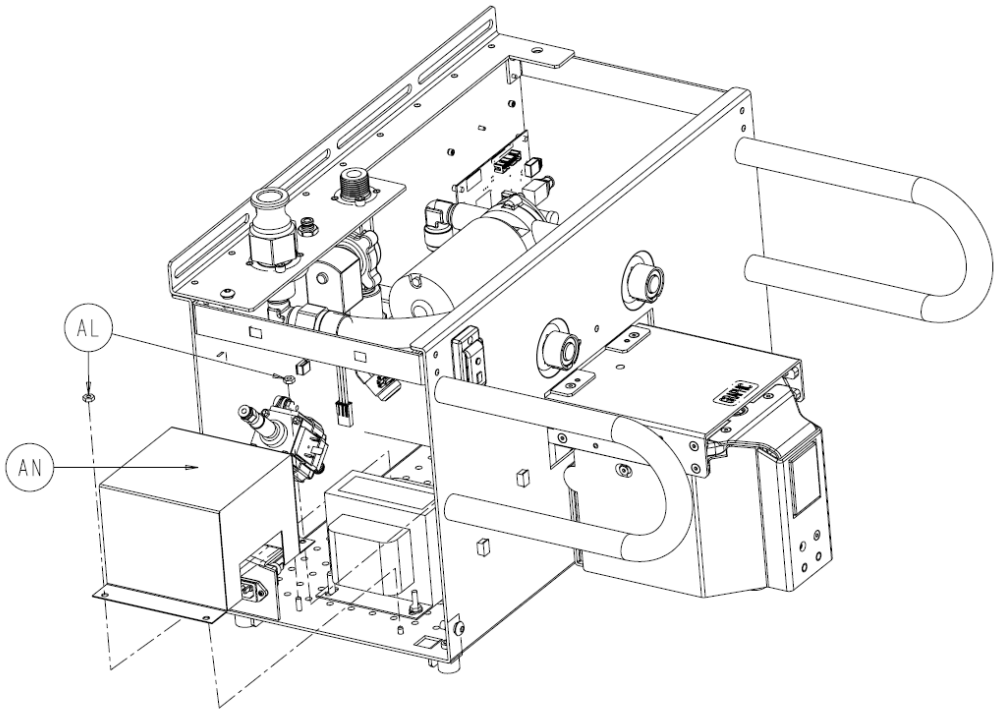
5. Using a 3/8” socket, loosen and remove the two **hex nuts** (P/N 0015-004-000) (AL) and two **flat washers** (P/N 0011-512-000) (AK).

6. Remove the **injector pump assembly** (P/N 0702-001-380) (AJ) from the **oscillating piston pump mount** (P/N 0702-001-382) (B) and set aside.

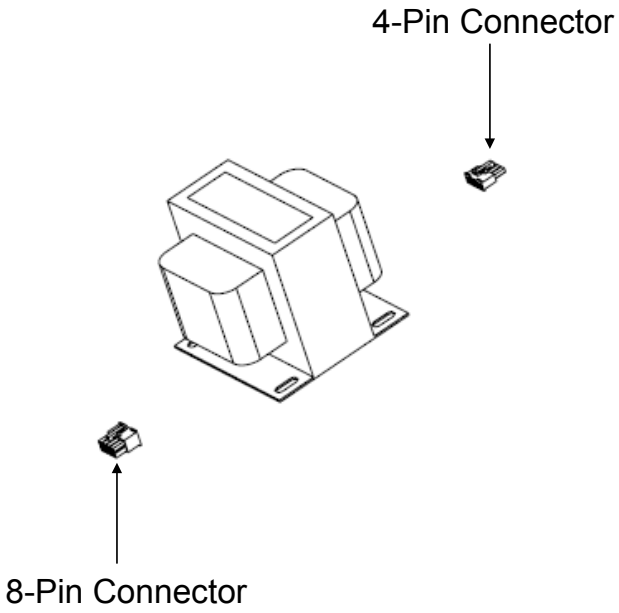


Docker Isolation Transformer P/N 0702-014-520

7. Remove two **hex nuts** (P/N 0015-004-000) (AL).
8. Remove **transformer cover** (P/N 0702-014-025) (AN) and set aside.

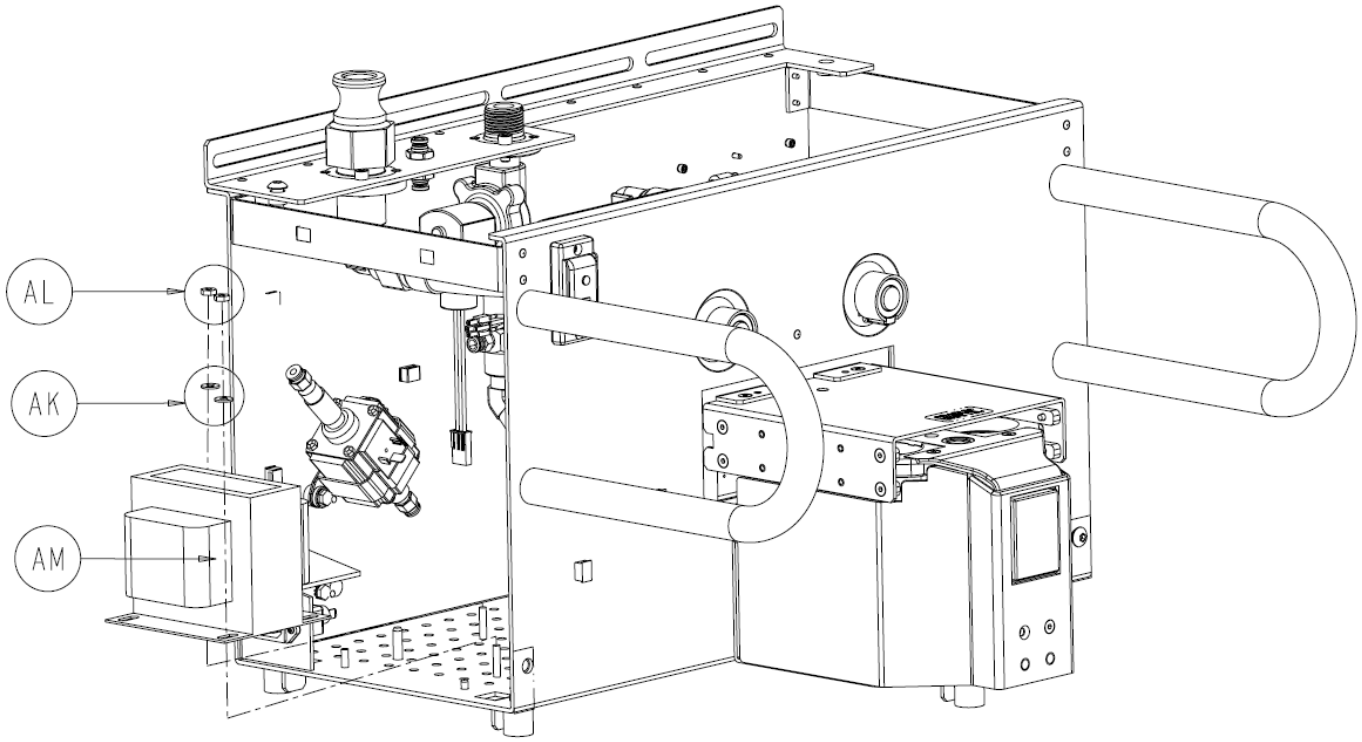


9. Unplug the connector labeled t**ransformer** from **isolated AC from transformer wire harness** (P/N 0702-014-021C). This wiring harness has an 8-pin connector with multi-colored wires. Next unplug the **power entry module to power switch wire harness** (0702-014-021H). This connector has a 4-pin connector with two brown and two blue wires.(It is connected to the power switch.)



10. Using a 3/8” socket, remove both **hex nuts** (P/N 0015-004-000) (AL) and both **flat washers** (P/N 0011-512-000) (AK).

11. Remove the **docker isolation transformer** (P/N 0702-014-520) (AM) and set aside.



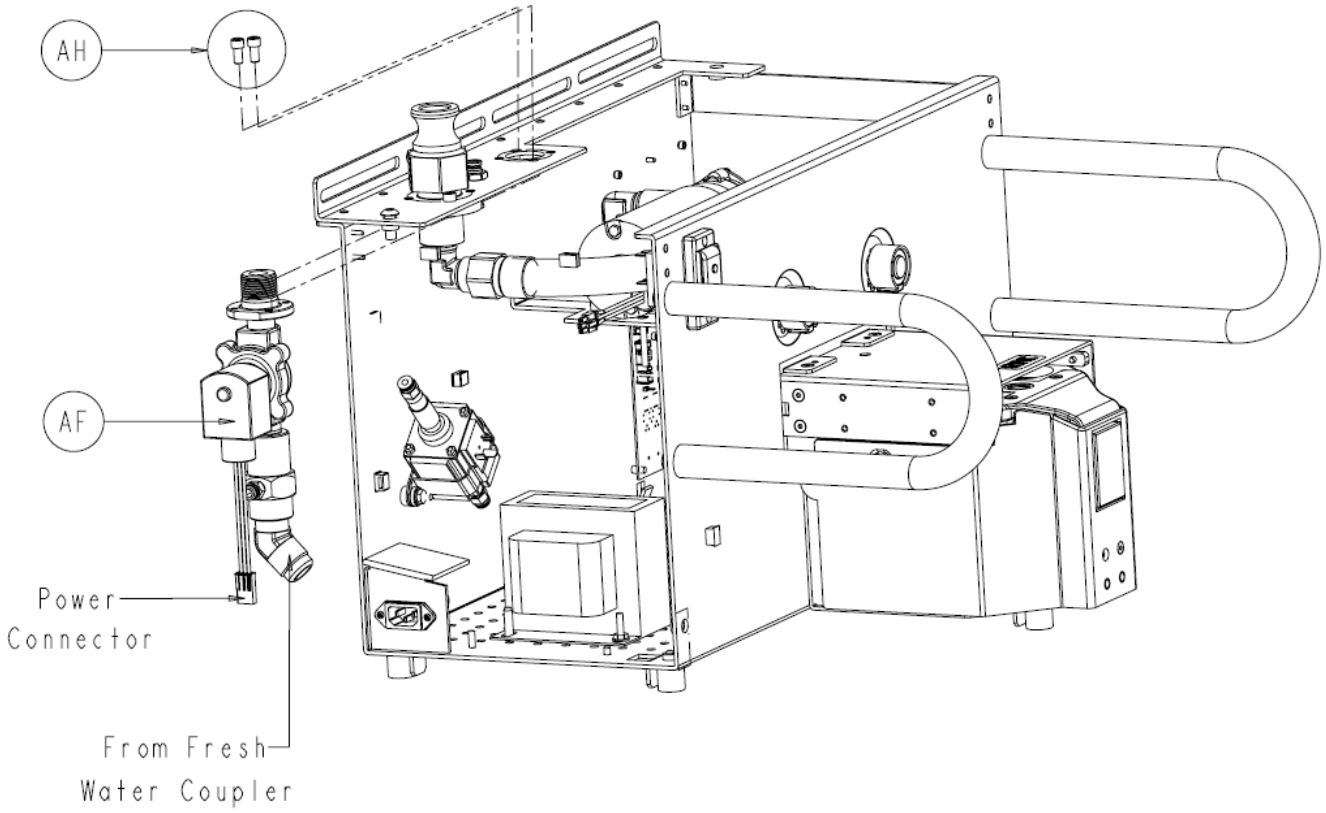
Note: Once the **docker isolation transformer** (P/N 0702-014-520) (AM), is reinstalled, the proper electrical safety tests must be performed before placing docking station back in service. Follow procedure ***6.5 Testing*** to make sure the proper testing requirements are met.

Water Inlet Assembly P/N 0702-014-400

1. Unplug the power connector labeled **water inlet**, from **water valve/ offload pump/ soap pump wire harness** (P/N 0702-014-021E).

2. Using an adjustable wrench, remove the fresh water hose connected to the **water inlet assembly** (P/N 0702-014-400) (AF) from the bottom of the assembly.

3. Using a 3/16” allen wrench, remove the two **socket head cap screws** (P/N 004-645-000) (AH) and remove the **water inlet assembly** (P/N 0702-014-400) (AF).



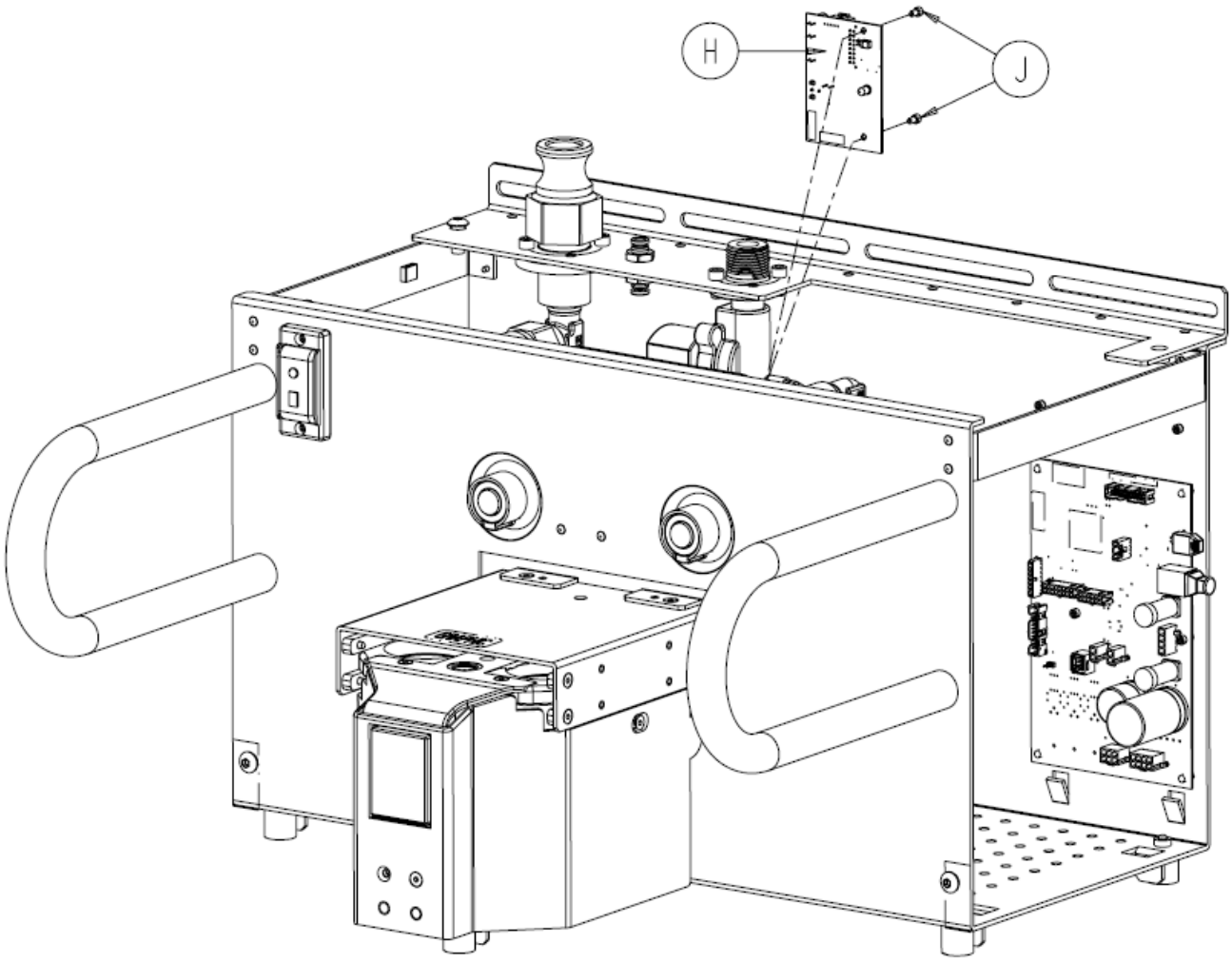
Docker Power Coupler PCBA P/N 0702-014-510

1. Disconnect connector labeled **IR board** from **power coupler wire harness** (P/N 0702-014-021B) at J3 on **docker power coupler PCBA** (P/N 0702-014-510) (H).

2. Disconnect connector labeled **coupling motor wire harness** (P/N 0702-014-021A) at J1 on **docker power coupler PCBA** (P/N 0702-014-510) (H).

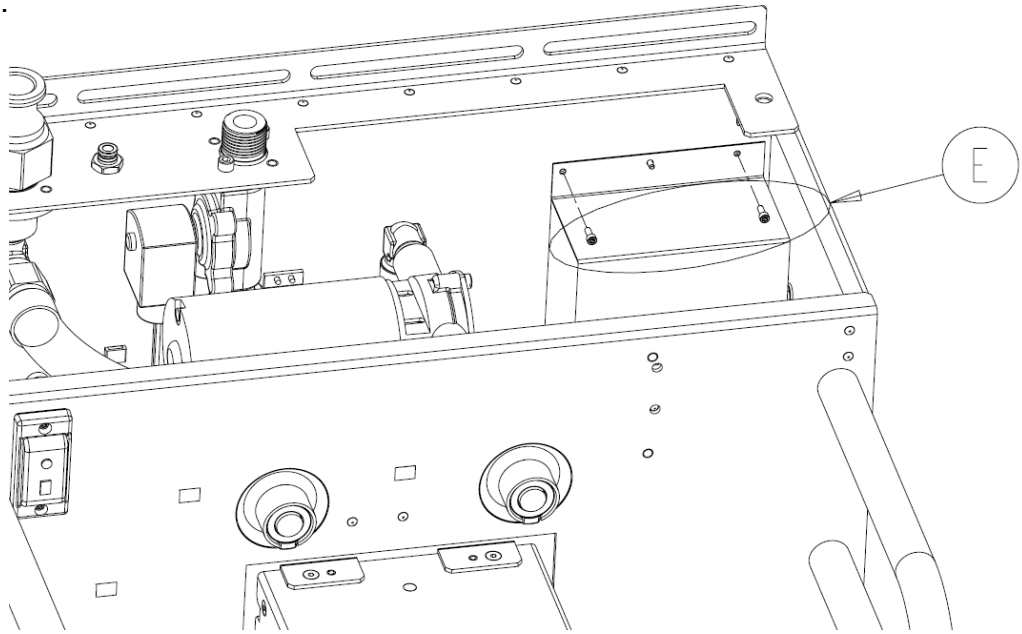
3. Using a 7/64” allen wrench, remove both **socket head cap screws** (P/N 004-022-000) (J).

4. Remove **docker power coupler PCBA** (P/N 0702-014-510) (H) and set aside.

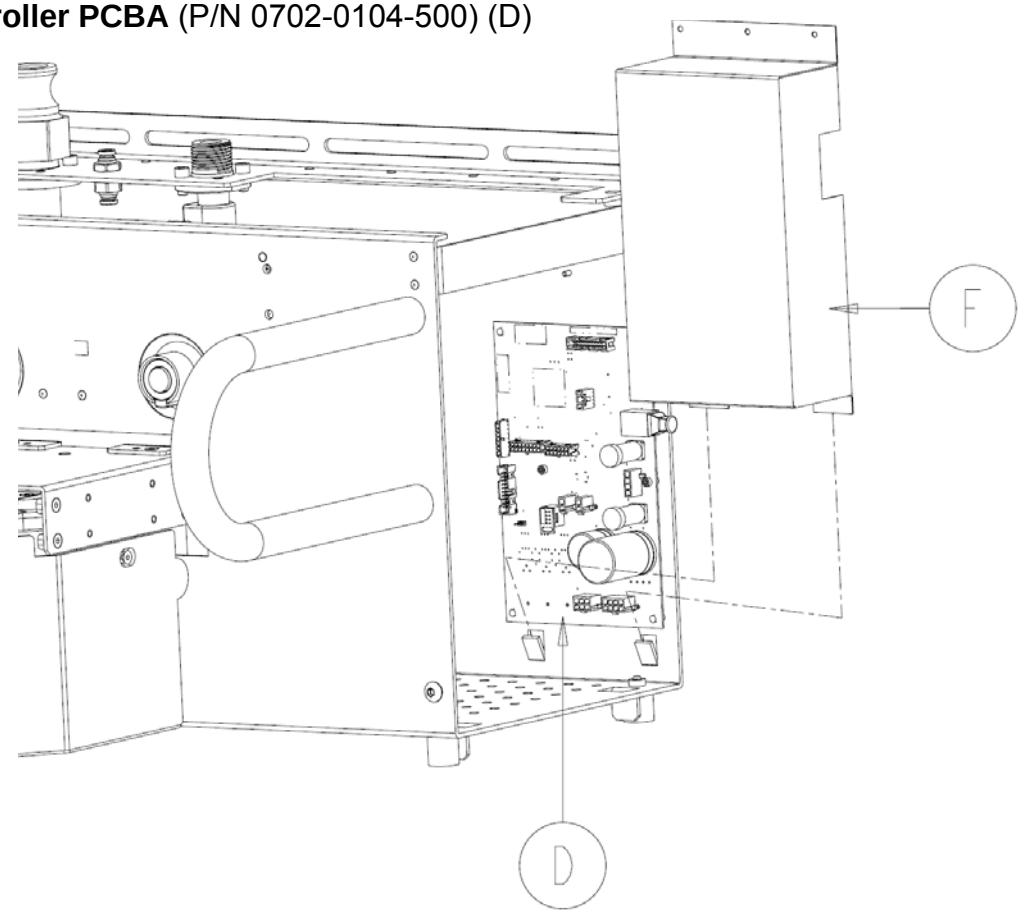


Docker Main Controller PCBA P/N 0702-014-500

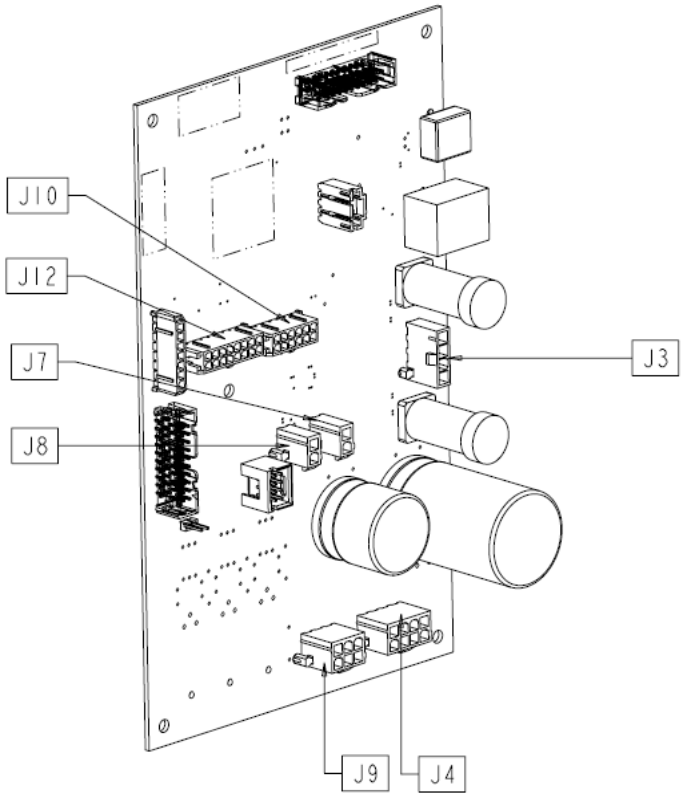
1. Remove two **socket head cap screws** (P/N 0004-529-000) (E) using a 7/64” allen wrench.



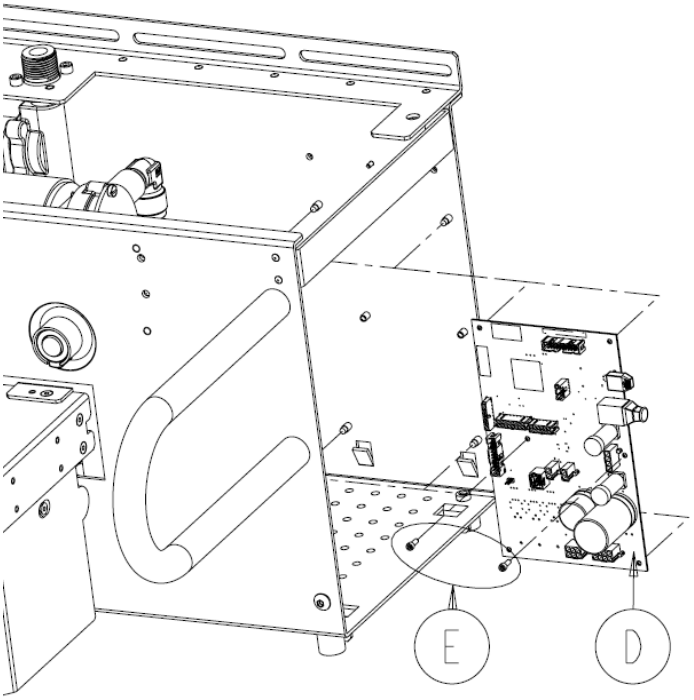
2. Remove **electronics shield** (P/N 0702-014-016) (F) to gain access to the **docker main controller PCBA** (P/N 0702-0104-500) (D)



3. Disconnect connections from **J3, J4, J7, J8, J9, J10, & J12** shown below from the **docker main controller PCBA** (P/N 0702-014-500).



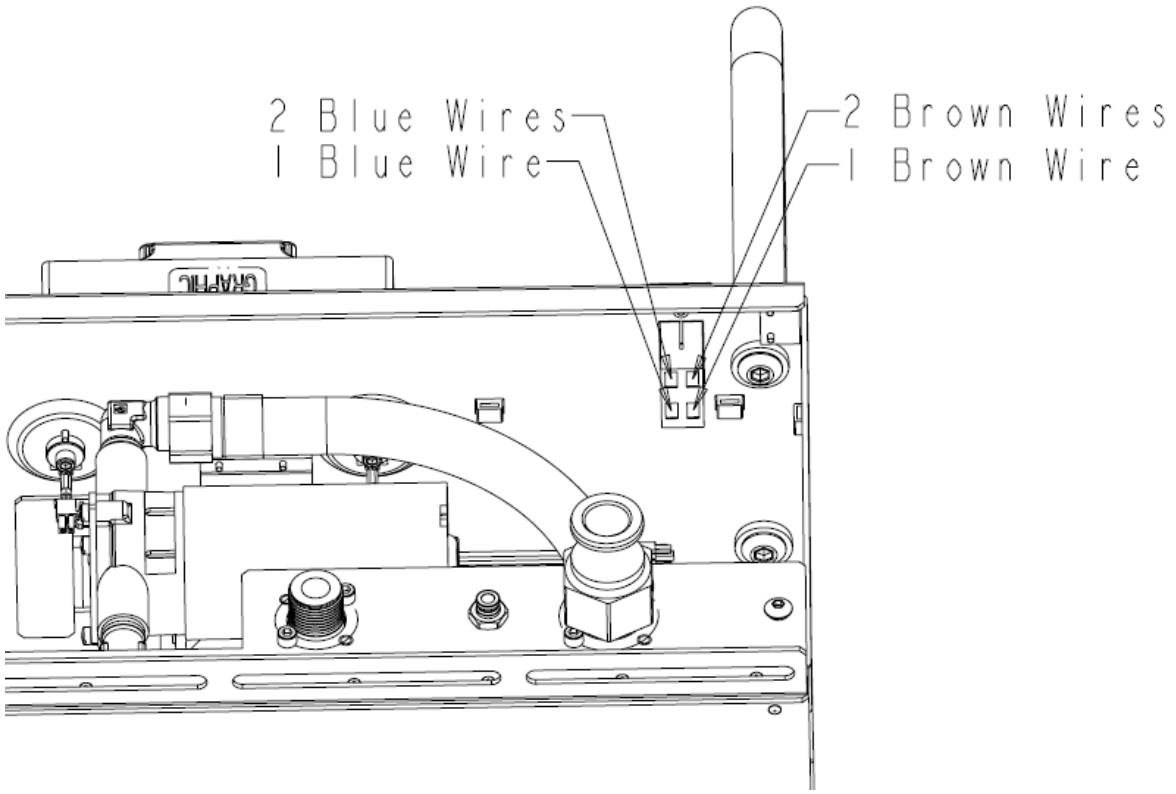
4. Remove two **socket head cap screws** (P/N 0004-529-000) (E) using 7/64” allen wrench and remove **docker main controller PCBA** (P/N 0702-014-500) (D) from docker chassis.



Power Switch P/N 0700-001-412

Note: Ensure that connections to the power switch are connected in the manner below as improper connection can cause damage to equipment as well as harm to technician.

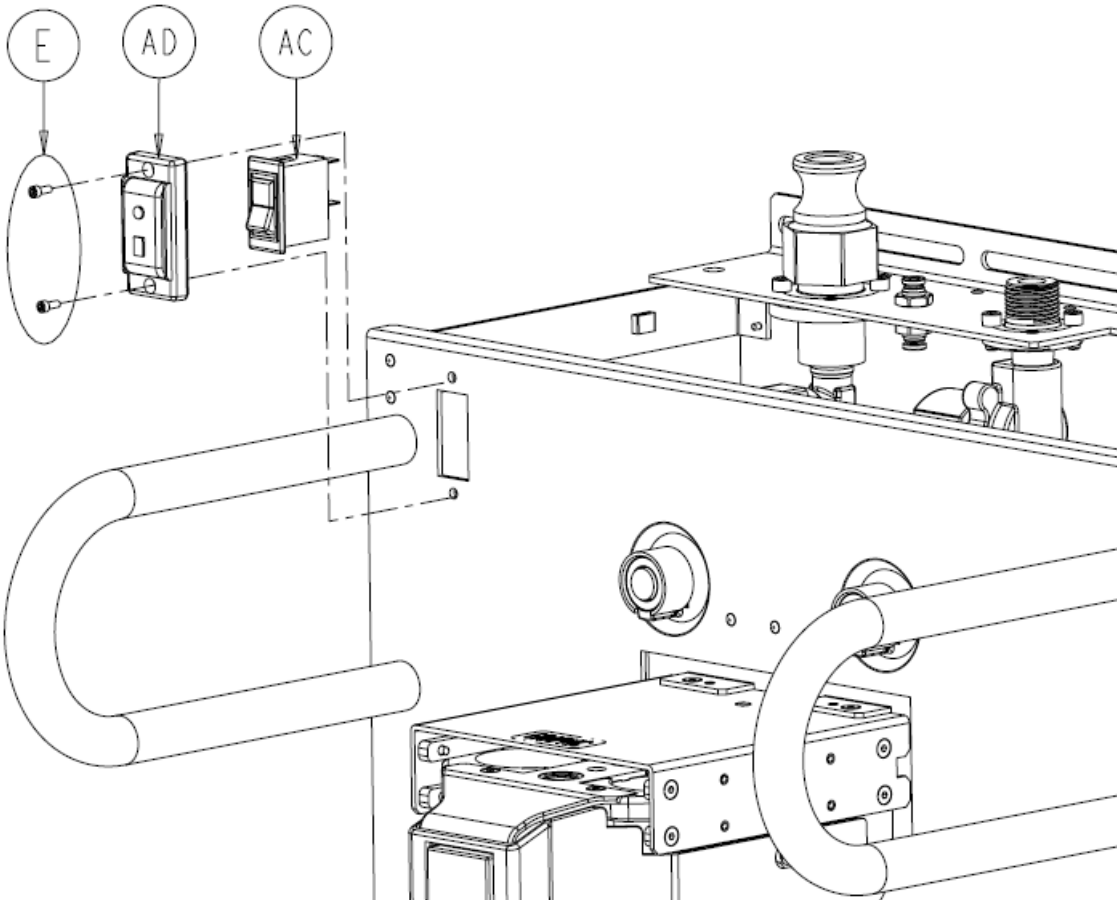
1. Unplug the connections at each of the four prongs on the back of the **power switch** (P/N 0700-001-412) (AC). The prongs on the top have two wires in each connector, while the prongs on the bottom only have one wire in each. The diagram below shows a rear view of how the wiring is connected with the **power switch** (P/N 0700-001-412) installed in the chassis.



Note: If the **power switch** (P/N 0700-001-412) (AC) is replaced, the proper electrical safety tests must be performed before placing docking station back in service. Follow procedure ***6.5 Testing*** on page 6-20 to make sure the proper testing requirements are met.

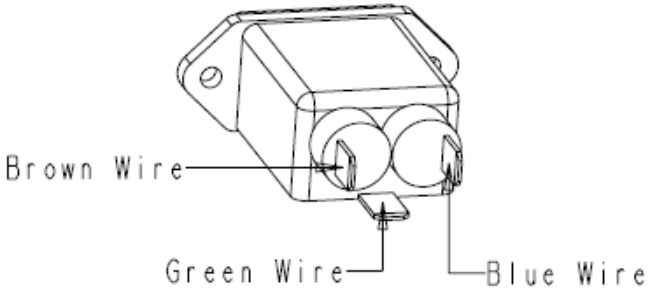
2. Using a 7/64” allen wrench, remove both **socket head cap screws** (P/N 0004-529-000) (E).
3. Remove the **power switch splash cover** (P/N 0700-001-409) (AD) and set aside.

4. Remove **power switch** (P/N 0700-001-412) (AC) by depressing tabs on the rear top and bottom and push forward.



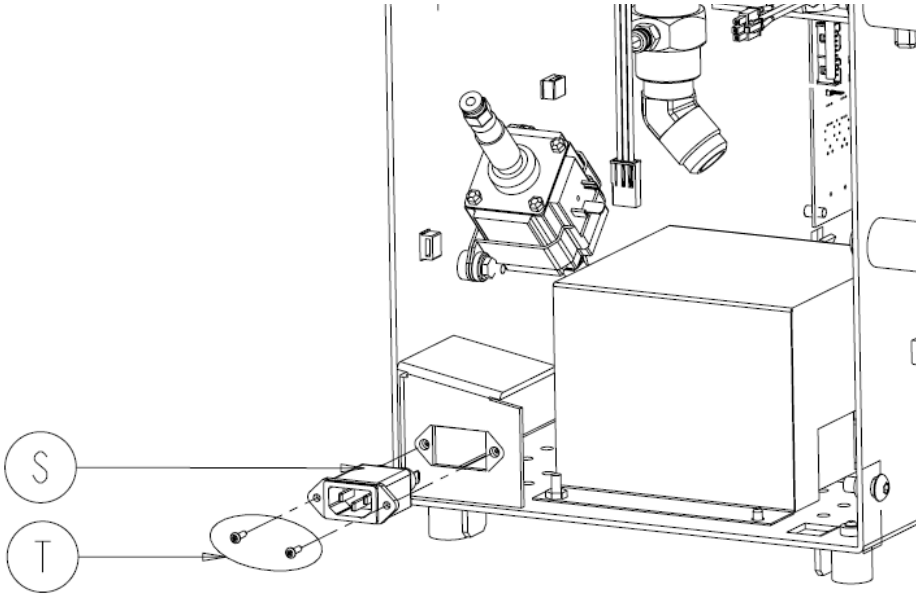
Power Plug Module P/N 0702-014-019

1. Unplug the electrical connections from the **power plug module** (P/N 0702-014-019) (T). The diagram below shows a rear view of how the wiring is connected with the **power plug module** (P/N 0702-014-019) (T) removed from the chassis.



2. Using a T9 torx wrench, remove both **button head socket cap screws** (P/N 004-639-000) (T).

3. Remove the **power plug module** (P/N 0702-014-019) (S) and set aside.



Note: If the **power plug module** (P/N 0702-014-019) (S) is reinstalled, the proper electrical safety tests must be performed before placing docking station back in service. Follow procedure ***6.5 Testing*** on page 6-20 to make sure the proper testing requirements are met.

Chapter 5 – Troubleshooting

Troubleshooting Overview

Troubleshooting the Neptune Ultra system is accomplished by using the half split method. The half split or half split bracketing method of troubleshooting divides the suspected faulty circuitry in half, and begins the diagnosis in the center. If the input is good and the output is bad, then the device is considered faulty and should be replaced. Note that if the device is an end item (such as an IV pole) the output may be an operation. As a troubleshooting aid, we will walk through an example of a faulty IV Pole. The illustrations and troubleshooting steps to follow serve as a guideline for the technician on how logical troubleshooting checks should be made based on the information in this chapter. The technician should use a combination of the block diagrams and the troubleshooting chart immediately following the troubleshooting example to determine failures in each subsystem.

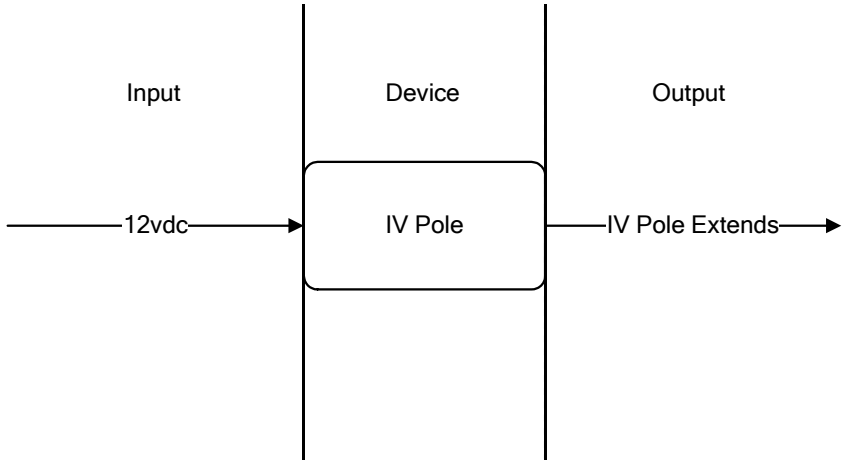


Figure 1: IV Pole Normal Operation

In the case of the IV Pole, the input is 12VDC and the output, or desired operation, is to extend the belt driven pole via the motor. Figure 1 illustrates this example. If the pole does not extend there are several possible causes. As stated earlier, the 12 volt input is required in order for the pole to extend. If the input is present and the IV Pole still does not work, then the IV pole assembly will be replaced. In some cases only the motor will be replaced but most of the time when replacing parts, the technician will *not* replace items on a component level. Instead, entire modules or circuit boards will be replaced. This is intended to facilitate troubleshooting and increase the reliability of the system.

However, if the technician finds that the 12 volt input is *not* present, then they should follow the path of troubleshooting towards the *source*. Most often, schematics or block diagrams show a circuit flow drawn from left to right. For this reason, the half split method usually uses the “good right, bad left” terminology to direct the technician back to the source.

The point in the circuitry that was found faulty now becomes the right portion of the half split. Figure 2 shows how the bracket is moved left (towards the source) for our next troubleshooting check.

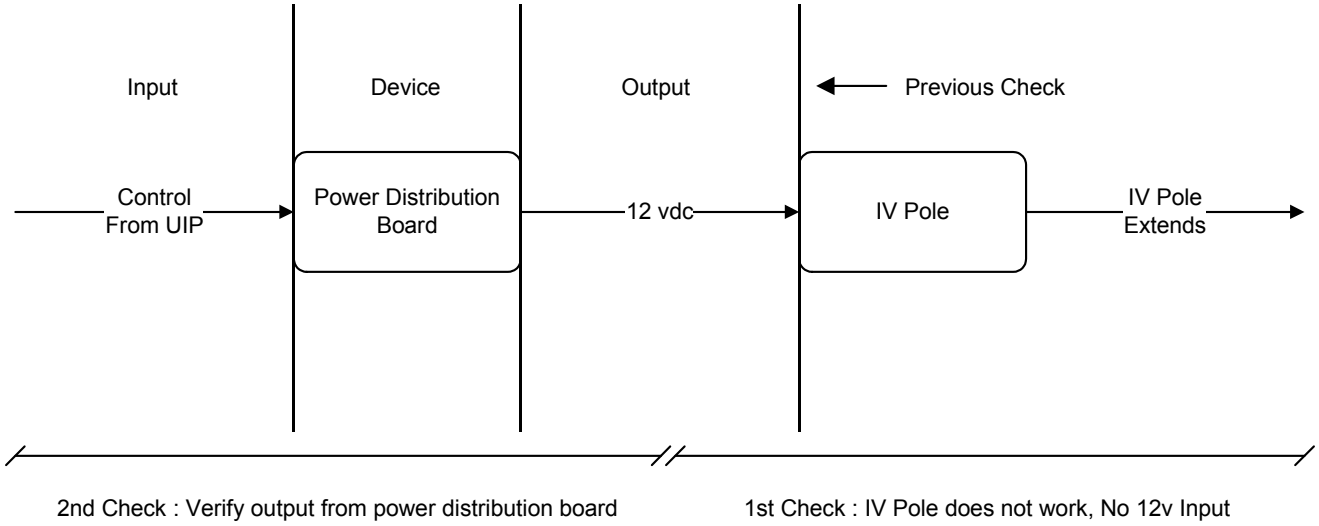


Figure 2: Bracket Moves Left Towards the Signal's Source

In the first check we determined that the motor did not run because of the missing 12 volt input. Moving *towards* the source, our bracket now encompasses the control input from the user interface panel, the power distribution board, and the 12 volt output to the IV pole motor.

The inputs and outputs to the power distribution board are difficult to check due to the physical orientation of the board. The circuit board plugs into a backplane with several connectors. For this reason, the technician will not be able to check the output of the power distribution board while it is plugged in. The 12 volt input was not present at the IV pole connector, which leaves the power distribution board via J13, pins 13 and 14. However, we can not assume that the power distribution board is bad without making a few more checks.

Although we can not check the output of the power distribution board directly, we can check the interface between the board and the IV pole connector – the wire harness. This is accomplished by turning off the rover, removing the power distribution board, and ohming the pins on the backplane connector to the pins on the IV pole connector. This check will determine if the interface is intact. If any of the pins are open, then the problem has been discovered and the repair can be completed on the faulty connector. If all of the pins on the connector ohm correctly then we can assume the interface is good and proceed to the left (towards the source) for the next check.

The input to the power distribution board is the control signal from the main control board (in the UIP). Again, the technician will not be able to verify these inputs at the backplane of this assembly. Instead we can proceed directly to the main control board to verify the inputs from the membrane switch and the control signal output to the power distribution board. Figure 3 illustrates how the bracket moves again to encompass the membrane switch input, main control board, and the control signal output.

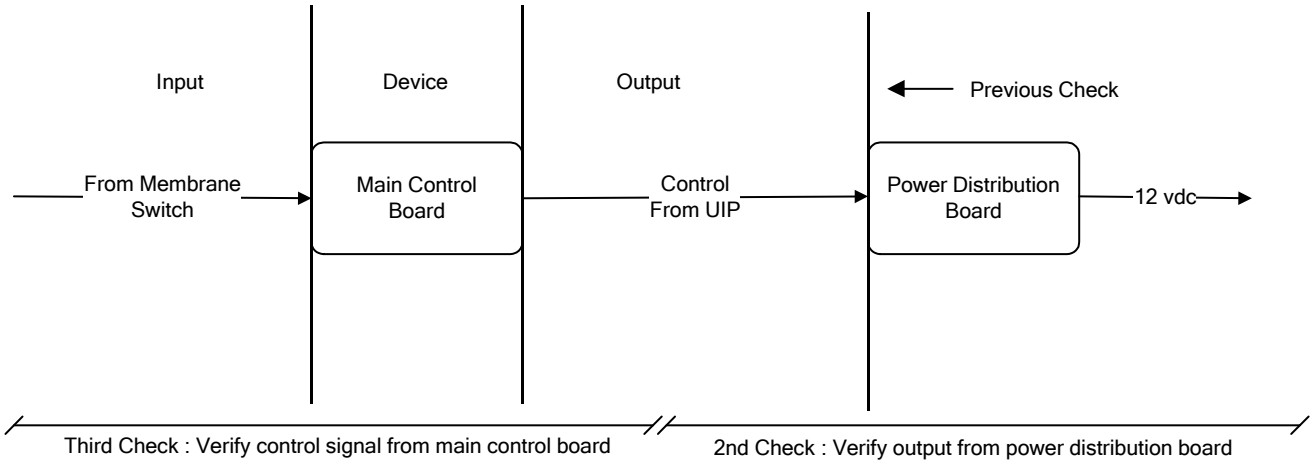


Figure 3: Verify Input From Membrane Switch

Thus far we have determined that the 12 volt output was not present at the IV pole connector, and that the interface from the power control board to the IV pole is intact. Since we can not check for 12vdc leaving the power distribution board, we have no way of knowing if it is operating properly. For now, we will go further towards the source of the signal to determine where the failure is occurring.

Keep in mind that the signal source *is* the membrane switch. When the user presses the IV pole up button, the motor turns on and the pole extends. Our next step is to determine if the control signal is coming from the membrane switch. This is accomplished by measuring the resistance at the ribbon cable between pins 1 and 6. If the resistance starts open and ohms closed when the button is pressed, then the input to the main control board is considered good. If the two points do not ohm check good, then the membrane switch should be replaced.

Assuming the membrane switch is good, the only possible solutions that remain are a faulty main control board, or the interface between the main control board and the power distribution board. The most logical check at this point would be to ohm the wire harness from the main control board to the power distribution board. This would verify that the interface is intact. If the harness does not ohm correctly then it should be repaired or replaced and the checks made again.

If the harness check ok, then there is only one step remaining before troubleshooting is complete. A good input to both the main control board (the membrane

switch) and the power distribution board (wire harness) means that either the main control board is faulty and not sending the signal to the power distribution board, or the power distribution board is faulty and it is not generating the required 12 volts to engage the IV pole motor. In either case the faulty circuit board should be replaced. (good input, no output) To determine which circuit board has failed, the technician should remove the output connector on the main control board and check the output while pressing the IV pole up button. A good output from the main control board and a known good interface suggest that the power control board is faulty. However, if the output of the main control board is bad, then the main control board should be replaced. Figures 4a and 4b illustrate the last check.

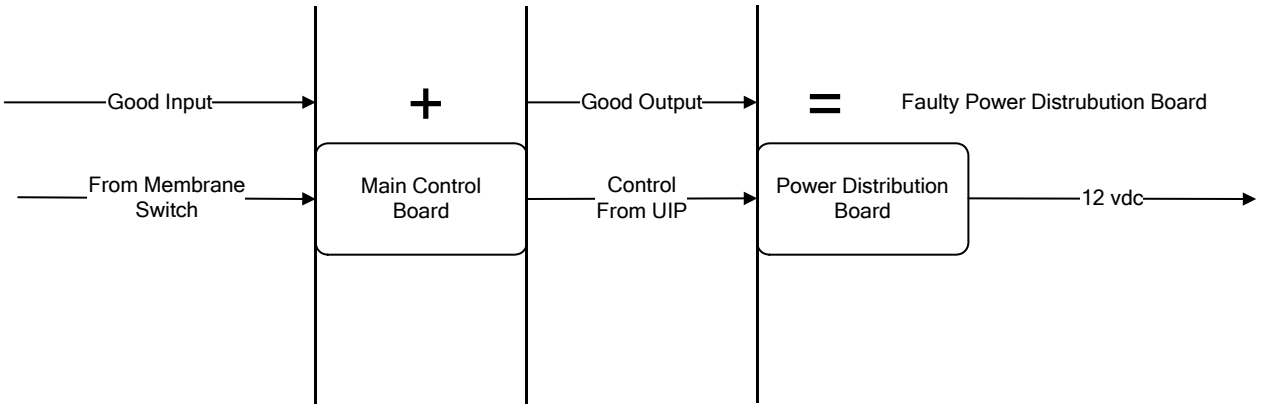


Figure 4a : Main Control Board Operating Correctly; Power Distribution Board is Faulty

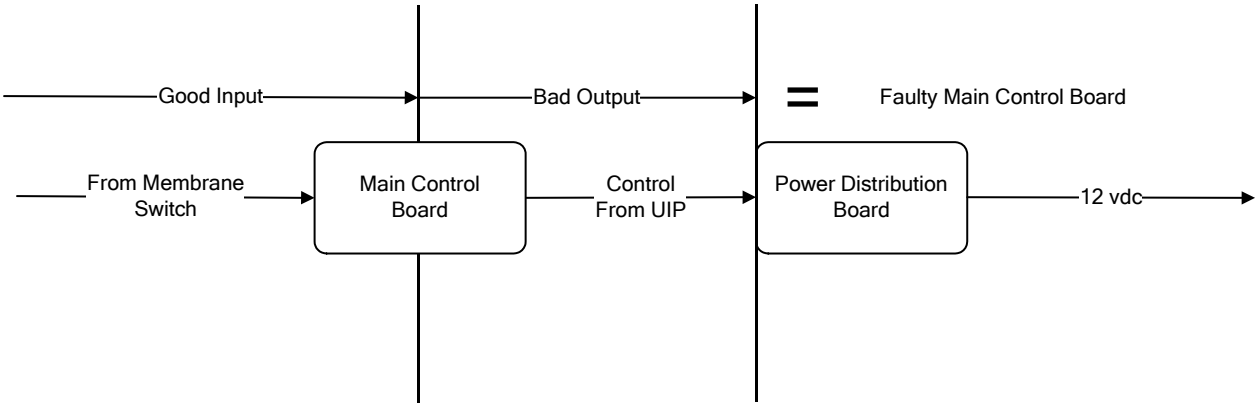
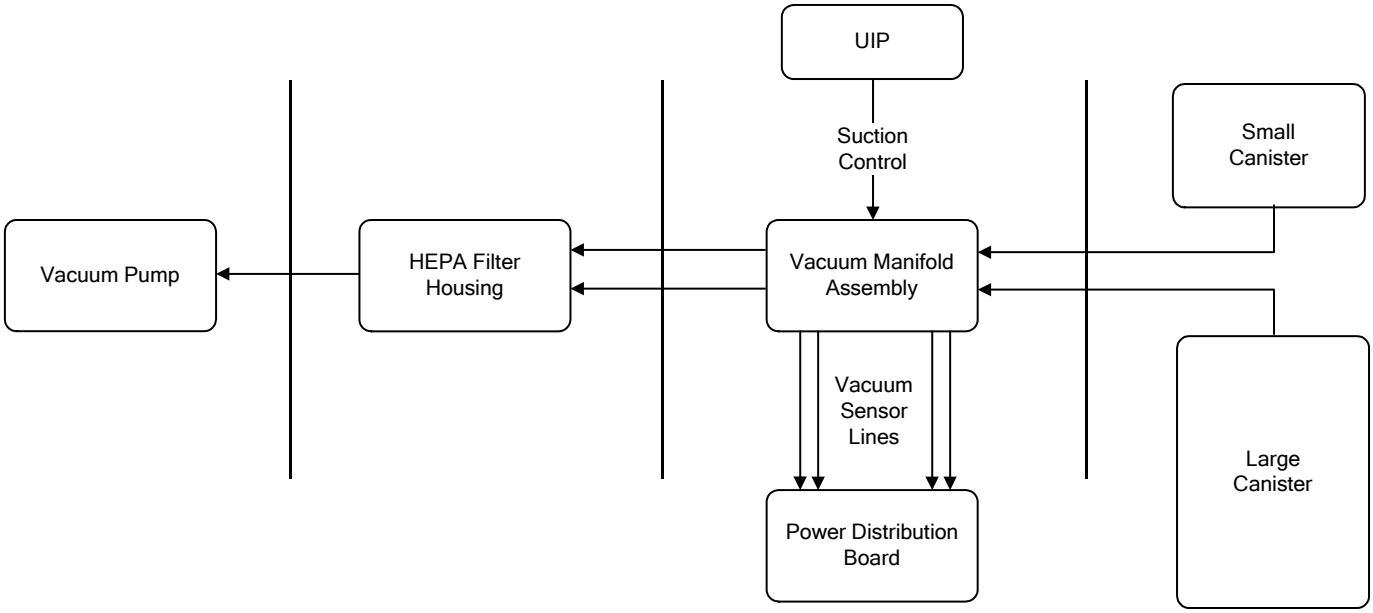


Figure 4b : Main Control Board Not Operating Correctly; Main Control Board is Faulty

Rover System Block Diagrams – Ultra Rover

Vacuum System

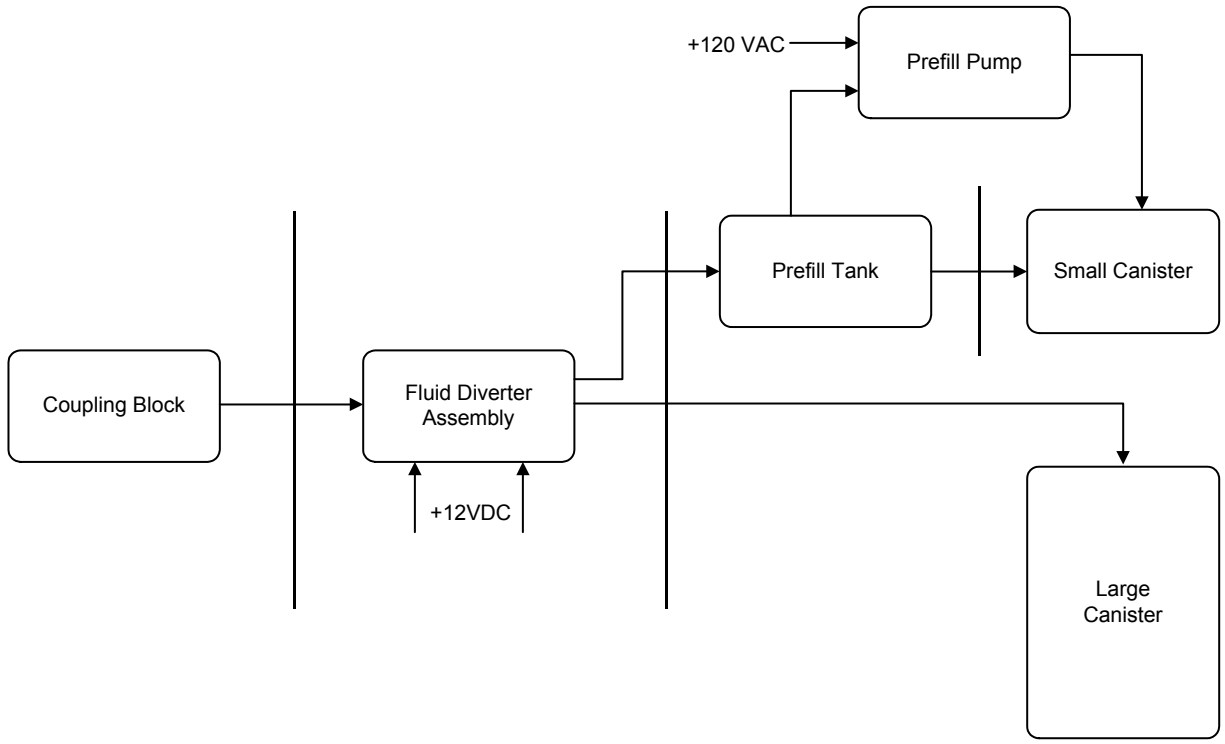
Although the vacuum pump is the source, it is *drawing* air in rather than exhausting. Just as in the troubleshooting example, a bad check at any point still requires a move ***towards*** the source. The technician should not confuse troubleshooting the vacuum pump with standard troubleshooting simply because it does not have an output. Checks are made the same way as with the rest of the system. The vacuum system block diagram is drawn with arrows pointing towards the vacuum pump to illustrate the air flow in the system, while the arrows going to the power control board represent a sample of the suction level going to the board. If suction is not present at a half-split point, the technician should check a point closer to the vacuum pump to determine where the failure lies.



Fresh Water System

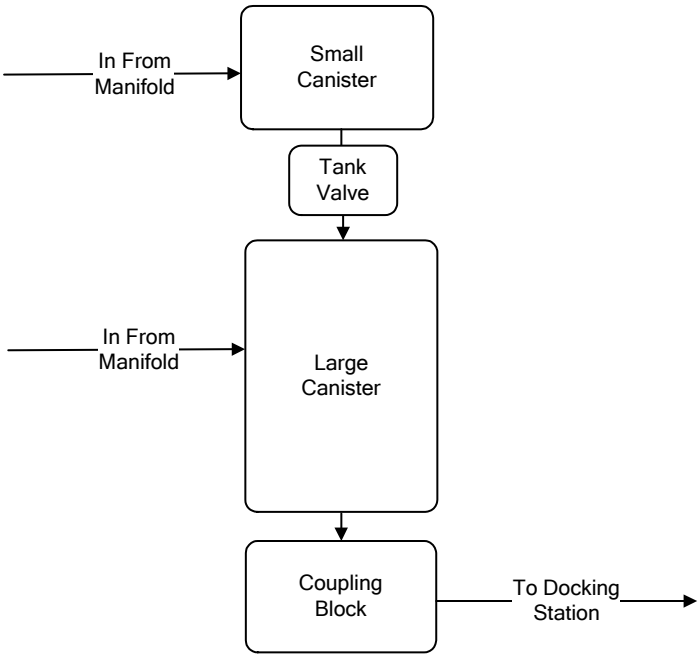
The fresh water system is used at two different times. During operation, the small tank can be emptied into the large tank after it is full. This would leave the small canister completely empty and unable to be used again. To prepare the small canister for use, we restore the prefill amount to the small canister. The prefill pump injects the prefill (taken from the prefill tank) back into the small canister. The prefill tank holds enough fluid for 3 prefills and once empty will require a docking cycle to refill the tank.

During the docking sequence, the fresh water system uses two solenoids to direct the water flow to either the small or large canister. The fresh water tubing for the large canister runs directly to the large canister cap. When the small canister is selected, water enters the small canister via the prefill tank. The water fills the prefill tank first to ensure that it is full, and then overflows from the top of the tank through another hose that is connected to the small canister cap. Because a 120 VAC input is required, the prefill pump will not run unless the rover is plugged in.

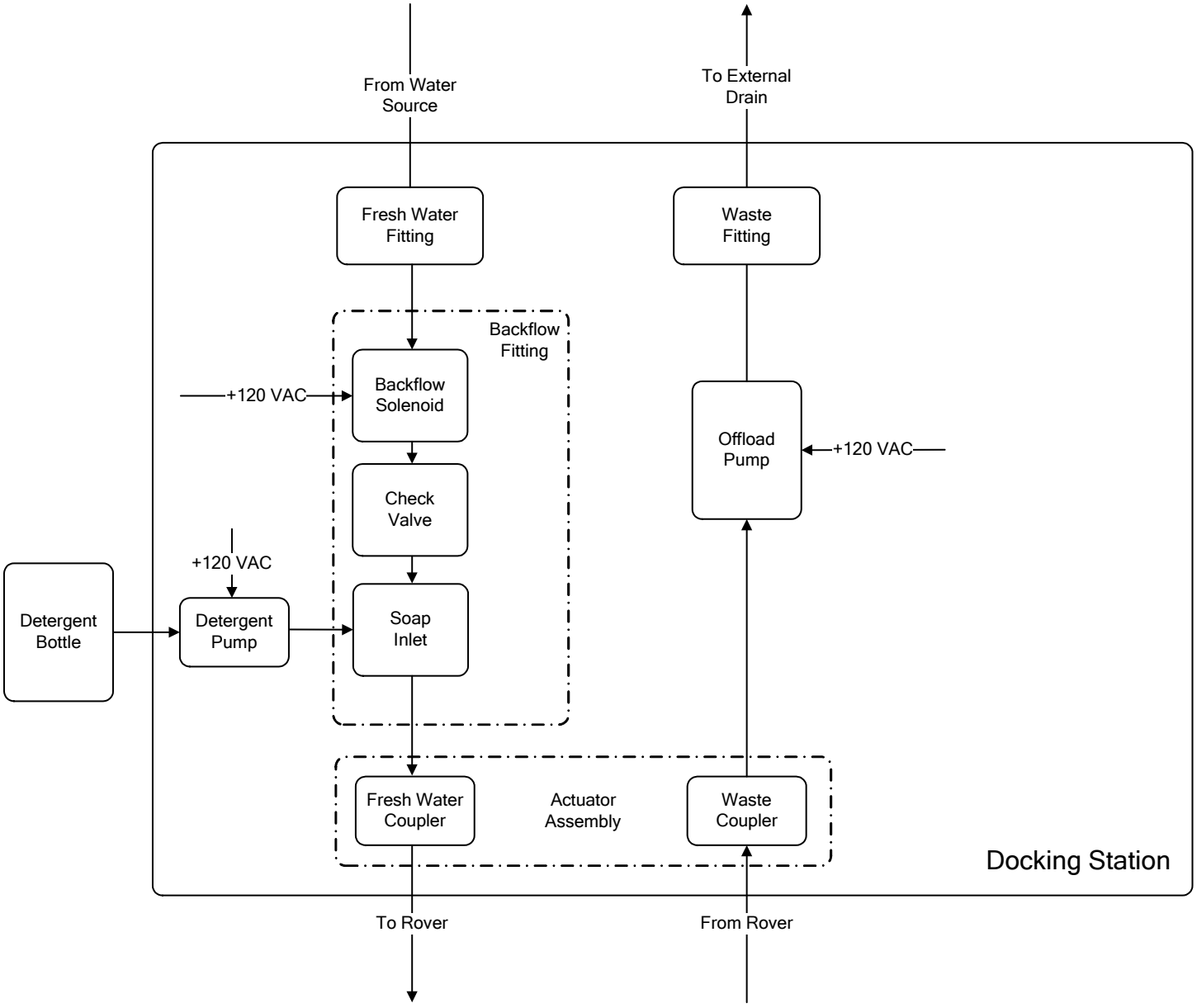


Waste System

The waste system is vertically aligned. Surgical fluid enters both canisters through either a single-port or four-port manifold. Fluid from the small canister empties into the large canister via a quarter turn drain valve. The large canister is tapered at the bottom to allow connection directly to the waste coupler without any tubing needed. Fluid leaves the coupling block and exits through the docking station's external waste hose.



Docking Station Block Diagram



System Troubleshooting Chart

Main Control Board

Component	Measurement Location	Black Lead	Red Lead	Reading	Unit of Measure	State
Main Control Board	J7 on Board	Pin 7	Pin 1	20	VDC	Rover power on, system idle
			Pin 2	5	VDC	Rover power on, system idle
			Pin 3	3.3	VDC	Rover power on, system idle
	J8 on Board	Pin 1	Pin 2	3.3	VDC	Rover power on, system idle
			Pin 3	3.3	VDC	Rover power on, system idle
			Pin 4	3.3	VDC	Rover power on, system idle
			Pin 5	3.3	VDC	Rover power on, system idle
			Pin 6	3.3	VDC	Rover power on, system idle
			Pin 7	3.3	VDC	Rover power on, system idle
			Pin 8	3.3	VDC	Rover power on, system idle
			Pin 9	3.3	VDC	Rover power on, system idle
			Pin 10	3.3	VDC	Rover power on, system idle
			Pin 11	3.3	VDC	Rover power on, system idle
			Pin 12	n/a	n/a	n/a
			Pin 13	n/a	n/a	n/a
			Pin 14	5	VDC	Rover power on, system idle

Main Control Board

Component	Measurement Location	Black Lead	Red Lead	Reading	Unit of Measure	State
Main Control Board	J8 on Connector	Pin 1	Pin 2	0	Ohm	Connector removed, while pressing button A
			Pin 3	0	Ohm	Connector removed, while pressing button B
			Pin 4	0	Ohm	Connector removed, while pressing button C
			Pin 5	0	Ohm	Connector removed, while pressing button D
			Pin 6	0	Ohm	Connector removed, while pressing pole up
			Pin 7	0	Ohm	Connector removed, while pressing pole down
			Pin 8	0	Ohm	Connector removed, while pressing volume reset
			Pin 9	0	Ohm	Connector removed, while pressing rank dump
			Pin 10	0	Ohm	Connector removed, while pressing vacuum system
			Pin 11	0	Ohm	Connector removed, while pressing smoke evacuator
			Pin 12	n/a	n/a	n/a
			Pin 13	n/a	n/a	n/a
			Pin 14	n/a	n/a	n/a

AC Power Board, Volume Display Board, & Tank Valve Motor

Component	Measurement Location	Black Lead	Red Lead	Reading	Unit of Measure	State
AC Power Board	J2 on Backplane	Pin 12	Pin 1	120	VAC	AC power board removed, rover power on, system idle
	F3 on Board	Fuse end	Fuse end	0	Ohm	Fuse removed, rover power off
	F4 on Board	Fuse end	Fuse end	0	Ohm	Fuse removed, rover power off
	LED D2	n/a	n/a	n/a	n/a	LED lights when vacuum system button is pressed (on)
Volume Display Board	J1 on Board	Pin 6	TP3	3.3	VDC	Rover power on, system idle
		Pin 6	Pin 1	5	VDC	Rover power on, system idle
Tank Valve Motor	J1 - Motor Side	Pin 5, Brown	Pin 3, Yellow	5	VDC	Rover power on, system idle
		Pin 5, Brown	Pin 4, Blue	1.1	VDC	Rover power on, system idle
				1.1 - 2.0	VDC	Changing tank valve position, power on (Auto)
				1.1 - 2.0	VDC	Magnet at varying distances, power on (Manual)
	J1 - Wire Harness Side	Pin 1, Black	Pin 2, Red	1.0 - 12.0	VDC	Harness disconnected, changing tank valve position, power on

IV Pole, Fluid Diverter, Power Coupler, Prefill Pump, & Canister Calibration Board

Component	Measurement Location	Black Lead	Red Lead	Reading	Unit of Measure	State
IV Pole	J1 - Motor Side (IV Pole Motor)	Pin 1, Red	Pin 2, Black	12	VDC	While pressing IV pole up, power on (0v when pole stops at top)
	J2 - Motor Side (IV Pole Brake)	Pin 1, Red	Pin 2, Black	18	VDC	Rover power on, system idle (0v when pressing up or down)
Fluid Diverter	J1 - Wire Harness Side	Pin 2, Grey	Pin 1, Grey	12	VDC	Diverter set to "Large" in dock control menu, harness connected
		Pin 3, White	Pin 4, White	12	VDC	Diverter set to "Small" in dock control menu, harness connected
		Pin 2, Grey	Pin 1, Grey	35	VDC	Diverter set to "Large" in dock control menu, harness disconnected
		Pin 3, White	Pin 4, White	35	VDC	Diverter set to "Small" in dock control menu, harness disconnected
	J1 - Fluid Diverter Side	Pin 2, Grey	Pin 1, Grey	~13	Ohm	With the harness disconnected each solenoid should have approximately the same resistance.
		Pin 3, White	Pin 4, White			
Power Coupler	J1	Pin 8, Black	Pin 2, Red	5	VDC	Rover power on, system idle
		Pin 8, Black	Pin 3, Orange	3.3	VDC	Rover power on, system idle
	J3	Pin 1, Black	Pin 3, Red	18 - 20	VDC	When rover is docked
Prefill Pump	J1	Pin 1	Pin 3	~107	VAC	Connecter removed
		Pin 1	Pin 3	~120	VAC	Prefill set to "On" in dock control menu, connecter removed
Canister Calibration PCBA	J1 - Wire Harness Side	Pin 1, Black	Pin 2, White	0	VDC	Rover power on, system idle
			Pin 3, Green	3.3	VDC	
			Pin 4, Brown	3.3	VDC	
			Pin 5, Red	3.3	VDC	

System Settings Menu Overview

The system settings menu allows the operator (the O.R. staff) to adjust the settings and indicators for the Neptune 2. The options in this menu *only* adjust operational settings such as fluid and suction units of measure, display brightness, and display contrast. While the operator will make most of these adjustments, the technician can certainly adjust these values if requested. The system settings menu also serves as a platform for which to enter the technician menu, which is discussed in the next section.

Adjusting System Settings

1. Verify the power switch is in the off position.
2. Ensure the power cord is connected between the rover and facility power.*
3. Push the control panel display button and the power button to on simultaneously (see figure 1).

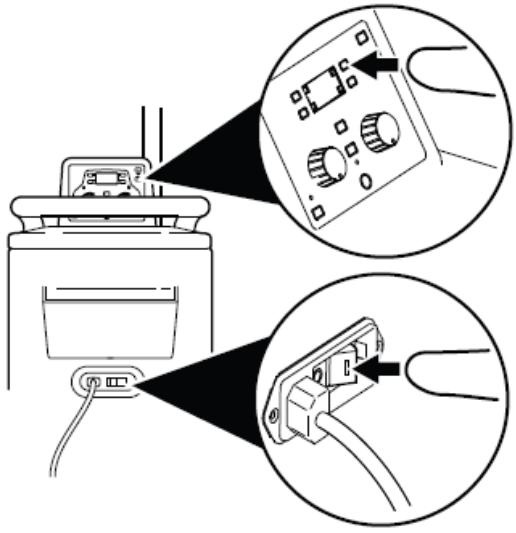


Figure 1: To Access System Setup

* This can also be accomplished by pushing the rover up to the docker and immediately proceeding to step 3. The rover is powered by the docker and does not need to be plugged in when docking.

4. Once the Neptune 2 splash screen appears, continue to push the display button until the tools indicator in the upper right corner is highlighted solid white (see figure 2).

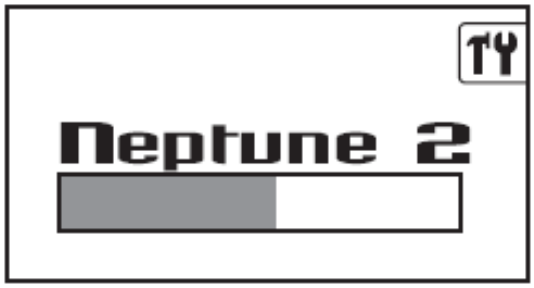


Figure 2: Neptune Splash Screen

5. From the system setup screen, push the buttons next to the arrow icons (on the left side) to highlight the appropriate system setting (see figure 3).

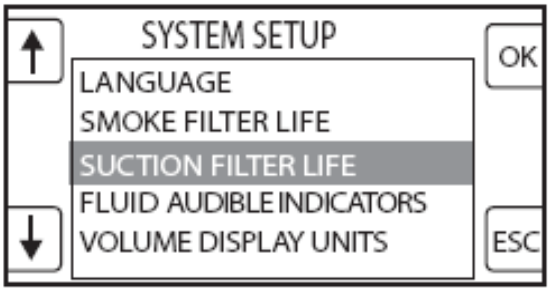


Figure 3: System Setup Screen

6. From the system setting screen, push the buttons next to the arrow icons to highlight or adjust the appropriate setting option (see figure 4). See the *System Setting Options* in table 4.0 for available settings.

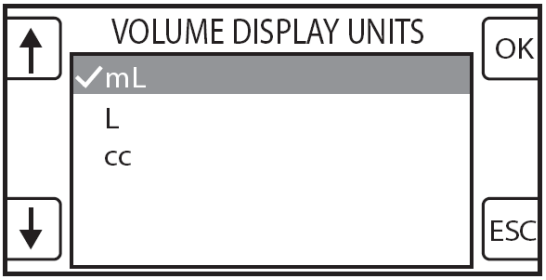


Figure 4: Sample System Setting Screen

7. Push the button next to the OK icon to select the appropriate system setting option. Push the button next to the ESC icon to cancel the selection and exit the screen.

Note: To reset the smoke filter timer or HEPA filter timer, see the instructions for use supplied with the filter for more information.

System Setting Options

SETTINGS	OPTIONS	FACTORY DEFAULT
Volume Display Units	mL [milliliter]	mL
	L [liter]	
	cc [cubic centimeters]	
Volume Display Bright	0 - 100%	50%
Fluid Audible Indicators	4-liter canister	600 mL (remaining capacity)
	20-liter canister	2000 mL (remaining capacity)
Vacuum Display Units	in-Hg [inches of mercury]	in-Hg
	mm-Hg [millimeters of mercury]	
	kPa [kilopascals]	
Vacuum Display Bright	0 - 100%	50%
Vacuum Display Contrast	0 - 100%	50%
Smoke Filter Life	RESET TIMER TO ACCEPT	80 hours
Suction Filter Life	RESET TIMER TO ACCEPT	500 hours
Language	English	English (only)
	Spanish [Espanol]	(future availability)
	French [Francais]	(future availability)
	German [Deutsch]	(future availability)
	Italian [Italiano]	(future availability)
	Polish [Polski]	(future availability)
	Chinese	(future availability)
	Japanese	(future availability)

Table 4.0 : System Settings Options

Technician Menu Overview

The technician menu is used to assist the technician with diagnostics and troubleshooting for the Neptune 2. The options in this menu allow for much more extensive control than the system settings menu. Here a technician can manually dock and offload a rover, analyze the performance of the volume sensing components, as well as verify the proper vacuum response. This menu is *only* accessible by the technician and should not be shared with anyone who has not been authorized by Stryker.

CAUTION: The safeguards for all control features are bypassed when in technician mode! When docking manually, make sure to note how much fluid is in each canister ***prior*** to turning on the water. The Neptune 2 software ***will not*** disengage the fluid diverter if the canisters are at full capacity when in manual mode.

To Access the Technician Menu

1. Follow the instructions to access the system settings menu.
2. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button (see figure 5).

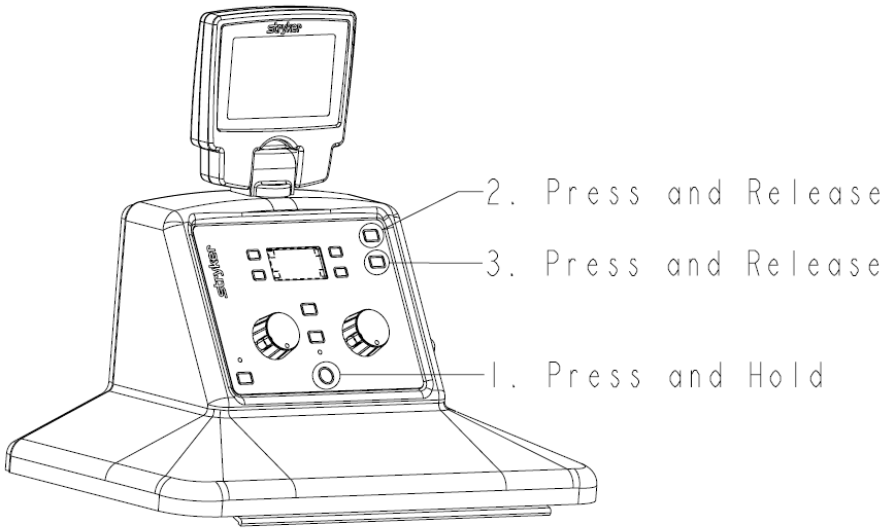


Figure 5: Access the Technician Menu

3. From the technician menu, push the buttons next to the arrow icons (on the left side) to highlight the appropriate system setting (see figure 6).

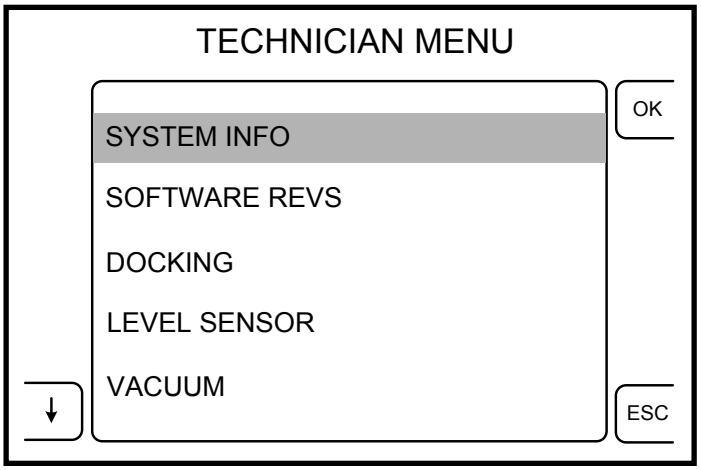


Figure 6: Technician Menu

4. Push the button next to the OK icon to select the appropriate technician menu option. Push the button next to the ESC icon to return to the system settings menu (see figure 6).

5. Once the desired selection has been made the technician can access the various sub-menus within the technician menu. (see figure 7) Refer to ***Technician Menu Options*** for a list of available menus and diagnostic functions.

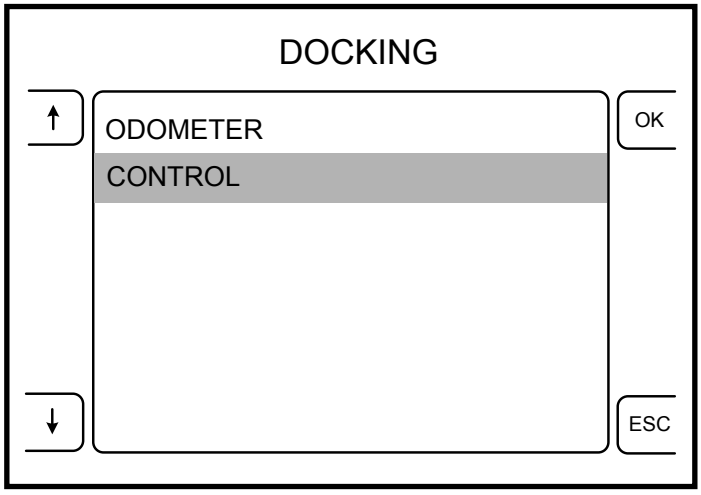


Figure 7: Sample Sub-Menu

Technician Menu Options

Menu Option	Displays	Detail
System Info	System Info Screen	
	PN	Rover part number
	SN	Rover serial number
	Date	Lists current date
	Time	Lists current time
Software Revs	Software Rev Screen	
	Small Vacuum	This screen displays the current software revision and build level for each of the listed circuit boards. The information will change as software is updated.
	Large Vacuum	
	Valve	
	Smoke	
	Canister	
	Pole	
	Level	
	EDMS	
	Vol Display	
	Main Control	
Docking	Docking Menu	
	Odometer	Records the total of each type of docking cycle (quick drain, normal, and extended wash) and the min/max water flow for the life of the docker.
	Control	
	Magnet	Indicates whether the magnet is on or off *
	Couplings	Press OK to change the status of the couplings: extending, extended, retracting, retracted, or error**
	Offload	Press OK to turn the offload pump on or off
	Drain Valve	Press OK to change the status of the drain valve: opening, open, closing, or closed
	Diverter	Press OK to change the status of the diverter: small, large, or closed.
	Water	Press and hold OK to turn the water on or off ***
	Prefill	Press and hold OK to turn the prefill pump on or off
	Soap	Press OK to turn the soap injector pump on or off ****
	Docked	Press OK to change the docking status to yes or no

* The magnet is activated by the “docked” feature. The magnet setting merely indicated the present magnet status.
** Set the diverter valve to “Large” before extending the couplings. This releases back pressure in the couplers.
*** The water will only flow if the diverter is set to either “small” or “large”. If the diverter is closed the water has no place to go.
**** The soap will not flow through the detergent pump if the diverter is set to closed.

Menu Option	Displays	Detail
Docking	Cycles	
	Quick Drain	Press OK to perform the selected cycle. (If connected to a docking station)
	Wash	
	Extended Wash	
	Shipping	
Level Sensor	Level Sensor Menu	
	Level Data	
	Float	Hexadecimal value for the float sensor position
	Ref	Hexadecimal value for the reference magnet position
	Diff	Difference in the reference and float magnet positions
	Volume	Displays the fluid volume for each canister (in milliliters)**
	Calibrate Float	
	4L Canister	Press OK to enter the calibration screen
	1000 ml	Use up and down arrows to adjust the amount of fluid used for calibration. Acceptable range is 500ml - 1500ml. (1000ml is ideal)
	20L Canister	Press OK to enter the calibration screen
	1000 ml	Use up and down arrows to adjust the amount of fluid used for calibration. Acceptable range is 500ml - 1500ml. (1000ml is ideal)
Vacuum	Vacuum Menu	
	Regulator	
	Enc	Indicates the total angle of rotation for the regulator disk. (This value is typically 110˚ – 113˚)
	Avg Mcur	Displays the average current draw of each regulator. (This value is updated each time the rover initializes) Current draw should not exceed 1500mA.
	Pos	Displays the real-time position of the regulator disk.
	PS Volt	Displays the real-time voltage of the power supply. Should be ≈ 18vdc when docked, when plugged in ≈ 25vdc - 40vdc.
	PS Cur	Displays the real-time current of the power supply. This should typically be less than 100mA.
	Mcur	Displays the real-time current draw of the regulator. (This is different from the average motor current.)
	Sensors	
	Pri	Displays the primary vacuum sensor readings for the small canister (left side) and large canister (right side).
	Sec	Displays the secondary vacuum sensor readings for the small canister (left side) and large canister (right side).

* The shipping cycle uses antifreeze instead of detergent to prepare the equipment for shipping in areas with sub freezing temperature.

** The level sensor “Volume” display reading is four digits. The unit of measure is mL. Therefore, a reading of 2380 equals 2.38 liters.

Menu Option	Displays	Detail
Diagnostics	Diagnostics Screen	
	TO	Displays the maximum timeout value. The timeout value measures the largest gap in communication between the rover and docker.
	Docker Present	Displayed below the timeout value when the rover is docked.
	Volt	Displays the voltage at the power coupler board. When docked this value should be 18vdc, when plugged in this value should be 36vdc.*
	Tries	These figures indicate the number of packets sent, received, and missed. Values should begin at 0 and increase while docked.
	Pass	
	Miss	
	Flow	Indicates the water flow rate measured in ml/s.**
	PD	Celsius temperature reading of the power distribution board.
	SC	Celsius temperature reading of the small canister.
	LC	Celsius temperature reading of the large canister.
Reprogramming	Reprogramming Menu	
	Reset EEPROM	Press OK to reset all stored values to zero.***
	Reprogram PD	Press OK to reprogram the Power Distribution PCB.****
	Reprogram Main	Press OK to reprogram the Main Control PCB only.

* The diagnostics screen “Volt” reading is four digits. The unit of measure is vDC. 18 and 36 volts will be displayed as 1800 and 3600 volts respectively. (These values may be approximate.)

** The flow rate can only be accessed at the end of each docking cycle. If the menu is not accessed immediately following a docking cycle, (when screen displays “Press OK to release”) the value will read zero.

*** Resetting the EEPROM will erase all of the stored values to include the min and max water flow, canister calibration, docking odometer records, and any user adjustments to brightness and contrast. The rover MUST be calibrated again once this has been performed!

**** Selecting this option will also reprogram the software for the other units in the rover. Use this to reprogram the large and small regulators, the tank dump valve, IV Pole, smoke evacuator, and canister calibration PCBA.

Neptune Error Messages

Neptune 2 Error Codes				
System	**Number**	**Error**	**Possible Cause**	**Trouble Shooting**
SYSTEM	0.0	Power Distribution reset switch	These errors are not likely to occur in the field. These are in place to ensure that unit passes testing during the manufacturing process. If error occurs, it is possible circuit boards have been damaged.	N/A
	0.1	Volume display reset switch		
	0.2	System not programmed		
	0.3	Main Control Rev Mismatch		
	0.4	Power Dist / Volume Display Micro Rev Mismatch		
EEPROM	1.0	RMC EEPROM checksum error	- EEProm failed	- Replace Main Control Board
	1.1	RMC EEPROM error	- Main control board not initialized	- Reprogram eeprom in technician menu - Recalibrate both canisters
	1.2	RMC EEPROM checksum error	- EEProm failed	- Replace Main Control Board
	1.3	Small tank calibration board error	- Calibration board failed	- Replace small or large canister - Calibrate float (see ***Performing the Canister Calibration*** on page 6-11)
	1.4	Large tank calibration board error		
	1.5	Power Distribution EEPROM read error	- Power distribution board failed	- Replace power distribution board

System	Number	Error	Possible Cause	Trouble Shooting
EEPROM	1.6	Small tank float calibration error	- Canister was replaced and float was not calibrated - Main controller PCBA was replaced - EEPROM was reset in technician mode	- Recalibrate small canister - Calibrate float (see ***Performing the Canister Calibration*** on page 6-11)
	1.7	Small tank float calibration error		- Recalibrate large canister - Calibrate float (see ***Performing the Canister Calibration*** on page 6-11)
	1.8	PNSN EEPROM error	- Serial number board detected did not match the expected value	- Verify serial number board is seated properly
COMM	2.0	UART checksum error	N/A	N/A
	2.1	UART timeout error	N/A	N/A
	2.2	TWI port expander error	- Main controller board failed	- Replace main controller board
	2.3	TWI MAIN eeprom error	N/A	N/A
	2.4	TWI timeout	N/A	N/A
	2.5	TWI PNSN eeprom error	- Serial number board has been unplugged	- Verify serial number board is seated properly

System	Number	Error	Possible Cause	Trouble Shooting
DOCKING	3.0	Docker communication error	- Rover main control board bad - Rover IR board bad - Docker IR board bad - Wiring harness bad	Problem is most likely due to IR communication failure. Check IR to make sure it is connected properly and is not obstructed. If a component has failed you will most likely receive a "Docker not Ready" fault as well.
	3.1	Coupling Extend Timeout	- Diverter valve failed - Extend hall sensor failed - Physical obstruction in the waste couplers	- Manually fill water in large tank to verify diverter is switching properly (using dock control) - Refer to procedure 6.8 ***Manually Raising and Lowering Docker Coupler*** on page 6-43 to verify proper hall sensor operation. - Check for obstruction in waste coupler
	3.2	Coupling Retract Timeout	- Retract hall sensor bad - Stepper motor failed or mounting hardware loose	- Verify stepper motor is mounted properly. - Replace the retract hall sensor.
	3.3	Offload error - small tank	- Fluid is not offloading due to clog. - Something preventing float from reaching the bottom of tank. - Small canister calibration board damaged. - Level transducer damaged. - Calibration is incorrect.	- Verify that something is not blocking the drain valve from emptying. - Verify nothing is underneath the float. - Recalibrate the canister. - Replace small tank float sensor - Replace small canister - Replace fluid level transducer
	3.4	Offload error - large tank	- Calibration is incorrect - Clog or obstruction in the large canister - Offload pump not running	- Recalibrate large canister - Check for and remove clog or obstruction - Check for proper voltage at offload pump
	3.5	Prefill error - small tank	- Calibration is incorrect; - Water has been shut off	- Recalibrate - Turn water on
	3.6	Prefill error - large tank	- Calibration is incorrect; - Water has been shut off	- Recalibrate - Turn water on
	3.7	Extend / Retract Sensor Error	- Water on the sensors. - Faulty sensors. - Faulty docker control board - Faulty wiring harness	- Ensure sensors are not wet. - Replace sensors. - Replace docker control board. - Check wiring harness.

System	Number	Error	Possible Cause	Trouble Shooting
DOCKING	3.8	Coupling Door Sensor Error	- Actuator door sensor failed	- Replace sensor
	3.9	Stepper Motor - Open Winding	N/A	- Replace connector - Replace wiring harness - Replace stepper motor
	3.10	Stepper Motor - Current Control Timeout	N/A	- Replace connector - Replace wiring harness - Replace stepper motor
	3.11	Invalid or No S/N	N/A	N/A
	3.12	Docking cycle not completed	- This fault will be present at power up if the rover had any error while docking.	- Redock the rover
	3.13	Docker not ready	- Docker did not respond to rover.	1. Turn docker off and back on 2. Wait two minutes 3. Dock the rover again. If the problem does not go away then check IR circuitry.
	3.14	Dock coupling switch error	- Docker door sensor is bad - Docker IR board is bad - Rover IR board is bad - Wiring harness is bad	- Replace door sensor - Replace docker or rover IR board

System	Number	Error	Possible Cause	Trouble Shooting
EMPTY TANK	4.0	High volume error	N/A	- Dock the rover
	4.1	High vacuum error	- Vacuum regulator may be clogged - Power distribution board failed	- Verify vacuum regulator is not plugged at exhaust port. - Replace power distribution board - Replace vacuum regulator
	4.2	Valve error	- Something stuck in drain valve - Drain valve bad - Power distribution board bad - Bad wiring harness to drain valve motor	- Try to manually turn valve with a wrench to verify that it turns. - Replace drain valve - Replace power distribution board - Check for proper voltage at wire harness
	4.3	Empty timeout	N/A	- Set suction to 21 in/Hg on both tanks and try to perform a tank dump.
	4.4	Prefill timeout	- Prefill pump is not running - Fluid level transducer not functioning - Faulty power distribution board - Prefill tank is empty	- Verify proper operating voltage for prefill pump. - Replace rover power distribution board. - Dock the rover
	4.5	Prefill Empty	N/A	- Dock the rover
FILTER	5.0	HEPA Filter Life	N/A	- Replace filter and reset hours in the system settings menu.
	5.1	Smoke Filter Life	N/A	- Replace filter and reset hours in the system settings menu.
VALVE	6.0	Drain valve timeout	- Something stuck in drain valve - Drain valve bad - Power distribution board bad - Bad wiring harness to drain valve motor	- Try to manually turn valve with a wrench to verify that it turns. - Replace drain valve - Replace power distribution board - Check for proper voltage at wire harness
	6.1	Valve comm error	- Wiring harness bad between power distribution board and main control board. - Power distribution board bad - Main control board failed	- Ohm check wiring harness - Replace power distribution board - Replace main control board

System	Number	Error	Possible Cause	Trouble Shooting
LEVEL	7.0	Gradient fetch error	- Possibly the fluid level transducer	- Hook up a different transducer outside the rover to verify error goes away. If it doesn't it could be the wire harness or the boards.
	7.1	Level sensor initialize error	- Bad fluid level transducer - Bad magnet(s) (reference or float) - Bad wiring harness or connector	May come up with other magnet errors
	7.2	Level sensor comm error	- Usually accompanies a 7.0 error	N/A
	7.3	Small magnet delta outside cal table - low	- Prefill is gone	Always get if prefill is low, if in technician mode… If empty
	7.4	Small magnet delta outside cal table - high	- Fluid raised higher than 4 liter mark.	N/A
	7.5	Large magnet delta outside cal table - low	- Unit has no prefill	- Check canister for leaks
	7.6	Large magnet delta outside cal table - high	- Fluid raised higher than 20 liter mark	- Verity fluid level in canister
	7.7	Under prefill error - small tank	- May accompany a 7.3 error - Could be a leak	- Check canister for leaks
	7.8	Under prefill error - large tank	- May accompany a 7.5 error - Could be a leak	- Check canister for leaks

System	Number	Error	Possible Cause	Trouble Shooting
LEVEL SCAN	8.0	Missing all magnets 100%	The magnet errors are designed to indicate what percentage of time the software reads the magnets. There are three states of magnet reporting that are listed in three, varying percentages of time. The three states are ALL, EXTRA, and no modifier (for only one). These three conditions can exist in varying degrees ranging from 1-5 at the lowest, to 5-128, to 100% of the time. **Missing:** Indicates only one magnet missing. **Extra:** Indicates only one extra magnet. **Missing All:** Indicates all magnets are missing. **1-5:** The reading was missed 1 to 5 out of 128 times. **5-128:** The reading was missed 5 to 128 out of 128 times. **100%:** The reading was missed 100% of the time **<u>Causes</u>** - Check the magnets in technician mode to verify proper operation. - Level sensor is not in the correct position at bottom of canister. - Cracked or broken reference or float sensor. - Electromagnetic interference	- Verify magnets are operating properly. (see ***Finding a Missing Magnet*** on page 6-37) - Verify fluid level transducer is installed correctly. (see ***Separation of Large and Small Canister Assemblies*** on page 2-31)
	8.1	Missing all magnets 5-128		
	8.2	Missing all magnets 1-5		
	8.3	Extra magnet 100%		
	8.4	Extra magnet 5-128		
	8.5	Extra magnet 1-5		
	8.6	Missing magnet 100%		
	8.7	Missing magnet 5-128		
	8.8	Missing magnet 1-5		
POLE	9.0	Pole comm error	- Wiring harness from the main control board to power distribution board bad - Main control board bad - Power Distribution board bad	- Ohm check interface wiring harness
	9.1	Pole timeout	- Belt on pole assembly is broken - Motor is broken	- Replace main control board
	9.2	Pole Motor Resistance	- IV pole cable(s) unplugged - IV Pole motor winding damaged	- Replace power distribution board

System	Number	Error	Possible Cause	Trouble Shooting
SMOKE	10	Smoke comm error	- Wiring harness bad between power distribution board and main control board. - Power distribution board bad - Main control board failed	- Ohm check wiring harness - Replace power distribution board - Replace main control board
	10.1	Smoke Controller 50/60 Hz Detection Error	- Always displayed when powered by docker - Bad AC Power board - Wiring harness from the main control board to power distribution board bad	N/A
	10.2	No smoke sensor detected	- Smoke ULPA filter not engaged fully - Wiring harness damaged - Smoke ULPA filter damaged	- Insert smoke ULPA filter - Ohm check / replace wiring harness - Replace smoke ULPA filter
VOL DISPLAY	11.0	Volume display comm error	- Wiring harness bad between volume display and main control board. - Power distribution board bad - Main control board failed	- Ohm check wiring harness - Replace volume display - Replace main control board
CANISTER	12.0	Canister reader comm error	- Wiring harness bad between power distribution board and main control board. - Power distribution board bad - Main control board failed	- Ohm check wiring harness - Replace power distribution board - Replace main control board
	12.1	FPGA load error	N/A	- Replace power distribution board
	12.2	FPGA flash error	N/A	- Replace power distribution board
	12.3	Ambient temp sensor error	N/A	N/A
	12.4	Small tank temp sensor error	- Wiring harness going to the canister calibration board - Canister calibration board failed	- Ohm check wiring harness - Replace canister
	12.5	Large tank temp sensor error	- Wiring harness going to the canister calibration board - Canister calibration board failed	- Ohm check wiring harness - Replace canister
	12.6	Small tank eeprom error	- Wiring harness going to the canister calibration board - Canister calibration board failed	- Ohm check wiring harness - Replace canister
	12.7	Large tank eeprom error	- Wiring harness going to the canister calibration board - Canister calibration board failed	- Ohm check wiring harness - Replace canister

System	Number	Error	Possible Cause	Trouble Shooting
VACUUM - LARGE - VAC	13.0	UART Error	- Wiring harness bad between power distribution board and main control board. - Power distribution board bad - Main control board failed	- Ohm check wiring harness - Replace power distribution board - Replace main control board
	13.1	Primary Vac Sensor out of range low	- Sensor on power distribution board is bad - Canister is pressurized **Note:** This fault is caused by faulty sensors or by actual positive pressure in the sensor lines. Although vacuum is negative pressure, it is displayed as a positive value on the screen. (i.e. 14 in/Hg) So a negative pressure is displayed as a positive value, and a positive pressure is displayed as a negative value. With no sensor lines attached, the sensors should read very close to zero. If the value displayed in technician menu does not change when the sensor lines are removed, then the sensors are bad. If it does change, then the sensors were working properly and the canister was pressurized. 13.1 and 13.3 will fault if lower than -.3 in/Hg (-.4, -.5, etc). Faults 13.2 and 13.4 will fault if higher than 24 in/Hg.	- Enter technician mode and go to the level sensor LEVEL DATA screen. - Unplug all sensor lines on power distribution board. **IF:** **suction displays a negative number,** replace the power distribution board. **suction displays a positive number ,** then the canister is pressurized. Find out what is causing the positive pressure in the canister.
	13.2	Primary Vac Sensor out of range high		
	13.3	Secondary Vac Sensor out of range low		
	13.4	Secondary Vac Sensor out of range high		
	13.5	Vacuum Vent Error	- Vacuum regulator may be clogged	- Verify vacuum regulator is not plugged at exhaust port.
			- Power distribution board failed	- Replace power distribution board
				- Replace vacuum regulator

System	Number	Error	Possible Cause	Trouble Shooting
VACUUM - LARGE - VAC	13.6	Positive Pressure	- Sensor on power distribution board is bad - Canister is pressurized **Note:** This fault is caused by faulty sensors or by actual positive pressure in the sensor lines. Although vacuum is negative pressure, it is displayed as a positive value on the screen. (i.e. 14 in/Hg) So a negative pressure is displayed as a positive value, and a positive pressure is displayed as a negative value. With no sensor lines attached, the sensors should read very close to zero. If the value displayed in technician menu does not change when the sensor lines are removed, then the sensors are bad. If it does change, then the sensors were working properly and the canister was pressurized. 13.1 and 13.3 will fault if lower than -.3 in/Hg (-.4, -.5, etc). Faults 13.2 and 13.4 will fault if higher than 24 in/Hg.	- Unplug all sensor lines on power distribution board. - Enter technician mode and go to the level sensor LEVEL DATA screen. **IF:** **suction reads a negative pressure,** replace the power distribution board. **suction reads a positive pressure or zero,** then the canister is pressurized. Find out what is causing the positive pressure in the canister.
	13.7	Overshoot	- Vacuum regulator can not physically control the amount of suction in the canister.	- Replace vacuum regulator - Replace power distribution board
	13.8	Vacuum Sensor mismatch	- Vacuum sensor line is off or is pinched - Fluid in one of the vacuum sensor lines - Bad power distribution board	- Verify that sensor lines are intact and properly installed. - Clear fluid from sensor lines - Replace power distribution board
	13.9	SPI Comm Error	N/A	N/A
	13.10	Vacuum Controller Comm Timeout	- Power distribution board failed - Main control board failed This fault usually accompanies other errors. Clear the fault in technician mode to verify if fault comes back. If fault clears then problem does not really exist. If it comes back, continue troubleshooting using two methods listed for this error code.	- Replace power distribution board - Replace main control board

System	Number	Error	Possible Cause	Trouble Shooting
VACUUM - LARGE - MOT	14.0	Regulator Init span high	Most vacuum errors can be narrowed to either the regulator or the power distribution board and associated wiring harness. To determine which has failed, swap the connectors for the large and small tank regulators. If the problem occurs in the other canister after the switch, then the regulator is bad. (part of the vacuum manifold assembly P/N 0702-001-110) If not, then proceed to check the wiring harness and power distribution board.	- Replace vacuum manifold assembly
	14.1	Regulator Init span low		
	14.2	Open motor control circuit		- Replace vacuum manifold assembly - Replace wiring harness
	14.3	Stalled regulator motor		- Replace vacuum manifold assembly
	14.4	Open on Encoder Circuit		- Replace vacuum manifold assembly - Replace wiring harness
	14.5	Shorted motor control circuit		- Replace power distribution board
	14.6	Motor Voltage Rail Low		- Check DC voltage while docked
	14.7	Motor Voltage Rail High		- Replace power distribution board
	14.8	PS Current Offset Error		- Replace power distribution board
	14.9	Motor Current 1 Offset Error		- Replace power distribution board
	14.10	Motor Current 2 Offset Error		- Replace power distribution board
	14.11	Power Good Error	N/A	- Replace power distribution board
VACUUM - SMALL - VAC	15.X	See Large Vacuum Errors (13.x)	These errors are the same as those for the small canister.	N/A
VACUUM - SMALL - MOT	16.X	See Large Vacuum Errors (14.x)	These errors are the same as those for the small canister.	N/A
POWER COUPLER	17.0	Power Coupler Communication Timeout	These errors are not likely to occur in the field. They are in place to verify that the manufacturing process was followed correctly.	N/A
	17.1	Power Coupler - WD Reset		
	17.2	Power Coupler - Locked Out		
	17.3	Power Coupler - I Limit		

Chapter 6 – Technical Procedures

Technical Procedures Overview

The technical procedures section guides the technician by using a step-by-step process. This section details the procedures necessary to perform specific maintenance for the system, such as priming the docker detergent pump and reprogramming software. Check the table of contents for a complete list of procedures.

Procedure 6.1 – Priming the Detergent Pump

This procedure is to be used when installing a new detergent pump (P/N 0702-014-380) during a repair, or when an existing detergent pump is not functioning properly. It is important to note that the rover will be powered off when docking the unit. In order to perform the following procedure the technician will be required to access the technician menu while docked. Once the rover has been powered by the docking station, proceed through the menu as normal. The only difference in accessing the menu while docked is that the docker is used to power the rover instead of the AC outlet.

a. To access the System Settings Menu while docked, hold down the display button in the upper-right hand corner and dock the unit. (See figure 1)

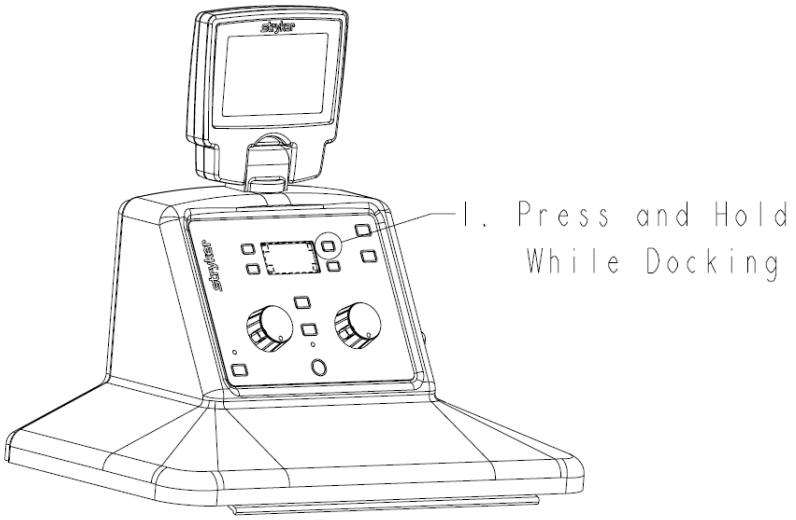


Figure 1: Accessing Menu While Docked

b. Once the Neptune 2 splash screen appears, continue to push the display button until the tools indicator in the upper right corner is highlighted solid white (see figure 2)

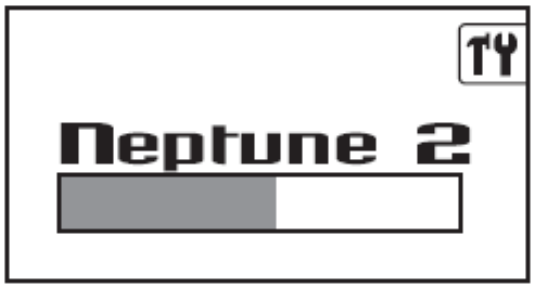


Figure 2: Neptune Splash Screen

c. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button. (see figure 3)

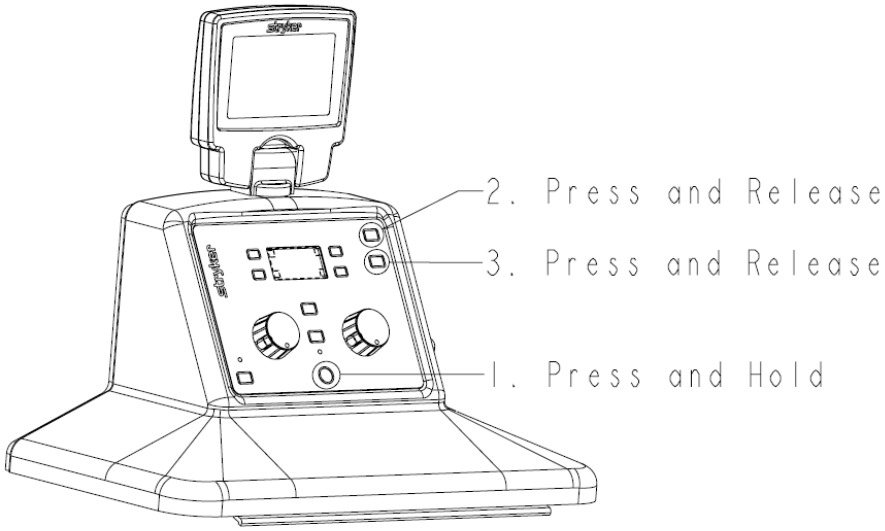


Figure 3: Accessing the Technician Menu

d. Once the technician menu is displayed, push the button next to the arrow icon (on the left side) to highlight the DOCKING option. Then press the button next to the OK icon to select the docking menu. (see figure 4)

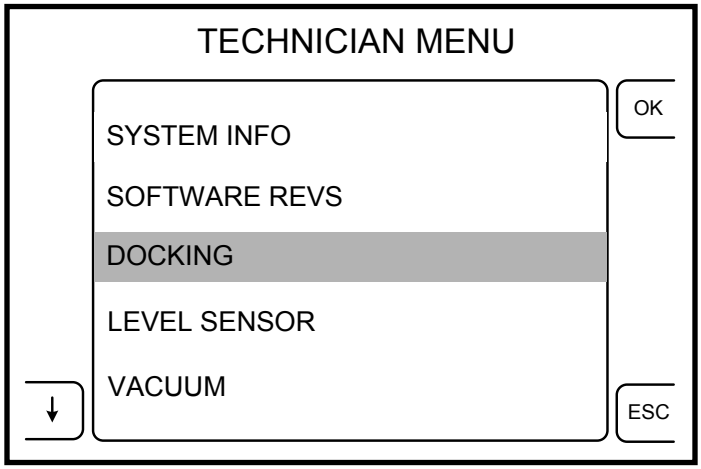


Figure 4: Select DOCKING Option

e. Next, push the button next to the arrow icon (on the left side) to highlight the CONTROL option. Then press the button next to the OK icon to select the docking menu. (see figure 5)

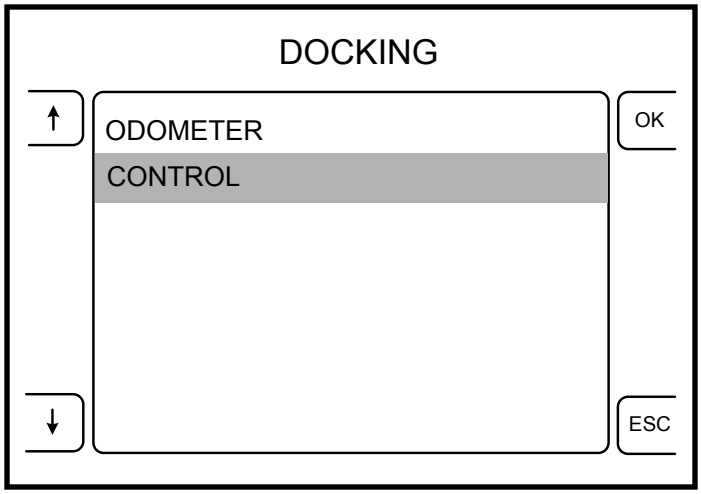


Figure 5: Select the DOCKING Option

f. In the DOCKING CONTROL menu, the OK button is used to cycle through the different options.* For instance, when OFFLOAD is highlighted, pressing OK will cycle between on and off. Continue to use the arrow buttons to highlight and the ok button to complete the required steps in table 6.1.

Step	Select Option (Use Arrow Keys)	Change To (Use OK Key)	Comments
1	Diverter	Large	
2	Couplings	Extending	Wait until couplings read "EXTENDED" before proceeding.
3	Water	On	Hold OK for 3 seconds. Verify water enters large canister.
4	Diverter	Closed	
5	Soap	On	Leave soap on (pump running) for step 6.
6	Diverter	Large	Verify soap enters large canister. (You will see bubbles)**
7	Soap	Off	Verify injector pump stops, soap stops entering canister.
8	Couplings	Retracting	Wait until couplings read "RETRACTED" before proceeding.
9	Diverter	Closed	Diverter may already be closed, if not close it.
10	Magnet	Off	Rover should release from docker.

Table 6.1: Priming the Detergent Pump

* When used for the WATER option, the OK button must be held to continuously to allow water to flow. The water flow will stop when the OK button is released.

** If the soap does not enter the large canister at this point (no visual bubbles), use the arrow keys to select Water, and then press and hold ok for two seconds and then release. Soap bubbles should now be visible in the large canister. It may be necessary to leave the soap injector pump running and cycle the diverter between Large and Closed. This will build up pressure in the injector pump and should aid in priming. Next, press and hold OK to turn the water on again for two seconds. If the preceding steps do not produce bubbles in the large canister, follow procedure ***6.2 - Manually Filling the Detergent Tube***.

Procedure 6.2 – Manually Filling the Detergent Tube

This procedure is only used when procedure 6.1 failed to properly prime the detergent pump. It is possible that the pump may not draw detergent from the bottle, but *will* prime correctly if the inlet tube is manually filled with detergent. The technician should obtain a syringe from the facility to properly complete this procedure.

Normally, this procedure is started after step 6 in procedure 6.1. That is to say that the technician has *already* tried to automatically prime the pump with no results. The instructions that follow assume that the rover is still connected to the docking station, the couplers are extended, and the SOAP option is set to off. Ensure that the rover and docker are currently in that condition before proceeding.

Step	Select Option (Use Arrow Keys)	Change To (Use OK Key)	Comments
1	Diverter	Closed	
2	Disconnect the detergent tubing on the top of the injector pump assembly in the docking station.		
3	Attach syringe to the tubing and manually draw detergent from the bottle until it reaches the end of the tube.		
4	Reconnect the detergent tubing to the injector pump		
5	Soap	On	Leave soap on (pump running) for step 6.
6	Diverter	Large	Verify soap enters large canister. (You will see bubbles)
7	Soap	Off	Verify injector pump stops, soap stops entering canister.
8	Couplings	Retracting	Wait until couplings read "RETRACTED" before proceeding.
9	Diverter	Closed	Diverter may already be closed, if not close it.
10	Magnet	Off	Rover should release from docker.

Procedure 6.3 – Reprogramming Rover Software

There are three options to choose from within the REPROGRAM menu. The technician can select EEPROM to reset all of the stored values, PD to reprogram the power distribution board, or MAIN which will reprogram the main controller. It is important to realize that if the eeprom is reset, the rover will no longer be properly calibrated. Follow procedure 6.4 ***Performing the Canister Calibration*** on p.6-11 for instructions on how to properly calibrate the volume measurement.

To begin reprogramming the rover software the technician must follow the same preliminary steps to gain access to the REPROGRAM menu. The technician must select the desired reprogram option in order to proceed. This procedure outlines the steps necessary to enter the technician menu, followed by the steps required for all 3 reprogram menu options. To determine when each option should be used, refer to table 5.1 below.

Reprogram Option	For Item Replaced
Reset EEPROM	1. Main Control Board - P/N 0702-001-800 2. Top Cover Assembly - P/N 0702-001-090
Reprogram PD	1. Main Control Board - P/N 0702-001-800 2. Power Distribution Board - P/N 0702-001-035 3. Volume Display Assembly - P/N 0702-001-840 4. Top Cover Assembly - P/N 0702-001-090
Reprogram Main	Currently, this option is reserved for use at the manufacturer only.

Table 5.1: Determining Which Reprogram Option to Use

1. Follow the instructions to access the system settings menu.

2. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button (see figure 1).

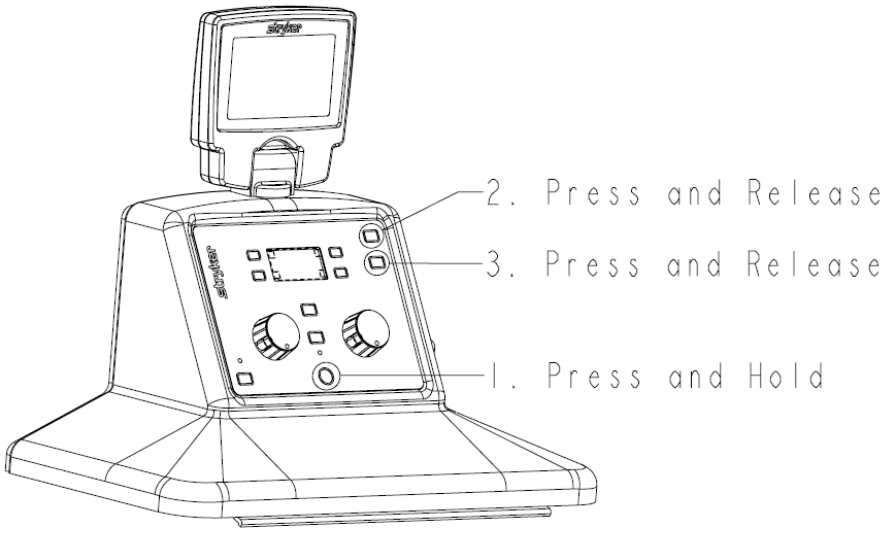


Figure 1: Access the Technician Menu

3. From the technician menu, push the buttons next to the arrow icons (on the left side) to highlight the REPROGRAMMING menu (see figure 2).

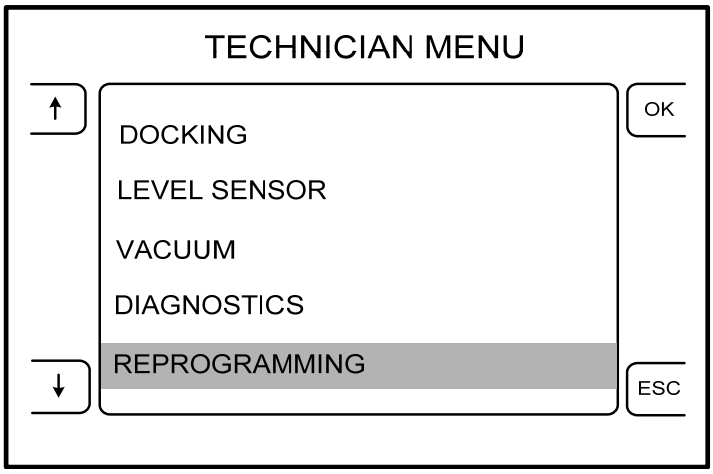


Figure 2: Select the REPROGRAMMING Menu

4. Push the button next to the OK icon to select the desired REPROGRAMMING menu option. Push the button next to the ESC icon to return to the previous menu (see figure 3).

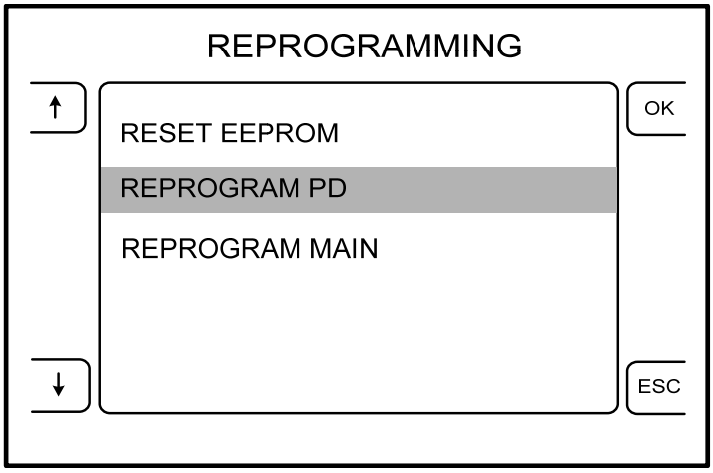


Figure 3: Select the Desired Option

5a. RESET EEPROM

Choosing this option will reset all of the values that are stored on the EEPROM. After selecting RESET EEPROM, the system will display a warning to indicate that the options will be erased (see figure 4). The values that will be restored to system defaults are:

1. Minimum and maximum water flow
2. Docking odometer
3. Display and brightness settings changed by the user
4. Fluid level sensor calibration*

* This will require the technician to recalibrate the canisters as detailed in procedure 6.4 ***Performing the Canister Calibration***

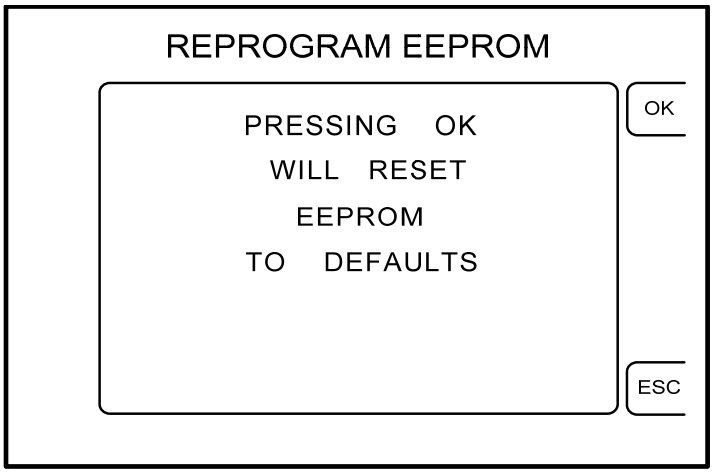


Figure 4: RESET EEPROM Confirmation Screen

5b. REPROGRAM PD

Choosing this option will update the software for the power distribution board. This option updates software for the power distribution board, which contains the operational program for the large and small vacuum regulators, tank dump valve, IV pole, smoke evacuator, and canister calibration boards. After selecting REPROGRAM PD, the system will display a message indicating which software version is currently being updated (see figure 5). After selecting REPROGRAM PD, the system will reset and initialize in approximately 30 seconds.

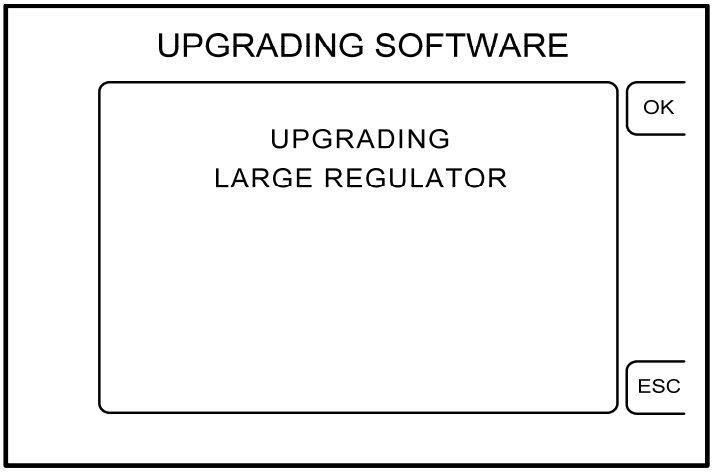


Figure 5: Upgrade Software Screen

5c. REPROGRAM MAIN

Choosing this option will update the software for *only* the main control circuit board in the rover. This procedure must be done only after replacing the main control board. After selecting REPROGRAM MAIN, the system will reset and initialize in approximately 30 seconds.

Procedure 6.4 – Performing the Canister Calibration

The canister calibration must be performed when volume sensing components are replaced. These components include the small canister (P/N 0702-001-300), large canister (P/N 0702-001-320), main controller circuit board (P/N 0702-001-800), level sensor assembly (P/N 0702-001-880), and float sensors (P/N 0700-001-155). The technician will need an ***accurate*** device capable of measuring 1 liter of fluid. A suitable beaker is listed in ***Appendix A: List of Materials***.

1. To access the System Settings Menu, hold down the display button in the upper-right hand corner and dock the unit. (See figure 1)

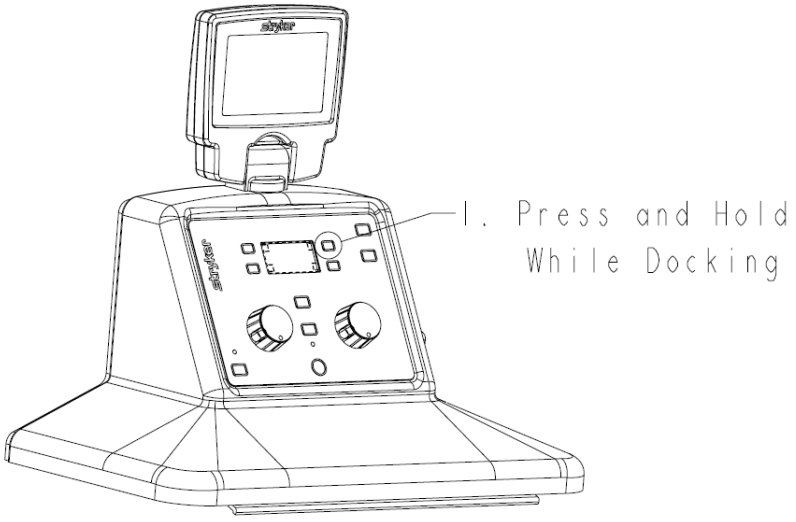


Figure 1: Accessing Menu While Docked

2. Once the Neptune 2 splash screen appears, continue to push the display button until the tools indicator in the upper right corner is highlighted solid white (see figure 2)

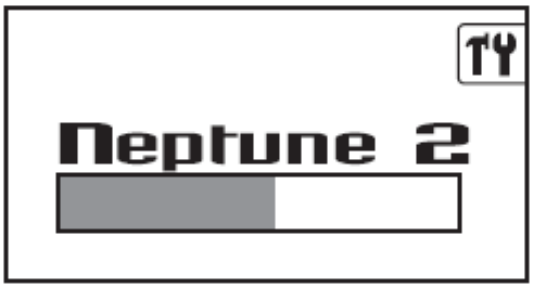


Figure 2: Neptune Splash Screen

3. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button. (see figure 3)

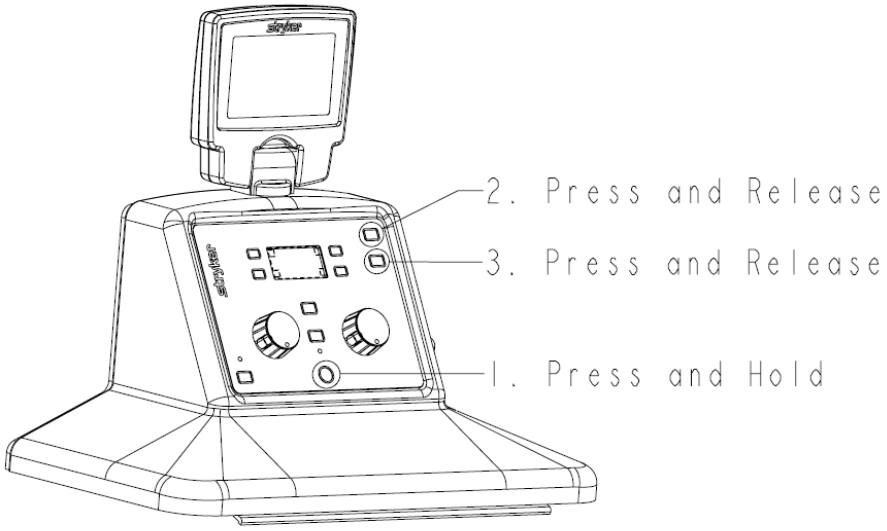


Figure 3: Accessing the Technician Menu

4. Once the technician menu is displayed, push the button next to the arrow icon (on the left side) to highlight the DOCKING option. Then press the button next to the OK icon to select the docking menu. (see figure 4)

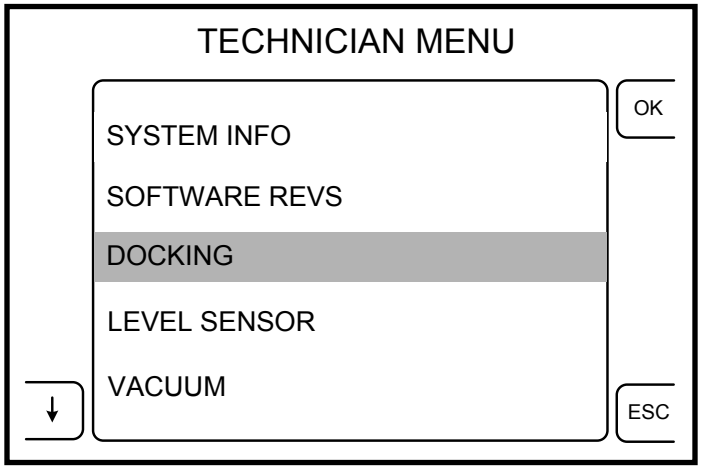


Figure 4: Select DOCKING Option

5. Next, push the button next to the arrow icon (on the left side) to highlight the CONTROL option. Then press the button next to the OK icon to select the docking menu. (see figure 5)

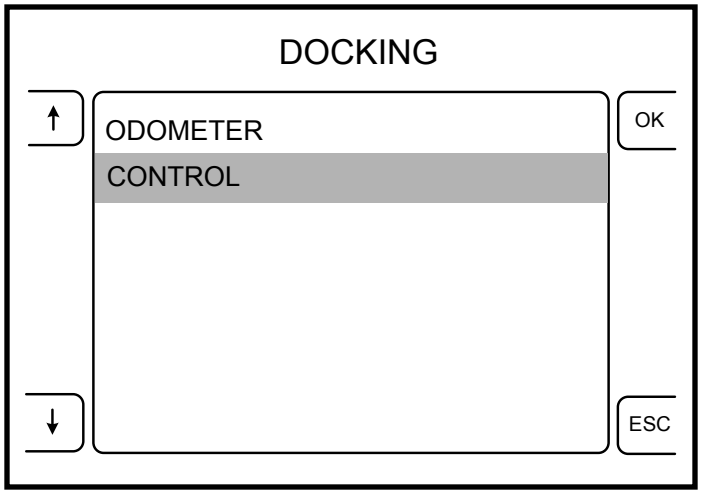


Figure 5: Select the DOCKING Option

6. In the DOCKING CONTROL menu, the OK button is used to cycle through the different options.* For instance, when OFFLOAD is highlighted, pressing OK will cycle between on and off. Continue to use the arrow buttons to highlight, and the ok button to select in order to complete the required steps in table 6.2, then proceed to step 7.

Step	Select Option (Use Arrow Keys)	Change To (Use OK Key)	Comments
6.1	Magnet	On	Magnet may already be on.
6.2	Diverter	Large	
6.3	Couplings	Extending	Wait until couplings read "EXTENDED" before proceeding.
6.4	Diverter	Closed	
6.5	Valve	Open	Verify fluid in small canister dumps into large canister
6.6	Offload	On	Let offload pump run until the water is completely gone.
6.7	Offload	Off	Verify offload pump stops.
6.8	Valve	Closed	
6.9	Diverter	Closed	
6.10	Couplings	Retracting	Wait until couplings read "RETRACTED" before proceeding.
6.11	Magnet	Off	Rover should release from the docking station.

Table 6.2: Empty the Fluid Collection Canister(s)

* When used for the WATER option, the OK button must be held to continuously to allow water to flow. The water flow will stop when the OK button is released.

7. Remove the rover from the docking station and plug in to AC wall outlet.

Note: It is normal for the system to have errors at this time, as there is no prefill.

8. Follow the instructions to access the system settings menu.

9. To access the technician menu from the system settings menu, hold down the vacuum system power button, then press and release the IV pole up button, and finally press and release the IV pole down button (see figure 5).

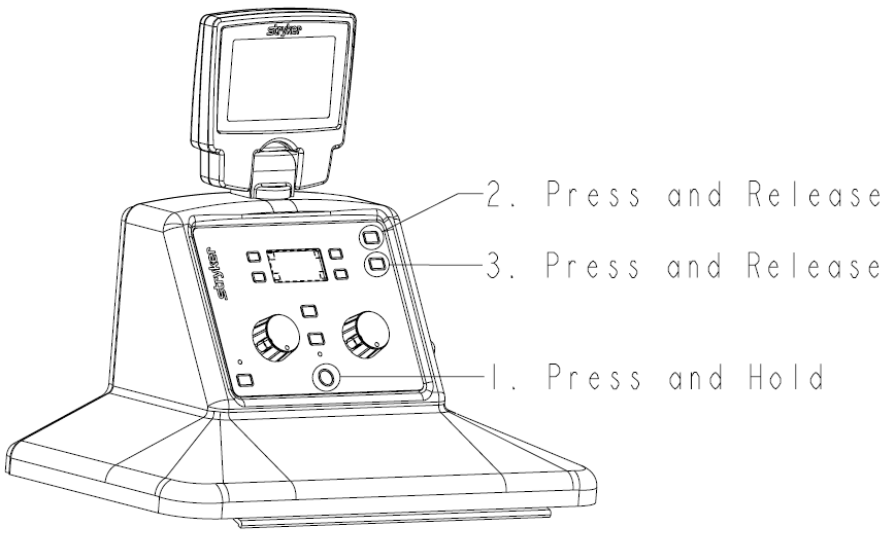


Figure 5: Access the Technician Menu

10. Push the button next to the ESC icon to return back to the System Settings menu.
11. Push the button next to the ESC icon to return to the user screen.
12. Next, push the button next to the button next to the ! icon to display the error log.
13. Depress the volume reset button to clear the error log screen long enough to allow the vacuum pump to turn on.
14. Press the button next to the ESC icon.
15. Turn on the suction by pressing the vacuum system power icon and adjust the suction to 15 in/hg in both canisters.
16. **If only calibrating the large canister, proceed to step 18**. Fill a 1 liter beaker with warm water and record the fluid amount. In most cases the volume will not be *exactly* 1 liter. Make sure to record the exact value within 1ml. (For example, 1002 ml) This will be used later on in step 27.

17. With a manifold inserted into the small canister manifold receptacle, suction the 1 liter prepared in step 16. Make sure as much fluid as possible is inside the canister and that as little as possible remains in the suction tubing and manifold. In order for the calibration to be accurate it is important that the majority of the measured fluid is inside the tank. **If only calibrating the small canister, proceed to step 20.**

18. Fill a 1 liter beaker with warm water and record the fluid amount. In most cases the volume will not be *exactly* 1 liter. Make sure to record the exact value within 1ml. (For example, 1002 ml) This will be used later on in step 27.

19. With a manifold inserted into the large canister manifold receptacle, suction the 1 liter prepared in step 18. Make sure as much fluid as possible is inside the canister and that as little as possible remains in the suction tubing and manifold. In order for the calibration to be accurate it is important that the majority of the measured fluid is inside the tank.

20. Turn off the suction by pressing the vacuum system power icon and allow the fluid to stabilize in the canister(s) for one minute.

21. Turn off the main power switch. Access the System Settings Menu by holding down the display button in the upper-right hand corner while turning on the main power switch. (See figure 6)

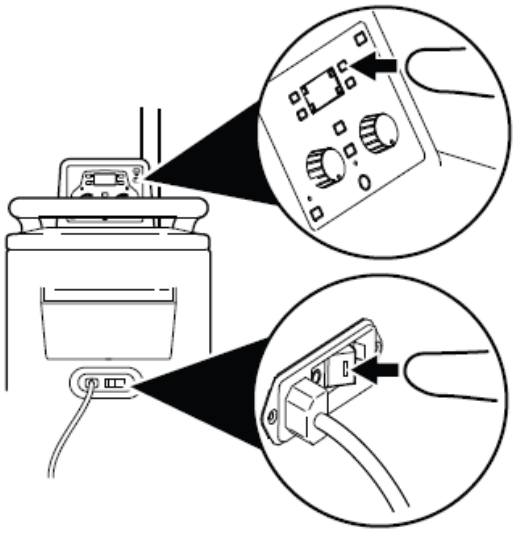


Figure 6: Access the System Settings Menu

22. Once the Neptune 2 splash screen appears, continue to push the display button until the tools indicator in the upper right corner is highlighted solid white (see figure 7)

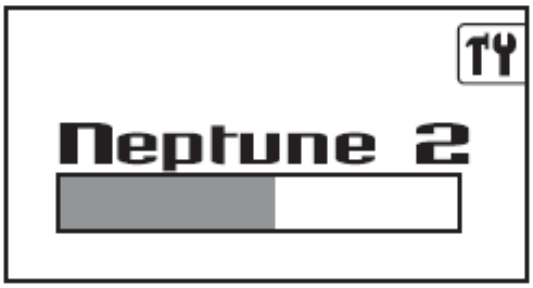


Figure 7: Neptune Splash Screen

23. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button. (see figure 8)

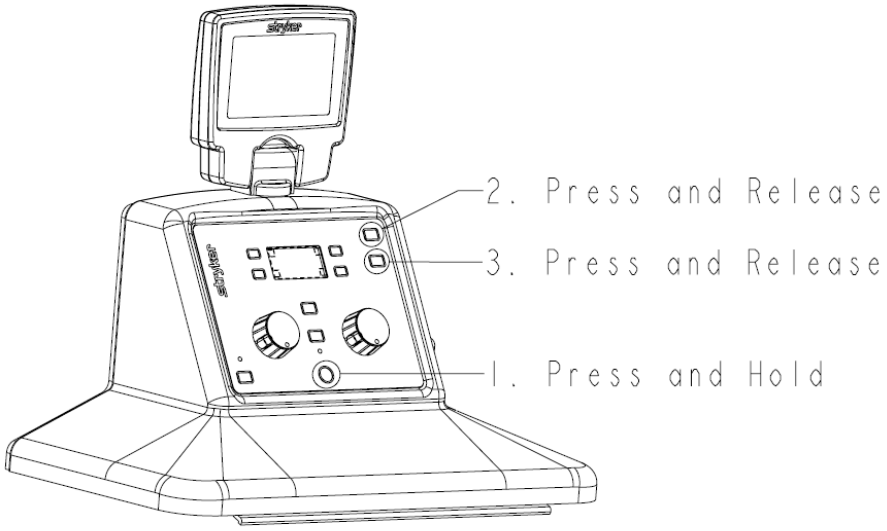


Figure 8: Accessing the Technician Menu

24. Once the technician menu is displayed, push the button next to the arrow icon (on the left side) to highlight the LEVEL SENSOR option. Then press the button next to the OK icon to select the docking menu. (see figure 9)

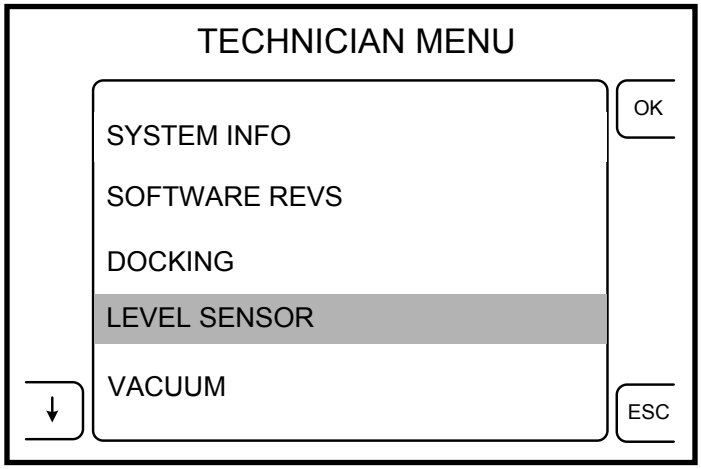


Figure 9: Select DOCKING Option

25. Next, select the CALIBRATE FLOAT option from the calibration menu.

26. If only one canister was calibrated, the technician only needs to complete the remainder of this procedure for that canister. Select either the 4L CANISTER or the 20L CANISTER option from the calibrate float menu (see figure 10).

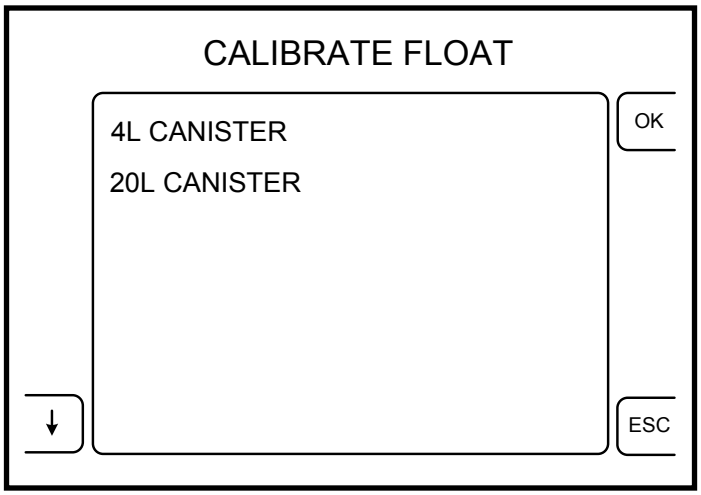


Figure 10: Select Canister to Calibrate

27. Using the buttons next to the arrow icons on the left, enter the recorded value from step 16 or 18 that was suctioned in to the canister (see figure 11).

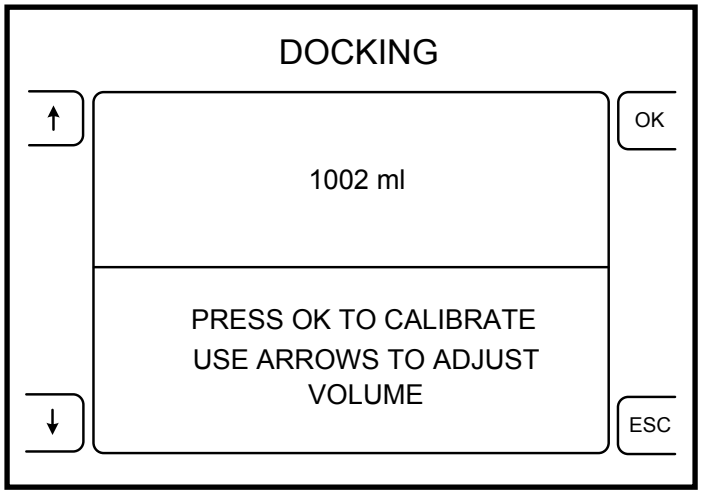


Figure 11: Entering Calibrated Fluid Amount (Adjusted to 1002 ml)

28. Press the button next to the OK icon. The audible alarm on the user interface panel should beep to indicate that the calibration has been accepted.

29. If both canisters are being calibrated, repeat steps 26 – 28 for the other canister. If only one canister was calibrated, proceed to step 30.

30. The rover will have errors following the calibration procedure. Turn the rover off at the main power switch and complete one docking cycle to clear the errors.

Procedure 6.5 – Testing

The testing listed in this section is performed after every service call, whether the maintenance action is a repair or scheduled preventive maintenance. The testing includes both electrical testing as well as a functional check. The rover and docker testing is completed in two stages. They are first tested with the covers removed, and then the tests are completed once the covers have been reinstalled. The test equipment used in the following procedures is listed in Appendix A. The list is *only* a reference designed to aid the technician in choosing suitable test equipment. The exact model ***is not*** required, but a suitable equivalent must be used when performing safety testing.

For example, the safety analyzer must be able to check earth leakage current in reversed polarity, but it does not have to be the Dale Technologies model listed in Appendix A. In either case, the technician must ensure that the test equipment used is within the calibration period, or "In Calibration", and that *any* test equipment used has not exceeded the calibration due date listed. Similarly, if a piece of test equipment does not have a calibration sticker, it can not be assumed that it is working properly. The technician should attempt to find an alternate means of testing the Neptune Waste Management System.

Neptune Rover Testing Requirements (P/N 0702-001-000)

Wire Integrity Test (Covers Removed)

1. Ensure mains wiring (blue and brown wires) inside the chassis are secure and not touching any components on the circuit boards.
2. Verify wires are secured in a manner to prevent chafing.

Amp Draw Test (Covers Removed)

1. Plug the rover into the safety analyzer.
2. Turn on both the **Smoke Evacuator** and **Vacuum Control (for the small and large canister)** and set both to maximum. (Canister suction and smoke evacuator to 100%)

NOTE: To ensures that the measurement is taken with all functions at maximum, the technician will need to measure and record the values in step 5 - while performing step 4.

3. Turn the analyzer dial to the INSTRUMENT CURRENT position.
4. Extend the IV pole by pressing the IV pole up button. (Hold through step 5)
5. Measure and record the amp draw. It must not exceed 13.2 amps.

Earth Leakage Current Test (Covers Removed)

1. Plug the rover into the safety analyzer.
2. Turn on both the **Smoke Evacuator** and **Vacuum Control (for the small and large canister)** and set both to maximum. (Canister suction and smoke evacuator to 100%)

NOTE: To ensures that the measurement is taken with all functions at maximum, the technician will need to measure and record the values in step 5 - while performing step 4.

3. Turn the analyzer dial to the LEAKAGE CURRENT position. The LEAKAGE switch must be depressed toward the EARTH label to record the values in step 5.
4. Extend the IV pole by pressing the IV pole up button. (Hold through step 5)
5. Measure and record the earth leakage in all combinations listed in table 6.5.1.

Analyzer Settings		Leakage Current Limit
Polarity	**Neutral**	
Normal	Closed	20 uA < X < 300 uA
Reverse	Closed	20 uA < X < 300 uA
Normal	Open	20 uA < X < 1000 uA
Reverse	Open	20 uA < X < 1000 uA

Table 6.5.1 Analyzer Settings and Earth Leakage Current Limit for Rover

NOTE: it is normal for the rover to turn off momentarily when the neutral switch is in the open position. The rover functions may turn off with changes between each setting below. Verify that required functions are running before recording the maximum value for each combination requiring the neutral switch being placed in the closed position.

Patient Leakage (Covers Removed)

1. Plug the rover into the safety analyzer.
2. Attach the test lead to the fluid level transducer just above the plastic where it attaches to the small canister cap.
3. Turn on both the **Smoke Evacuator** and **Vacuum Control (for the small and large canister)** and set both to maximum. (Canister suction and smoke evacuator to 100%)

NOTE: To ensure that the measurement is taken with all functions at maximum, the technician will need to measure and record the values in step 6 - while performing step 5.

4. Configure the safety analyzer to measure PATIENT LEAKAGE.
5. Extend the IV pole by pressing the IV pole up button. (Hold through step 6)

6. Measure and record the patient leakage in all combinations listed in table 6.5.2.

Analyzer Settings		Leakage Current Limit
Polarity	**Neutral**	
Normal	Closed	< 10 uA
Reverse	Closed	< 10 uA
Normal	Open	< 50 uA
Reverse	Open	< 50 uA

Table 6.5.2 Analyzer Settings and Patient Leakage Current Limit for Rover

Hi-Pot Test (Covers Installed)

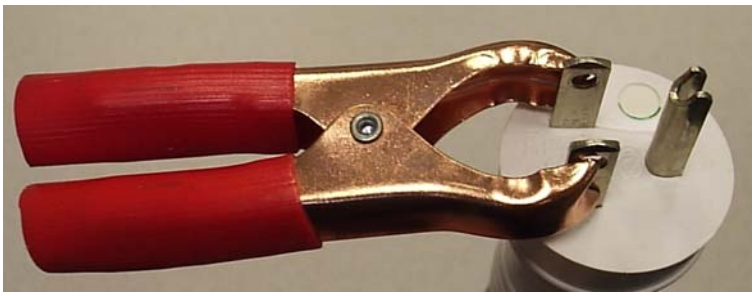
The technician will change three functions of the hi-pot tester to set up for the test: voltage, trip current, and dwell time. To configure the hi-pot tester. Press the SET button to select either VOLTAGE, CURRENT, or DWELL. (When the correct setting is selected, the corresponding LED will blink on the face of the hi-pot tester.) Use the up and down arrows to adjust for the proper value. See table 6.5.3 for the values for the rover hi-pot test.

> **WARNING:** DO NOT touch the rover while performing the Hi-Pot test!! Serious harm may result in touching any portion of the rover while testing.

Hi-Pot Setting	Set To	Actual Value
Voltage	1.8	1800 v
Current	10.00	10 mA
Dwell	1.0	1 second

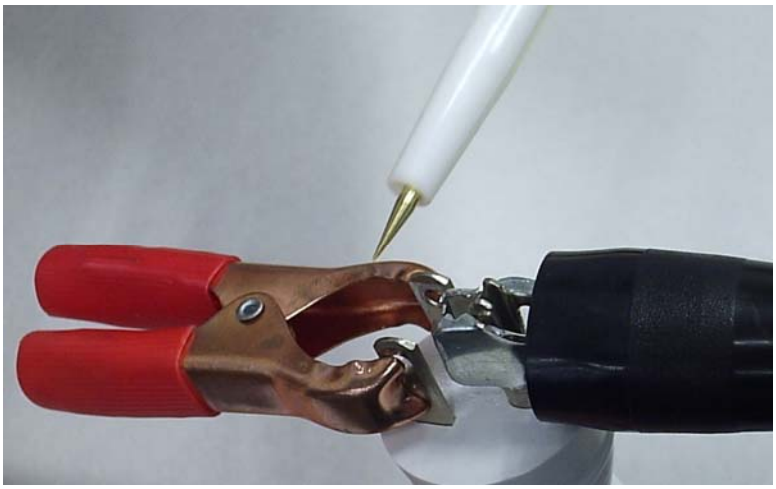
Table 6.5.3 Hi-Pot Settings for Rover

1. Verify that the hi-pot tester is configured properly for rover testing. (See table 6.5.3)
2. Ensure the rover power cord is plugged into the rover. ***DO NOT*** plug the other end of the power cord into the AC wall outlet!
3. The technician must test the hi-pot tester before proceeding. To do this, short the leads together and press the TEST button. The reset button must illuminate and be followed by a continuous beep. If this does not happen, do NOT continue the test. Press reset to continue.
4. Attach metal clamp to the live and neutral terminals of the power cord.



5. Attach the ground lead (small black clamp) to the ground pin on the power cord.

6. Touch the high voltage lead (red, pen-like attachment) to the shorted live and neutral terminals, **ensuring *not* to touch the ground pin.**



7. Press the TEST button. The test is passed when a single short beep is heard. If pressing the test button yields the same results as in step 3 (continuous beep and audible alarm) the rover has failed.

Ground (Earth) Resistance Test (Covers Installed)

1. Turn rover power switch off.
2. Plug rover power cord into safety analyzer.
3. Attach the test lead to one of the strike plates or strike plate mounting PEMs.
4. Set the analyzer to normal polarity and neutral open.
5. Measure earth (ground) resistance by placing the analyzer dial to the chassis resistance position.
6. Resistance must be less than .12 ohms.

Rover Functional Test

Vacuum Function

1. Ensure the rover is plugged in and turned on.
2. Insert a manifold (with all ports closed) into the large canister manifold receptacle.
3. Turn on the vacuum pump (Vacuum Subsystem ON button)
4. Turn the large canister control knob to 100% and ensure the set point reads 21.0 in/Hg.
5. The large canister actual vacuum level should reach a minimum of 18.9 in/Hg within 10 seconds.
6. Ensure the vacuum level does not fluctuate greater than +/- 1.0 in/Hg from the set point. Observe vacuum level for 30 seconds and verify actual level is maintained.
7. Turn the large canister control knob to 20%.
8. Ensure the vacuum level does not fluctuate greater than +/- 1.0 in/Hg from the set point. Observe vacuum level for 30 seconds and verify actual level is maintained.
9. Turn the large canister control knob to 0%.
10. Verify that both the set point and the actual suction level read 0.0 in/Hg.
11. Repeat steps 2 through 10 for the small canister.

Smoke Evacuator Function

NOTE: If the smoke ULPA filter is not present, it is possible that the customer is not using the smoke evacuator function of the rover. In this case, it is not necessary to test the smoke evacuator function.

1. Ensure smoke ULPA filter is fully seated. (The edge of the filter remains about ¼" away from the chassis when fully seated)
2. Ensure the rover is plugged in and turned on.
3. Press smoke evacuator button and adjust level to 100% using buttons on the left of the display.
4. Press smoke evacuator button again and verify it goes into auto mode.
5. Press smoke evacuator button again to power off smoke evacuator.

IV Pole

1. Ensure the rover is plugged in and turned on.
2. Depress and hold the IV Pole up arrow button. Ensure the pole moves up smoothly until it reaches the top of its range of motion.
3. Depress and hold the IV Pole down arrow button. Ensure the pole moves down smoothly until it reaches the bottom of its range of motion.
4. Depress and hold the IV Pole up arrow button again to fully extend the IV Pole.
5. Turn off the rover power switch and verify that the pole descends within 9.5 seconds.
6. Note any unusual vibrations or noise while pole is ascending or descending.

Neptune Docker Testing Requirements (P/N 0702-014-000)

Wire Integrity Test (Covers Removed)

1. Ensure mains wiring (blue and brown wires) inside the chassis are secure and not touching any components on the circuit boards.
2. Verify wires are secured in a manner to prevent chafing.

Functional Test / Amp Draw Test (Covers Removed)

1. Plug the docker into the safety analyzer.
2. Turn on the main power switch on the docker and verify the power switch illuminates.

NOTE: Be sure to wait two minutes after turning the docking station on. This will allow sufficient time for the docking station to initialize.

3. Fill a rover with approximately 5 liters of clean fresh water. Ensure the detergent inlet tube is connected to the inlet port on the docker. Place the other end of the tube into the Neptune detergent container.
4. Push the rover up to the docker. Ensure that magnets hold rover in place.
5. Confirm that the power coupler provides power to the rover.
6. Select WASH from the cleaning cycle options.
7. Turn the analyzer dial to the INSTRUMENT CURRENT position.
8. Measure and record the amp draw while the offload pump is running. It must not exceed 1.8 amps AC.
9. Observe the peak current draw during the remainder of the offload cycle. Docker current draw must not exceed 3 amps AC.
10. Observe that the detergent injector is pumping detergent out of the container. This should be evident by decreasing amount of detergent and soap bubbles in the rover canister.
11. Rover will complete the docking cycle, retract the couplings, and release from the docker. Note any unusual noises during this time.
12. Check the hoses and fittings for signs of leaks inside the docker at the end of the docking cycle.
13. Check waste and water couplings for signs of leaks. Anything more than 1 or 2 drops of fluid on the top of each coupler is considered excessive.

Hi-Pot Test (Covers Installed)

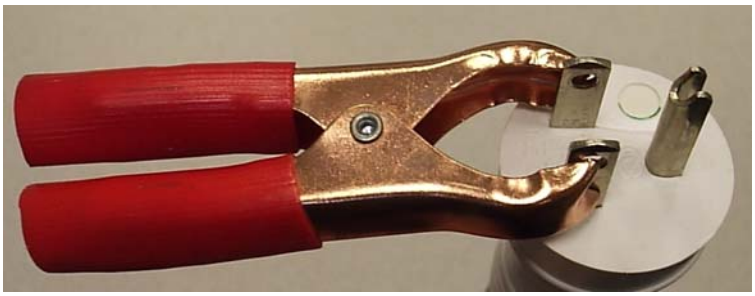
The technician will change three functions of the hi-pot tester to set up for the test: voltage, trip current, and dwell time. To configure the hi-pot tester. Press the SET button to select either VOLTAGE, CURRENT, or DWELL. (When the correct setting is selected, the corresponding LED will blink on the face of the hi-pot tester.) Use the up and down arrows to adjust for the proper value. See table 6.5.4 for the values for the docker hi-pot test.

> **WARNING:** DO NOT touch the docker while performing the Hi-Pot test!! Serious harm may result in touching any portion of the rover while testing.

Hi-Pot Setting	Set To	Actual Value
Voltage	1.2	1200 v
Current	10.00	10 mA
Dwell	1.0	1 second

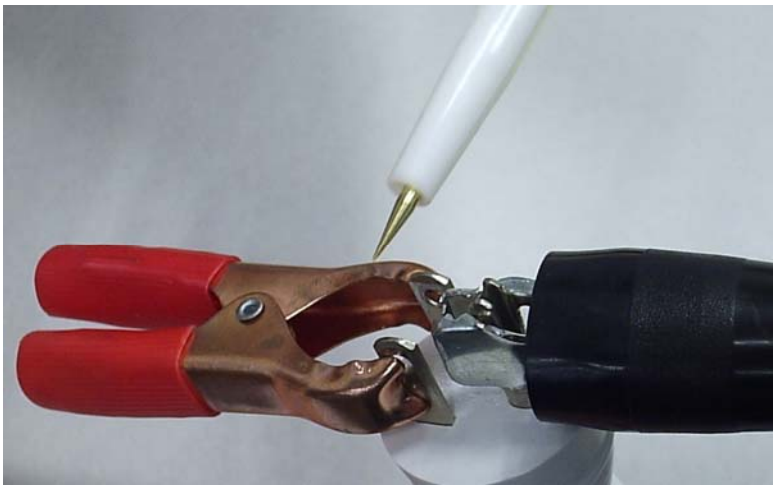
Table 6.5.4 Hi-Pot Settings for Docking Station

1. Verify that the hi-pot tester is configured properly for docker testing. (See table 6.5.4)
2. Ensure the docker power cord is plugged into the docker. ***DO NOT*** plug the other end of the power cord into the AC wall outlet!
3. The technician must test the hi-pot tester before proceeding. To do this, short the leads together and press the TEST button. The reset button must illuminate and be followed by a continuous beep. If this does not happen, do NOT continue the test. Press reset to continue.
4. Attach metal clamp to the live and neutral terminals of the power cord.



5. Attach the ground lead (small black clamp) to the ground pin on the power cord.

6. Touch the high voltage lead (red, pen-like attachment) to the shorted live and neutral terminals, **ensuring *not* to touch the ground pin.**



7. Press the TEST button. The test is passed when a single short beep is heard. If pressing the test button yields the same results as in step 3 (continuous beep and audible alarm) the docker has failed.

Ground (Earth) Resistance Test (Covers Installed)

1. Turn docker power switch off.
2. Plug docker power cord into safety analyzer.
3. Attach the test lead to the water inlet fitting on the top of the docker chassis.
4. Set the analyzer to normal polarity and neutral open.
5. Measure earth (ground) resistance by placing the analyzer dial to the chassis resistance position.
6. Resistance must be less than .09 ohms.

Earth Leakage Current Test (Covers Installed)

1. Plug the docker into the safety analyzer.
2. Turn on the docker.
3. Turn the analyzer dial to the LEAKAGE CURRENT position. The LEAKAGE switch must be depressed toward the EARTH label to record the values in step 4.

4. Measure and record the earth leakage in all combinations listed in table 6.5.5.

Analyzer Settings		Leakage Current Limit
Polarity	**Neutral**	
Normal	Closed	20 < X < 300 uA
Reverse	Closed	20 < X < 300 uA
Normal	Open	30 < X < 1000 uA
Reverse	Open	30 < X < 1000 uA

Table 6.5.5 Analyzer Settings and Leakage Current Limit for Docking Station

Procedure 6.6 – Clearing a Clog in the Small Canister

It is unlikely that the bottom canister will experience an offload error, as the waste couplers for the Neptune 2 are considerably larger. However, the drain valve between the small canister and the large canister is smaller than the waste coupler. If fluid is allowed to remain in the small canister for extended periods of time, it is possible for coagulation to begin and may result in an offload error. The following procedure details how to remove the fluid from the small canister.

NOTE: The offload error in the small canister usually occurs after fluid has been drained from the large canister. If this is the case, you will not be able to use the vacuum pump as required in this procedure because the unit will have an error. If the unit has at least ***1 liter*** of fluid in the large canister proceed to step 7. If not, begin this procedure at step 1 below.

1. To access the System Settings Menu, hold down the display button in the upper-right hand corner and dock the unit. (See figure 1)

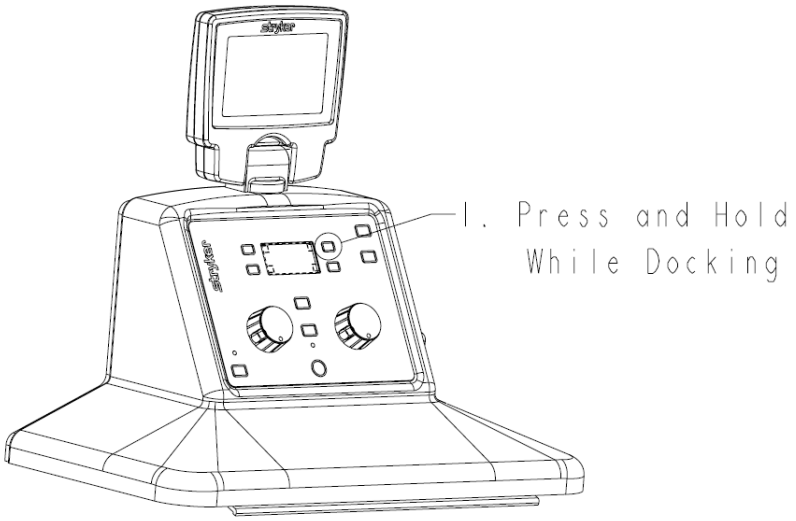


Figure 1: Accessing Menu While Docked

2. Once the Neptune 2 splash screen appears, continue to push the display button until the tools indicator in the upper right corner is highlighted solid white (see figure 2)

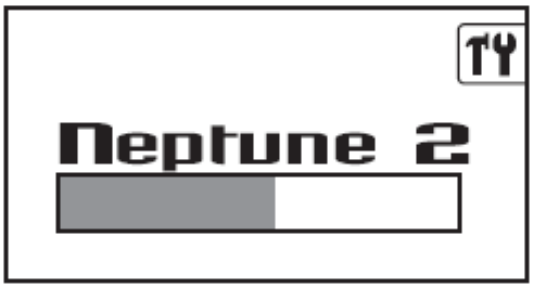


Figure 2: Neptune Splash Screen

3. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and then press and release the IV Pole DOWN button. (see figure 3)

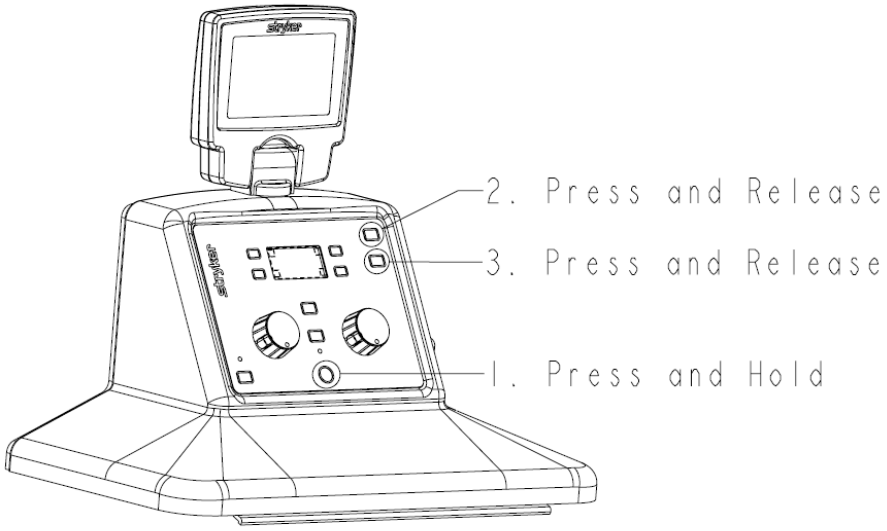


Figure 3: Accessing the Technician Menu

4. Once the technician menu is displayed, push the button next to the arrow icon (on the left side) to highlight the DOCKING option. Then press the button next to the OK icon to select the docking menu. (see figure 4)

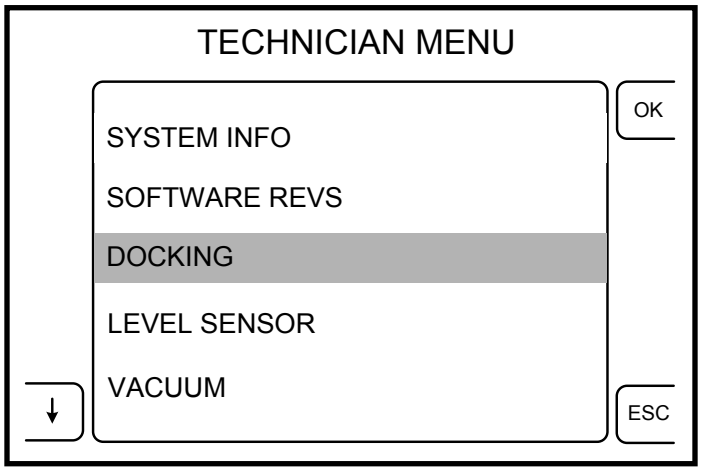


Figure 4: Select DOCKING Option

5. Next, push the button next to the arrow icon (on the left side) to highlight the CONTROL option. Then press the button next to the OK icon to select the control menu. (see figure 5)

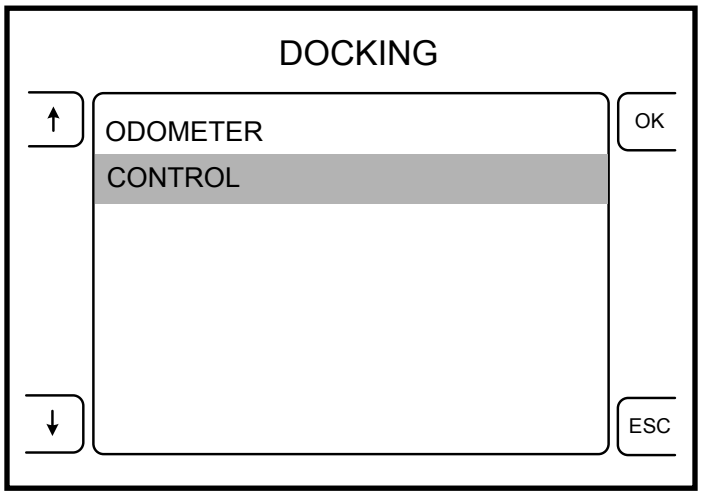


Figure 5: Select the DOCKING Option

6. In the DOCKING CONTROL menu, the OK button is used to cycle through the different options.* For instance, when OFFLOAD is highlighted, pressing OK will cycle between on and off. Continue to use the arrow buttons to highlight, and the ok button to select in order to complete the required steps in table 5.3, then proceed to step 7.

Step	Select Option (Use Arrow Keys)	Change To (Use OK Key)	Comments
6.1	Magnet	On	Magnet may already be on.
6.2	Diverter	Large	
6.3	Couplings	Extending	Wait until couplings read "EXTENDED" before proceeding.
6.4	Water	On	Press and Hold OK to fill large** canister to 2 liters.
6.5	Diverter	Closed	
6.6	Couplings	Retracting	Wait until couplings read "RETRACTED" before proceeding.
6.7	Magnet	Off	Rover should release from the docking station.

Table 6.3: Restoring the Prefill in the Canisters

* When used for the WATER option, the OK button must be held continuously to allow water to flow. The water flow will stop when the OK button is released.
** If placing water into the small canister, it is ok to add two liters of fluid, as long as doing so will not overflow the tank. **DO NOT** add two liters if the small canister has more than two liters currently present. Cycling water on/off and on/off may break up remaining debris in canister.

7. Plug the rover in to AC wall outlet and turn on main power switch (see figure 6)

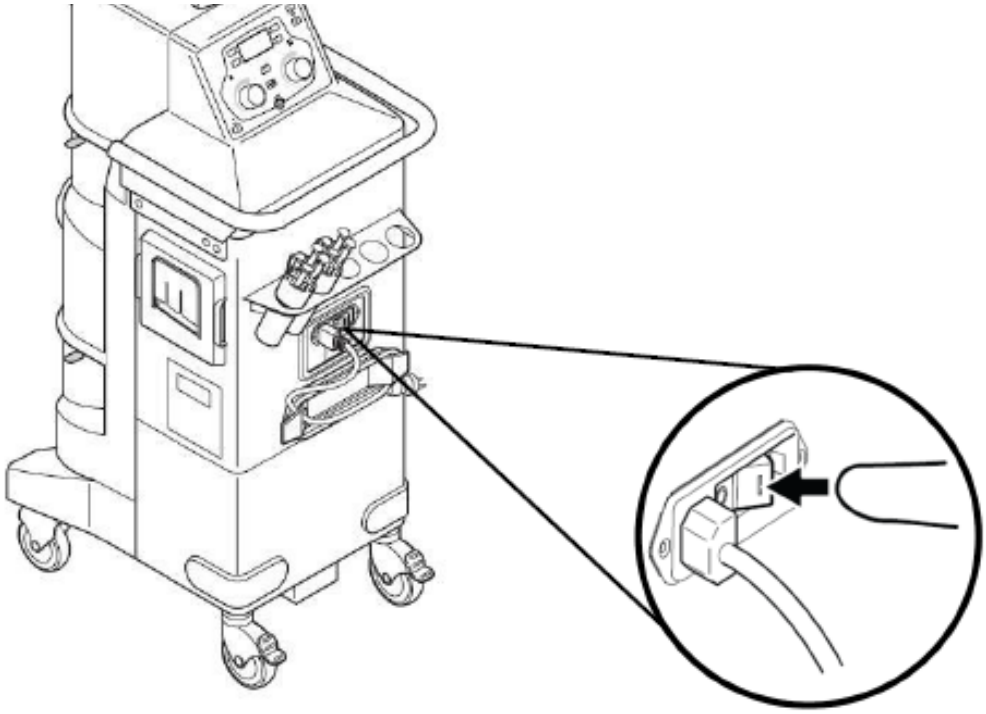


Figure 6. Turn on Main Power Switch

8. On the user interface panel, adjust the suction in both canisters to 100% and press the vacuum system power icon. The suction display should be approximately 21 in/Hg.

9. Press the empty tank button on the user interface panel to empty the contents of the small canister into the large canister.

10. The screen will then display a caution message informing the user that suction will be lost. Press OK to continue.

11. At this point, the drain valve will open and the fluid from the small canister should empty into the large canister. Verify that the fluid in the small canister is now empty.

Warning: If any debris still remains in the small canister, it may be possible to break it apart by introducing water into the rover at the docking station. Follow steps 1 through 6 of this procedure to manually dock the rover. Instead of selecting LARGE in step 6.2, change the diverter to SMALL. Complete the remaining steps in table 6.3, **MAKING SURE** not to put too much water in the small canister. Then, attempt to remove the clog again by finishing through step 11.

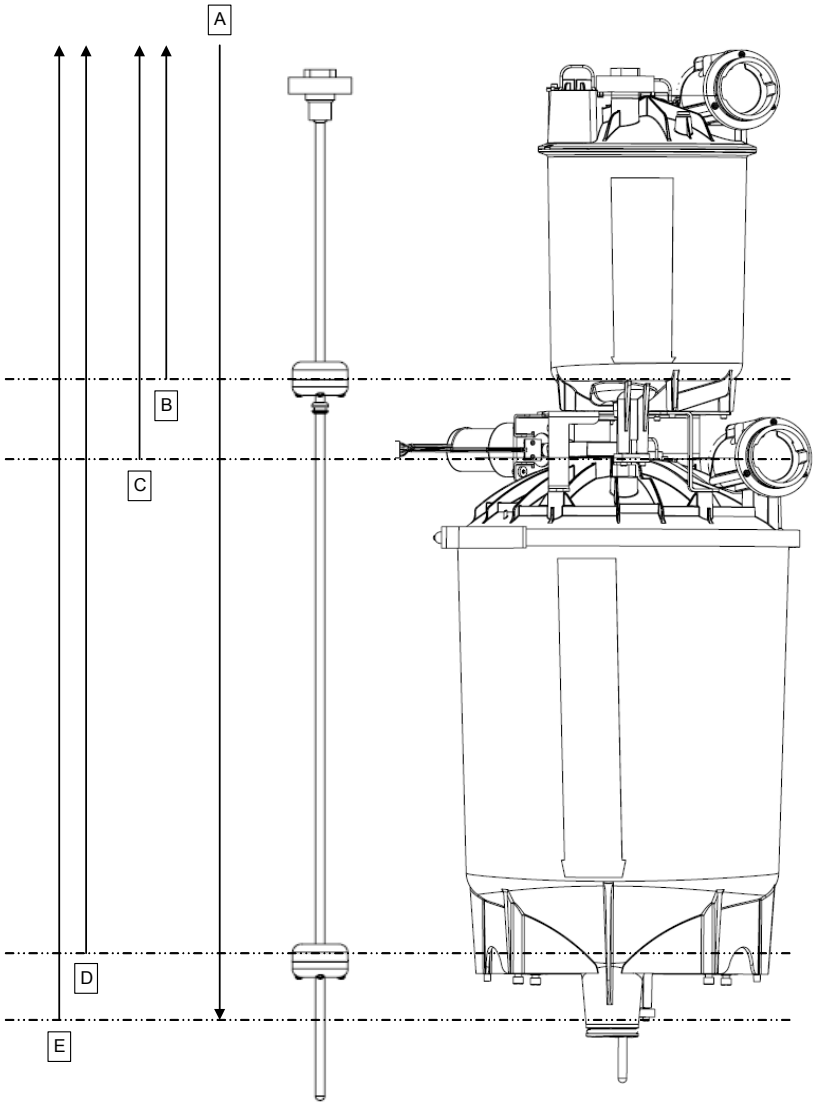
12. Turn off the rover power switch and dock the rover. Verify that the clog is no longer present and there are no errors remaining in the system.

Procedure 6.7 – Finding a Missing Magnet

Overview

The volume sensing system in the rover is comprised of a single transducer rod used for both canisters, and a float magnet and reference magnet for each canister. The reference magnets are fixed at the bottom of both the large and small canisters, and the float sensors indicate the present fluid level. The difference between the two readings indicates the fluid volume for each canister. This information is displayed in the technician menu in the level sensor data screen.

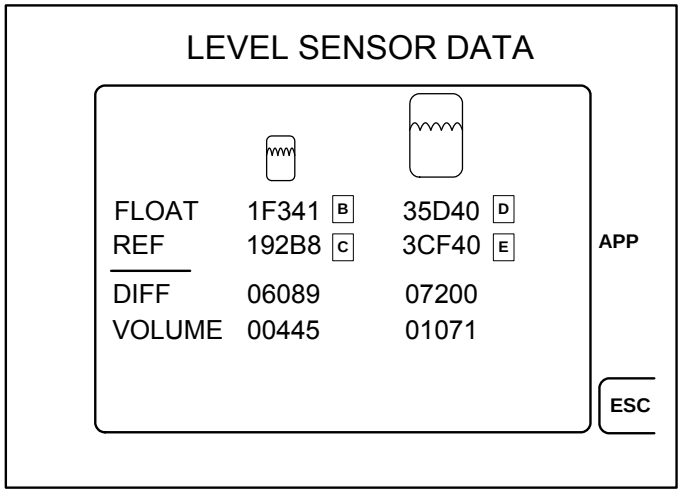
To determine the position of each magnet, the sensor transmits a signal starting at the top of the transducer rod (A). The signal is sent at a known speed, so the distance to the magnet can be determined by timing the response from each magnet. (Using the formula distance = rate x time). (See Figure 1)



A	Signal Sent From Transducer Rod
B	Response From Small Tank Float Sensor
C	Response From Small Tank Reference Magnet
D	Response From Large Tank Float Sensor
E	Response From Large Tank Reference Magnet

Figure 1. Transducer Rod and Magnets

Once a response comes back, that value is displayed in the level sensor data screen. The value will be a hexadecimal figure representing the physical location of each magnet. (See Figure 2) The first value will be received from the small tank's float sensor, since it is the closest to the top of the transducer rod. Next the signal from the small canister reference magnet will be received, followed by the signal from the large canister's float sensor. Finally, the signal from the large tank's reference magnet will be received. Under normal operation the values will be placed as shown in figure 2.



B	Response From Small Tank Float Sensor
C	Response From Small Tank Reference Magnet
D	Response From Large Tank Float Sensor
E	Response From Large Tank Reference Magnet

Figure 2. Response Time Values For Level Sensor

Each magnet has a number range that it should fall between. (Especially the reference magnets since they do not move) The software does not compare the actual returned values to make sure they are within an expected returned value range. It simply takes the first response and *assumes* the value is the response for the small canister's float sensor [B]. Likewise, the second response is automatically assumed to be the response for the small canister's reference magnet [C]. Therefore, if only one magnet has failed, the remaining three responses will be entered as if they were the *expected* first three. The data for the fourth response will be missing. (It was placed in the 3rd slot) Consequently, the large tank's reference magnet's slot will display all zeros. Figure 3 illustrates the expected value range for all four magnets, while Figure 4 is an example of what the level sensor data screen will display when a magnet has failed.

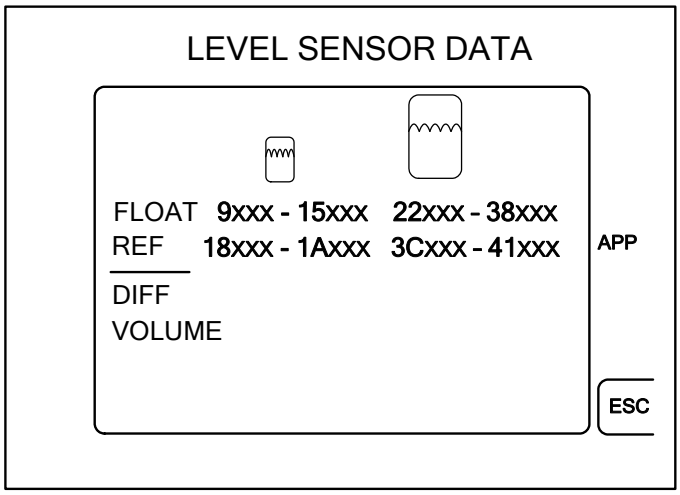


Figure 3. Expected Value Range for Magnets

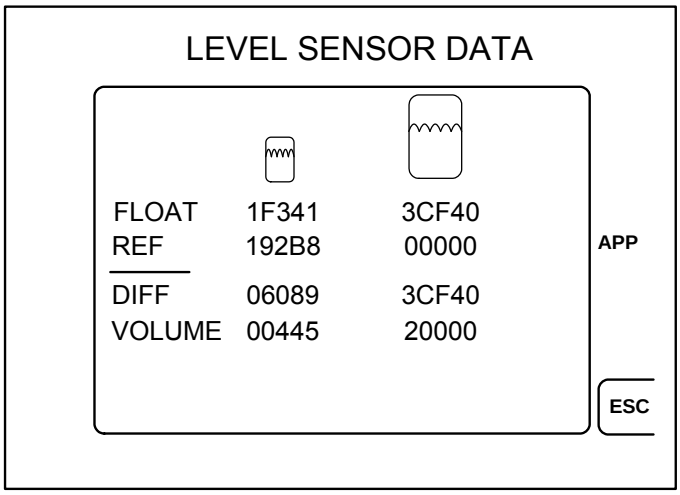


Figure 4. Magnet Failed

Figure 5 shows the decimal equivalents for hexadecimal values. The technician only needs to verify that the magnet is ***within range*** of the expected value. For instance, the small canister reference magnet should be between 18xxx and 1Axxx. Hexadecimal is simply a base 16 number system ranging from 0 – F. By looking at figure 5 we can see that "A" is bigger than "8". Our actual returned value from figure 4 for the reference magnet was **192B8 (see figure 4)**. The last 3 figures can be ignored since we only need to verify the range. We can see that 19xxx can be considered a good response, as it falls within the expected range of 18xxx and 1Axxx.

DEC	HEX		DEC	HEX		DEC	HEX
1	1		11	B		30	1E
2	2		12	C		40	28
3	3		13	D		50	32
4	4		14	E		60	3C
5	5		15	F		70	46
6	6		16	10		80	50
7	7		17	11		90	5A
8	8		18	12		100	64
9	9		19	13		500	1F4
10	A		20	14		1000	3E8

Figure 5. Hexadecimal to Decimal Conversion

It is important to note that while the large canister reference magnet displays all zeros, we can not automatically assume that it failed. From our previous explanation, we know that this result means *one* of the magnets did not respond. The software simply places the three responses in order. When the fourth response does not come back, it assumes the fourth magnet is missing. In the case of figure 4, we should look at the values that were returned to determine which magnet is actually missing.

By looking at figure 6 we see that the original value for the large canister's reference magnet is **3CF40**. (This is also reference [E] in figure 2)

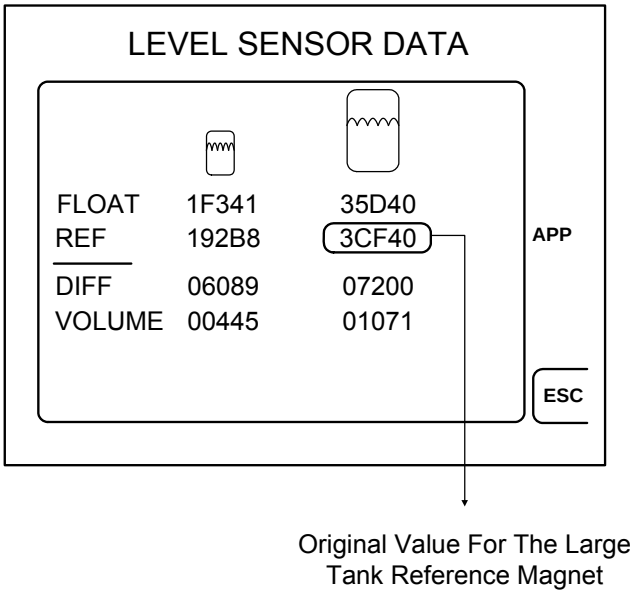


Figure 6: Level Sensor Data Screen; All Magnets Functioning Normally

If the float sensor in the large tank malfunctions, it will not send a response to the transducer rod. Consequently, the software will mistake the response from the large tank's reference magnet (the fourth magnet) for the large tank's float sensor (the third magnet). This is easily recognizable because the large tank's float sensor now displays a value that is *in the range* of the large tank's reference magnet. Figure 7 illustrates how the response is placed on the screen.

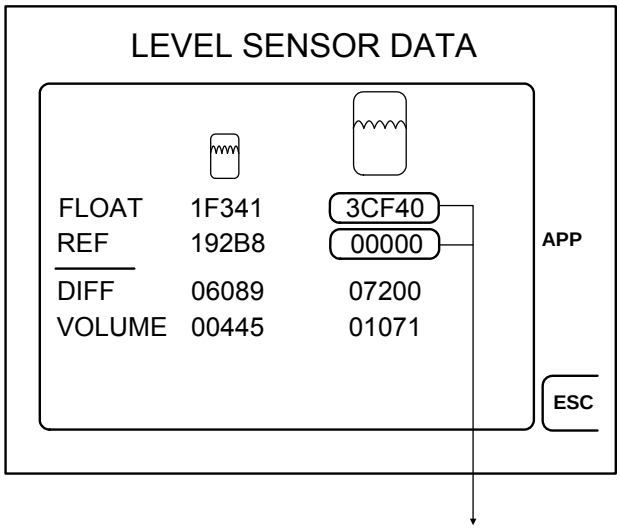


Figure 7: Data Screen Displays Zeros for a Missing Magnet

In this case, the missing magnet is the large tank's float sensor because ***that position*** is displaying a value that is out of range. The technician should replace the large tank's float sensor and verify that the readings are correct. In the event that more than one magnet has failed, the technician would find the first position that is out of range and replace it before proceeding. The procedure beginning on page 6-42 outlines the steps necessary to enter the technician menu and determine which magnet is malfunctioning.

Procedure

1. Follow the instructions to access the system settings menu.

2. To access the technician menu from the system settings menu, hold down the Vacuum System power button, then press and release the IV Pole UP button, and finally press and release the IV Pole DOWN button (see figure 6).

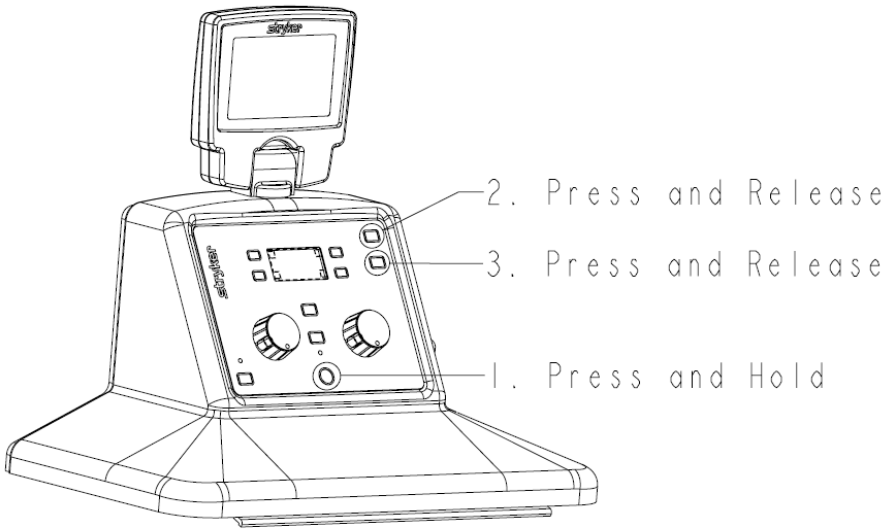


Figure 6: Access the Technician Menu

3. From the technician menu, push the buttons next to the arrow icons (on the left side) to highlight the LEVEL SENSOR menu and press OK to select the level sensor menu. (see figure 7)

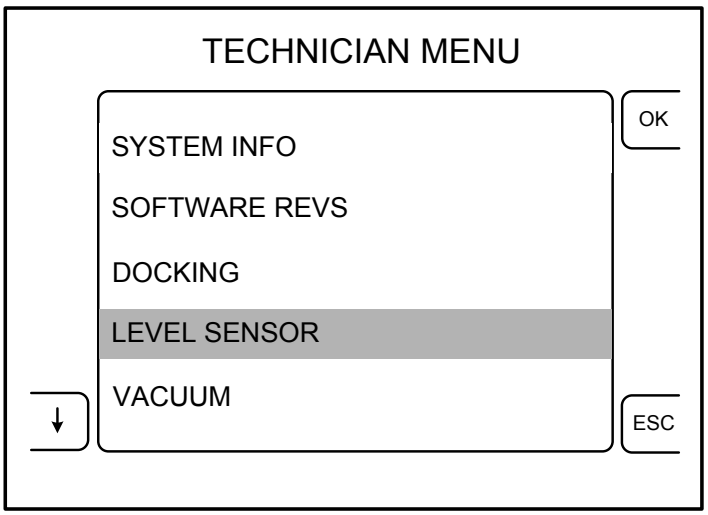


Figure 7: Select the LEVEL SENSOR Menu

4. Next, push the buttons next to the arrow icons (on the left side) to highlight the LEVEL DATA menu and press OK to display the level data screen. (see figure 8)

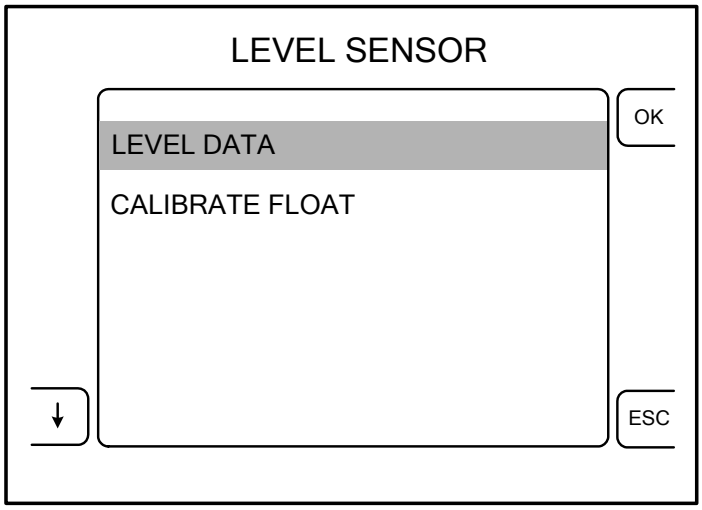


Figure 8: Select the LEVEL DATA Menu

5. The level sensor data screen will display “APP” centered on the far right hand portion of the screen. Press and hold the button at the upper right hand corner until the screen displays DIAG. (see figure 9)

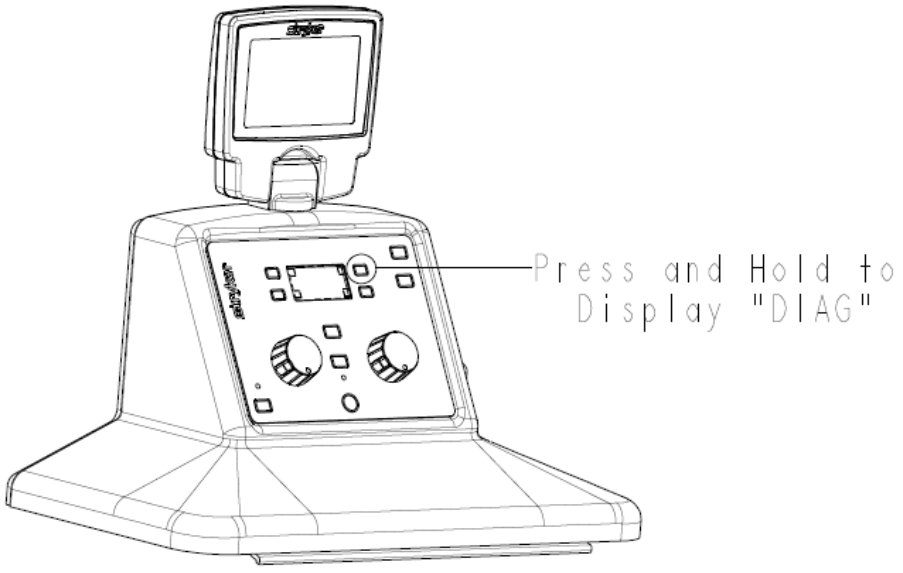


Figure 9: Hold Upper Right Hand Button

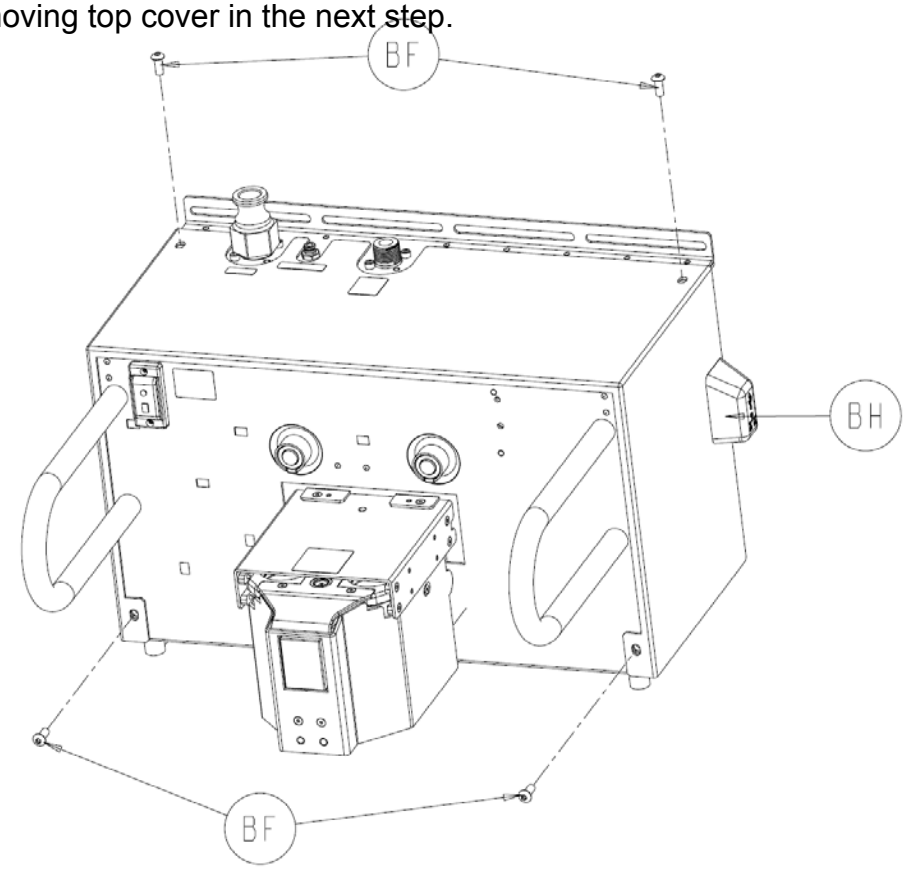
6. Initially the values displayed on the screen will be rapidly changing. Once the screen displays DIAG, the values displayed for each magnet will slowly stop changing and eventually settle at one number.

7. Determine which value is not in the correct range as discussed in the overview.

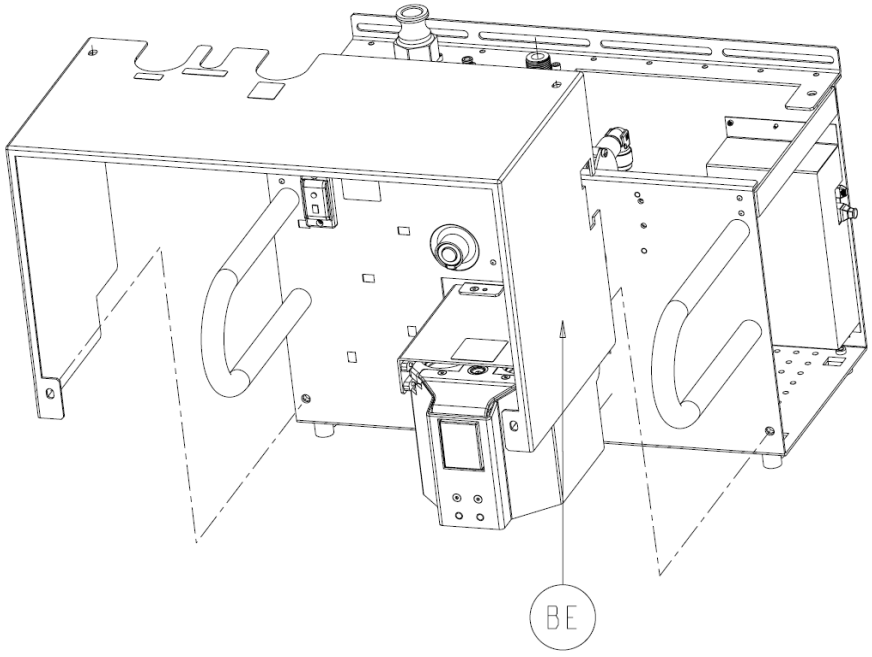
8. Unplug the rover and replace the faulty component.

Procedure 6.8 – Manually Raising & Lowering Docker Couplers

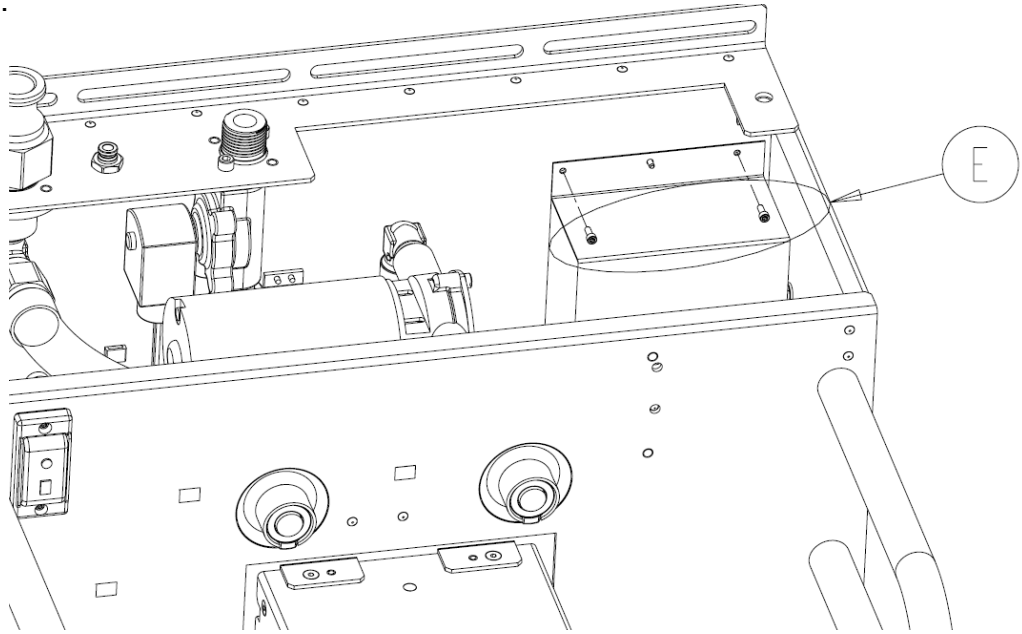
1. Using a 3/16” allen wrench, remove four **socket head cap screws** (P/N 0004-638-000). Make sure to remove the **electronic ports cover** (P/N 0702-014-027) (BH) before removing top cover in the next step.



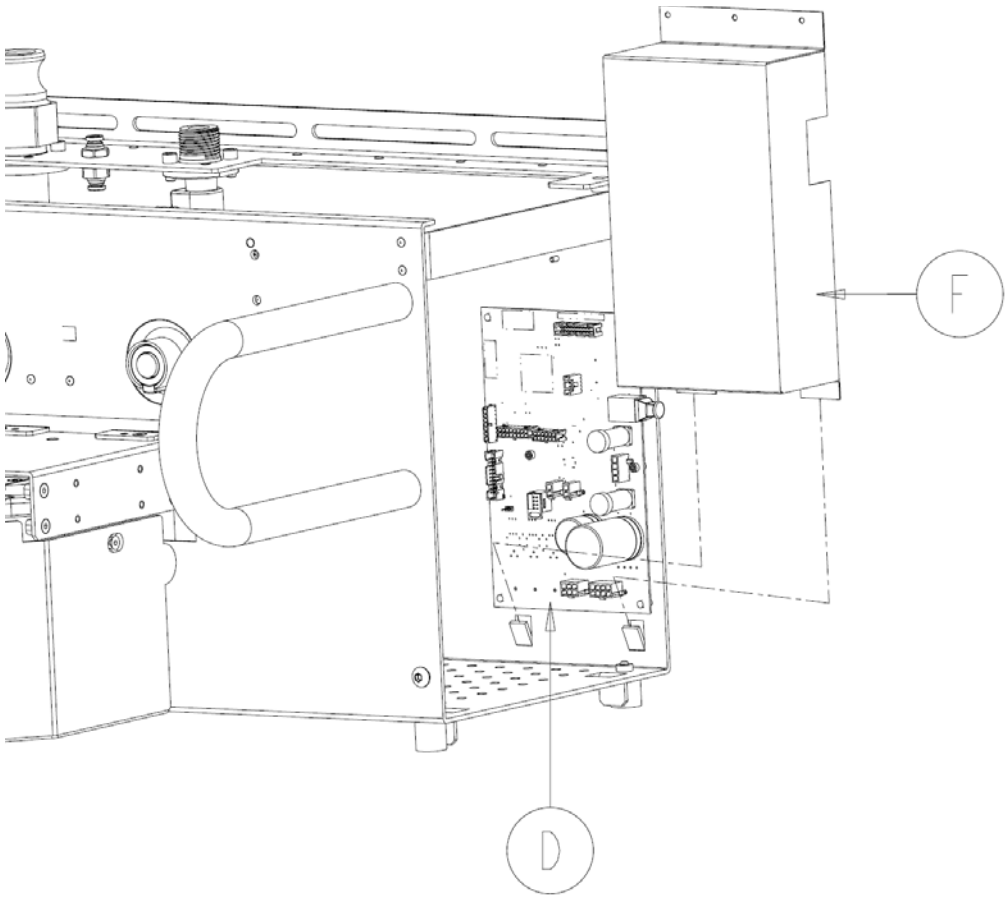
2. Slide **chassis top cover** (0702-014-011) (BE) forward and remove from chassis assembly.



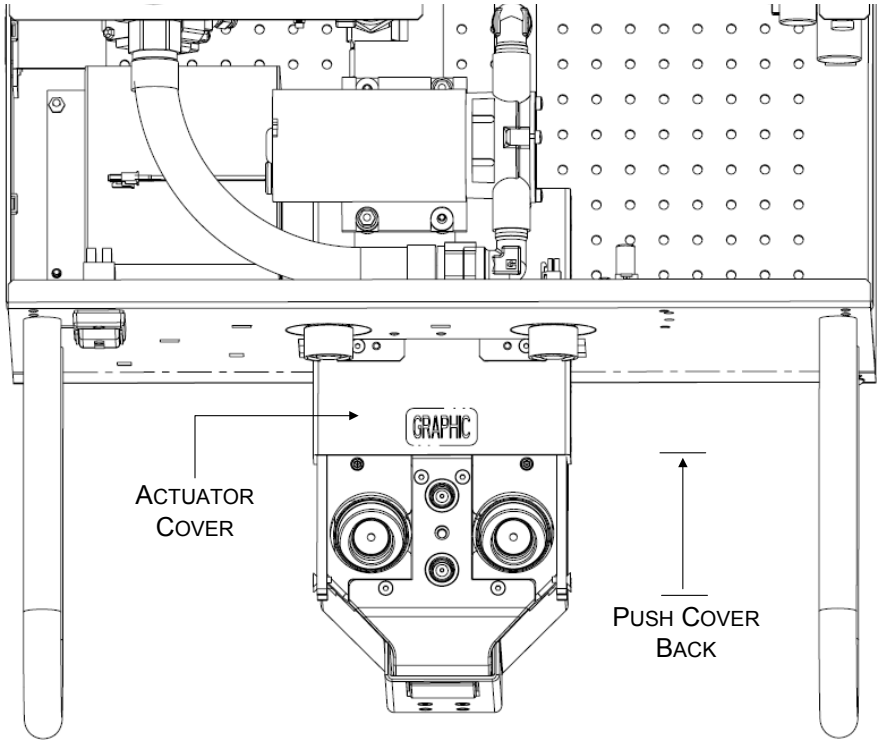
3. Remove two **socket head cap screws** (P/N 0004-529-000) (E) using a ¼" allen wrench.



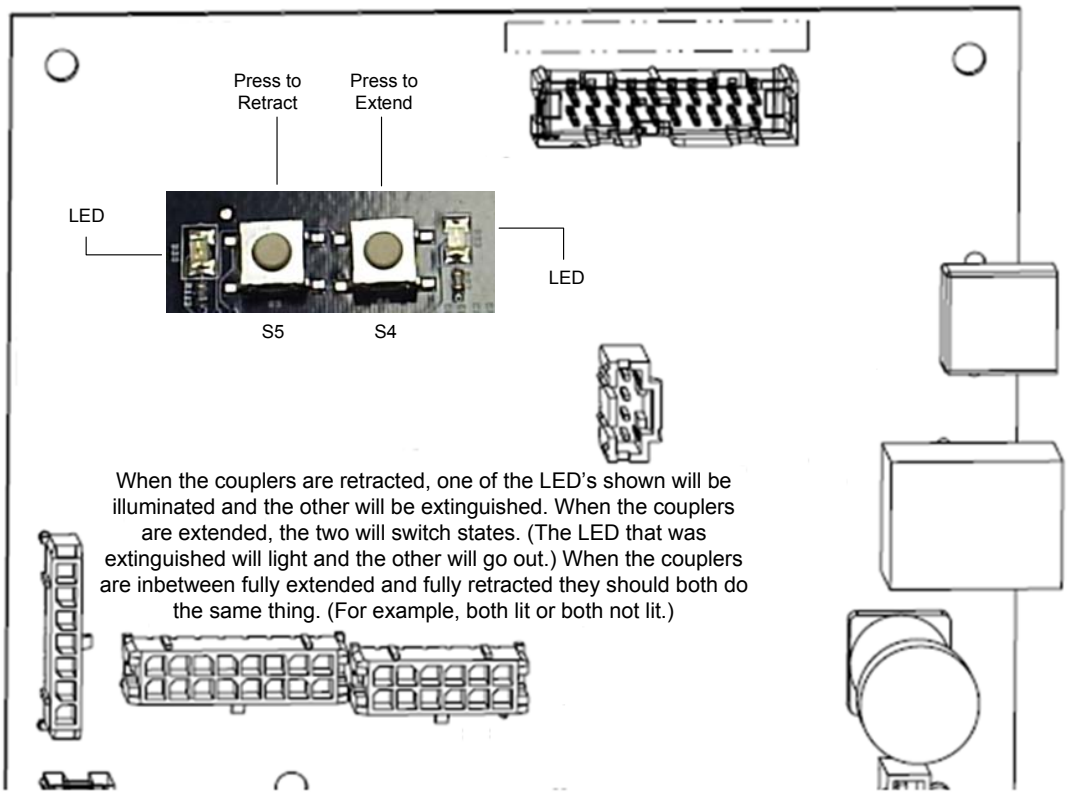
4. Remove **electronics shield** (P/N 0702-014-016) (F) to gain access to the **docker main controller PCBA** (P/N 0702-0104-500) (D)



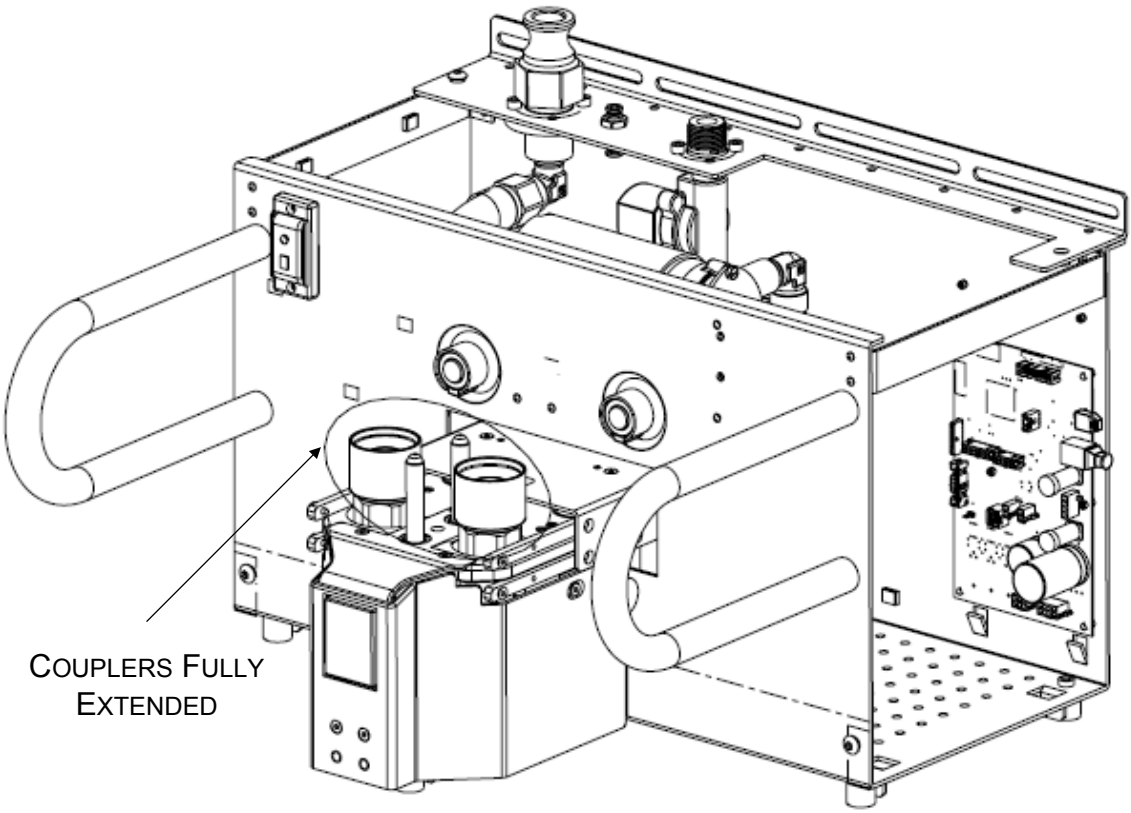
5. Hold the **actuator cover** in the open position. Make sure it is fully opened to allow sufficient clearance for the couplers to extend without hitting the top of the cover.



6. Switches S4 and S5 are located in the upper left hand corner of the circuit board. Press and hold S4 (on the right) to extend the couplers. Press and hold S5 (on the left) to retract the couplers. The LED's work differently depending on the revision of the docker control board. In either revision, if the LED's do not illuminate as described below, the corresponding hall sensor is faulty and should be replaced immediately.



7. Release the extend switch S4 when the couplers have fully extended and the **extended led** is illuminated.



Procedure 6.9 – Preventive Maintenance

The preventive maintenance for the Neptune Waste Management System includes electrical safety testing and functional testing performed in procedure 6.5 ***Testing***, as well as additional checks and cleaning.

Neptune Rover (P/N 0702-001-000)

1. Note any errors present in the system and then clear them.
2. Remove the front cover, rear panel, and lower panel.
3. Inspect the large and small canisters for cleanliness, cracks, or leaks. If the canister requires cleaning, complete procedure 6.10 ***Cleaning the Fluid Collection Canisters*** before proceeding.
4. Remove the fresh water and suction fittings on both canister caps and replace the o-rings for each fitting.
5. Verify the elbow fittings are intact, and that the coupling clips properly lock over each elbow fitting when reinstalled.
6. Verify the area inside both manifold receptacles is free of debris and clean as necessary.
7. Check the alignment of the v-clamps on the large and small canister. Ensure that the clamp is secured properly and that it is turned to the 10 o'clock position. (when looking down on the canister cap, the IV pole would be considered 9 o'clock)
8. Inspect the norprene tubing that connects the vacuum sensor to the vacuum manifold assembly. Ensure there are no cracks, pinched sections, cuts, or signs of degradation.
9. Replace grey exhaust filter on the silencer manifold.
10. Replace both the in and out carbon filters on the vacuum pump. (including the end cap and o-rings)
11. Complete the rover testing requirements in procedure 6.5 ***Testing*** on page 6-19. (Final testing will require the technician to reinstall the front cover, rear panel, and lower panel.)
12. Observe and record the offload rate for the rover. This is accomplished by filling the unit with 8 liters of water in dock control and recording the amount of time (in seconds) required to empty the fluid. Time should not exceed 1 minute for 8 liters of fluid.
13. Replace fluid suction HEPA filter and reset the time counter in the system settings menu. While in the system settings menu, proceed to the technician menu and record the voltage for the power supply voltages.
14. Wipe the exterior of the rover. Pay special attention to the IR window on the rover front cover.
14. Return the rover to service.

Neptune Docking Station (P/N 0702-014-000)

1. Replace the offload pump impeller.
2. Replace the fresh water filter.
3. Perform procedure 6.8 ***Manually Raising & Lowering Docker Couplers*** on page 6-43 and verify that hall sensors operate properly, and that the stepper motor extends and retracts the couplers without interruption. Leave the docker top cover off after verifying hall sensor operation.
4. Complete the docker testing requirements in procedure 6.5 ***Testing*** on page 6-19.

Procedure 6.10 – Cleaning the Fluid Collection Canisters

The cleaning should be perfumed as close to the docking station as possible. The technician will be required to manually dock the rover using technician mode to drain fluid from the rover during the cleaning procedure.

1. Dock the rover in technician mode and ensure all fluid is removed from both canisters.
2. Remove the front cover.
3. Remove all fittings and connections from the small and large canister caps.(to include electrical connections)
4. Remove the transducer rod from the small canister.
5. Disconnect the small v-clamp and remove the small canister cap.
6. Disconnect the large v-clamp and remove the large canister cap. Make sure to leave the large canister cap connected to the small canister.
7. Spray the large canister with Neptune Cleaner. Using the cleaning brush packaged with the cleaner, remove any buildup in the canister by scrubbing the sides. Reapply cleaner as necessary.
8. Once the large canister is free from debris and buildup, Place the large canister cap and small canister back on top of the large canister.
9. Secure the large v-clamp that holds the two canisters together.
10. Make sure to leave the small canister cap OFF of the canister. Insert the transducer rod that was removed in step 4. This will prevent fluid from leaking out while cleaning the small canister.
11. Spray the small canister with Neptune Cleaner. Using the cleaning brush packaged with the cleaner, remove any buildup in the canister by scrubbing the sides. Reapply cleaner as necessary.
12. Once the small canister is free from debris and buildup, dock the unit in technician mode and drain the fluids. This is accomplished by opening the drain valve to empty the fluids in the small canister and then turning on the offload pump in the docking station to remove the remainder of the fluids from the large canister.
13. Once all the fluid has been removed, undock the rover.
14. Remove the transducer rod, and reinstall the small canister cap and v-clamp.
15. Insert the transducer rod.
16. Reconnect all fittings, wiring harnesses, and connections that were removed earlier in step 3.
17. If the cleaning is performed as part of procedure 6.9 ***Preventive Maintenance***, return to step 4 on page 6-47. If performing the cleaning as a stand alone service, proceed to step 18 below.

NOTE: The technician does not need to complete the testing after completing the cleaning procedure, as it will be done later in the preventive maintenance procedure.

18. Complete procedure 6.5 ***Testing*** on page 6-19 and return the rover to service.

Chapter 7 – Installation

Important Information

The words WARNING, CAUTION and NOTE have special meaning and should be reviewed.

WARNING: Disregarding WARNING information may compromise the safety of the patient and/or health care staff and may result in injury.

CAUTION: Disregarding CAUTION information may compromise product reliability and may result in damage.

NOTE: NOTE information supplements and/or clarifies procedural information.

A triangle with an exclamation point alerts the health care professional to read and understand the accompanying instructions, especially the operating, maintenance, and safety information.

For Use With

The Stryker Docking Station (docker) is for use with the Neptune 2 Waste Management System, specifically the Neptune 2 Rover (rover).

Indications For Use

The Neptune 2 Waste Management System is intended to be used in the operating room, pathology, surgical center, and doctor's office to collect and dispose of surgical fluid waste.

Description

The docker is a wall-mounted component of the Neptune 2 Waste Management System. The rover interfaces with the docker to empty and rinse the rover's canister(s) of fluid waste. A detergent dispenser is connected to the docker to release Stryker-approved detergent into the rover's canister system automatically.

The docker is installed in a utility closet or disposal area with access to electrical power, a water supply, and a fluid waste drain. The health care facility is responsible for the preparation of the installation site and the availability of utilities.

User/Patient Safety*

WARNINGS:

- Only trained and experienced health care professionals should use this equipment. Before using any system component, or any component compatible with this system, read and understand the instructions. Pay special attention to WARNING information. Become familiar with the system components prior to use.
- Upon initial receipt and before each use, operate the equipment and inspect each component for damage. DO NOT use any component if damage is apparent.
- Take special precautions regarding electromagnetic compatibility (EMC) when using electrical equipment like this system. Install and place this system into service according to the EMC information contained in this manual. Portable and mobile RF communications equipment can affect the function of this system.
- DO NOT use this equipment in the presence of a mixture consisting of a flammable anesthetic and air or oxygen or nitrous oxide.
- Only trained and experienced health care professionals should install and maintain this equipment.
- The Bloodborne Pathogens Standard provided by the United States Occupational Safety and Health Association (US OSHA) requires all workers with exposure to "potentially infectious materials" wear the correct personal protection equipment and be offered immunization against hepatitis B. As an additional precaution, these workers should receive tetanus immunization and boosters when required.

Accessory/Disposable Information*

WARNING: Use only Stryker-approved components and detergent, unless otherwise specified. Using other components may result in increased electromagnetic emissions or decreased electromagnetic immunity of the system. DO NOT modify any component or accessory.

Description	REF
Neptune Docking Detergent	0700-001-026
Neptune Detergent Mounting Kit	0700-005-026

* If you need more information or a complete list of accessory information, contact your Stryker sales representative or call Stryker Neptune customer service at 1-800-550-7836. Outside the US, contact your nearest Stryker subsidiary.

Features

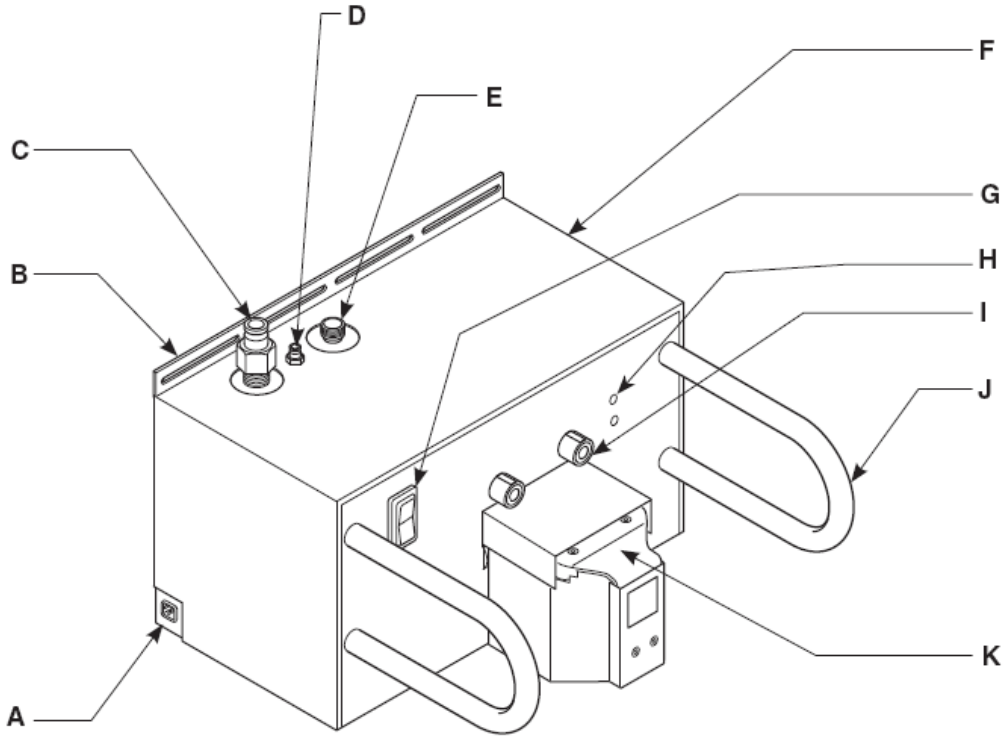
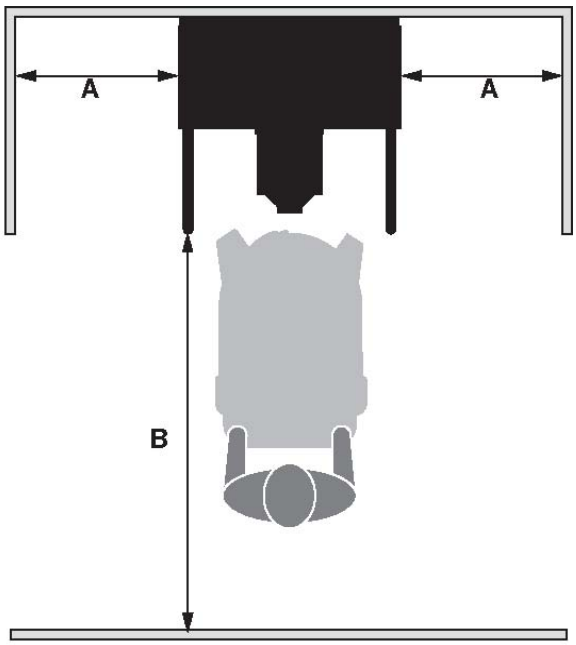


Figure 1: Docking Station Feature Locations

A	**Power Cord Receptacle** - Allows for the connection of facility power using the docker power cord.
B	**Mounting Bracket** - Using mounting hardware, the bracket allows for the permanent installation of the docker to a flat wall surface.
C	**Waste Outlet Port** - Allows for the disposal of fluid waste from the rover when the rover is connected to the docker.
D	**Detergent Inlet Port** - Allows detergent to enter the rover's fluid collection system to facilitate cleaning when the rover is connected to the docker.
E	**Water Inlet Port** - Allows fresh water to enter the rover when the rover is connected to the docker.
F	**Ethernet and USB Ports** - These ports are located on the side panel (not visible in illustration) and may be accessed by removing a cover. Allows for Stryker-approved software upgrades and maintenance.
G	**Power Switch** - The toggle switch allows for the application or removal of facility power.
H	**Infrared Communication Windows (two)** - Allows infrared data transfer between the docker and rover. Data transfer is necessary during the docking procedure.
I	**Magnets (two)** - Provides for the automatic physical alignment and connection of the rover to the docker.
J	**Guides (two)** - Facilitates the alignment of the rover to the docker.
K	**Power and Fluid Connectors** - When the rover is connected to the docker, the rover receives power through a power connector from the docker. Two fluid connectors are also present. One connector allows fresh water to enter the rover. The other connector provides for the disposal of waste water from the rover. The fluid connectors are located under a spring-loaded cover.

NOTE: See the *Specifications* section for electrical power, water, and drainage requirements. See figures 1 and 2 to ensure the installation area meets utility and space requirements.



A	Side Clearance	20 inches [50.8 cm]
B	Front Clearance	48 inches [121.9 cm]

Figure 2: Minimum Space Requirements

Instructions

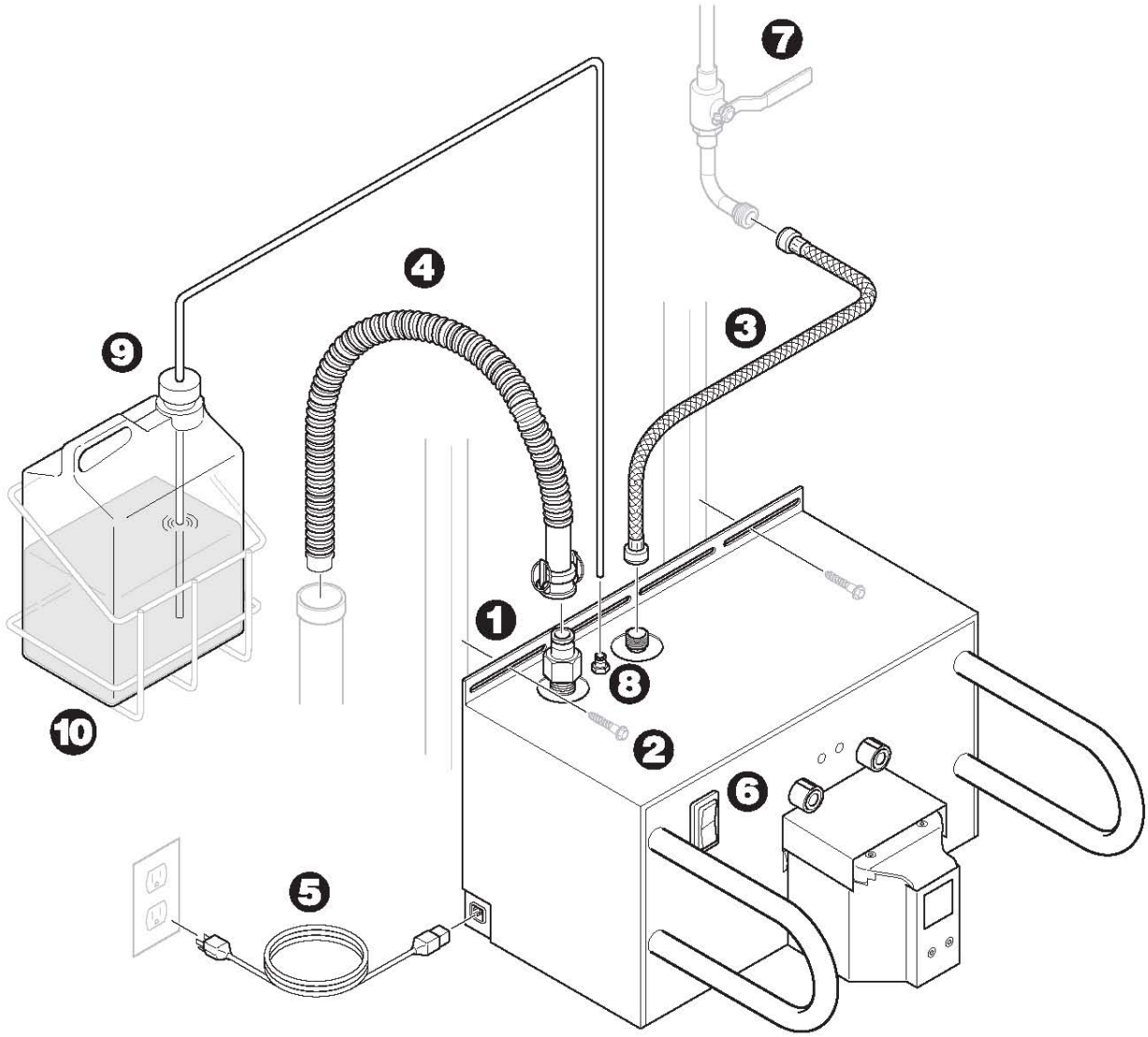


Figure 3 Docking Station Installation

Symbol Definitions

Power ON	Power OFF	Universal Serial Bus (USB) Port	Ethernet Port	Pinch Point

Instructions

To Install the Docker

WARNING: ALWAYS have more than one person unpack and lift the docker off the shipping pallet.

1. Place the docker against a wall with access to electrical power, water, and fluid waste disposal.

NOTE: To ensure the docker is mounted securely to the wall, align the mounting hardware with the wall studs.

2. Install the mounting screws through the mounting bracket of the docker and secure the docker to the wall.

NOTES:

- The docker is equipped with an internal anti-siphon device. See *Specifications* section for details. If the docker anti-siphon device does not meet local code requirements, obtain and install an anti-siphon device that will meet the necessary requirements. Install the device near the dedicated water shutoff valve of the facility water supply.
- Ensure the plumbing configuration is NOT susceptible to water hammer conditions.

3. Connect the water inlet hose between the water inlet port of the docker and the facility water supply.

WARNING: Follow the current local regulations governing biohazardous waste to safely handle and dispose of surgical fluid waste.

4. Connect the waste outlet hose between the waste outlet port of the docker and the drain emptying into the facility waste disposal system.

NOTE: A properly connected waste outlet hose will minimize the escape of noxious fumes and odors (see figure 3).
5. Connect the power cord between the electrical receptacle of the docker and the facility electrical power source.

6. Press the power switch ON. Observe the power switch illuminate.

NOTE: Before docking the rover, always allow the docker to warm up for at least 60 seconds after applying initial power to the docker.

7. Open the facility water valve to allow water to flow to the docker. Inspect the water supply connections for any leaks. Repair any plumbing to stop leakage if necessary.

8. Connect the detergent inlet tube to the detergent inlet port of the docking station.

9. To connect the detergent, see the label instructions on the Stryker approved detergent REF 0700-001-026.

To Replace the Detergent Bottle

1. Remove the detergent inlet tube from the empty bottle. Follow the current local regulations governing environmental protection to recycle or dispose of the bottle.
2. To connect the detergent, see the label instructions on the Stryker approved detergent REF 0700-001-026.

Cleaning Recommendations

CAUTION: DO NOT use glutaraldehyde or similar chemical cleaners on the docker.

1 Wipe the external surfaces of the docker with a soft cloth dampened with a non-abrasive, hospital disinfectant.
2 Thoroughly wipe the infrared communication windows to ensure the rover and docker can communicate and function properly.

Storage and Handling

To ensure the longevity, performance, and safety of this equipment, use the original packaging when storing or transporting this equipment.

Periodic Maintenance

INTERVAL	ACTIVITY
As Required	Inspect the plumbing connections and hoses for leaks. Repair any plumbing to stop leakage as required. Replace leaking hoses as required.
As Required	Check the level of the detergent in the dispensing bottle Replace the bottle of detergent as required.

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Troubleshooting Guide*

PROBLEM	CAUSE	ACTION
Power switch does not illuminate in the ON position.	Power cord is not connected securely.	Connect the power cord securely.
Water inlet hose is leaking.	Water inlet hose is damaged.	Contact Stryker.*
Waste outlet hose is leaking.	Waste outlet hose is damaged.	Contact Stryker.*
Sporadic electrical interference is experienced.	Electrical noise is present.	Turn off all the electrical equipment in the room. Relocate the electrical equipment to maximize the distance between the equipment. Increase spatial distance. Plug equipment into different outlets.

*DO NOT service this equipment. If you require service, contact your Stryker sales representative or call Stryker Neptune customer service at 1-800-550-7836. Outside the US, contact your nearest Stryker subsidiary.

Specifications*

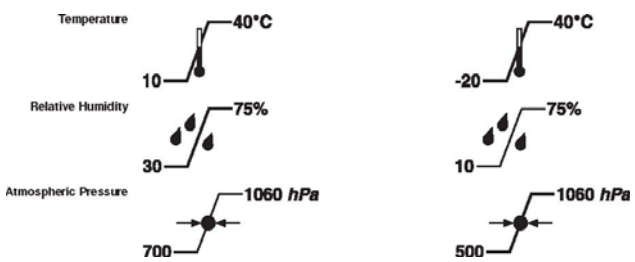
Model:	Neptune 2 Docking Station
REF:	0702-014-000
Electrical Power Requirements:	120 V ~, 60 Hz, 3.0 A 15 A receptacle connection
Size:	23 inch [58.4 cm] width 16 inch [40.6 cm] height 23 inch [58.4 mm] depth
Weight:	95 lbs. [43 kg]
Equipment Type:	Class I
Enclosure Protection:	IPX0 Ordinary equipment
Infrared Communication Windows:	
Protective Earth Ground:	
Approval:	 CSA International CAN/CSA-C22.2 No. 601.1 M90: 2003 BS EN 60601-1: 1997 UL 60601-1: 2003

Water Requirements:

Pressure Range	50 to 120 psi [2,586 to 6,206 mmHg]
Anti-siphon Device	ANSI/NSF-61
Temperature	40 to 110 F [4.4 to 43.3 C]
Connection	Source accepts garden hose fitting and has dedicated shutoff valve
Quality	Potable tap water
Usage	Nine gallons [34 liters] per rinse cycle at default settings on standard cycle; water usage fluctuates due to selected cycle and facility flow.

Drainage Requirements:	Floor drain or permanent service connection per local plumbing codes; 8 feet [2.44 m] connection distance (maximum)
Water Inlet Hose	0.75 inch [1.9 cm] diameter 6 feet [1.83 m] length
Waste Outlet Hose	1.0 inch [25.4 cm] diameter 6 feet [1.83 m] length
Detergent Inlet Tube	0.25 inch [0.635 cm] outer diameter 4 feet [1.2 m] length

Environmental Conditions:



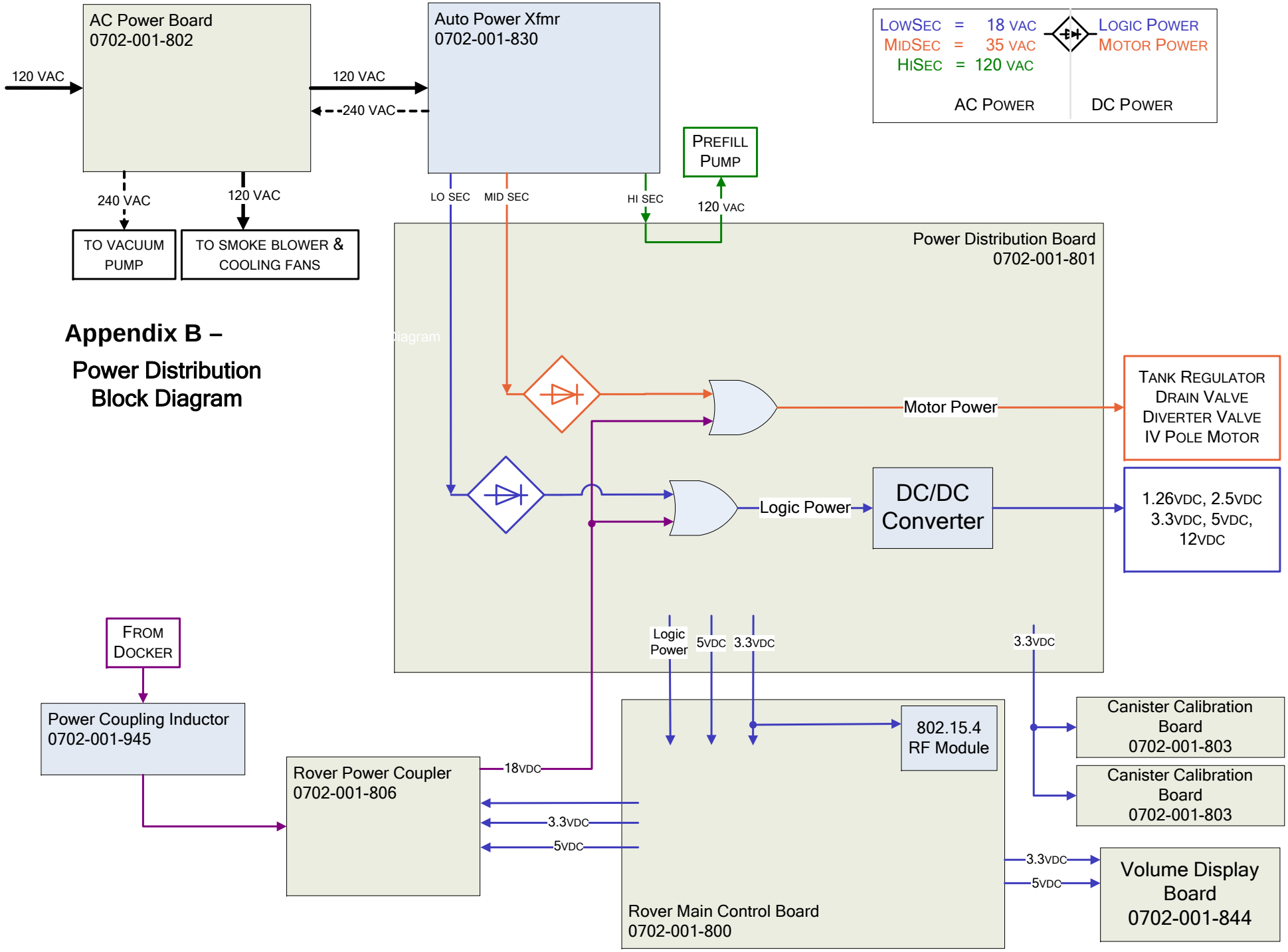
***Specifications are approximate and may vary from unit to unit or by power supply fluctuations.**

Chapter 8 – Appendices

Appendix A – List of Materials

The list of materials is meant to provide the technician with a reference for the parts used in and with the Neptune 2 system, but that may not be listed elsewhere in the service manual. The technician is not required to have the exact tools listed in the tools section, but they will have to have those items on hand.

Item Family	Distributor	Part Number	Item Name
Disposables	Stryker	0044200310	TWO SIDED FOAM TAPE
		0058099000	CABLE TIE
		0058104000	CABLE TIE, HEAT SENSITIVE
		0058113010	CABLE TIE
		0058330000	CABLE TIE
Chemicals	Stryker	0072002001	LOCTITE 242
		0072002002	LOCTITE 271 3/4oz. BOTTLE
		0072002004	LOCTITE 680
		0072002010	LOCTITE BLK MAX 38050 1OZ
		0072002032	RTV 162 3OZ
		0072005050	MOBIL-XHP 222 SPECIAL
Calibrated Items & Test Equipment	McMaster Carr	1475T16	1 LITER GRADUATED CYLINDER
	Techni-Tool	987TE5441	ELECTRICAL SAFETY ANALYZER (Dale Technologies Model LT544 D Plus)
	Slaughter	1305	AC HI-POT TESTER (Slaughter Model 1305)
Tools	McMaster Carr	5630A1	NEEDLE-NOSED PLIERS
	McMaster Carr	5285A84	SLIP JOINT PLIERS
	Techni-Tool	272PL136	DAIGONAL CUTTERS
	Techni-Tool	204WR392	TORX L-KEYS; 7 PIECE
	McMaster Carr	7813A12	STANDARD ALLEN KEY SET
	Techni-Tool	272WR022	12" ADJUSTABLE WRENCH
	Techni-Tool	758ST1058	ESD WRIST STRAP
	Techni-Tool	272SC676	6" SLOTTED SCREWDRIVER
	Techni-Tool	272SC810	6" PHILLIPS SCREWDRIVER


AC Power Board
0702-001-802
120 VAC
120 VAC
240 VAC
Auto Power Xfmr
0702-001-830
LOWSEC = 18 VAC
MIDSEC = 35 VAC
HISEC = 120 VAC
LOGIC POWER
MOTOR POWER
AC POWER
DC POWER
PREFILL PUMP
120 VAC
240 VAC
120 VAC
TO VACUUM PUMP
TO SMOKE BLOWER & COOLING FANS
LO SEC
MID SEC
HI SEC
Power Distribution Board
0702-001-801
Appendix B –
Power Distribution Block Diagram
Motor Power
TANK REGULATOR
DRAIN VALVE
DIVERTER VALVE
IV POLE MOTOR
Logic Power
DC/DC Converter
1.26VDC, 2.5VDC
3.3VDC, 5VDC,
12VDC
FROM DOCKER
Power Coupling Inductor
0702-001-945
Logic Power
5VDC
3.3VDC
3.3VDC
Rover Power Coupler
0702-001-806
18VDC
3.3VDC
5VDC
802.15.4
RF Module
Canister Calibration Board
0702-001-803
Canister Calibration Board
0702-001-803
3.3VDC
5VDC
Volume Display Board
0702-001-844
Rover Main Control Board
0702-001-800