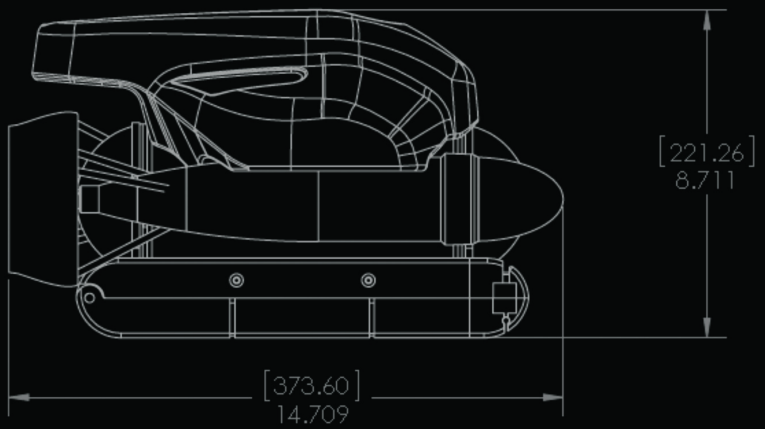
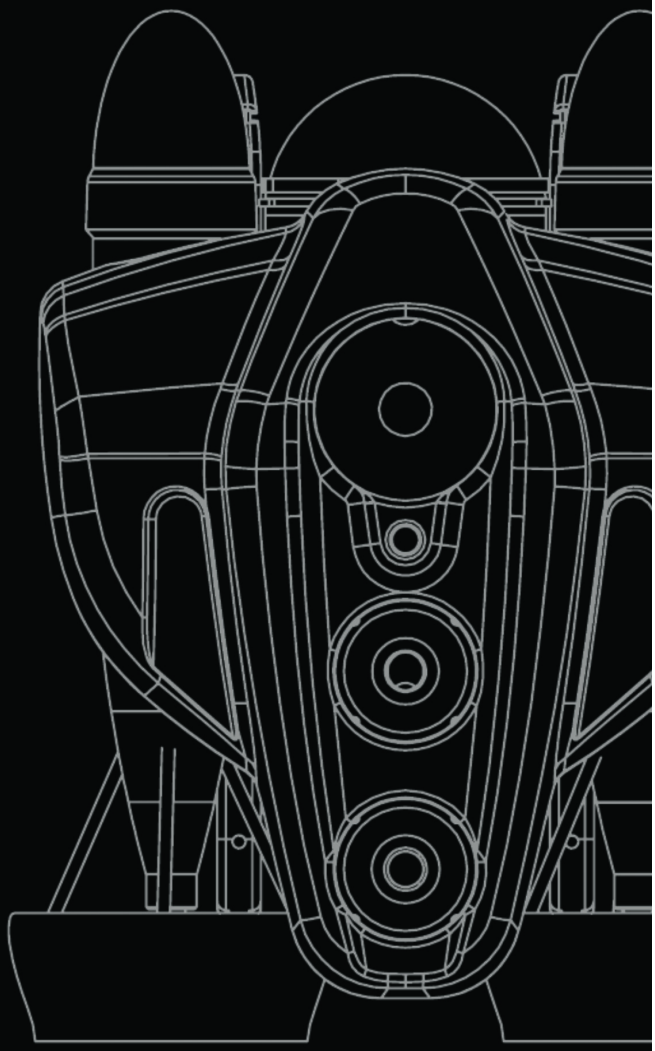
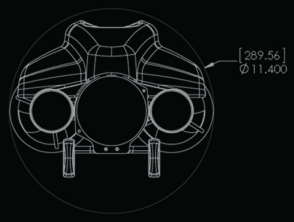
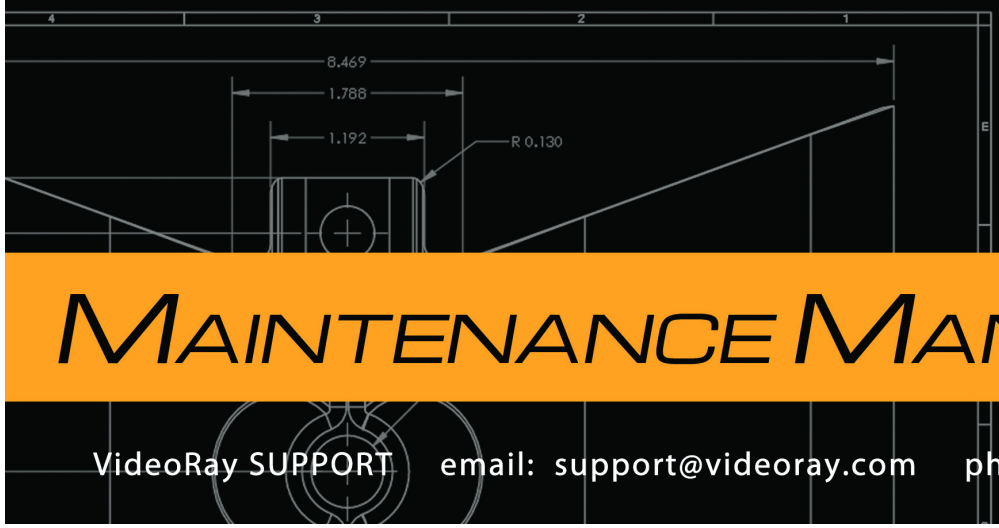
VideoRay

PRO 4









MAINTENANCE MANUAL

VideoRay SUPPORT email: support@videoray.com phone: +1 (610) 458-3000

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Table of Contents

Horizontal Propeller

- Removal Procedures
  - 1 - Horizontal Propeller
- Replacement Procedures
  - 1 - Horizontal Propeller

Horizontal Cartridge Seal

- Removal Procedures
  - 2 - Horizontal Cartridge Seal
- Replacement Procedures
  - 1 - Horizontal Cartridge Seal

Horizontal Nozzle

- Removal Procedures
  - 2 - Horizontal Nozzle
- Replacement Procedures
  - 1 - Horizontal Nozzle

Horizontal Cone

- Removal Procedures
  - 4 - Horizontal Cone
- Replacement Procedures
  - 1 - Horizontal Cone

Horizontal Bearing

- Removal Procedures
  - 5 - Horizontal Bearing
- Replacement Procedures
  - 1 - Horizontal Bearing

Horizontal Drive Train

- Removal Procedures
  - 5 - Horizontal Drive Train
- Replacement Procedures
  - 1 - Horizontal Drive Train

Horizontal Motor Mount

- Removal Procedures
  - 6 - Horizontal Motor Mount
- Replacement Procedures
  - 1 - Horizontal Motor Mount

Horizontal Motor

- Removal Procedures
  - 7 - Horizontal Motor
- Replacement Procedures
  - 1 - Horizontal Motor

Dome Retaining Rings

- Removal Procedures
  - 5 - Dome Retaining Rings
- Replacement Procedures
  - 1 - Dome Retaining Rings

Front Dome

- Removal Procedures
  - 6 - Front Dome
- Replacement Procedures
  - 1 - Front Dome

Front Hull Ring

- Removal Procedures
  - 7 - Front Hull Ring
- Replacement Procedures
  - 1 - Front Hull Ring

Camera Assembly

- Removal Procedures
  - 8 - Camera Assembly
- Replacement Procedures
  - 1 - Camera Assembly

Camera Lens-Focus

- Removal Procedures
  - 7 - Camera Lens-Focus
- Replacement Procedures
  - 1 - Camera Lens-Focus

Camera Interface

- Removal Procedures
  - 9 - Camera Interface
- Replacement Procedures
  - 1 - Camera Interface

Camera Tilt Servo

- Removal Procedures
  - 9 - Camera Tilt Servo
- Replacement Procedures
  - 1 - Camera Tilt Servo

Camera Mount Base

- Removal Procedures
  - 11 - Camera Mount Base
- Replacement Procedures
  - 1 - Camera Mount Base

Camera Focus Servo

- Removal Procedures
  - 13 - Camera Focus Servo
- Replacement Procedures
  - 1 - Camera Focus Servo

Camera

- Removal Procedures
  - 13 - Camera
- Replacement Procedures
  - 1 - Camera

Camera Mount Cover

- Removal Procedures
  - 15 - Camera Mount Cover
- Replacement Procedures
  - 1 - Camera Mount Cover

Rear Dome

- Removal Procedures
  - 6 - Rear Dome
- Replacement Procedures
  - 1 - Rear Dome

Compass-Nav Module

- Removal Procedures
  - 7 - Compass-Nav Module
- Replacement Procedures
  - 1 - Compass-Nav Module

Rear Hull Ring

- Removal Procedures
  - 7 - Rear Hull Ring
- Replacement Procedures
  - 1 - Rear Hull Ring

Desiccant Pack

- Removal Procedures
  - 9 - Desiccant Pack
- Replacement Procedures
  - 1 - Desiccant Pack

ROV Board Set

- Removal Procedures
  - 9 - ROV Board Set
- Replacement Procedures
  - 1 - ROV Board Set

ROV CPU Board

- Removal Procedures
  - 10 - ROV CPU Board
- Replacement Procedures
  - 1 - ROV CPU Board

ROV Heat Sink

- Removal Procedures
  - 10 - ROV Heat Sink
- Replacement Procedures
  - 1 - ROV Heat Sink

ROV Power Board

- Removal Procedures
  - 12 - ROV Power Board
- Replacement Procedures
  - 1 - ROV Power Board

Camera Ribbon Cable

- Removal Procedures
  - 12 - Camera Ribbon Cable
- Replacement Procedures
  - 1 - Camera Ribbon Cable

Termination Block

- Removal Procedures
  - 13 - Termination Block
- Replacement Procedures
  - 1 - Termination Block

Pressure Sensor

- Removal Procedures
  - 14 - Pressure Sensor
- Replacement Procedures
  - 1 - Pressure Sensor

Vertical Thruster Kit

- Removal Procedures
  - 16 - Vertical Thruster Kit
- Replacement Procedures
  - 1 - Vertical Thruster Kit

Vertical Motor Mount

- Removal Procedures
  - 17 - Vertical Motor Mount
- Replacement Procedures
  - 1 - Vertical Motor Mount

Vertical Motor Adapter

- Removal Procedures
  - 18 - Vertical Motor Adapter
- Replacement Procedures
  - 1 - Vertical Motor Adapter

Vertical Motor Shield

- Removal Procedures
  - 19 - Vertical Motor Shield
- Replacement Procedures
  - 1 - Vertical Motor Shield

Vertical Motor

- Removal Procedures
  - 20 - Vertical Motor
- Replacement Procedures
  - 1 - Vertical Motor

Wire Harness

- Removal Procedures
  - 15 - Wire Harness
- Replacement Procedures
  - 1 - Wire Harness

Horizontal Thrust Tube

- Removal Procedures
  - 20 - Horizontal Thrust Tube
- Replacement Procedures
  - 1 - Horizontal Thrust Tube

Main Hull Tube

- Removal Procedures
  - 24 - Main Hull Tube
- Replacement Procedures
  - 1 - Main Hull Tube

About this Document

Online Manual

This Quick Start Guide is a subset of the full version of this manual, which is available on the Pro 4 control panel and online in the following formats:

- Installed on the Pro 4 control panel at: _mnt_global for viewing the HMTL locally.
- http://download.videoray.com/_mnt_global for viewing the HMTL online.
- http://download.videoray.com/documentation/mnt/pdf/videoray_doc__mnt_global.pdf for viewing the PDF online.
- http://download.videoray.com/documentation/mnt/zip/videoray_doc__mnt_global.exe for downloading the HTML and PDF files.

Document Conventions

Several symbols are used throughout this documentation to add emphasis and to assist in relocating important information. The following table describes these symbols and their uses.

SYMBOL	DESCRIPTION
DANGER	The **Danger** icon is used to indicate there is a potential risk of personal injury or death. Extra care should be taken to understand the risks, and all personnel should exercise caution. It may also be appropriate to warn others in the immediate vicinity.
CAUTION	The **Caution** icon is used to indicate there is a potential risk of damage to the equipment or surrounding property. Personnel should receive training in the appropriate procedures before attempting to operate or maintain the equipment.
	The **Do Not** icon is used to indicate that an action or activity should NOT be performed.
	The **Note** icon is used to highlight a specific detail or point of information.
	The **Tip** icon is used to highlight a suggestion or recommendation.

Beyond this Document

There is no substitute for experience and/or training, especially with respect to the real purpose for which you plan to use this equipment. We encourage you to explore options beyond the scope of these materials to expand your knowledge and skills necessary to support your applications. In addition to this documentation, VideoRay offers training and technical support and hosts a general user discussion forum and user image gallery.

We also realize that collectively, users of our products spend considerably more time operating our systems than we do ourselves. Users also encounter more diverse operating environments across an extremely broad range of applications. We highly value this vast experience base, and invite and encourage you to share your experiences and suggestions with us. Please feel free to contact us by any of the methods listed below.

Quality Commitment

VideoRay strives to design, manufacture, deliver and support the highest quality products and services, including this documentation. We have made every effort to ensure that this documentation is accurate and provides you with the most up-to-date information.

If you find any errors in this documentation or have suggestions for improvements, each page contains a "Help us improve this document" feedback link in the left margin (you must be connected to the Internet to use this link).

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Disclaimer

This document is deemed accurate at the time of its writing, however it is not a legal contract and the information contained herein should not be construed to represent any form of commitment. This document as well as the associated products and services are subject to change without notice.

How to Get Help

Help for your Pro 4 is available through several channels.

All Hours Self-Service / Crowd-Source Tools

Operator's Manuals and Standard Operating Procedures	www.videoray.com/support/manuals.html
Software Downloads	www.videoray.com/support/downloads.html
Frequently Asked Questions	www.rovfaq.com
ROV User Forum	www.rovinfo.com

Global Support

Email	support@videoray.com
Phone	+1 610-458-3000 (*select option* 1)
Skype	videoray.support (*by appointment*)
Remote Sessions	www.videoray.com/support/remote-support.html (*by appointment*)

Regional Support

VideoRay Authorized Service Centers and Dealers	www.videoray.com/dealer.html

Training

Operator Training	www.videoray.com/learn-more/training.html
Advanced Maintenance Training	www.videoray.com/learn-more/advanced-maintenance-courses.html

Operational Strategies and Tactics Support

If you need help understanding how to apply your system to a specific project, contact VideoRay or you local VideoRay dealer. We can provide guidance or help you find a certified consultant.

Maintenance Best Practices

DANGER CAUTION To avoid injury or damage to the VideoRay, disconnect the system power and tether before commencing any maintenance and/or repairs.

The best maintenance programs begin before trouble occurs, and preventative maintenance should be your first step on the road to reliable system performance.

Inspections

Inspections should be carried out before and after every dive as part of the pre- and post-dive procedures. Be observant for signs of loose parts, wear or impending failure - catch small problems before they become big problems. A

CAUTION Failure to inspect and replace thruster cartridge seals regularly is one of the most common reasons for systems to be returned to VideoRay for repair. Water ingress through the thruster cartridge seals typically leads to major internal component damage, which is expensive to repair. View example cartridge seals.

Trained Operators

Do not subject equipment to accidental or inadvertent abuse by someone who is not trained in its proper use.

Trained Technicians

Maintenance should be completed by trained and certified technicians, and using factory authorized parts. VideoRay recommends that you create and maintain a system logbook. The logbook entries can include details of missions (date, location, conditions, dive time, etc.) and maintenance performed (date, procedure, parts replaced, etc.). The logbook may help identify possible causes of problems and systemic issues that should be reported to VideoRay for further investigation.

Service

Follow recommended periodic maintenance schedules, documented procedures and use the proper tools. Work in a clean environment. For any service or repair procedure beyond the scope of the simpler procedures defined in the User Maintenance Policy, contact VideoRay for assistance.

Well Equipped Shop

A well equipped shop is organized, clean, and well lit. Ideally all work can be conducted in such an environment, however there may be times when maintenance or repairs must be completed in the field. For those occasions,

Maintenance Tools Required

VideoRay is designed with ease of maintenance in mind, and only a few tools are required to service the system. In fact, many maintenance procedures, such as changing light modules can be done without tools. VideoRay also includes a small tool and spares kit with each system delivered that contains most of the required tools. The following list of tools is recommended:

TOOL	TYPICAL USE
O-ring lubricator	Lubricating O-rings and O-ring grooves and landings.
Multi-tip screwdriver with 1/4" and 5/16" nut drivers	Miscellaneous screws and main hull rods
5/16" Open end wrench	Main hull rods
7/16" Open end wrench	Propeller locking nuts
Rubber tipped pipe pliers*	Thruster cones
11/16" Open end wrench*	Termination block (tether connection)
13/16" Open end wrench*	Termination block (tether connection)
3/4" Open end wrench*	Pressure sensor
7/8" Open end wrench*	Pressure sensor (required for old style black aluminum housing pressure sensors only)
1-1/4" Open end wrench*	Vertical thruster
Multi-meter*	Electrical circuit testing
Soldering iron*	Electrical circuit repair
Flashlight*	Internal inspections

* - These items are not included in the standard tool kit that comes with the Pro 4.

Additionally, small trays to hold parts and fasteners are recommended.

Field Tool Kit

Ideally all work can be conducted in a workshop environment, however there may be times when maintenance or repairs must be completed in the field. For those occasions, it is recommended that you carry a well stocked tool kit, and a clean mat that can be used as a clean workspace for

maintenance.

Basic Equipment Care

Do not abuse the VideoRay and be careful not to damage the system's components through normal use. For example, avoid letting the tether connectors come in contact with the ground where rough surfaces or dirt can damage the contacts.

Cleaning

VideoRay systems should always be cleaned after use. When used in salt water or contaminated environments, make sure to thoroughly rinse and then soak all wet components. It is especially important that you rinse the pressure sensor and allow it to drain. You must remove the float block to do this.

CAUTION Use care when cleaning the pressure sensor to avoid damaging the sensor. Do not insert anything into the pressure sensor cavity, and do not apply high pressure spray to the sensor.

Storage and Transport

Always pack the system securely to make sure it is not damaged in transport.

Special Handling

CAUTION VideoRay ROVs and their components can be damaged by improper care and handling. The following sections provide guidelines and procedures for working with these components.

O-Ring Care and Handling

O-Ring Rule of Thumb - If in doubt, throw it out! Generally, when compared to the equipment they are protecting, O-rings are very inexpensive. Should an incorrectly sized or damaged O-ring be installed, the result can be catastrophic. If there is any doubt as to the suitability or condition of an O-ring it should be replaced.

O-rings and other components with sealing surfaces should never be handled with dirty or gritty hands. A small amount of dirt trapped next to an O-ring will cause leakage, which could result in serious damage to the ROV's internal components. The most common situation is a single strand of hair or lint, so care should be taken to ensure a clean work area. Should an O-ring or sealing surface become dirty, wash it with mild soap and water, and then rinse it with clean water. Avoid scratching the surfaces of the O-ring grooves and landings. Do not use sharp objects such as a knife or screwdriver to pry apart sealed assemblies or remove O-rings. Serious damage to the O-ring or the seat may result.

O-ring Lubrication - VideoRay recommends the use of pure silicone spray or the O-ring lube kit that comes in the standard tool kit. Other lubricants can lead to deterioration and failure of the O-rings and components. Do not use other lubricants! Other lubricants may cause deterioration or attract dirt and lead to leaks or premature failure.

O-ring Inspection - O-rings wear out over time. Inspect all O-rings whenever a sealed assembly is apart. "Healthy" O-rings are soft, flexible and have not been pinched or nicked. Should an O-ring appear brittle, or have apparent cracks, nicks, or evidence of being pinched or permanently compressed, it should be replaced. Sealing surfaces should also be inspected while an assembly is apart. The surfaces should be examined to determine that they are free of dirt, nicks, scratches, or damage, which may result in seal failure once reassembled.

O-ring Storage - O-rings should be stored in clean plastic bags to protect them from dust when not in use. Avoid prolonged storage in direct sunlight as this may result in deterioration of the O-ring material. Stored O-rings should be sorted with regard to type and size with that information noted on the storage bag. Use of an incorrect O-ring can result in an ineffective seal.

Cartridge Seals

View example cartridge seals.

CAUTION Cartridge seals must be checked before every dive and must be replaced with new ones before the air bubble reaches 1/2 of the volume of the seal. Cartridge seals must also be replaced with new ones if they contain contamination or look milky instead of clear. On long duration dives, the cartridge seals should be checked at hourly intervals during the dive unless this is impossible (for example, continuous extended video is required). Any cartridge seal that shows a high rate of air bubble growth or increasing contamination should be replaced (if unable to be replaced on-site, it must be checked more frequently until it is replaced). When replacing seals that are worn, the shaft must be checked for scoring or other signs of wear that could lead to premature seal failure. The shaft must also be checked for wobble (bent), which could also lead to premature seal failure. Thrusters should not be run for more than a minute in air, which could also result in premature seal failure. Cartridge seals must be replaced in a clean environment to ensure a good water tight fit of the O-ring and seals.

If these recommendations are followed, the ROV should NEVER experience a flood through the cartridge seal unless the seal itself suffers a catastrophic failure. VideoRay's warranty does not cover damage due to flooding of the ROV through a cartridge seal unless the customer can demonstrate that they have followed the above recommendations and there is reasonable evidence that the seal failed catastrophically due to a manufacturing defect.

Cartridge Seal Storage Recommendations:

- Cartridge seals should be stored in a sealed plastic bag so they do not attract dirt.

- Recommended storage temperature is between 2 to 15 degrees C (35 to 60 degrees F) to keep the storage gel from softening and allowing the oil to drain.
- Storage or transport at low air pressure (checked baggage in an unpressurized cabin) is not recommended.

Example Cartridge Seals

New cartridge seal.

Cartridge seal with an acceptable bubble - this seal is okay to use.

CAUTION Nearly empty cartridge seal - this seal should have been replaced when the oil level reached 1/2 of the original volume.

Cartridge seals like this should not be used.

CAUTION Cartridge seal with contamination - this seal should be replaced.

Cartridge seals like this should not be used.

Electronics Components Care and Handling

Electronic components (circuit boards) are susceptible to damage from ESD (Electro-Static Discharge). Numerous sources are available that provide background information and recommend procedures for handling these components. These procedures should be followed when directly handling VideoRay's electronic components.

ESD is caused by the build up of static electricity. Steps to reduce the build up of static electricity or drain off any static build up are encouraged in order to prevent ESD damage.

General Guidelines for handling electronic components include:

- Avoid static build up in the work area
    - Avoid carpet in work areas
    - Maintain proper humidity levels: 40 - 60%
- Implement practices to prevent static build up
    - Provide ground points in the work area
    - Wear a grounded wrist strap
    - Provide grounded static dissipative mats on work surfaces and floors
    - Wear static dissipative outer clothing
    - Work standing rather than sitting
- Use ESD protective packaging

If you cannot work in a properly equipped ESD safe area, there are some general precautions you can follow in addition to the above.

- Always touch a metal ground to dissipate any static charge build up before handling circuit boards.
- When transferring a circuit board to another person or work surface, touch the person or surface with your free hand to dissipate and static charge build up.

Hull Materials Care and Handling

Aluminum Hull Components

VideoRay's aluminum parts are protected by anodizing and/or ceramic coatings. The use of metal tools can scratch these coatings leading to corrosion. Be careful when working with with metal tools near hull parts. Use only wood or plastic tools when the tool must contact an aluminum hull component.

Main Dome and Light Dome

The domes should be cleaned with mild soap and water. They are acrylic and small scratches can be buffed out.

CAUTION Do not use cleaners that contain alcohol or other solvents. Solvents can make the domes brittle.

Galvanic Corrosion

Galvanic corrosion results from dissimilar metals being in contact when exposed to a conductive medium like salt water. Make sure all stainless steel fasteners are not in direct contact with aluminum hull parts. VideoRay uses nylon spacers for these contact points to keep the materials separated. Always make sure to use these spacers when reassembling parts after routine maintenance or a repair.

Periodic Maintenance

The following tables provide information for periodic inspection and maintenance. All users should follow these guidelines, however, some repair / replacement procedures require advanced training.

Action	Frequency	Skill Level for Repair / Replacement	Reference / Notes
External Visual Inspection	Before and after every dive.	All Users	See the Quick Start Guide in the Operator's Manual.
Fresh Water Soak	After every dive.	All Users	See the Quick Start Guide in the Operator's Manual.
Cartridge Seal Replacement	When the cartridge seal oil level is less than 1/2 the volume of the cartridge. When the cartridge seal oil looks cloudy or contaminated. When you notice a significant change in the cartridge seal oil level over a short period of time or use.	All Users	See the horizontal or vertical cartridge seal removal and replacement instructions in the Maintenance Manual.
Propeller Replacement	When the propeller blade is cracked, chipped or excessively worn.	All Users	See the horizontal or vertical propeller removal and replacement instructions in the Maintenance Manual.
Float Block Replacement	If the ROV is used in environments where the float block is routinely scraped, such as in ship hull inspections, the float block should be replaced if the outer shell is significantly worn. The float block should be replaced before the outer shell is worn through to the core material.	All Users	See the float block removal and replacement instructions in the Maintenance Manual.
Main Dome Replacement	When the dome is scratched or marred within the camera's view. When the dome has deep scratches or cracks.	Advanced Training Required	See the front or rear dome removal and replacement instructions in the Maintenance Manual. Note: The main domes are interchangeable and the rear dome can be used on the front of the ROV to replace a mildly scratched or marred dome that affects camera image quality.
Light Dome Replacement	When the dome has deep scratches or cracks.	Advanced Training Required	See the light dome removal and replacement instructions in the Maintenance Manual.
Desiccant Pack Replacement	When condensation appears on the inside of the domes and a leak has been ruled out.	Advanced Training Required	See the desiccant pack removal and replacement instructions in the Maintenance Manual. Note: The desiccant pack can be dried and reused. To dry the desiccant pack, remove it and heat it in a low temperature oven (150-200 F or 65-95 C) for about 1/2 hour.
O-ring Replacement	Annually. When an O-ring looks cracked or suffering from dry rot.	Advanced Training Required	See the specific instructions for each component in the removal and replacement section of the Maintenance Manual.
Hull Component Replacement	With proper maintenance and cleaning, most hull components have life expectancy of many years. If you notice corrosion or deep pitting, you may need to replace that component.	Advanced Training Required	See the specific instructions for each component in the removal and replacement section of the Maintenance Manual.

⚠ Procedures with a skill level of "Advanced Training Required" require knowledge and skill levels beyond what is presented in this user manual. VideoRay offers training courses for operators and technicians to address these needs. Contact VideoRay for more information.

Procedures for removing and replacing common wear items can be found in the Removal and Replacement section of the Maintenance Manual.

Diagnostics and Repair

Are you having a bad day with your Pro 4? You have come to the right place.

Solving problems requires either a methodical diagnostics approach, or lots of luck. If you don't like to gamble, the following may help you overcome challenges that inevitably present themselves from time to time.

Before providing the specific details of diagnosing and repairing the Pro 4, some basic troubleshooting guidelines are in order. Following these practices should make your efforts much more efficient and successful.

- Suspect and check the obvious first - It's easy to get distracted and overlook something obvious.
- Recheck the obvious - Have someone verify your work. If you're helping someone, verify what you've been told. Sometimes, just talking through the details can help you realized you missed a step or fact.
- Understand correct operation and expected results - How should it work and what should happen? Does it?
- Learn and recognize symptoms - What are the results telling you? What are the most likely suspects and what can be ruled out?
- Isolate, Divide and Conquer - Classify the problem to sub-systems, remove what you can and substitute known working parts if possible. Or, try suspect parts with a known working system.
- One step at a time - Be logical and make each test provide results you can use to narrow down the problem.

The Pro 4 is a collection of relatively simple components, but when something goes wrong, it's easy to get overwhelmed. The following steps should be your first response to a general system malfunction, especially if the power and communications warning indicators in the ROV Health instrument are lit.

1. Power down the system, check the connections and restart using the recommended procedures.
2. USB problems can be the root of several basic system malfunctions. Disconnect the USB cable from the back of the computer, wait a few seconds and then reconnect it. Sometimes the USB controller can be locked up. Try connecting the USB cable to a different port on the computer or rebooting the computer.
3. To identify whether the tether is a possible source of the problem, connect the ROV directly to the control panel to see if the symptoms persist.
4. Remove all attached accessories to eliminate the possibility that an accessory is the source of the problem.

If the problem is more isolated to a specific function, or these steps fail to resolve a general problem, it's time for a closer look at the symptoms and subsystems.

Sub-System Diagnostics

- Power
- Communications
- Control
- Controller
- Video

Diagnostics and Repair - System Start Up

When VideoRay Cockpit starts up, it checks the hardware configuration to detect three required items:

- Video Interface
- Communications Interface
- Hand Controller

If any of these items are not detected, VideoRay Cockpit will display an error message and will not operator correctly until the configuration issues are corrected.

In each case, the first thing to check is that the appropriate cable is plugged in. For the first two, the USB cable from the computer to the control panel must be plugged in. For the hand controller, its USB cable must be plugged into the computer or one of the ports at the rear of the control panel.

Additional details about diagnosing each one of these items are provided in the following sections.

Diagnostics and Repair - Power

When the ROV powers up, you will hear a series of tones, the lights will flash, and you should be able to see some internal LEDs light up. If none of these occur a power problem is possible. Power problems can occur on the AC side or DC side. If some, but not all of the start-up indicators work, a power problem is less likely, and a communications or other ROV internal problem is possible.

AC Power Problems

If the control panel will not turn on, the first place to check is the power cord and power source. Press the GFCI test button. The GFCI will not trip without power being applied to it. If the system does not trip, either there is no power (more likely) or the GFCI has malfunctioned (less likely). If you confirm there is power and the power cord is plugged in, but the GFCI will not trip, a faulty GFCI is possible.

If the system passes the GFCI test, then the 2 IEC outlets on the rear of the panel should have power when the GFCI is turned on - the computer should show it is operating on AC power and not its battery. If the GFCI is on, and there is no power at the IEC outlets, a faulty GFCI switch or wire fault in the panel is possible.

DC Power Problems

When you turn on the power switch, you should hear the fans turn on, and the green power LED should light. You should also be able to measure 75 Volts DC in the tether connector between pins 3 and 5. If any of these do not work, it could be a faulty power switch, power supply failure or wiring problem (loose or disconnected connector).

If you measure 75 Volts DC in the tether connector, but the ROV still does not have power, it could be a fault in the tether or ROV. Connect the ROV directly to the panel without the tether. If the ROV works, it could be a problem in the tether or its connectors. If the ROV does not work, it could be a problem in its tether connector, or it could be a board failure in the ROV.

The Pro 4 includes a DC LIM (Line Insulation Monitor) protection circuit that is similar to a GFCI. If the LIM is tripped, a yellow LED alarm light on the control panel will illuminate. The LIM can be tested and reset using the buttons on the control panel. If the LIM alarm does not clear after pressing the reset button for at least 30 seconds, eliminate the tether and try again. If the LIM alarm still does not clear, the ROV or control panel must be serviced. See the LIM section of the Operator's manual for more information.

Test Points

Test	Procedure / Location	Expected Result
Measure tether Ohms for continuity	Tether pin 3 male to pin 3 female	Continuity
Measure tether Ohms for continuity	Tether pin 5 male pin 5 female	Continuity
Test tether for a short	Tether pin 3 male/female to any other pin	No short
Test tether for a short	Tether pin 5 male/female to any other pin	No short
Measure control panel voltage	With the control panel on, measure 74 V DC on control panel tether pin 3 female (+) to tether pin 5 (- ground)	74 V DC +/-

Measure ROV accessory port voltage	With the ROV connected and the system on, measure 24 V DC on ROV accessory port pin 3 female (+) to accessory port pin 5 female (- ground)	24 V DC +/-
Measure ROV accessory port voltage	With the ROV connected and the system on, measure 12 V DC on ROV accessory port pin 9 female (+) to accessory port pin 5 female (- ground)	12 V DC +/-

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Diagnostics and Repair - Communications

Communications problems can result in loss of control of the ROV. Communications in the Pro 4 occurs at several levels.

The computer has to communicate with the control panel via the USB cable. First verify that the cable is connected. The computer must also recognize the control panel devices, specifically the RS-485 interface. The RS-485 device will only be recognized while the control panel is turned on. To check the status of the communications with the RS-485 device, the control panel must be turned on. The RS-485 interface can be confirmed by checking the Ports in Device Manager. To access device manager, open the Windows Control Panel, and in the Classic View, click on System. Next, click on the Hardware tab, and then the Device Manager button. Click on the plus sign (+) next to Ports and confirm that the SeaLevel RS-485 port is listed as one of the ports. If the RS-485 device is not listed, unplug the USB cable, wait a few seconds and plug it back in. If the RS-485 device is still not listed, power down the control panel and reboot the computer. If the RS-485 device is not listed after a shut down, restart and reboot, a problem with the USB cable, RS-485 device, or internal USB hub or controller is possible.

The control panel must communicate with the ROV through the tether. Communications occur via pins 7 and 8. verify the continuity of the tether to ensure all conductors are intact. The tether conductors are straight through - pin 1 to pin 1, pin 2 to pin 2, etc. You can also connect the ROV directly to the control panel without the tether to either rule out or confirm whether the tether is the problem.

Test Points

Test	Procedure / Location	Expected Result
Communications device present	Verify "SeaLINK +485Isolated USB to RS-422/485 Converter (COM*x*)" is visible in Device Manager under "Ports"	Device recognized and no warnings
Measure tether Ohms for continuity	Tether pin 7 male to pin 7 female	Continuity
Measure tether Ohms for continuity	Tether pin 8 male pin 8 female	Continuity
Test tether for a short	Tether pin 7 male/female to any other pin	No short
Test tether for a short	Tether pin 8 male/female to any other pin	No short
Measure control panel Ohms	Control panel tether pin 7 female to control panel tether pin 8 female	120 kOhm +/-
Measure ROV Ohms	ROV tether pin 7 male to ROV tether pin 8 male	120 Ohm +/-
Measure ROV Ohms	ROV tether pin 7 male to ROV accessory port pin 7 female	120 Ohm +/-
Measure ROV Ohms	ROV tether pin 8 male to ROV accessory port pin 8 female	120 Ohm +/-
Measure ROV Ohms for continuity	ROV tether pin 7 male to ROV accessory port pin 8 female	Continuity
Measure ROV Ohms for continuity	ROV tether pin 8 male to ROV accessory port pin 7 female	Continuity

---

Diagnostics and Repair - Control

Control problems can occur due to a communications problem, a hand controller problem, a problem with an ROV subsystem, poorly adjusted buoyancy, or a physical problem like a stuck tether or fouled propeller.

VideoRay Cockpit instruments can confirm that a hand controller input is being received. If the instrument does not indicate a controller input, such as the camera indicator does not move when you press the camera tilt button, then check to make sure the hand controller is plugged in. You can also check whether the hand controller is recognized by Windows. You can check if the hand controller is recognized by Windows using the Game Controller application in the Windows Control Panel.

If the hand controller is working, but you cannot pilot the ROV, check for a loose or fouled propeller. If the propellers are clear, the problem could be a thruster motor or motor controller. If the problem is vertical control, then you might need to adjust the ballast.

If the ROV can be piloted, but another subsystem, like camera tilt, is not functioning, verify the hand controller function as listed above, and then suspect the subsystem.

 See the Control Sensitivity and Systems Tuning section of the VideoRay Cockpit Guide for more information about adjusting the responsiveness and power settings of the thrusters.

Diagnostics and Repair - Hand Controller

Directional control and other ROV functions result from a series of operations, configuration settings, wiring and functions. Normally, pressing forward on the joystick results in the ROV moving forward, pulling the joystick in reverse reverses the ROV, and left and right joystick inputs result in the ROV turning left and right respectively. If the behavior is not as expected, one of the following can be the problem. It is important to correct the situation in the right place, otherwise it may compound the problem and make components (controller, computer, ROV) incompatible with other systems.

Holding the joystick inverted

The VideoRay hand controller should be held so that the joystick and the wire to the control panel are to the right.

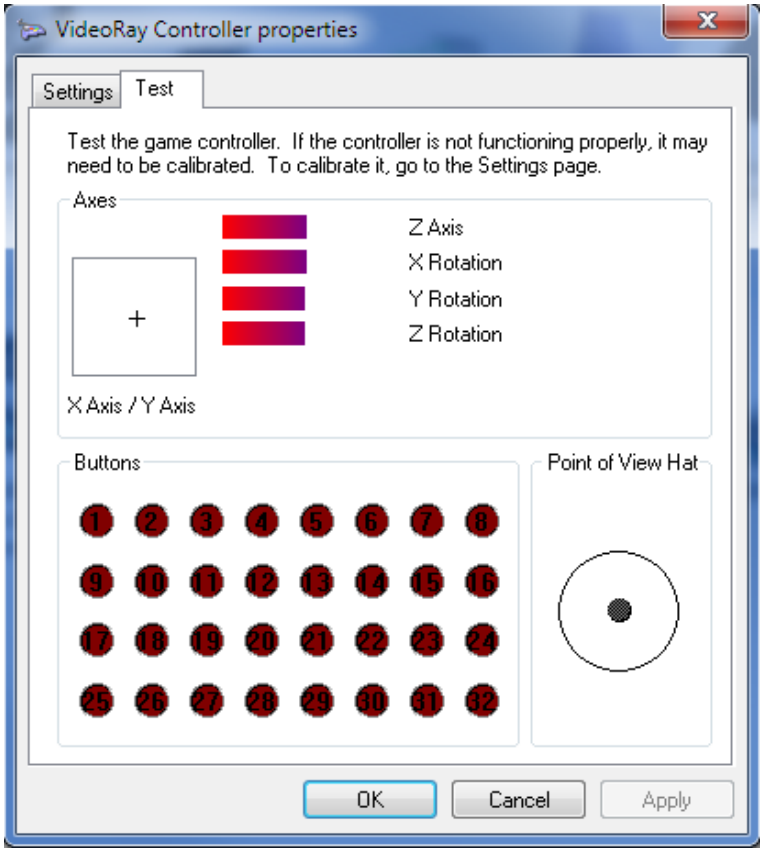
Broken joystick

If the joystick does not "feel" right, it might be broken. If there is no response (as opposed to an incorrect response) the joystick might be broken. This may also result from a wire failure in the hand controller or between the hand controller and the computer. The joystick can be checked using the Windows game controller properties found in the Windows Control Panel. Also, when you move the joystick, you should see the corresponding thruster indicator(s) moving in VideoRay Cockpit.

Mis-wired joystick

If the joystick is mis-wired it may not operate as expected. The joystick wiring can be checked using the Windows game controller properties found in the Windows Control Panel.

The default joystick and knob response for the VideoRay Industrial Hand Controller is shown in the following image:



Move joystick to the right (J1 +X) = The crosshair should move to the right

Move joystick away (forward) (J1 +Y) = The crosshair should move down

Rotate the joystick clockwise (J1 CW) = the bar size should decrease

Rotate controller knob on upper left clockwise (RX CW) = the bar size should decrease

Rotate controller knob on lower left clockwise (RY CW) = the bar size should decrease

Rotate controller knob on the side clockwise (RZ CW) = the bar size should decrease

Default Button Mapping

1. Manipulator Close
2. Manipulator Open
3. Focus Out
4. Tilt Up
5. Help
6. Snapshot
7. Lights Bright
8. Lights Dim
9. Tilt Down
10. Focus In
11. Camera Select
12. Record/Stop

Error in the joystick configuration file

The configuration file maps joystick inputs to specific ROV functions. If these are not mapped correctly, a different response can be expected. This is not always a problem - changing the configuration file is required in order to create a custom configuration. Configuration files are XML. They require manual edit, but a future version of VideoRay Cockpit will include a joystick mapping user interface.

Modified Thruster Direction Setting in the main configuration file

There is a setting in the main VideoRay Cockpit configuration file to change the port thruster direction. <InvertPortThrusterDirection>. If this value is set to true, the port thruster direction will operate in the reverse direction from normal operation. This setting is for legacy support and should not normally be changed.

Mis-wired thruster motors

If the thruster motor wires are incorrect, the thruster motor may rotate in the wrong direction. Swapping any two of the three thruster motor wires should correct this problem.

Improper propeller installation

The propellers on a Pro 4 are counter rotating (reverse pitch) and should be installed so that the top blade curves towards the center when viewed from behind. Do not install the propellers on the wrong shaft, and do not install two propellers with the same directional pitch.

Diagnostics and Repair - Video

Understanding the video circuit can help in diagnosing and solving video problems. Typical video problems include complete loss of video, video noise, image quality (focus, color, inverted image) and video frame rate (stutter).

Overview

Composite video (in NTSC or PAL format depending upon country standards) originates in the primary, or external, camera and passes through a switching circuit in the ROV. The switching circuit determines which camera source signal is displayed, and is controlled by VideoRay Cockpit software on the topside. From the ROV, the video is passed via the tether to the control panel. Within the control panel the video is either passed through a Lyyn visual enhancement system, if one is installed, or directly to a video splitter. The video splitter provides video feeds to both a digital and analog display circuits.

Digital Circuit

The digital circuit includes a USB video capture device, which is connected to a USB hub within the control panel and then to a computer via a USB cable. Within the computer, VideoRay Cockpit software can display the video, in real time with or without video overlay text or graphics. If a second monitor is attached to the computer, the video window can be displayed on either or both display devices. VideoRay Cockpit software can also record the video to disk. Other software can also use the digital video source, and this can be helpful for diagnostic purposes.

Analog Circuit

The analog circuit passes from the splitter directly to a Video Out RCA style connector on the rear of the control panel. From this connection, a cable can be connected to a monitor or video recording device. If the video is split at this point to two or more devices, a video amplifier/splitter is recommended. Splitting the video without an active amplifier is likely to result in poor video quality.

Note: Video overlay text and graphics are supported on the digital circuit, but not the analog circuit.

Summary of Video Circuit Components

- Camera
- Switching circuit within the ROV
- Wiring within the ROV, tether or control panel
- Video capture device
- USB system
- Software
- Display component
- Power

When diagnosing video problems, the divide and conquer method is recommended. See the other FAQs about video problems for more specific instructions.

Video problems are widely variable. It could be a faulty cable, signal problem, video noise, improper camera setting for the conditions, or even lighting.

If there is no video signal, first verify that rest of the system is functional. If the rest of the system is functional, verify that the video circuit in the control panel is recognized by the computer. The video circuit can be verified by checking the Sound, video and game controllers section in Device Manager. To access device manager, open the Windows Control Panel, and in the Classic View, click on System. Next, click on the Hardware tab, and then the Device Manager button. Click on the plus sign (+) next to Sound, video and game controllers and confirm that the DVD Maker 2 (or USB 2861 Device) is listed. If the DVD Maker 2 device is not listed, unplug the USB cable, wait a few seconds and plug it back in. If the DVD Maker 2 is still not listed, power down the control panel and reboot the computer. If the DVD Maker 2 is not listed after a shut down, restart and reboot, a problem with the USB cable, DVD Maker 2 device, or internal USB hub or controller is possible.

If video noise seems to be a problem, it could be local interference, a mismatched ground, or a poor connection somewhere in the system. If you are operating off a local power source such as a generator, make sure the ground is the same as the water in which the ROV is being used. Also, check that each connection in the tether is clean and well seated.

If you do not have video on the second monitor, make sure the monitor is powered on, the cable connected and computer configured to display on two screens.

If the video image is poor, check the camera focus and the camera settings. You may also need to adjust the lights.

Test Points

Test	Procedure / Location	Expected Result
Video capture device present	Verify "DVD Maker" or "USB 2861 Device" is visible in Device Manager under	Device recognized and no

	"Sound video and game controllers"	warnings
Verify video presence on analog video out	Connect a monitor to the analog video out connector	Video displayed on external monitor
Measure tether Ohms for continuity	Tether pin 1 male to pin 1 female	Continuity
Measure tether Ohms for continuity	Tether pin 2 male pin 2 female	Continuity
Test tether for a short	Tether pin 1 male/female to any other pin	No short
Test tether for a short	Tether pin 2 male/female to any other pin	No short
Measure control panel Ohms for continuity	Control panel tether pin 1 female to Video Out RCA ground	Continuity
Measure control panel Ohms for continuity	Control panel tether pin 2 female to Video Out RCA signal	Continuity
Measure ROV Ohms for continuity	ROV Tether pin 2 male to ROV accessory port pin 2 female	No continuity

Component Removal and Replacement

This documentation guides users through removal and replacement of the primary components of the ROV. These components are categorized as requiring Novice, Intermediate or Advanced knowledge and skills, and versions of this document have been created to include only up to one of these levels. At the Advanced level, all Intermediate and Novice components are included, so all three versions are not needed to have the full set. This Novice version is included with product documentation. The Intermediate and Advanced versions are included with the appropriate training courses.

The instructions for each component consist of two sections:

1. Removal
2. Replacement

Each section consists of:

1. A one page overview that includes
    a. Skill level requirement
    b. Estimated time to complete the overall removal or replacement process
    c. A list of the tools required
    d. A list of the other components that need to be removed/replaced
2. Pages that outline the steps for each component that needs to be removed or replaced that include
    a. Skill level requirement for the specific component
    b. Estimated time to complete the steps for the specific component
    c. A list of the tools required for the specific component
    d. A detailed list of parts that are considered part of the specific component, such as screws, washers, and/or other miscellaneous hardware items.

In addition, there is a "Comprehensive Parts List," page that lists all of the parts that have to be removed or replaced for the specific component and all of the associated components that must be removed or replaced.

Main Hull

The Main Hull section includes removal and replacement steps for the following components:

1. Float Block Kit [N]
2. Strain Relief Cable Kit [N]
3. Skid Kit [N]
4. Dome Retaining Rings and Main Hull Rods [I]
5. Front Dome [I]
6. Rear Dome [I]
7. Desiccant Pack [I]
8. Front Hull Ring Assembly with Camera [I]
9. Rear Hull Ring Assembly [I]
10. Pressure Sensor Kit [A]
11. Termination Block and Accessory Port [A]
12. ROV Wire Harness [A]
13. Main Hull Tube [A]

Horizontal Thrusters

The Horizontal Thrusters section includes removal and replacement steps for the following components:

1. Horizontal Thruster Propeller Kit (Left and Right) [N]
2. Horizontal Thruster Cartridge Seal [N]
3. Horizontal Thruster Nozzle Kit [N]
4. Horizontal Thruster Cone Assembly [I]
5. Horizontal Thruster Bearing [I]
6. Horizontal Thruster Drive Train Assembly [I]

7. Horizontal Thruster Motor Mount [A]
8. Horizontal Thruster Motor Assembly [A]
9. Horizontal Thruster Tube [A]

Vertical Thruster

The Vertical Thruster section includes removal and replacement steps for the following components:

1. Vertical Thruster Propeller Kit [N]
2. Vertical Thruster Splitter [N]
3. Vertical Thruster Cartridge Seal [N]
4. Vertical Thruster Kit [A]
5. Vertical Thruster Motor Mount [A]
6. Vertical Thruster Motor Adapter [A]
7. Vertical Thruster Motor Shield [A]
8. Vertical Thruster Motor Assembly [A]

Lights

The Lights section includes removal and replacement steps for the following components:

1. Light Dome [I]
2. LED Light Module Assembly [I]
3. LED Light Reflector Set [A]
4. LED Light Printed Circuit Board [A]
5. LED Light Mount [A]

Camera

The Camera section includes removal and replacement steps for the following components:

1. Camera Assembly [A]
2. Camera Lens-Focus Cam Gear [A]
3. Camera Interface Printed Circuit Board [A]
4. Camera Tilt Servo Motor Assembly [A]
5. Camera Mount Base Assembly [A]
6. Camera Focus Servo Motor Assembly [A]
7. Camera [A]
8. Camera Mount Cover [A]
9. Camera Ribbon Cable [A]

Electronics

The Electronics section includes removal and replacement steps for the following components:

1. ROV Board Set [A]
2. Compass - Navigation Module [A]
3. ROV CPU Printed Circuit Board [A]
4. ROV Power Control Printed Circuit Board [A]
5. ROV Heat Sink [A]

Float Block Kit

- Part Number: FB-001-KIT-P4

Float Block Kit Removal Overview

Skill level recommended: Novice

Total time required: Approximately 2 Minutes

Tools required:

- None

The following components must be removed:

- Float Block Kit

Float Block Kit Removal Procedures

Time required for this step: Approximately 2 Minutes

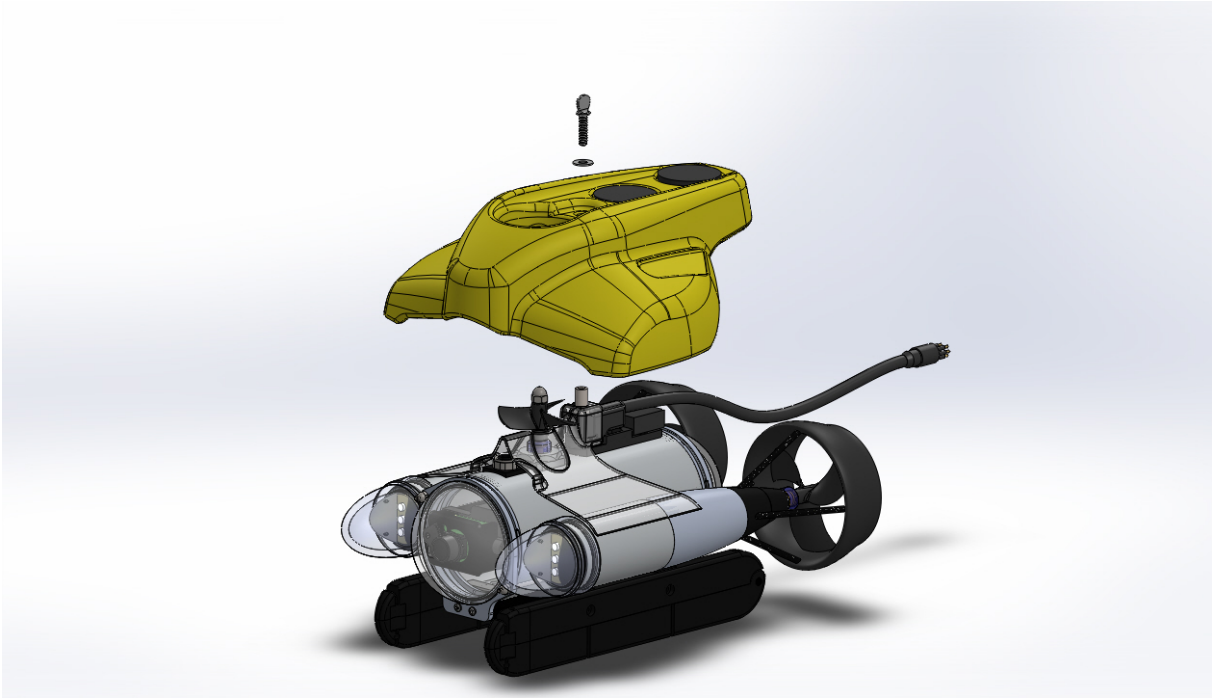
Tools required for this step:

- None

Parts involved in this step:

FB-001-KIT-P4 Float Block Kit

Quantity	Part Number	Part Description
1	VR-PRO4-06-0001	Float Block Assembly - Filled (Pro 4)
1	91744A542	Screw 1/4"-20 x 1" Thumb SS
1	92141A029	Washer 1/4" x 0.05" Flat SS
2	FB-PLG-ACC-KIT	Float Block Assembly Insert Small



Steps

1. Remove any accessories that are attached to the float block.
2. Remove the 1/4-20 X 1-1/4 inch thumb screw and 1/4 inch washer.
3. Lift the float block off of the ROV.

Float Block Kit Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 2 Minutes

Tools required:

- None

The following components must be replaced:

- Float Block Kit

Float Block Kit Replacement Procedures

Time required for this step: Approximately 2 Minutes

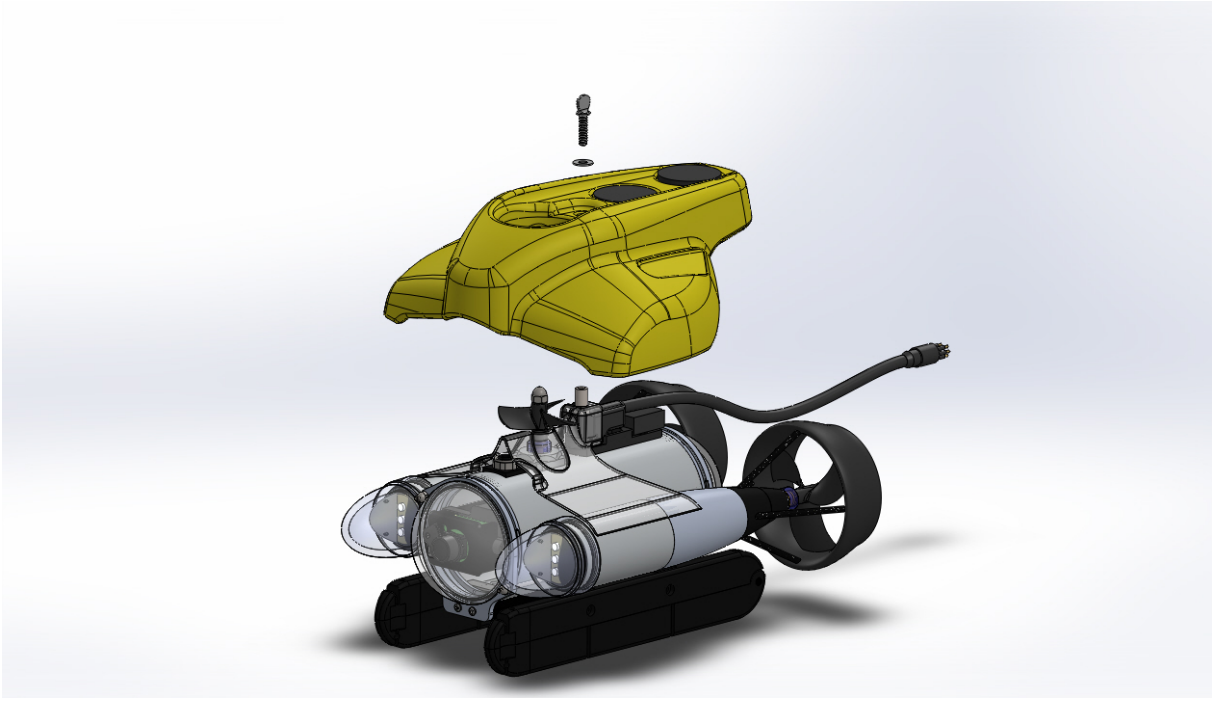
Tools required for this step:

- None

Parts involved in this step:

FB-001-KIT-P4 Float Block Kit

Quantity	Part Number	Part Description
1	VR-PRO4-06-0001	Float Block Assembly - Filled (Pro 4)
1	91744A542	Screw 1/4"-20 x 1" Thumb SS
1	92141A029	Washer 1/4" x 0.05" Flat SS
2	FB-PLG-ACC-KIT	Float Block Assembly Insert Small



Steps

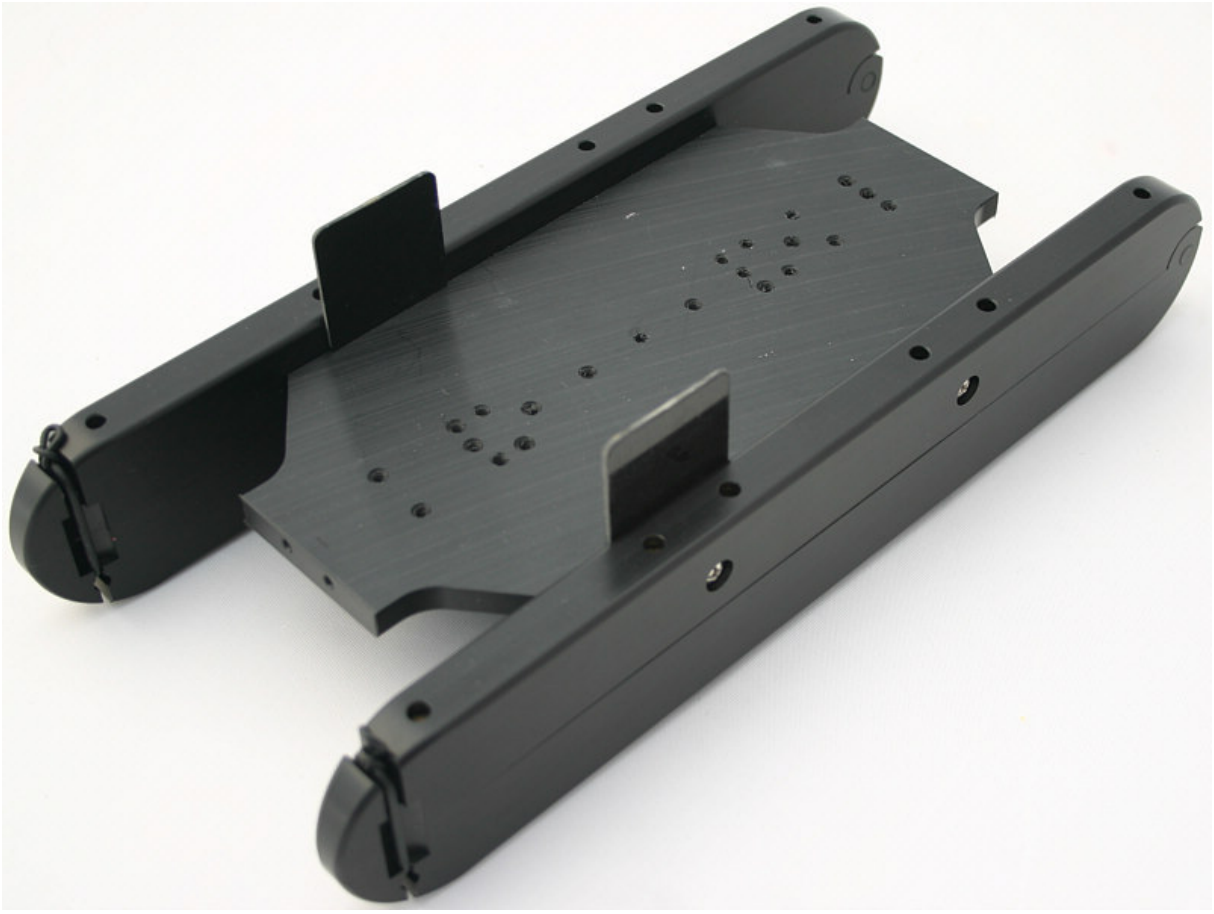
1. Orient the float block on top of the ROV and align the large through-hole in the float block with the thruster and the small hole with the termination block stud.
2. Place the float block in position on the ROV.
3. Secure the float block with the 1/4-20 X 1-1/4 inch float block retaining screw and 1/4 inch washer.

Tip

If accessories are to be attached to the ROV accessory port, it might be easier to connect them to the accessory port before the float block is replaced.

Skid Kit

- Part Number: SK-PRO4-KIT



Skid Kit Removal Overview

Skill level recommended: Novice

Total time required: Approximately 5 Minutes

Tools required:

- #2 Phillips Head Screw Driver

The following components must be removed:

- Skid Kit

Skid Kit Removal Procedures

Time required for this step: Approximately 5 Minutes

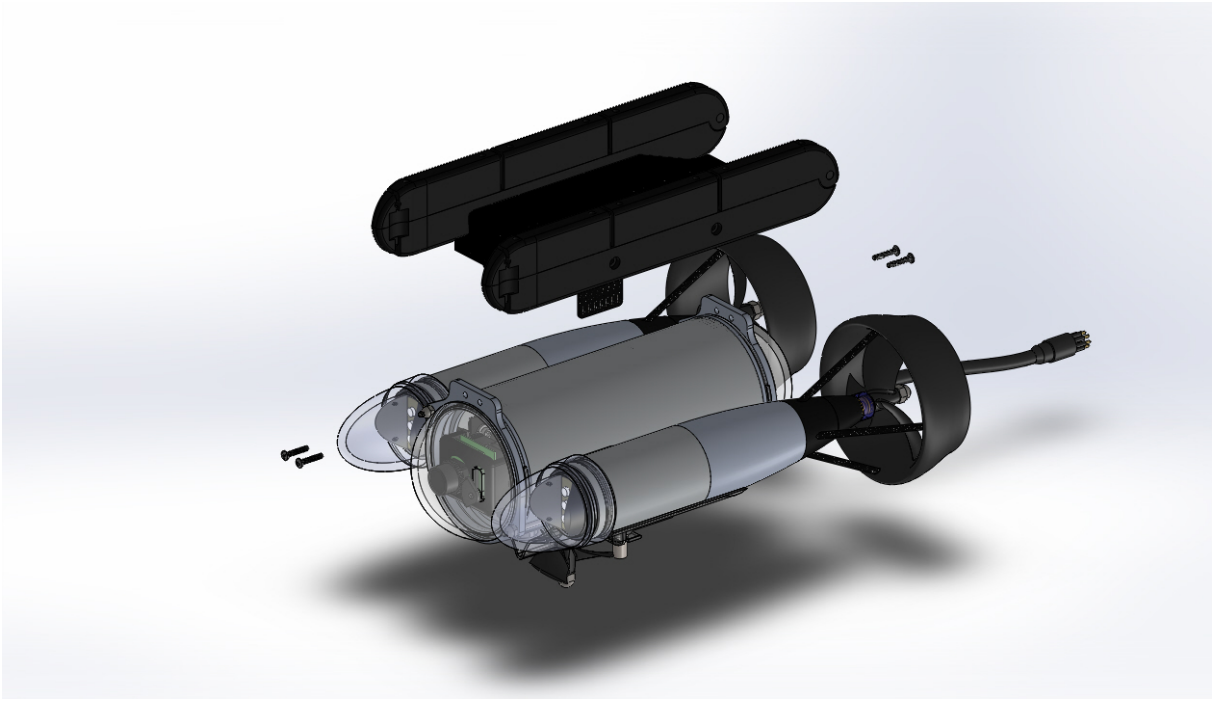
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

SK-PRO4-KIT Skid Kit

Quantity	Part Number	Part Description
1	VR-PRO4-07-0001	Skid Assembly
4	91772A151	Screw #6-32 x 3/4" Pan Head Phillips SS
4	561-06012	Washer #6 Insulating Nylon
48	BW-001-4	Ballast Weight Part Rod (Pro 4)
1	91772A192	Screw #8-32 x 3/8" Pan Head Phillips SS
1	98370A011	Washer #8 x 0.075" Flat SS



Steps

1. Remove any accessories that are mounted on the float block.
2. Turn the ROV upside down and rest it on its float block.
3. Remove any accessories that are attached to the skid assembly.
4. Remove the strain relief cable from the skid by removing the #8-32 x 3/8 inch Phillips head screw and #8 x 0.075" flat washer.
5. Remove the two #6-32 X 3/4 inch Phillips head screws from the front of the skid assembly near the bottom of the front dome. Make sure to keep track of the plastic inserts.
6. Remove the two #6-32 X 3/4 inch Phillips head screws from the rear of the skid assembly near the bottom of the rear dome. Make sure to keep track of the plastic inserts.
7. Remove the skid assembly from the ROV.

Tips

If the float block has been removed, it may be easier to remove the skid by replacing the float block on the ROV and turning the ROV upside down to rest flat on your workspace. Make sure there are no accessories attached to the float block.

Alternately, you can set the ROV on it's thruster nozzles to remove the front screws and on it's nose to remove the rear screws. Support the skid when removing the screws.

Skid Kit Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 5 Minutes

Tools required:

- #2 Phillips Head Screw Driver

The following components must be replaced:

- Skid Kit

Skid Kit Replacement Procedures

Time required for this step: Approximately 5 Minutes

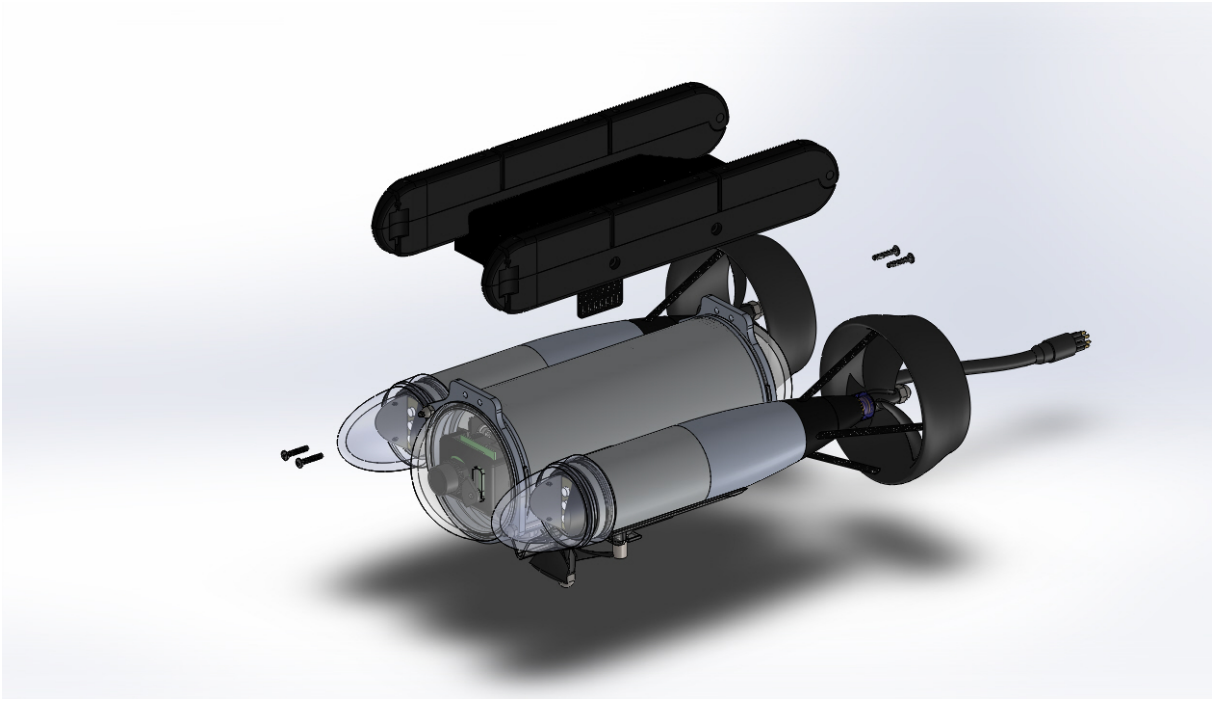
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

SK-PRO4-KIT Skid Kit

Quantity	Part Number	Part Description
1	VR-PRO4-07-0001	Skid Assembly
4	91772A151	Screw #6-32 x 3/4" Pan Head Phillips SS
4	561-06012	Washer #6 Insulating Nylon
48	BW-001-4	Ballast Weight Part Rod (Pro 4)
1	91772A192	Screw #8-32 x 3/8" Pan Head Phillips SS
1	98370A011	Washer #8 x 0.075" Flat SS



Steps

1. Remove any accessories that are mounted on the float block.
2. Turn the ROV upside down and rest it on its float block.
3. Orient the skid on the bottom of the ROV so that the ballast pod hinges are at the rear of the ROV and the ballast pods open away from the ROV. The thruster support struts should be facing toward the ROV and closer to the front of the ROV.
4. Place the skid in position on the bottom of the ROV and align the holes in the dome retaining rings with the holes in the front and back of the skid.
5. Make sure the plastic inserts are installed in the dome retaining rings.
6. Replace the two #6-32 X 3/4 inch Phillips head skid screws at the front of the skid. Do not tighten the screws all of the way.
7. Replace the two #6-32 X 3/4 inch Phillips head skid screws at the rear of the skid. Tighten the screws so that they are snug, but do NOT over tighten them.
8. Tighten the front skid screws so that they are snug, but do NOT over tighten them.
9. Install the #8-32 X 3/8 inch screw and washer into the loop in the strain relief cable and screw it to the center hole near the rear of skid.

Tip

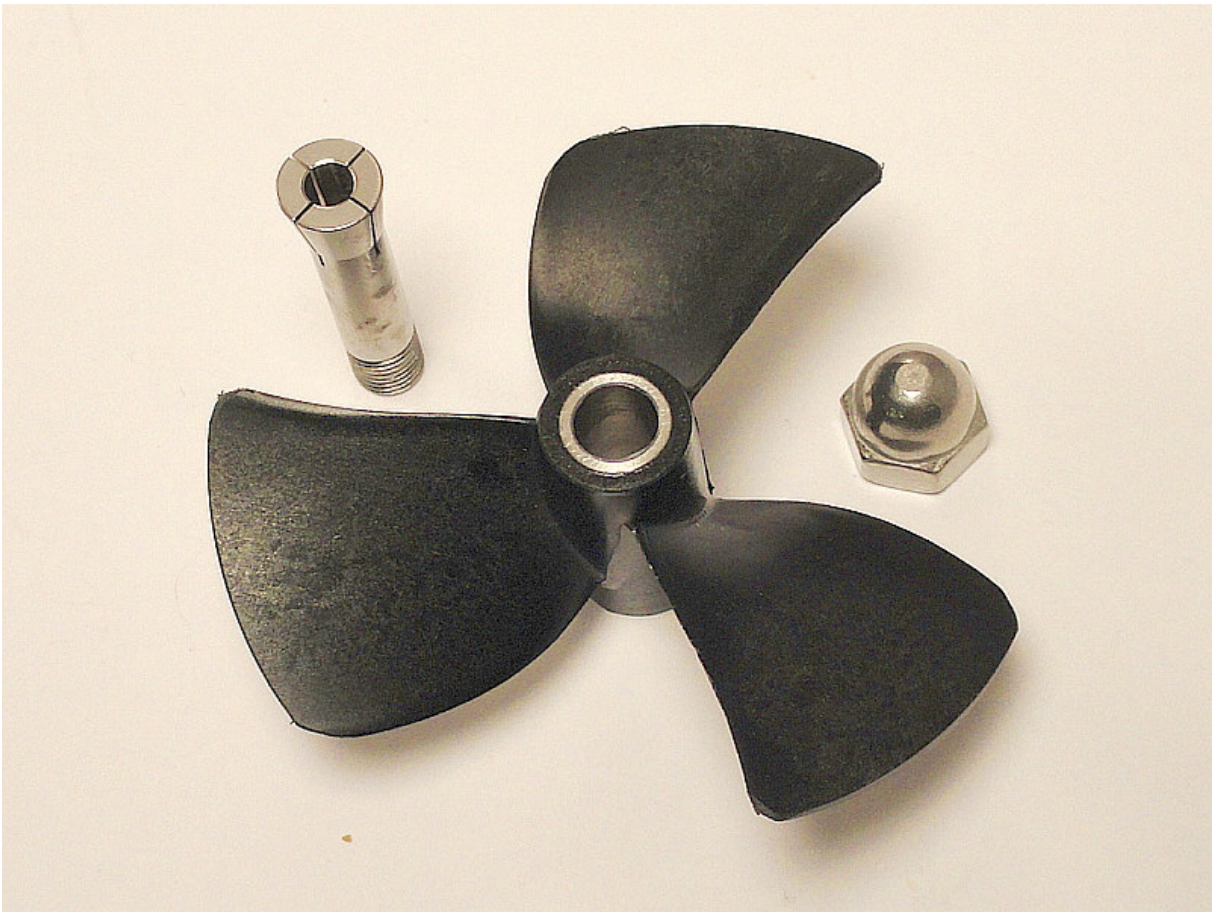
It may be easier to replace the skid by first replacing the float block temporarily and setting the ROV upside down on the float block so that it sits level.

Alternately, you can set the ROV on it's thruster nozzles to replace the front screws and on it's nose to replace the rear screws.

If the ballast pods were removed, they must be replaced so that the holes at the front and rear of the skid plate are closer to the ROV. The pod hinges should be toward the rear and the pods should open away from the ROV. The notches for the thruster support struts should be closer to the front of the skid.

Vertical Thruster Propeller Kit

- Part Number: GTO-006LS-KIT



Vertical Thruster Propeller Kit Removal Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Float Block Kit
- Vertical Thruster Propeller Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Propeller Kit.

Notes:

- The vertical propeller can be removed without removing the float block, but these instructions recommend that you remove the float block for easier access to the propeller.

Vertical Thruster Propeller Kit Removal Procedures

Time required for this step: Approximately 2 Minutes

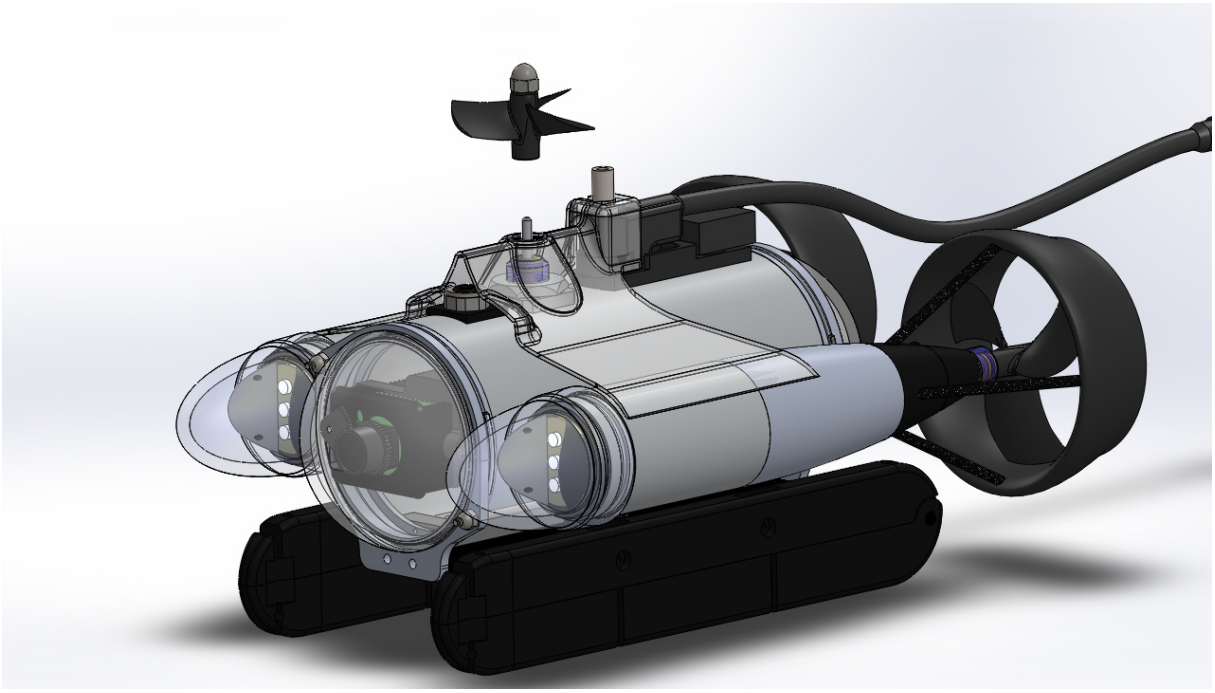
Tools required for this step:

- 7/16 Inch Open End or Socket Wrench

Parts involved in this step:

GTO-006LS-KIT Vertical Thruster Propeller Kit

Quantity	Part Number	Part Description
1	GTO-006LS-KIT	Propeller Kit Vertical 45mm 3 Blade Shaved (Pro 4)



Steps

1. Loosen, but do not remove, the 7/16 inch acorn nut at the outboard end of the vertical propeller.
2. Pull the vertical propeller from the vertical thruster shaft.

Tips

The vertical propeller nut has right-handed threads. Turn the nut counterclockwise, when viewed from the top of the ROV, in order to loosen it.

If the vertical propeller does not come off of the vertical thruster shaft easily after loosening the nut, tap the nut while pulling on the propeller hub. This should loosen the propeller collet and the propeller should slide free from the shaft.

Vertical Thruster Propeller Kit Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Vertical Thruster Propeller Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Propeller Kit.

Notes:

- Before replacing the vertical propeller, check to make sure that the thruster shaft is not bent or scored.

Vertical Thruster Propeller Kit Replacement Procedures

Time required for this step: Approximately 2 Minutes

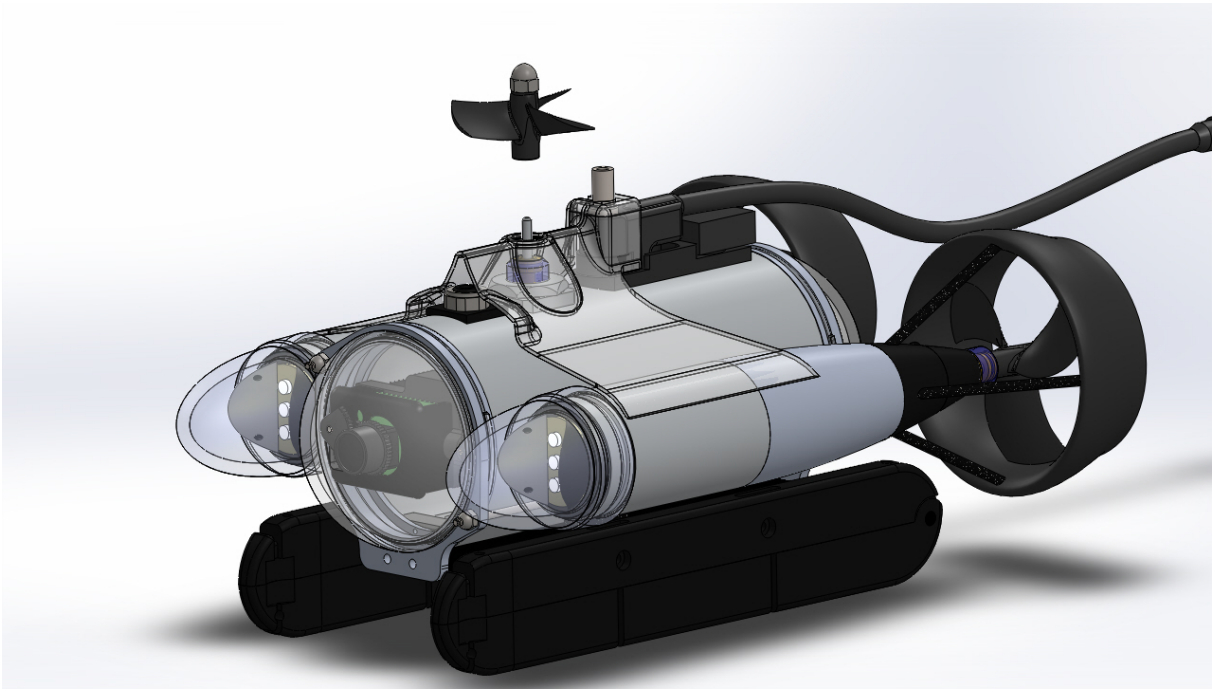
Tools required for this step:

- 7/16 Inch Open End or Socket Wrench

Parts involved in this step:

GTO-006LS-KIT Vertical Thruster Propeller Kit

Quantity	Part Number	Part Description
1	GTO-006LS-KIT	Propeller Kit Vertical 45mm 3 Blade Shaved (Pro 4)



Steps

1. Orient the vertical propeller assembly with the open end of the propeller collet toward the vertical thruster shaft.
2. Press the propeller assembly onto the shaft until it stops. There should be a gap of approximately 1 mm or less between the propeller and the cartridge seal. If there is no gap, the cartridge seal may not be seated - check the cartridge seal to make sure it is fully seated. If the gap is lager than 1 mm, the propeller is not fully seated - You may need to loosen the 7/16 inch acorn nut to allow the collet to open further.
3. Hold the propeller assembly by its hub and tighten the 7/16 inch acorn nut. Do NOT hold the propeller by its blades while tightening the nut, because that could cause a blade to break.

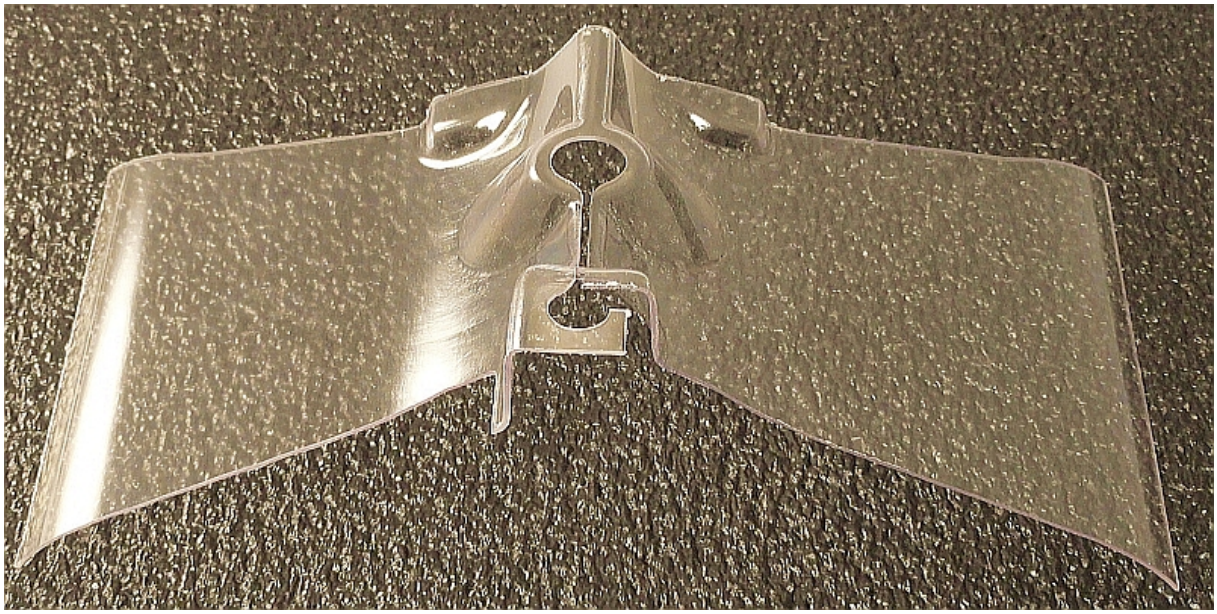
Tip

The vertical propeller nut has right-handed threads. Turn the nut clockwise, when viewed from the top of the ROV, in order to tighten it.

Check to make sure that the propeller turns freely.

Vertical Thruster Splitter

- Part Number: FB-008



Vertical Thruster Splitter Removal Overview

Skill level recommended: Novice

Total time required: Approximately 6 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Float Block Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Splitter.

Vertical Thruster Splitter Removal Procedures

Time required for this step: Approximately 2 Minutes

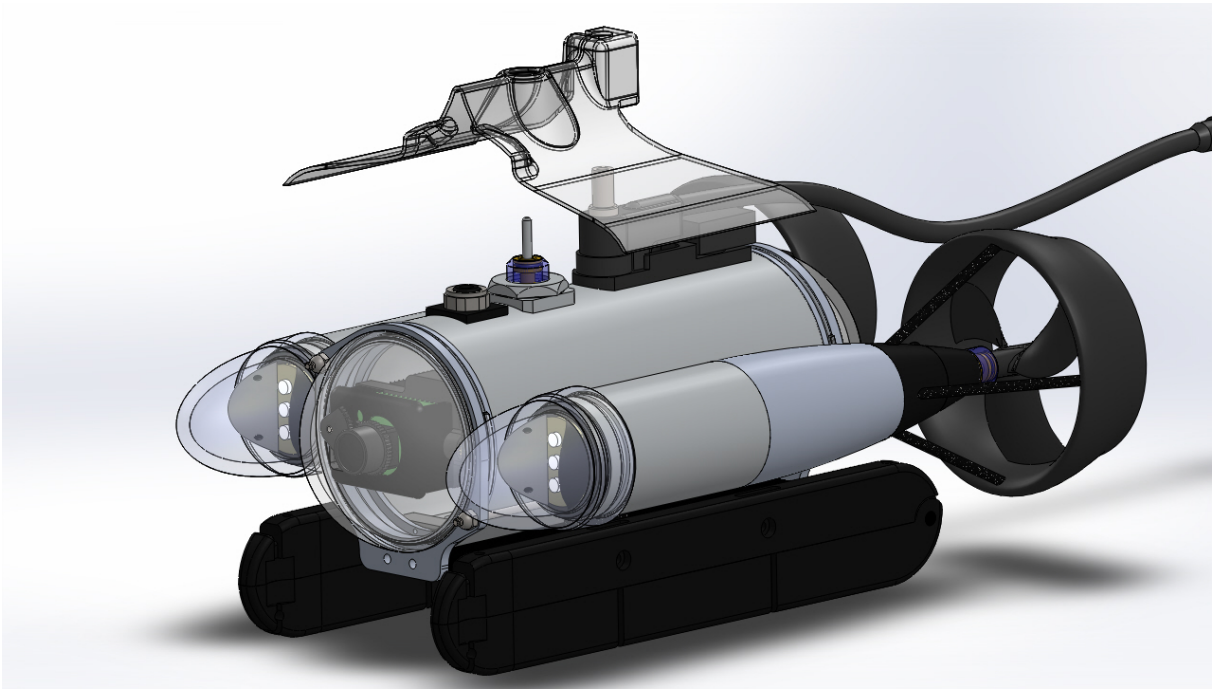
Tools required for this step:

- None

Parts involved in this step:

FB-008 Vertical Thruster Splitter

Quantity	Part Number	Part Description
1	FB-008	Thruster Part Vertical Splitter



Steps

1. Lift the vertical thrust splitter off of the ROV.

Vertical Thruster Splitter Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 6 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Splitter.

Vertical Thruster Splitter Replacement Procedures

Time required for this step: Approximately 2 Minutes

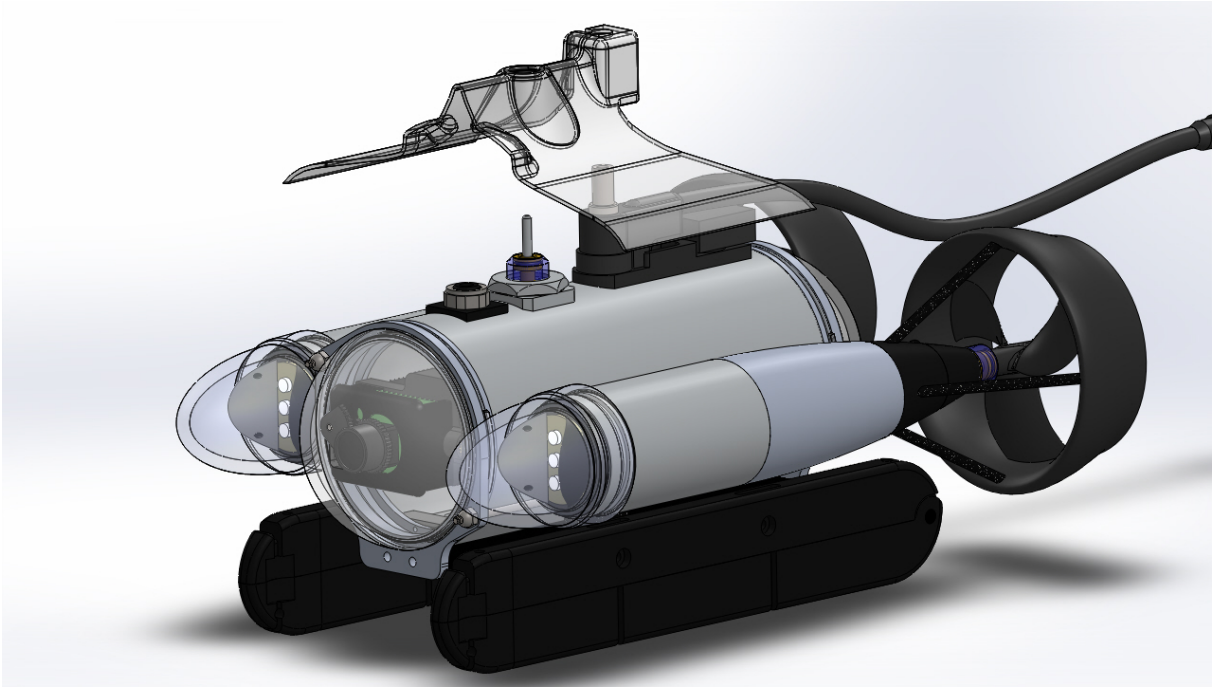
Tools required for this step:

- None

Parts involved in this step:

FB-008 Vertical Thruster Splitter

Quantity	Part Number	Part Description
1	FB-008	Thruster Part Vertical Splitter

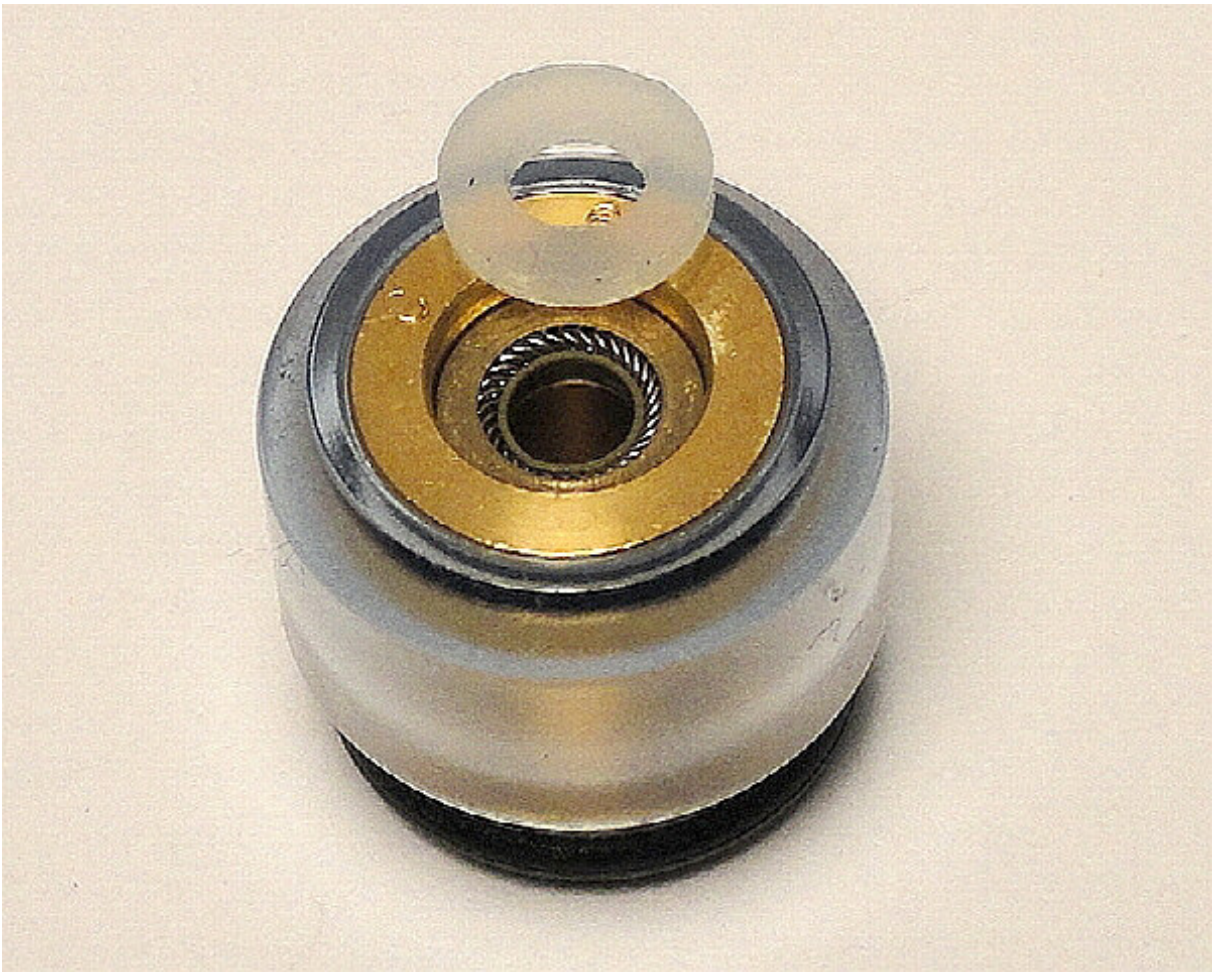


Steps

1. Orient the vertical thrust splitter over the top of the ROV so that the center is higher than the sides and the upper hole is aligned with the termination block stud and the lower hole is aligned with the vertical thruster shaft.
2. Place the vertical thrust splitter on the ROV over the termination block stud and vertical thruster shaft.

Vertical Thruster Cartridge Seal

- Part Number: CS-KIT-BL(v)



Vertical Thruster Cartridge Seal Removal Overview

Skill level recommended: Novice

Total time required: Approximately 8 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Float Block Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Cartridge Seal.

Vertical Thruster Cartridge Seal Removal Procedures

Time required for this step: Approximately 2 Minutes

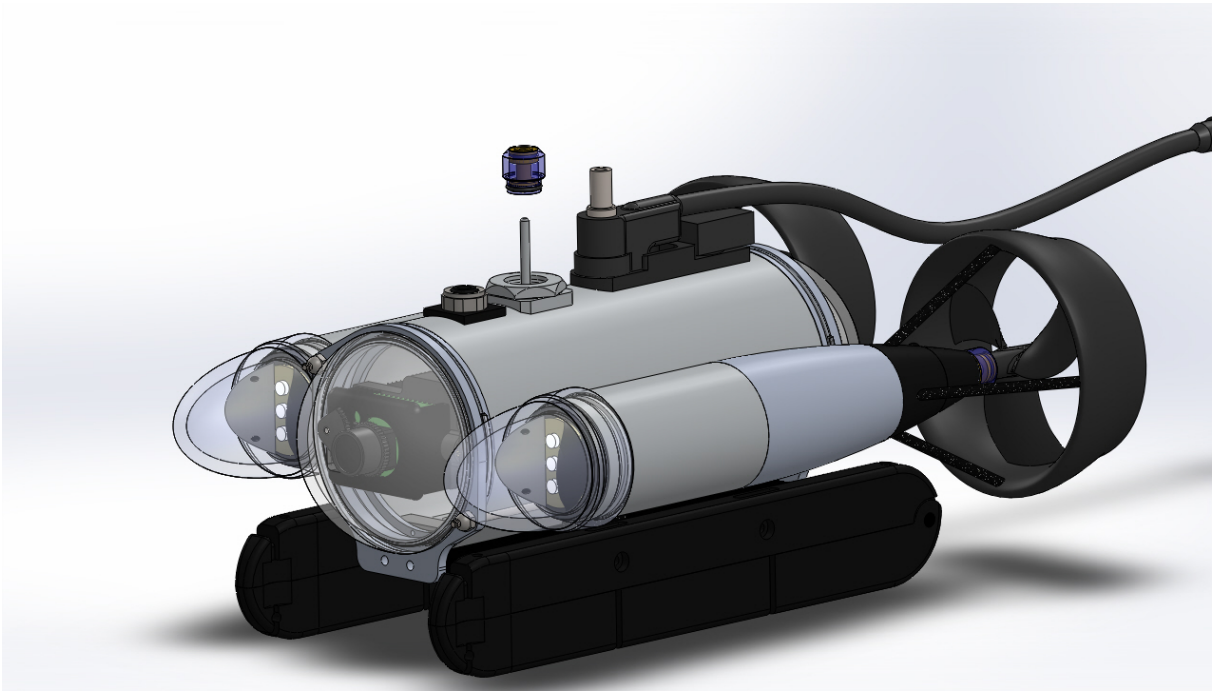
Tools required for this step:

- None

Parts involved in this step:

CS-KIT-BL(v) Vertical Thruster Cartridge Seal

Quantity	Part Number	Part Description
1	CS-KIT-BL(h)	Cartridge Seal Assembly Blue
1	90295A090	Washer #6 x 0.06" Flat Nylon (Thick)



Steps

1. Pull the vertical cartridge seal off of the vertical thruster shaft. Make sure to keep track of the cartridge seal washer inside the top of the cartridge seal.

Tip

If the vertical cartridge seal is hard to pull free from its seat, twist the cartridge seal to free it for easier removal.

Vertical Thruster Cartridge Seal Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 8 Minutes

Tools required:

- Lint-Free Tissue or Rag
- O-Ring Lubricator
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Cartridge Seal.

Notes:

- Before replacing the vertical cartridge seal, check to make sure that the cartridge seal, vertical thruster shaft and area where the cartridge seal seats are clean. Also, make sure the thruster shaft is not bent or scored.

Vertical Thruster Cartridge Seal Replacement Procedures

Time required for this step: Approximately 2 Minutes

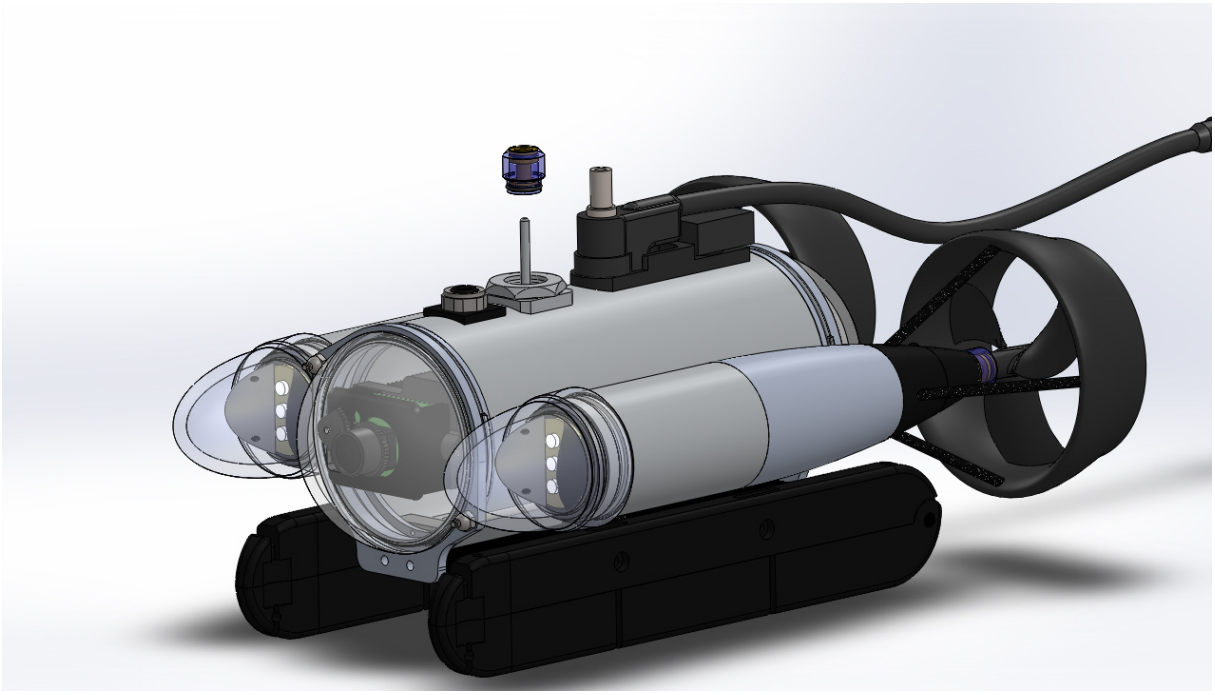
Tools required for this step:

- Lint-Free Tissue or Rag
- O-Ring Lubricator

Parts involved in this step:

CS-KIT-BL(v) Vertical Thruster Cartridge Seal

Quantity	Part Number	Part Description
1	CS-KIT-BL(h)	Cartridge Seal Assembly Blue
1	90295A090	Washer #6 x 0.06" Flat Nylon (Thick)



Steps

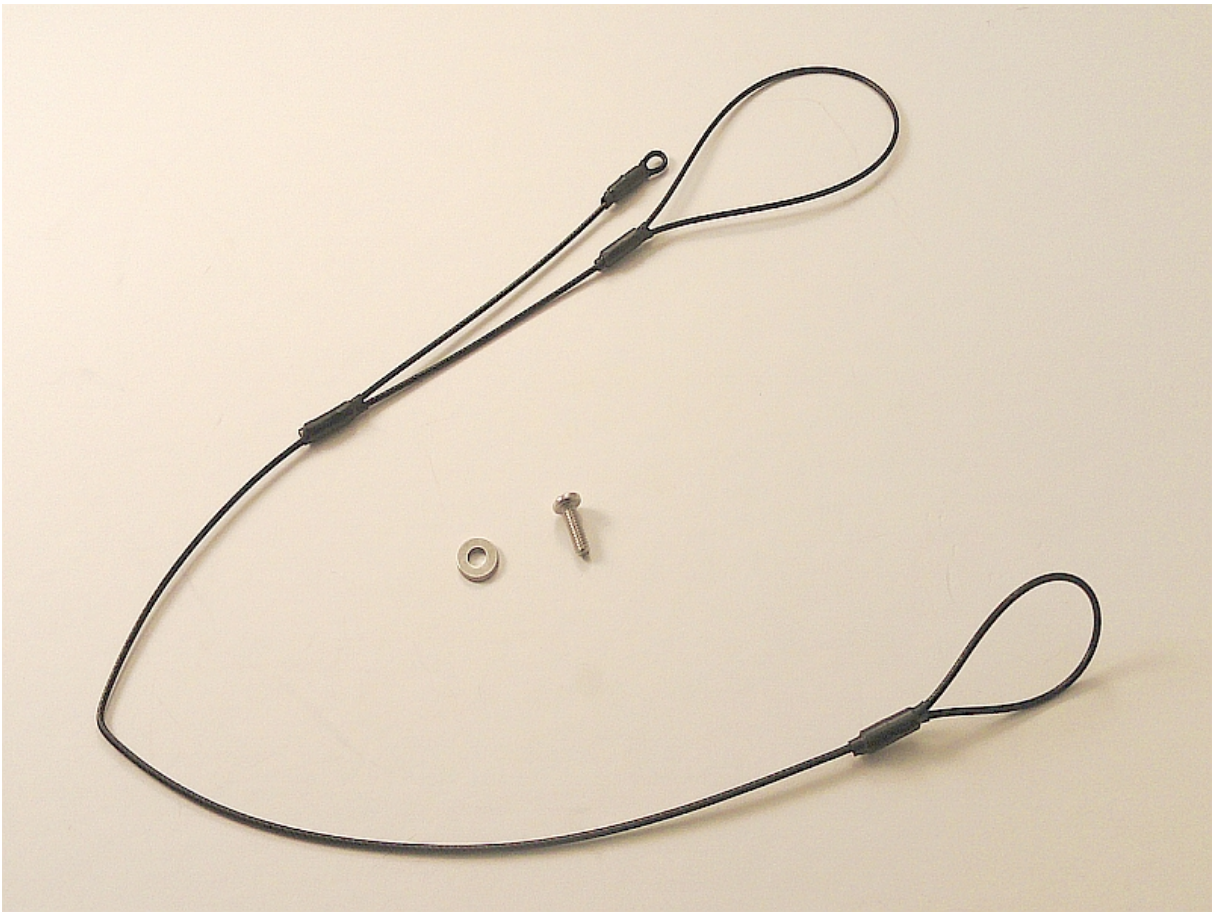
1. Orient the cartridge seal with its O-ring end toward the ROV.
2. Press the cartridge seal all the way down the thruster shaft until it is seated in the vertical motor mount. You should not be able to see the O-ring when the cartridge seal is seated.
3. Place the cartridge seal washer on thruster shaft.
4. Press the cartridge seal washer down the shaft until is it seated inside of the cartridge seal.

Tip

You will notice that some silicone gel will be pushed from the center core of the cartridge seal. This is normal. The gel is used to keep the cartridge seal oil from leaking out of the cartridge seal during shipping and storage and can be wiped away with a tissue.

Strain Relief Cable Kit

- Part Number: THR-HARNESS-P4-KIT



Strain Relief Cable Kit Removal Overview

Skill level recommended: Novice

Total time required: Approximately 9 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be removed:

- Float Block Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Strain Relief Cable Kit

See the corresponding sections of this manual for instructions for parts other than the Strain Relief Cable Kit.

Strain Relief Cable Kit Removal Procedures

Time required for this step: Approximately 3 Minutes

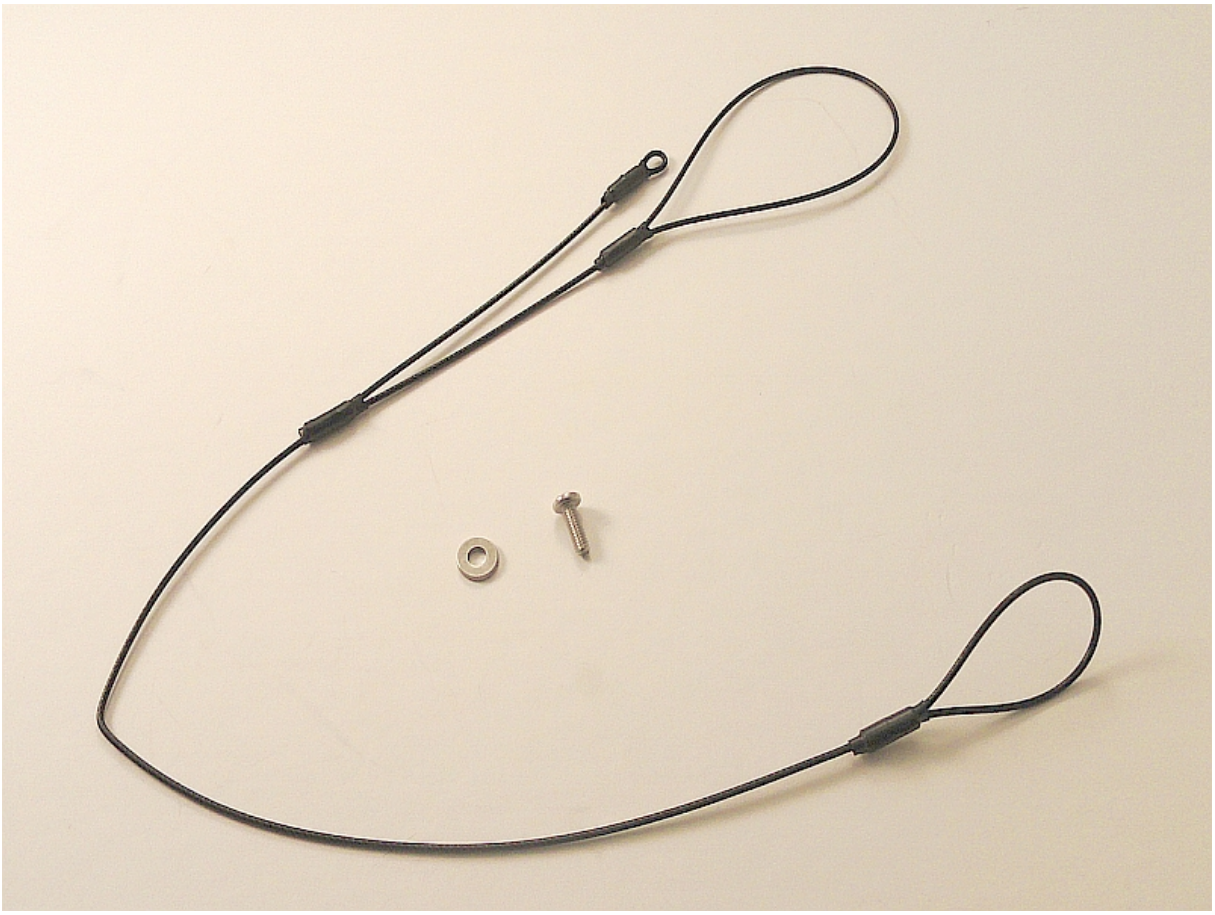
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

THR-HARNESS-P4-KIT Strain Relief Cable Kit

Quantity	Part Number	Part Description
1	THR-HARNESS-P4	Strain Relief Assembly ROV (Pro 4)
1	91772A192	Screw #8-32 x 3/8" Pan Head Phillips SS
1	98370A011	Washer #8 x 0.075" Flat SS



Steps

1. Turn the ROV upside down and rest securely so that it does not tip over and you do not damage the vertical propeller or shaft.
2. Remove the #8-32 X 3/8 inch screw and #8 x 0.075" flat washer that hold the strain relief cable to the skid.
3. Return the ROV to the upright position and slip the strain relief cable off of the term block.

Strain Relief Cable Kit Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 12 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Strain Relief Cable Kit
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit

See the corresponding sections of this manual for instructions for parts other than the Strain Relief Cable Kit.

Strain Relief Cable Kit Replacement Procedures

Time required for this step: Approximately 3 Minutes

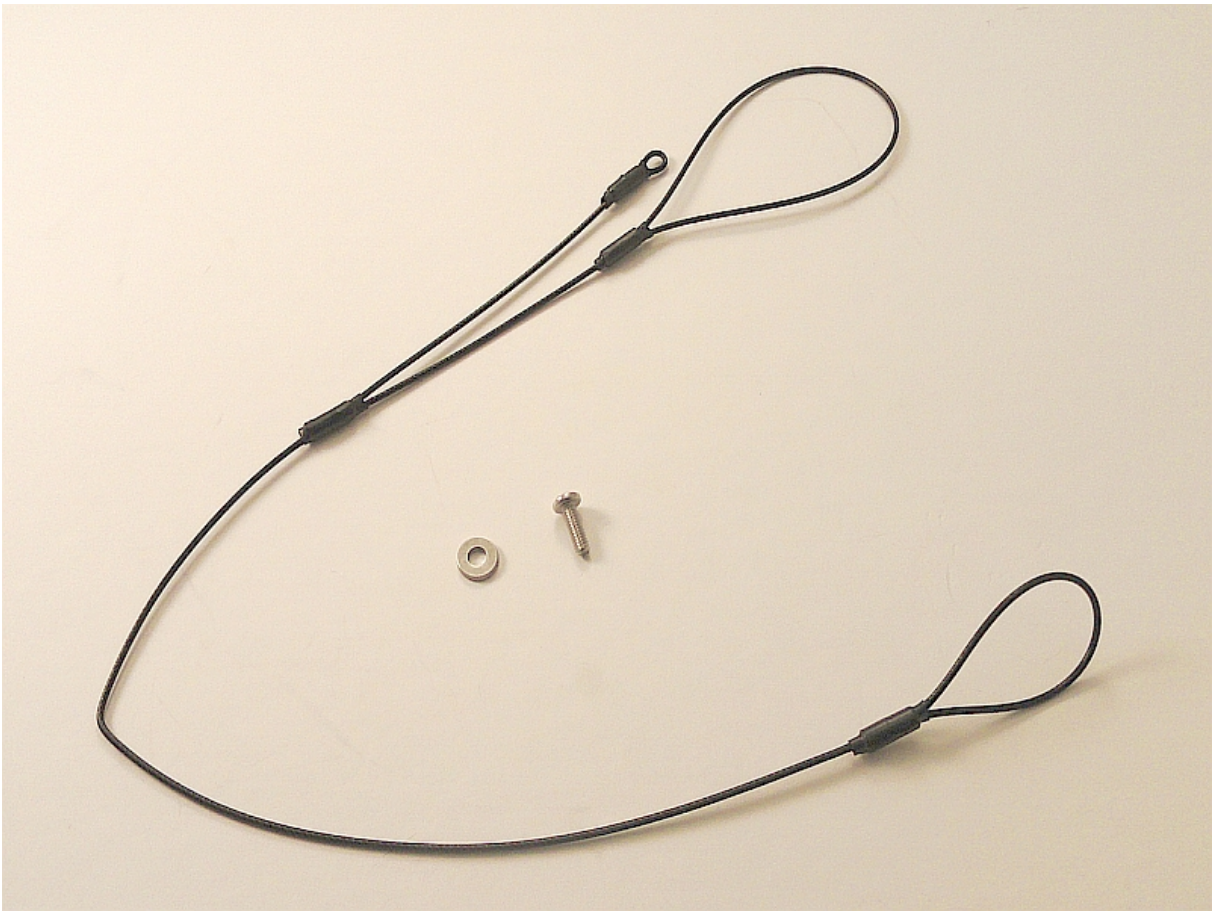
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

THR-HARNESS-P4-KIT Strain Relief Cable Kit

Quantity	Part Number	Part Description
1	THR-HARNESS-P4	Strain Relief Assembly ROV (Pro 4)
1	91772A192	Screw #8-32 x 3/8" Pan Head Phillips SS
1	98370A011	Washer #8 x 0.075" Flat SS



Steps

1. Slip the strain relief cable over the ROV tether whip and onto the term block.
2. Turn the ROV upside down and rest securely so that it does not tip over and you do not damage the vertical propeller or shaft.
3. Install the #8-32 X 3/8 inch screw and washer into the loop in the strain relief cable and screw it to the center hole near the rear of the skid.

Light Dome

- Part Number: LT-001-4

Light Dome Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 2 Minutes (4 Minutes for both sides)

Tools required:

- None

The following components must be removed:

- Light Dome

Light Dome Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

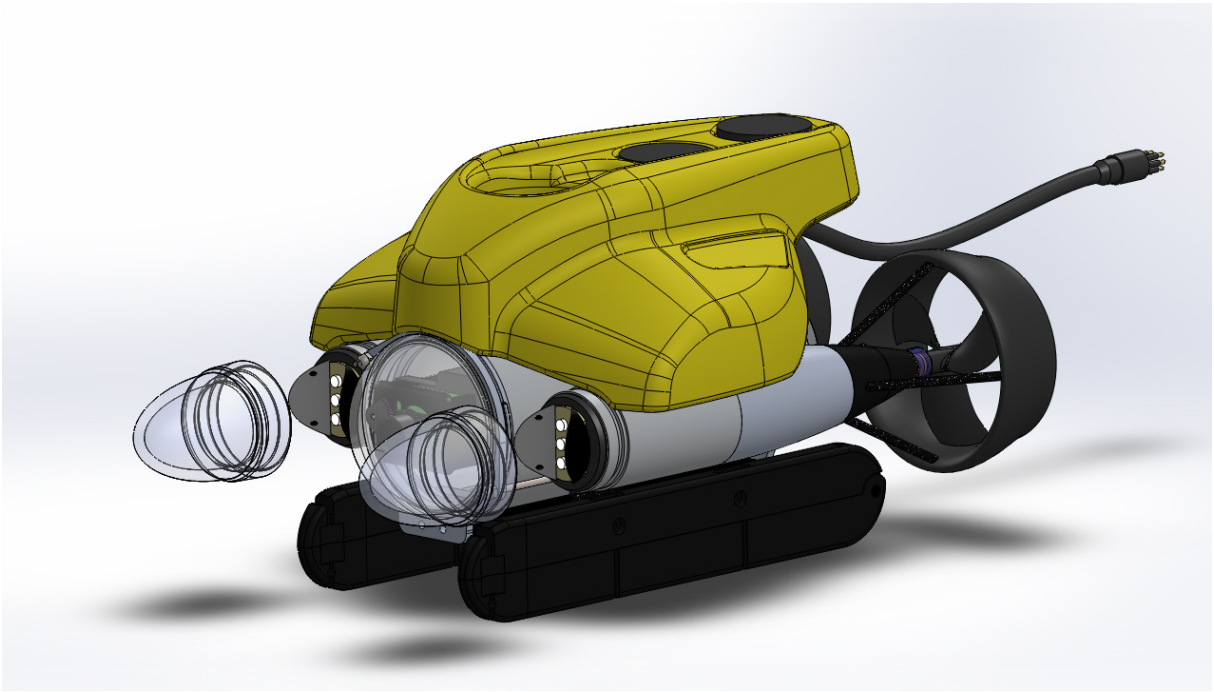
Tools required for this step:

- None

Parts involved in this step:

LT-001-4 Light Dome

Quantity	Part Number	Part Description
1	LT-001-4	Light Part Dome Industrial
1	OR-135	O-Ring #135



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Light Domes.

1. Unscrew the light dome from the horizontal thruster tube.
2. If you plan to replace the O-ring, remove it by pinching it around the horizontal thruster tube to create a slack section that can be grabbed. Do NOT use a metal tool to remove the O-ring.

Tips

The light dome has right-handed threads. Turn the light dome counterclockwise, when viewed from the front of the ROV, in order to loosen it.

If you cannot loosen the light dome by hand, you can use a non-slip pad, strap wrench or rubber coated pipe pliers.

Light Dome Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 2 Minutes (4 Minutes for both sides)

Tools required:

- O-Ring Lubricator

The following components must be replaced:

- Light Dome

Notes:

- Before installing the light dome, inspect it for scratches or cracks.
- Do NOT use a deeply scratched or cracked dome, because it may fail under pressure.
- This procedure is best done with the ROV nose up, resting on the thruster nozzles. This keeps the LED light modules from falling out while you try to secure the light dome.

Light Dome Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

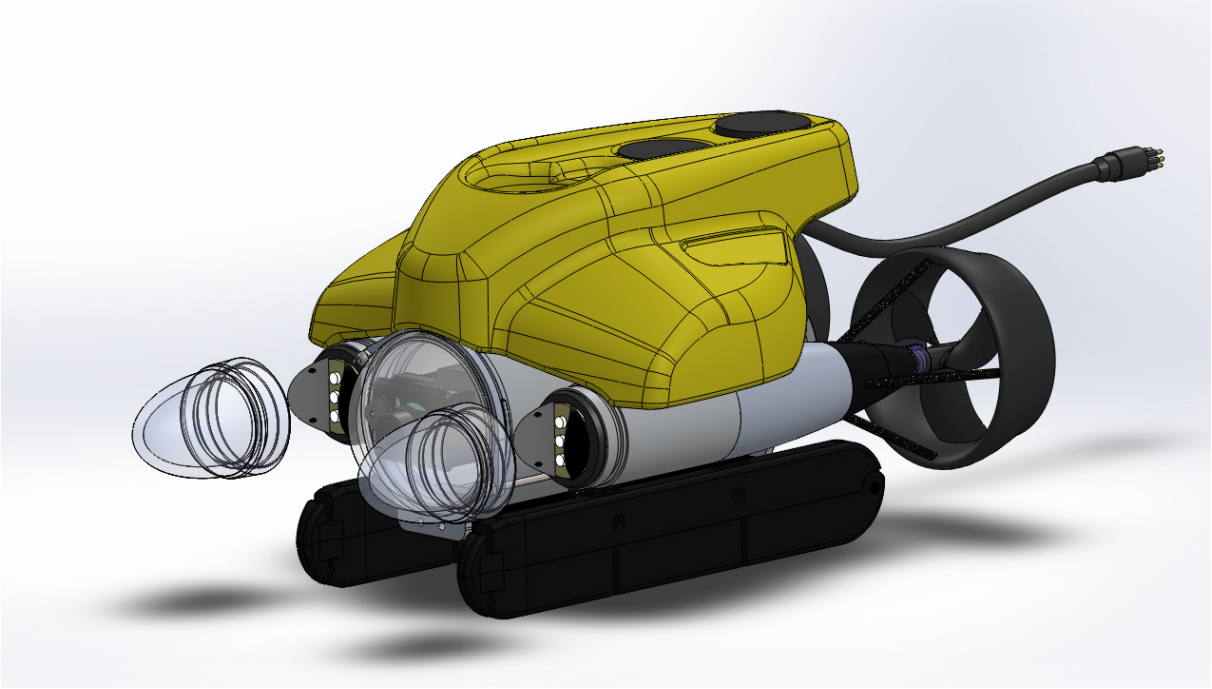
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

LT-001-4 Light Dome

Quantity	Part Number	Part Description
1	LT-001-4	Light Part Dome Industrial
1	OR-135	O-Ring #135



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Light Domes.

1. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it in the O-ring groove at the front of the horizontal thruster tube. Make sure the O-ring is seated in the groove.
2. Make sure the LED light module is seated in the thruster tube.
3. Orient the light dome so that the open end is toward the front of the horizontal thruster tube.
4. Screw the light dome onto the horizontal thruster tube until the base of the light dome touches the landing on the horizontal thruster tube. Do NOT leave a gap, and do NOT over tighten the light dome.

Tips

The light dome has right-handed threads. Turn the light dome clockwise, when viewed from the front of the ROV, in order to tighten it.

The light dome diameter is relatively large compared to the thread pitch. Make sure the light dome is on straight before tightening it in order to avoid cross threading the dome onto the horizontal thruster tube.

If you cannot tighten the light dome by hand, you can use a non-slip pad, strap wrench or rubber coated pipe pliers.

Inspect the O-ring under the light dome to make sure it is in contact with the light dome all the way around. The O-ring should look solid black. If you see a lighter colored spot, that could indicate a hair or a piece of dirt and the light dome should be removed and the O-ring and sealing surfaces inspected.

LED Light Module Assembly

- Part Number: VR-PRO4-05-0001

LED Light Module Assembly Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- None

The following components must be removed:

- Light Dome
- LED Light Module Assembly

See the corresponding sections of this manual for instructions for parts other than the LED Light Module Assembly.

LED Light Module Assembly Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

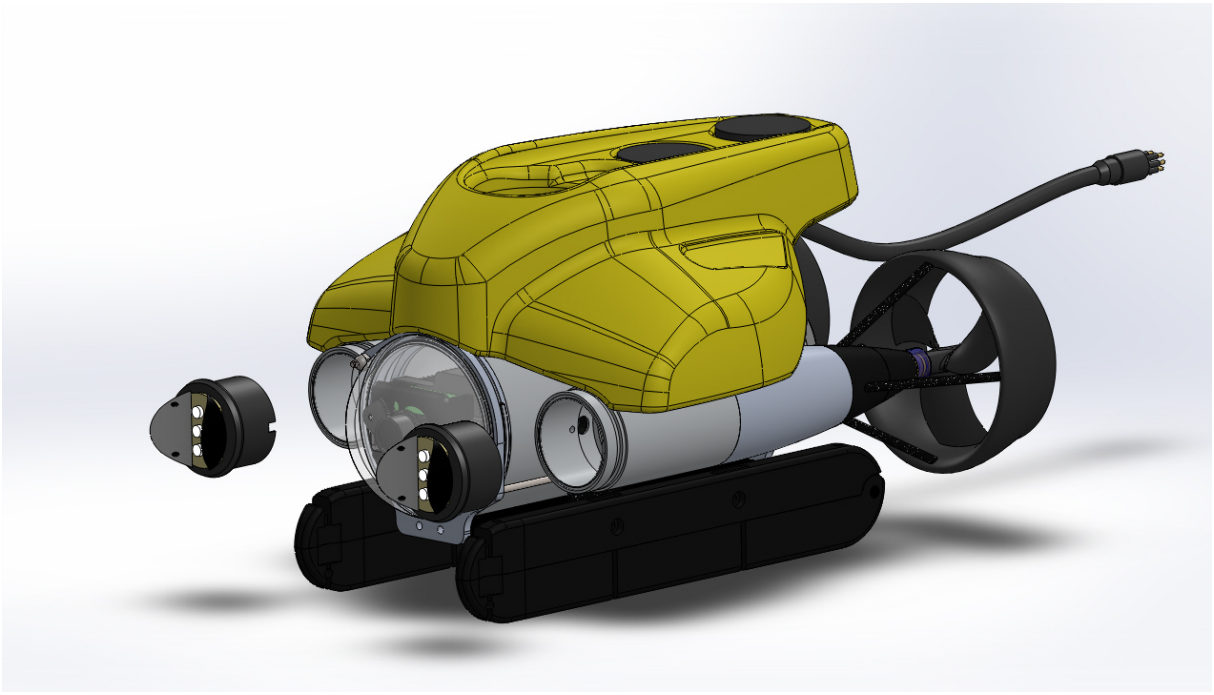
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-05-0001 LED Light Module Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-05-0001	Light Assembly LED Module (Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both LED Light Modules.

1. Pull the LED light module assembly from the horizontal thruster tube. Do NOT pull the assembly out too fast, or you could damage the wires.
2. Disconnect the LED light module assembly wire by pressing on the clip on the connector and pulling the connector halves apart.

Tip

If you plan to remove the horizontal thruster drive train assembly, you can also disconnect the motor wires from within the front of the horizontal thruster tube after the LED light module assembly is out of the way.

LED Light Module Assembly Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- O-Ring Lubricator

The following components must be replaced:

- LED Light Module Assembly
- Light Dome

See the corresponding sections of this manual for instructions for parts other than the LED Light Module Assembly.

LED Light Module Assembly Replacement Procedures

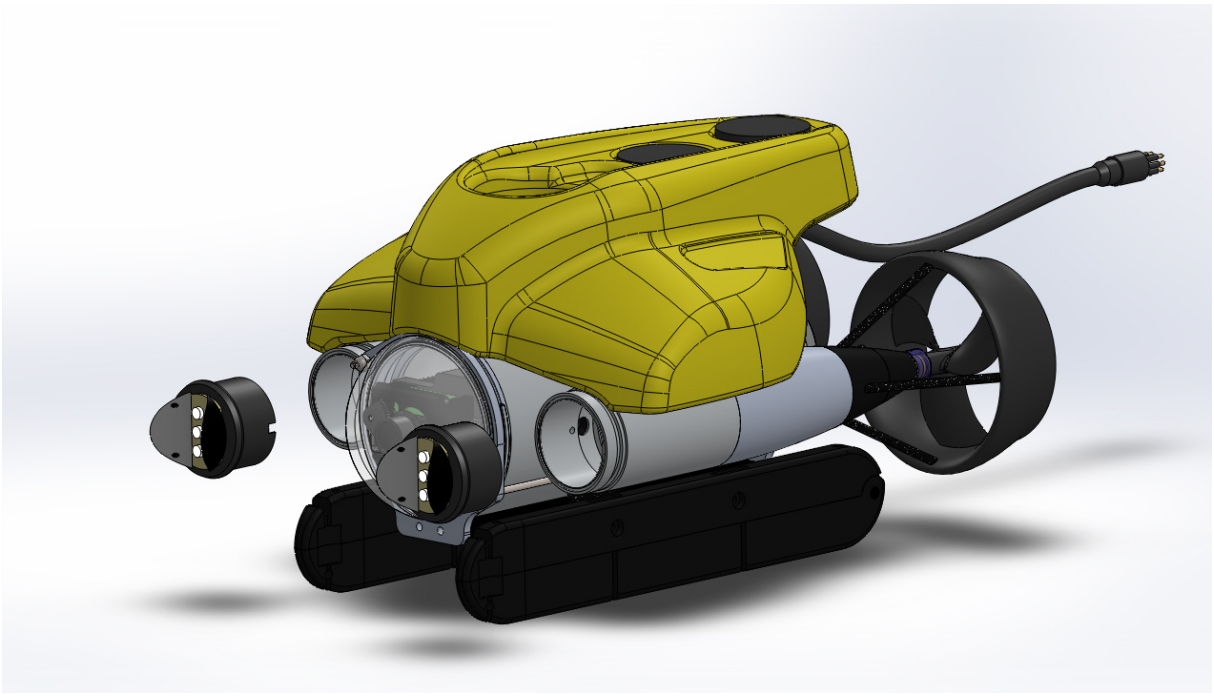
Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

Tools required for this step:

Parts involved in this step:

VR-PRO4-05-0001 LED Light Module Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-05-0001	Light Assembly LED Module (Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both LED Light Modules.

1. Place or make sure the O-ring is seated in the groove on the front face of the horizontal thruster tube.
2. Orient the LED light module at the front of the horizontal thruster tube so that the LEDs are facing forward and the notch at the rear of the module is facing toward the main hull. This notch has to engage with the screw that holds the horizontal thruster tube to the main hull.
3. Align the LED light module assembly connector clip with the catch on the ROV wire harness connector for the lights in the horizontal thruster tube.
4. Make sure the wires are inserted into the horizontal thruster tube and will not be pinched by the LED light module when it is inserted.
5. Slide the LED light module into the horizontal thruster tube until it seats against the O-ring in the front face of the horizontal thruster tube.

Tip

VideoRay recommends that you test the LED light module after it is installed and before replacing the light dome.

LED Light Reflector Set

- Part Number: MAR-002-ASSM

LED Light Reflector Set Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 9 Minutes (18 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver

The following components must be removed:

- Light Dome
- LED Light Module Assembly
- LED Light Reflector Set

See the corresponding sections of this manual for instructions for parts other than the LED Light Reflector Set.

LED Light Reflector Set Removal Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

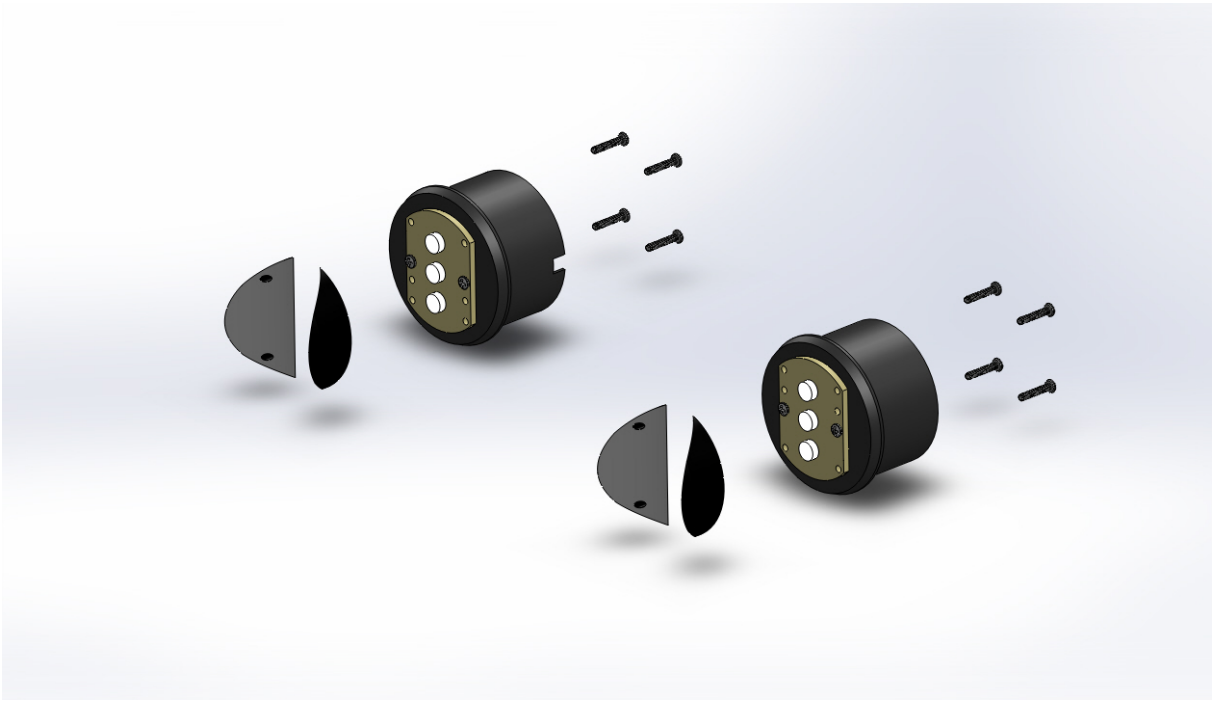
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-002-ASSM LED Light Reflector Set

Quantity	Part Number	Part Description
2	MAR-002-ASSM	Light Assembly LED Reflector (Pro 4)
4	91249A058	Screw #2-56 x 1/2" Pan Head Phillips SS Black



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both LED Light Reflector Sets.

1. From the back side of the LED light module assembly, unscrew the two 2-56 X 1/2 inch Phillips head LED reflector screws that hold each LED light reflector in place.
2. Remove the LED light reflectors from the LED light module assembly.

Tip

Be careful not to damage the LED light reflector surfaces.

LED Light Reflector Set Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 9 Minutes (18 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver
- O-Ring Lubricator

The following components must be replaced:

- LED Light Reflector Set
- LED Light Module Assembly
- Light Dome

See the corresponding sections of this manual for instructions for parts other than the LED Light Reflector Set.

LED Light Reflector Set Replacement Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

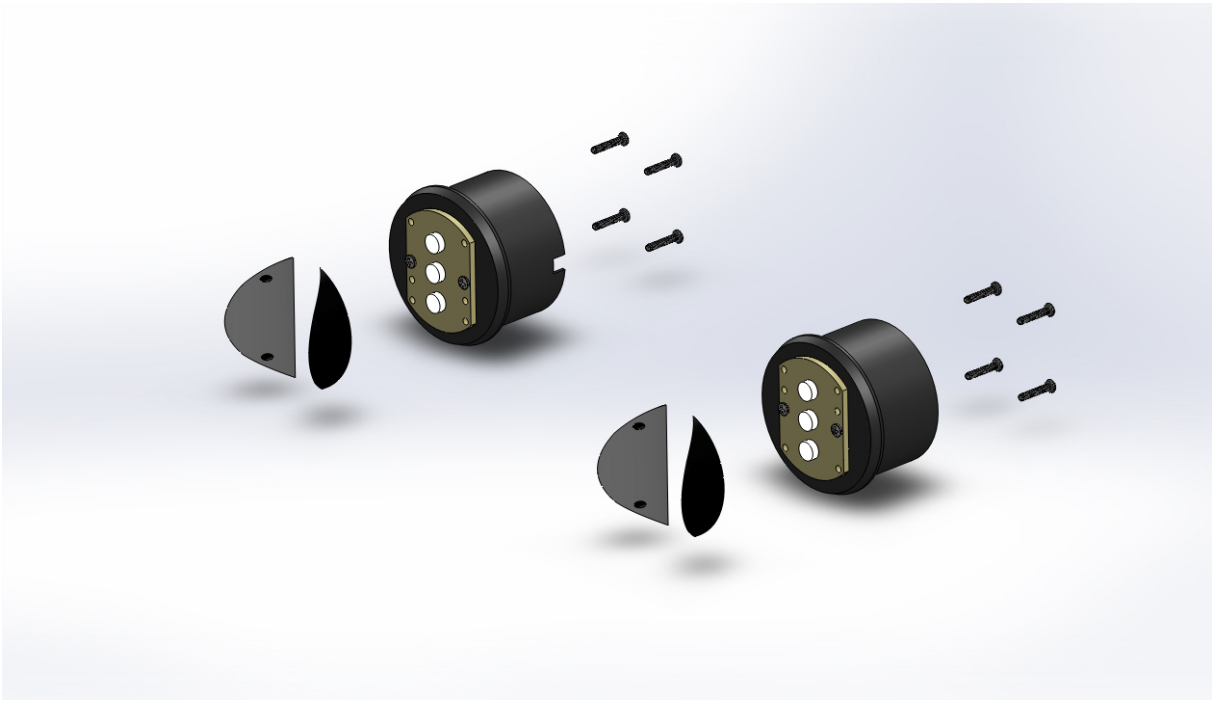
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-002-ASSM LED Light Reflector Set

Quantity	Part Number	Part Description
2	MAR-002-ASSM	Light Assembly LED Reflector (Pro 4)
4	91249A058	Screw #2-56 x 1/2" Pan Head Phillips SS Black



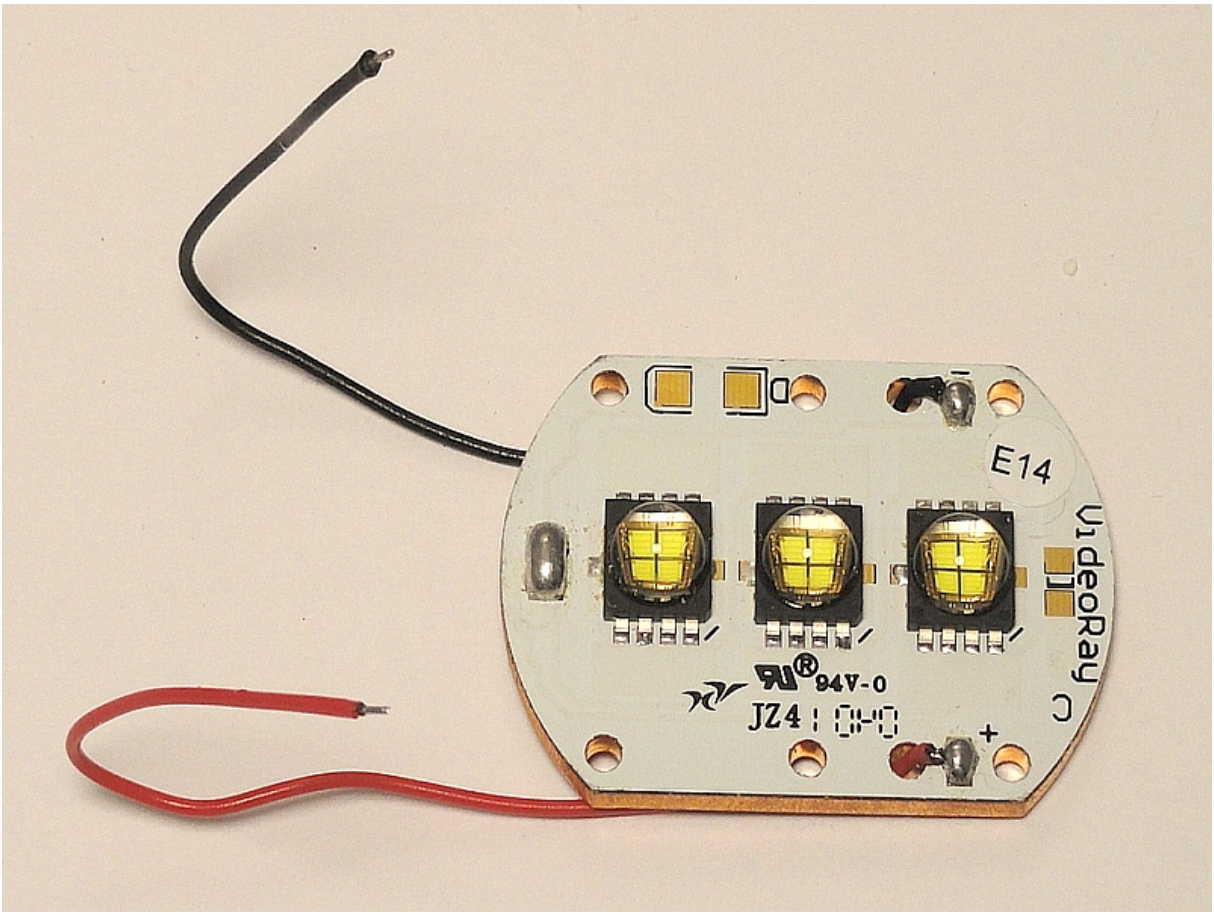
Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both LED Light Reflector Sets.

1. Orient the LED reflector so that the straight edge is parallel with the LED array, and the reflector surface is facing toward the LED array .
2. Replace the 2-56 X 1/2 inch Phillips head LED reflector screws from the rear of the LED light module assembly into the LED reflector and tighten the screws.
3. Repeat this process for the other LED reflector.

LED Light Printed Circuit Board

- Part Number: VR-PRO4-05-0002



LED Light Printed Circuit Board Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 14 Minutes (28 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Light Dome
- LED Light Module Assembly
- LED Light Reflector Set
- LED Light Printed Circuit Board

See the corresponding sections of this manual for instructions for parts other than the LED Light Printed Circuit Board.

LED Light Printed Circuit Board Removal Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

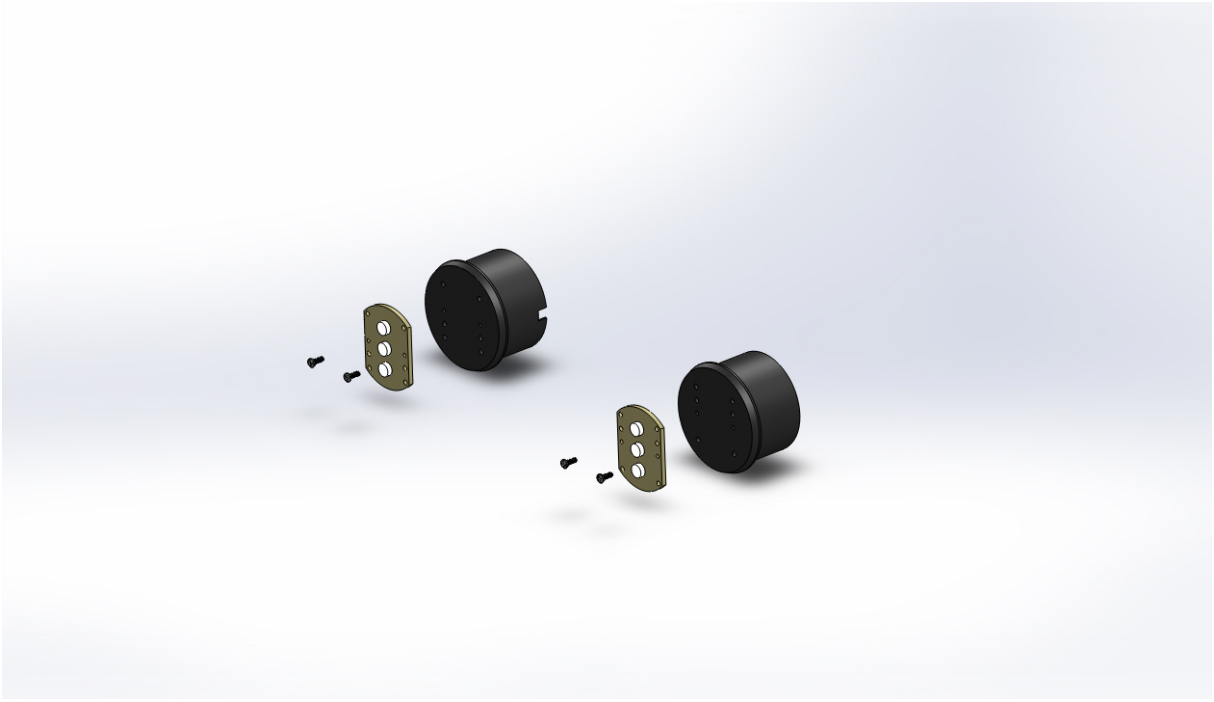
Tools required for this step:

- #1 Phillips Head Screw Driver
- Soldering Iron

Parts involved in this step:

VR-PRO4-05-0002 LED Light Printed Circuit Board

Quantity	Part Number	Part Description
1	VR-PRO4-05-0002	Circuit Board ROV LED Lights (Pro 4 front)
2	91249A050	Screw #2-56 x 1/4" Pan Head Phillips SS Black
1	WM1845-ND	Connector 2 x 1 Molex Micro-Fit Female
2	538-43030-0010	Crimp Pin 26-30 AWG Molex Micro-Fit Female



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both LED Light Boards.

1. Unsolder the two wire leads from the face of the LED light board.
2. Remove the wires by pulling them from the rear of the LED light module assembly.
3. Unscrew the two 2-56 X 1/4 inch Phillips head screws the hold the LED light board to the LED light mount.
4. Remove the LED light board from the LED light mount.

LED Light Printed Circuit Board Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 14 Minutes (28 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- O-Ring Lubricator

The following components must be replaced:

- LED Light Printed Circuit Board
- LED Light Reflector Set
- LED Light Module Assembly
- Light Dome

See the corresponding sections of this manual for instructions for parts other than the LED Light Printed Circuit Board.

LED Light Printed Circuit Board Replacement Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

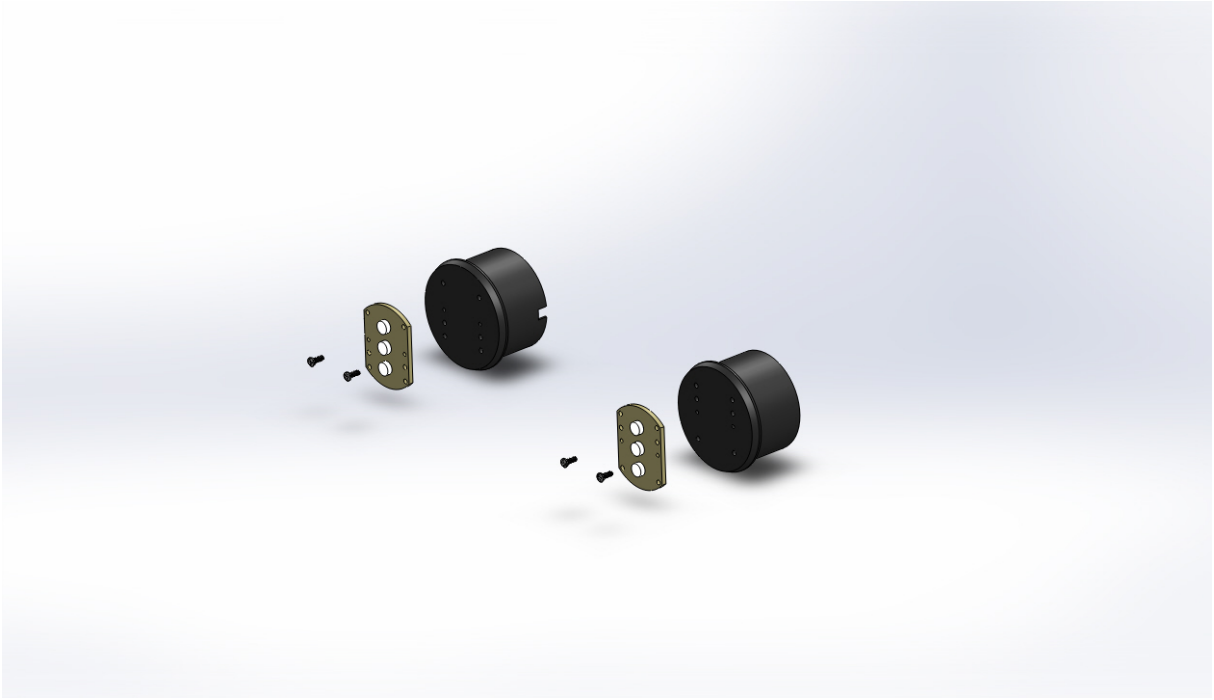
Tools required for this step:

- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder

Parts involved in this step:

VR-PRO4-05-0002 LED Light Printed Circuit Board

Quantity	Part Number	Part Description
1	VR-PRO4-05-0002	Circuit Board ROV LED Lights (Pro 4 front)
2	91249A050	Screw #2-56 x 1/4" Pan Head Phillips SS Black
1	WM1845-ND	Connector 2 x 1 Molex Micro-Fit Female
2	538-43030-0010	Crimp Pin 26-30 AWG Molex Micro-Fit Female



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both LED Light Boards.

1. Orient the LED light board (with the LEDs facing out) on the front face of the LED light mount and align the eight holes. If all of the holes are not aligned, rotate the LED light board 180 degrees.
2. Insert the 2-56 X 1/4 inch Phillips head LED light board screws through the center holes in the front of the LED light module into the LED light mount and tighten the screws.
3. Insert the red wire from the wire connector through the "+" side from the rear of the LED light mount and solder it to the "+" solder pad. Make sure the solder or wire does not touch the screw.
4. Insert the black wire from the wire connector through the "-" side from the rear of the LED light mount and solder it to the "-" solder pad. Make sure the solder or wire does not touch the screw.

Tip

VideoRay recommends that you test the LED light board for a short between the wires and the LED board base and test the light board in a known working ROV before replacing the remaining LED light module parts.

LED Light Mount

- Part Number: MAR-001

LED Light Mount Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 14 Minutes (28 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Light Dome
- LED Light Module Assembly
- LED Light Reflector Set
- LED Light Printed Circuit Board
- LED Light Mount

See the corresponding sections of this manual for instructions for parts other than the LED Light Mount.

LED Light Mount Removal Procedures

Time required for this step: Approximately 0 Minutes (0 Minutes for both sides)

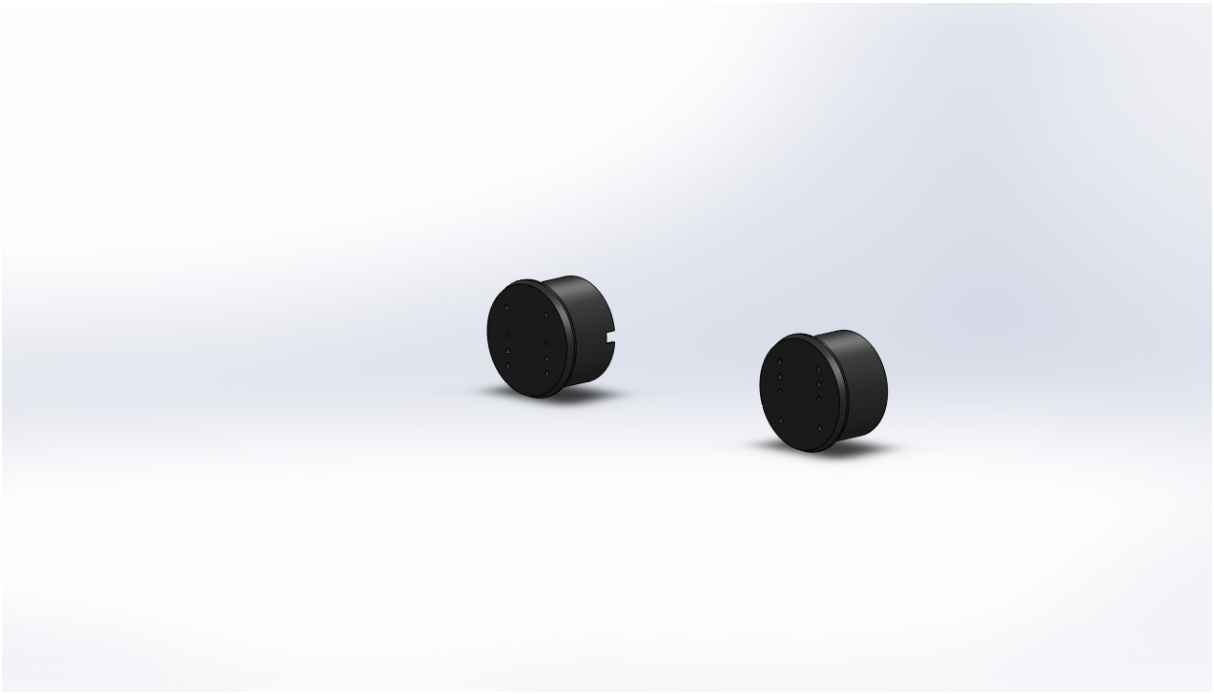
Tools required for this step:

- None

Parts involved in this step:

MAR-001 LED Light Mount

Quantity	Part Number	Part Description
1	MAR-001	Light Part LED Mount (Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both LED Light Mounts.

1. After removing the LED light board, the LED light mount is considered removed.

LED Light Mount Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 14 Minutes (28 Minutes for both sides)

Tools required:

- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- O-Ring Lubricator

The following components must be replaced:

- LED Light Mount
- LED Light Printed Circuit Board
- LED Light Reflector Set
- LED Light Module Assembly
- Light Dome

See the corresponding sections of this manual for instructions for parts other than the LED Light Mount.

LED Light Mount Replacement Procedures

Time required for this step: Approximately 0 Minutes (0 Minutes for both sides)

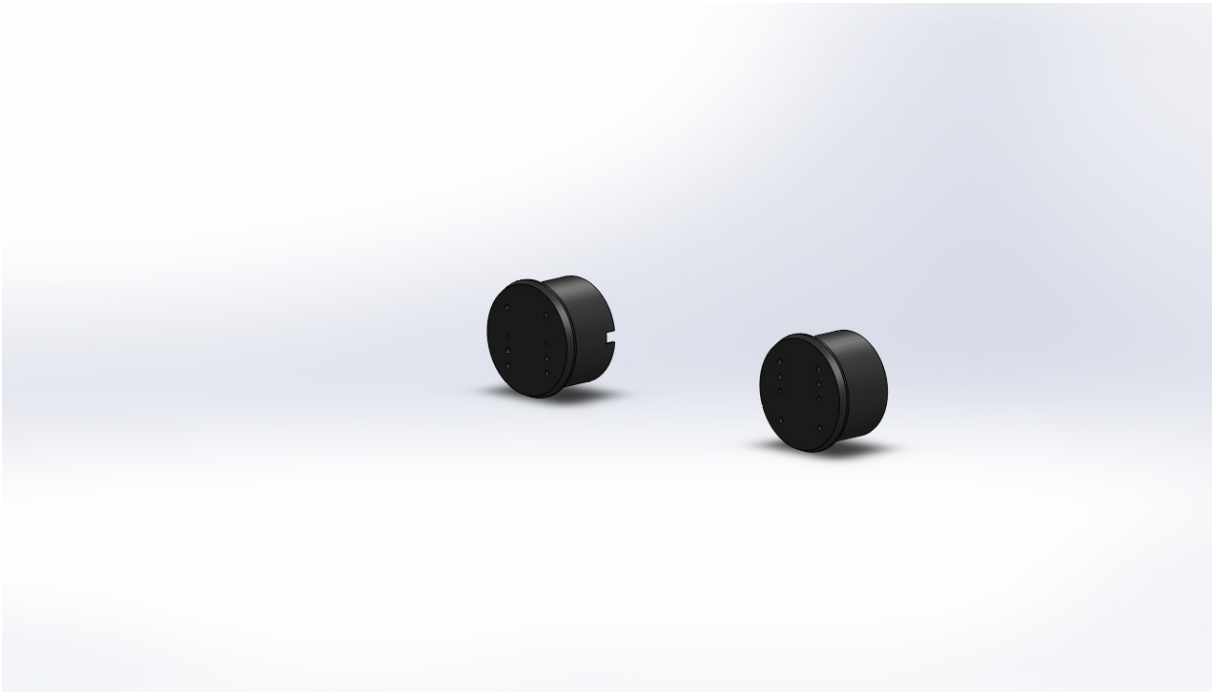
Tools required for this step:

- None

Parts involved in this step:

MAR-001 LED Light Mount

Quantity	Part Number	Part Description
1	MAR-001	Light Part LED Mount (Pro 4)



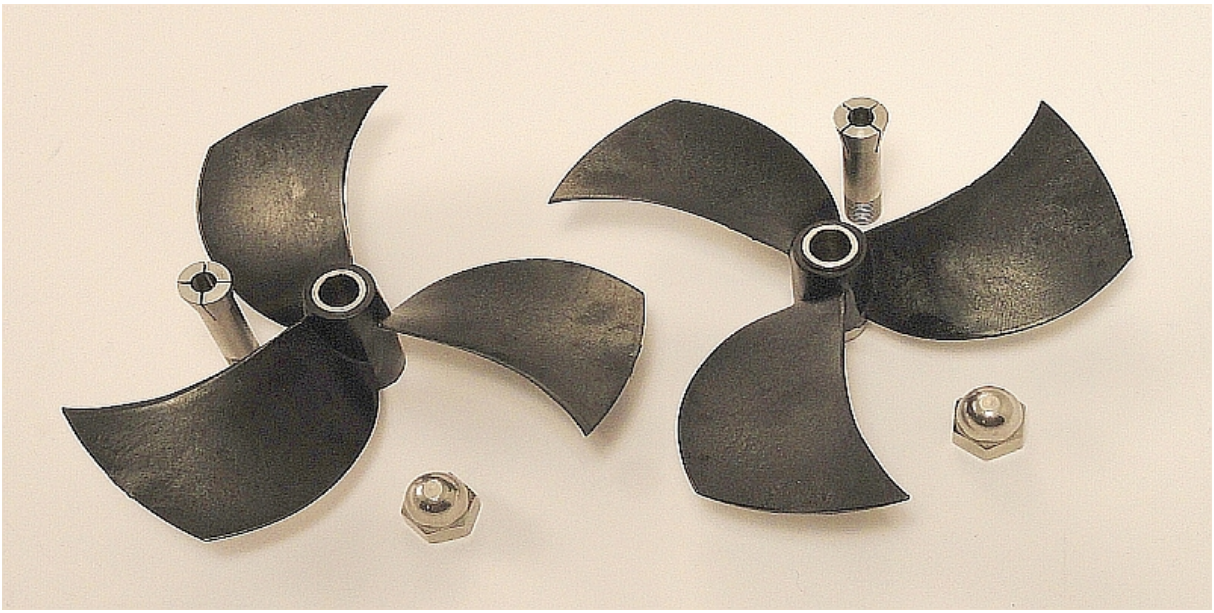
Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both LED Light Mounts.

1. To begin the replacement of the LED light mount, proceed to the next step and install the LED light board on the LED light mount.

Horizontal Thruster Propeller Kit (Left and Right)

- Part Numbers: GTO-006L-KIT (Left), GTO-006R-KIT (Right)



Horizontal Thruster Propeller Kit (Left and Right) Removal Overview

Skill level recommended: Novice

Total time required: Approximately 2 Minutes (4 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)

Horizontal Thruster Propeller Kit (Left and Right) Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

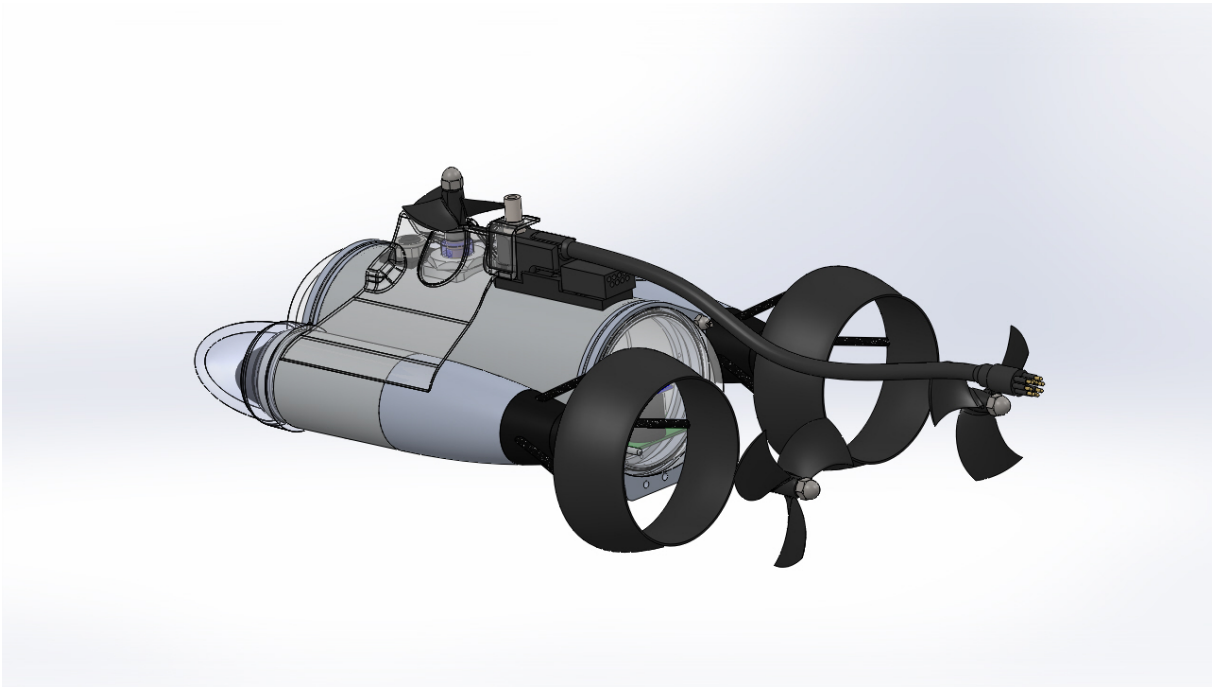
Tools required for this step:

- 7/16 Inch Open End or Socket Wrench

Parts involved in this step:

GTO-006L-KIT~GTO-006R-KIT Horizontal Thruster Propeller Kit (Left and Right)

Quantity	Part Number	Part Description
1	GTO-006L-KIT	Propeller Kit Horizontal 100mm 3 Blade Left (GTO, Deep Blue, Pro 4)
1	GTO-006R-KIT	Propeller Kit Horizontal 100mm 3 Blade Right (GTO, Deep Blue, Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Propellers.

1. Loosen, but do not remove, the 7/16 inch acorn nut at the outboard end of the horizontal propeller.
2. Pull the horizontal propeller from the horizontal thruster shaft.

Tip

Both horizontal propeller nuts have right-handed threads. Turn the nuts counterclockwise, when viewed from the rear of the ROV, in order to loosen them.

If the horizontal propeller does not come off of the horizontal thruster shaft easily after loosening the nut, tap the nut while pulling on the propeller hub. This should loosen the propeller collet and the propeller should slide free from the shaft.

Horizontal Thruster Propeller Kit (Left and Right) Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 2 Minutes (4 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Propeller Kit (Left and Right)

Notes:

Horizontal propellers are counter rotating and must be installed on the correct side. When installed properly, the blade pointing up will curve toward the middle of the ROV when viewed from behind.

Before replacing the horizontal propeller, check to make sure that the thruster shaft is not bent or scored.

Horizontal Thruster Propeller Kit (Left and Right) Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

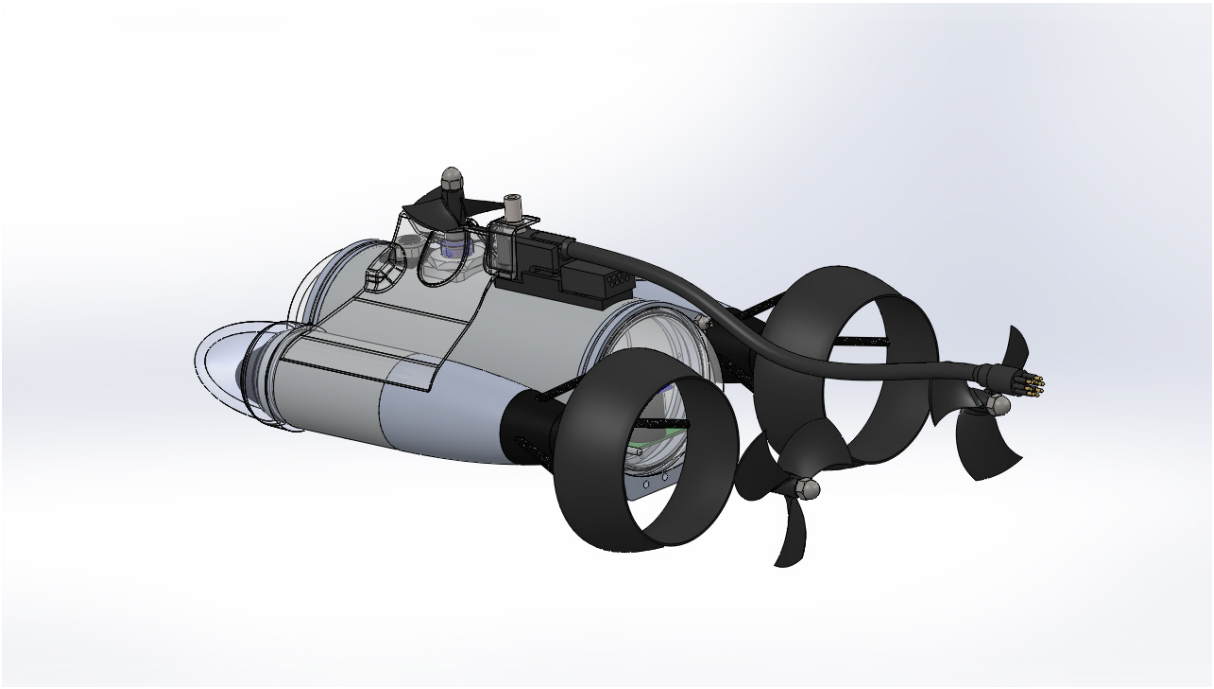
Tools required for this step:

- 7/16 Inch Open End or Socket Wrench

Parts involved in this step:

GTO-006L-KIT~GTO-006R-KIT Horizontal Thruster Propeller Kit (Left and Right)

Quantity	Part Number	Part Description
1	GTO-006L-KIT	Propeller Kit Horizontal 100mm 3 Blade Left (GTO, Deep Blue, Pro 4)
1	GTO-006R-KIT	Propeller Kit Horizontal 100mm 3 Blade Right (GTO, Deep Blue, Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Propellers.

1. Orient the horizontal propeller assembly with the open end of the propeller collet toward the horizontal thruster shaft.
2. Press the propeller assembly onto the shaft until it stops. There should be a gap of approximately 1 mm or less between the propeller and the cartridge seal. If there is no gap, the cartridge seal may not be seated - check the cartridge seal to make sure it is fully seated. If the gap is lager than 1 mm, the propeller is not fully seated - You may need to loosen the 7/16 inch acorn nut to allow the collet to open further.
3. Hold the propeller assembly by its hub and tighten the 7/16 inch acorn nut. Do NOT hold the propeller by its blades while tightening the nut, because that could cause a blade to break.

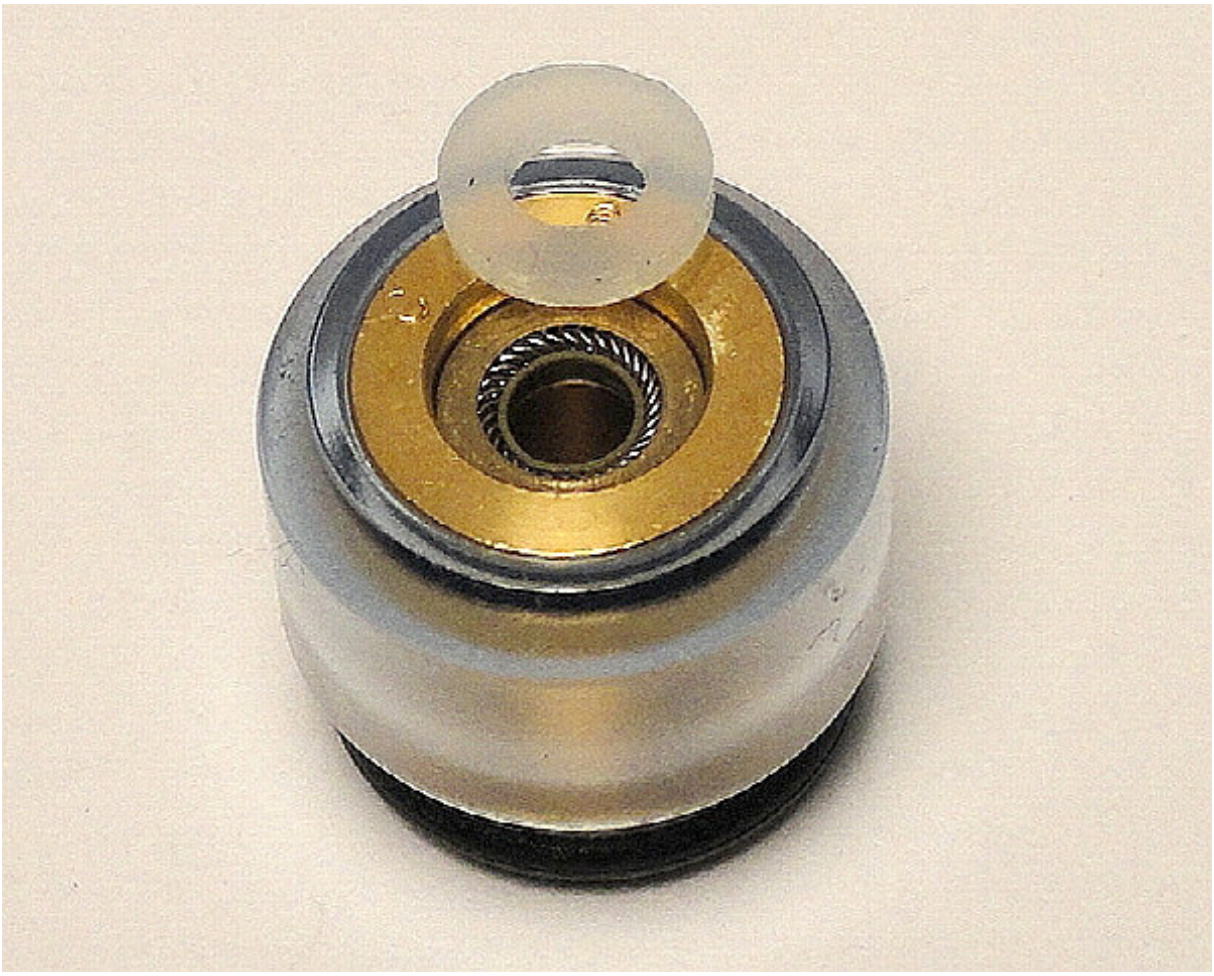
Tip

The horizontal propeller nut has right-handed threads. Turn the nut clockwise, when viewed from the rear of the ROV, in order to tighten it.

Check to make sure that the propeller turns freely.

Horizontal Thruster Cartridge Seal

- Part Number: CS-KIT-BL



Horizontal Thruster Cartridge Seal Removal Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Cartridge Seal.

Horizontal Thruster Cartridge Seal Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

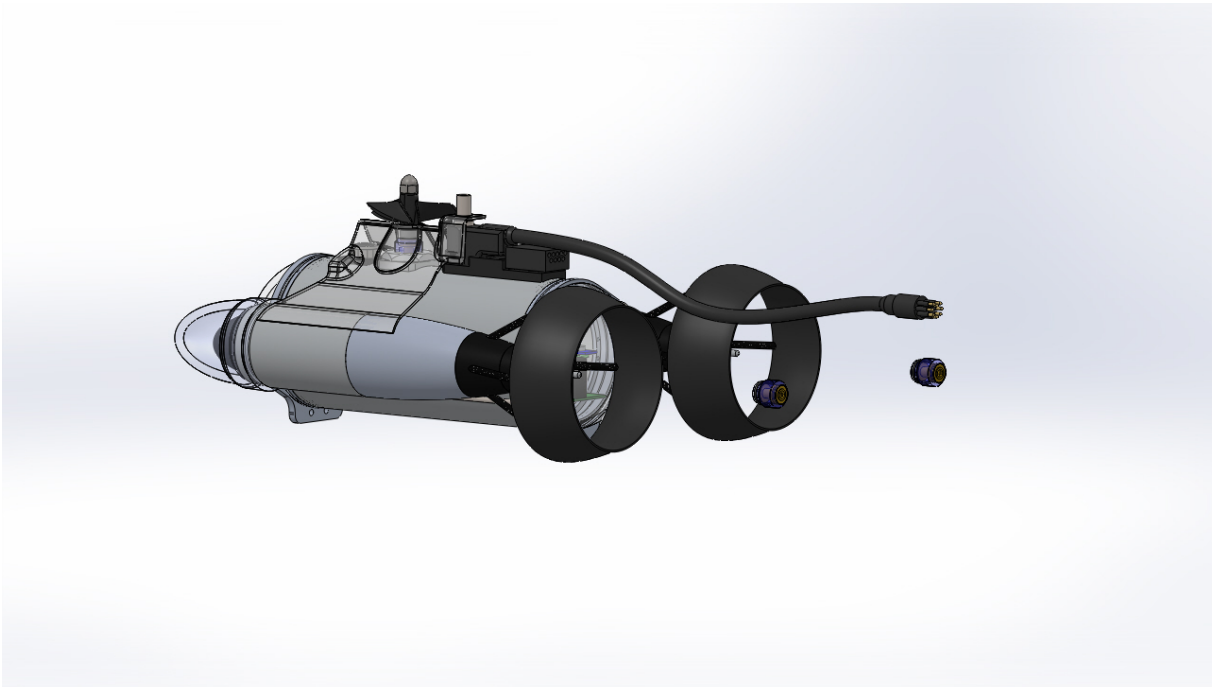
Tools required for this step:

- None

Parts involved in this step:

CS-KIT-BL(h) Horizontal Thruster Cartridge Seal

Quantity	Part Number	Part Description
1	CS-KIT-BL(h)	Cartridge Seal Assembly Blue
1	90295A090	Washer #6 x 0.06" Flat Nylon (Thick)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Cartridge Seals.

1. Pull the horizontal cartridge seal off of the horizontal thruster shaft. Make sure to keep track of the cartridge seal washer inside the outboard end of the cartridge seal.

Tip

If the horizontal cartridge seal is hard to pull free from its seat, twist the cartridge seal to free it for easier removal.

Horizontal Thruster Cartridge Seal Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- Lint-Free Tissue or Rag
- O-Ring Lubricator
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Cartridge Seal.

Notes:

- Before replacing the horizontal cartridge seal, check to make sure that the cartridge seal, horizontal thruster shaft and area where the cartridge seal seats are clean. Also, make sure the thruster shaft is not bent or scored.

Horizontal Thruster Cartridge Seal Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

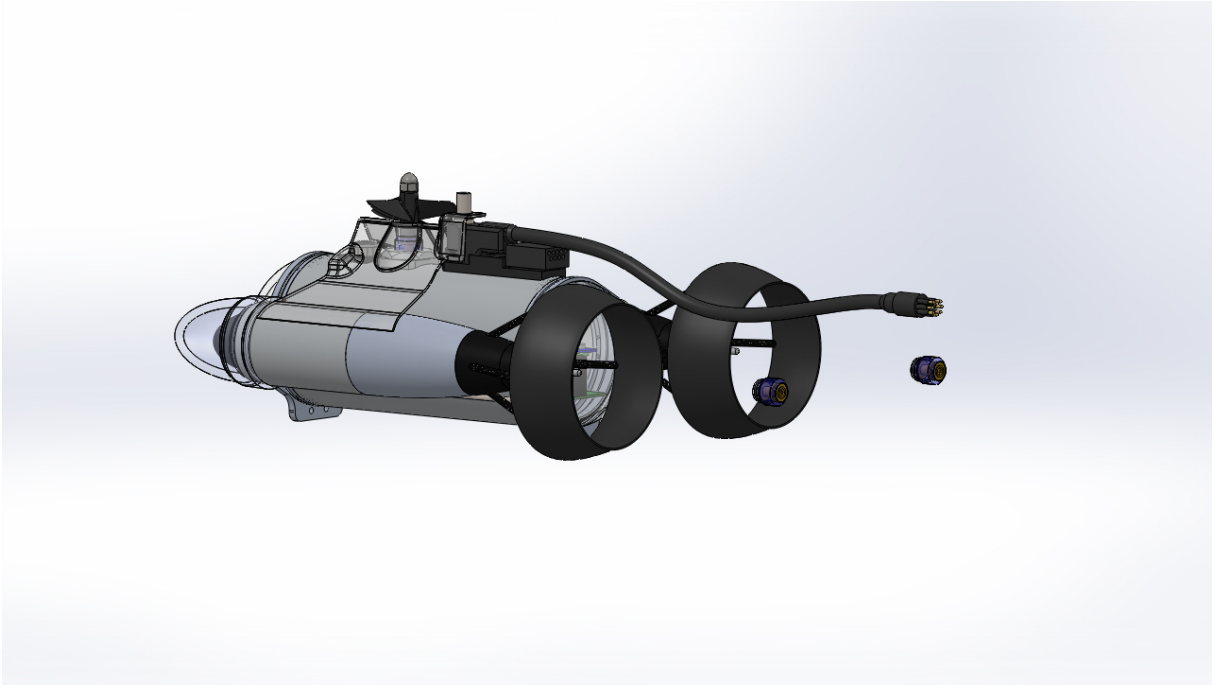
Tools required for this step:

- Lint-Free Tissue or Rag
- O-Ring Lubricator

Parts involved in this step:

CS-KIT-BL(h) Horizontal Thruster Cartridge Seal

Quantity	Part Number	Part Description
1	CS-KIT-BL(h)	Cartridge Seal Assembly Blue
1	90295A090	Washer #6 x 0.06" Flat Nylon (Thick)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Cartridge Seals.

1. Orient the cartridge seal with its O-ring end toward the ROV and the small hole and black line in its center core is facing downward.
2. Press the cartridge seal all the way onto the thruster shaft until it is seated in the horizontal thruster cone. You should not be able to see the O-ring when the cartridge seal is seated.
3. Place the cartridge seal washer on thruster shaft.
4. Press the cartridge seal washer down the shaft until is it seated inside of the cartridge seal.

Tip

You will notice that some silicone gel will be pushed from the center core of the cartridge seal. This is normal. The gel is used to keep the cartridge seal oil from leaking out of the cartridge seal during shipping and storage and can be wiped away with a tissue.

Horizontal Thruster Nozzle Kit

- Part Number: VR-PRO4-08-0001

Horizontal Thruster Nozzle Kit Removal Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Nozzle Kit.

Horizontal Thruster Nozzle Kit Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

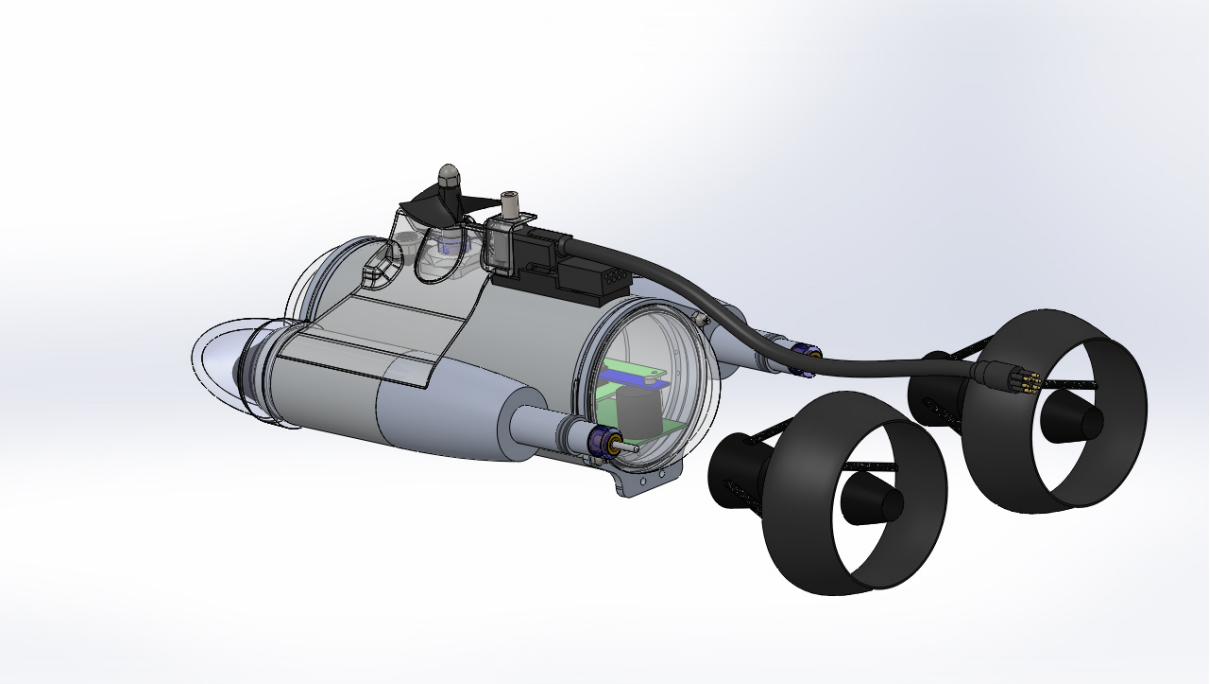
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-08-0001 Horizontal Thruster Nozzle Kit

Quantity	Part Number	Part Description
1	GTO-017-ASSM	Thruster Nozzle Assembly
1	GTO-012	Thruster Nozzle Part Nut (GTO, Deep Blue, Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Nozzles.

1. Unscrew the horizontal thruster nozzle nut from the horizontal thruster cone.
2. Once the horizontal thruster nut is removed, slide the horizontal thruster nozzle assembly off of the horizontal thruster cone.

Tips

The horizontal thruster nut has right-handed threads. Turn the thruster nut counterclockwise, when viewed from the rear of the ROV, in order to loosen it.

If you cannot turn the horizontal thruster nozzle nut, grasp the horizontal thruster nozzle assembly and nut and turn them both at the same time. This should free the nut enough that it can be turned by hand.

Horizontal Thruster Nozzle Kit Replacement Overview

Skill level recommended: Novice

Total time required: Approximately 4 Minutes (8 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Nozzle Kit.

Horizontal Thruster Nozzle Kit Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

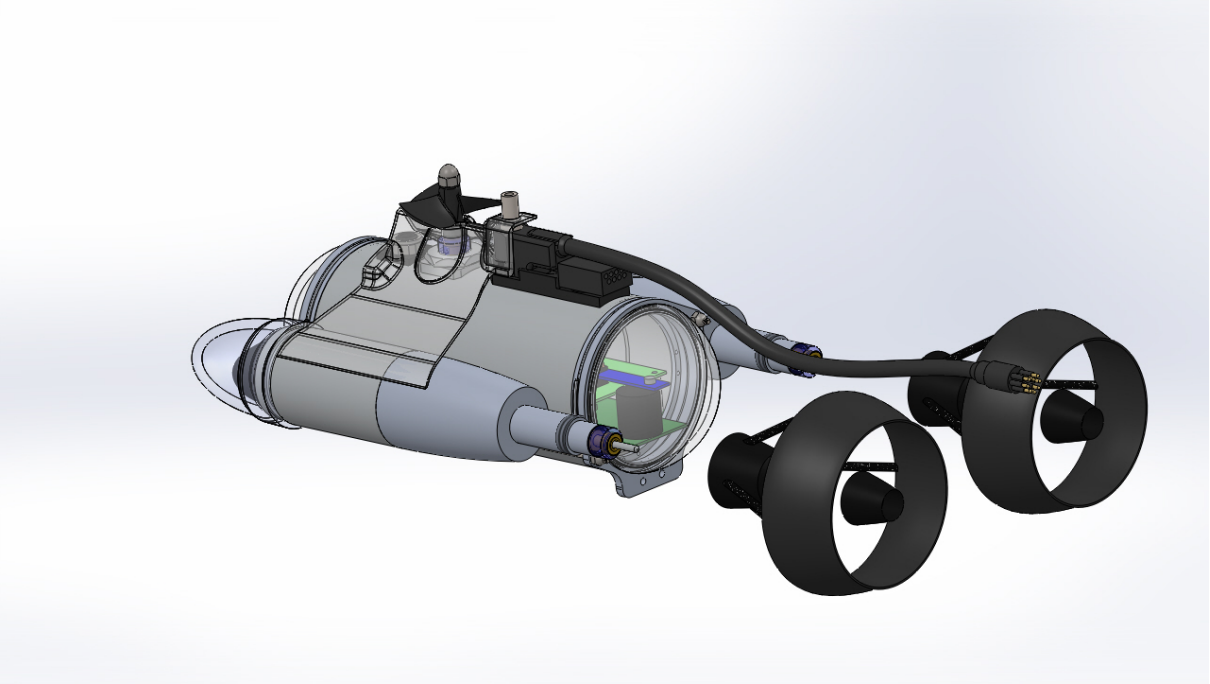
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-08-0001 Horizontal Thruster Nozzle Kit

Quantity	Part Number	Part Description
1	GTO-017-ASSM	Thruster Nozzle Assembly
1	GTO-012	Thruster Nozzle Part Nut (GTO, Deep Blue, Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Nozzles.

1. Orient the horizontal thruster nozzle assembly with the smaller end toward the front of the ROV.
2. Slide the horizontal thruster nozzle assembly onto the horizontal thruster cone.
3. Orient the horizontal thruster nozzle nut with the larger end toward the front of the ROV.
4. Replace the horizontal thruster nozzle nut and tighten it against the hub of the horizontal thruster nozzle.
5. Holding both the horizontal thruster nozzle and nut, turn them together until the assembly is snug. Do NOT over tighten the nozzle assembly.

Tip

The horizontal thruster nut has right-handed threads. Turn the thruster nut clockwise, when viewed from the rear of the ROV, in order to tighten it.

Horizontal Thruster Cone Assembly

- Part Number: HT-002-GY-ASSM

Horizontal Thruster Cone Assembly Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 9 Minutes (18 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Cone Assembly.

Horizontal Thruster Cone Assembly Removal Procedures

Time required for this step: Approximately 3 Minutes (6 Minutes for both sides)

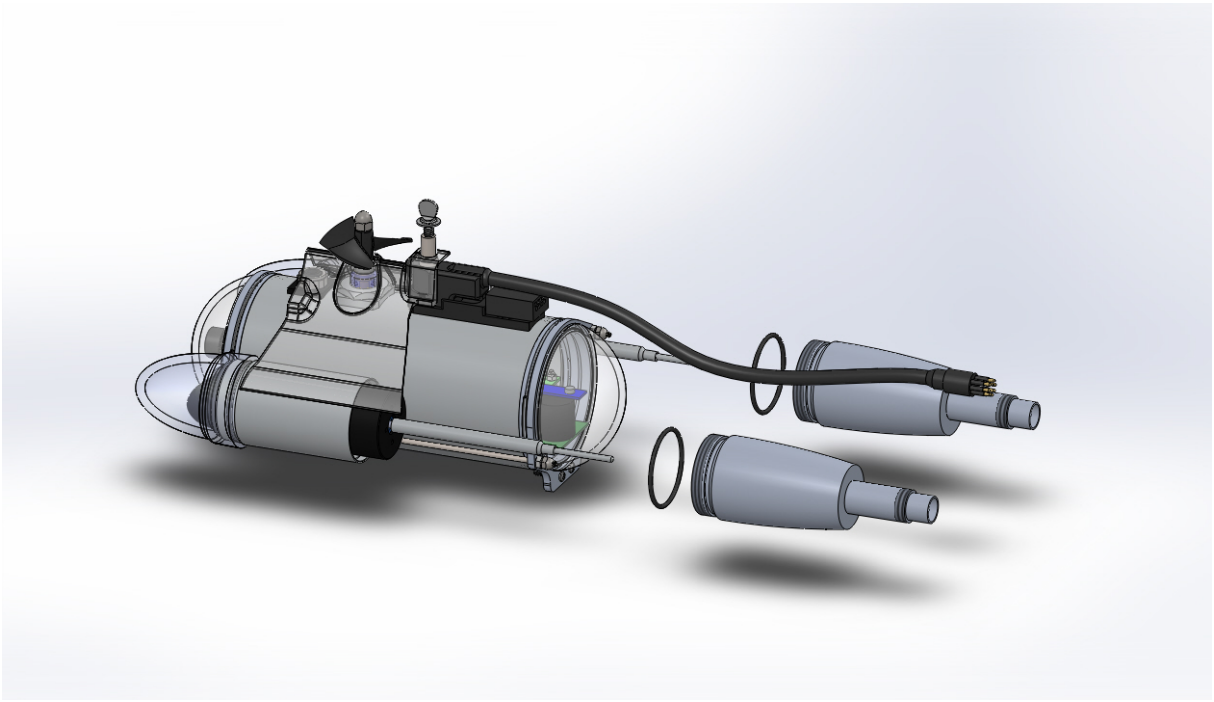
Tools required for this step:

- Strap Wrench or Rubber Coated Pipe Pliers

Parts involved in this step:

HT-002-GY-ASSM Horizontal Thruster Cone Assembly

Quantity	Part Number	Part Description
1	HT-002-GY-ASSM	Thruster Assembly Horizontal Cone (Pro 4)
1	OR-135	O-Ring #135



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Cones.

1. Unscrew the horizontal thruster cone assembly from the horizontal thruster tube.
2. If you plan to replace the O-ring, remove it by pinching it around the horizontal thruster tube to create a slack section that can be grabbed. Do NOT use a metal tool to remove the O-ring.

Tips

The horizontal thruster cone assembly has right-handed threads. Turn the thruster cone counterclockwise, when viewed from the rear of the ROV, in order to loosen it.

If you cannot loosen the horizontal thruster cone assembly by hand, you can use a non-slip pad, strap wrench or rubber coated pipe pliers.

Horizontal Thruster Cone Assembly Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 8 Minutes (16 Minutes for both sides)

Tools required:

- Strap Wrench or Rubber Coated Pipe Pliers
- O-Ring Lubricator
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Cone Assembly.

Horizontal Thruster Cone Assembly Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

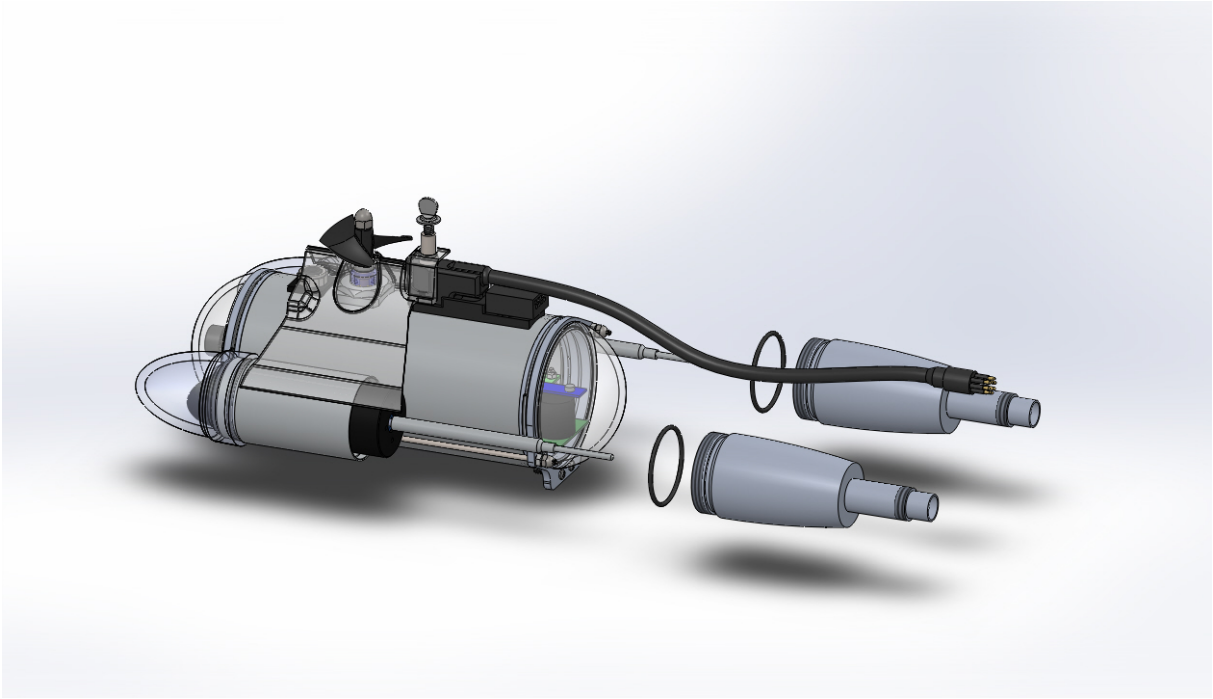
Tools required for this step:

- Strap Wrench or Rubber Coated Pipe Pliers
- O-Ring Lubricator

Parts involved in this step:

HT-002-GY-ASSM Horizontal Thruster Cone Assembly

Quantity	Part Number	Part Description
1	HT-002-GY-ASSM	Thruster Assembly Horizontal Cone (Pro 4)
1	OR-135	O-Ring #135



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Cones.

1. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it in the O-ring groove at the rear of the horizontal thruster tube.
2. Orient the horizontal thruster cone assembly at the rear of the horizontal thruster shaft with the large end of the cone facing toward the front of the ROV.
3. Slide the horizontal thruster cone assembly over the thruster motor shaft and being careful not to pinch the O-ring, screw the cone onto the horizontal thruster tube until the base of the cone touches the landing on the thruster tube. Do NOT leave a gap, and do NOT over tighten the thruster cone.

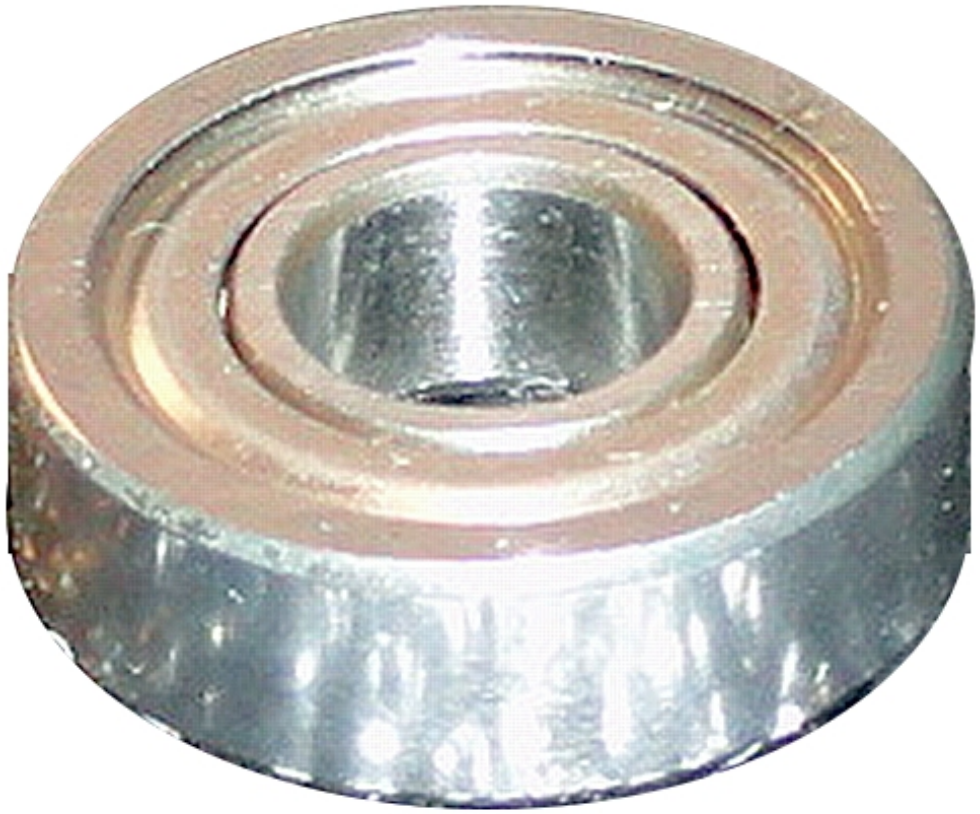
Tip

The horizontal thruster cone has right-handed threads. Turn the thruster cone clockwise, when viewed from the rear of the ROV, in order to tighten it.

If you cannot tighten the horizontal thruster cone by hand, you can use a non-slip pad, strap wrench or rubber coated pipe pliers.

Horizontal Thruster Bearing

- Part Number: GTO-015



Horizontal Thruster Bearing Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 11 Minutes (22 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers
- Wooden Dowel Rod 3/8" x 12"

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Bearing

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Bearing.

Horizontal Thruster Bearing Removal Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

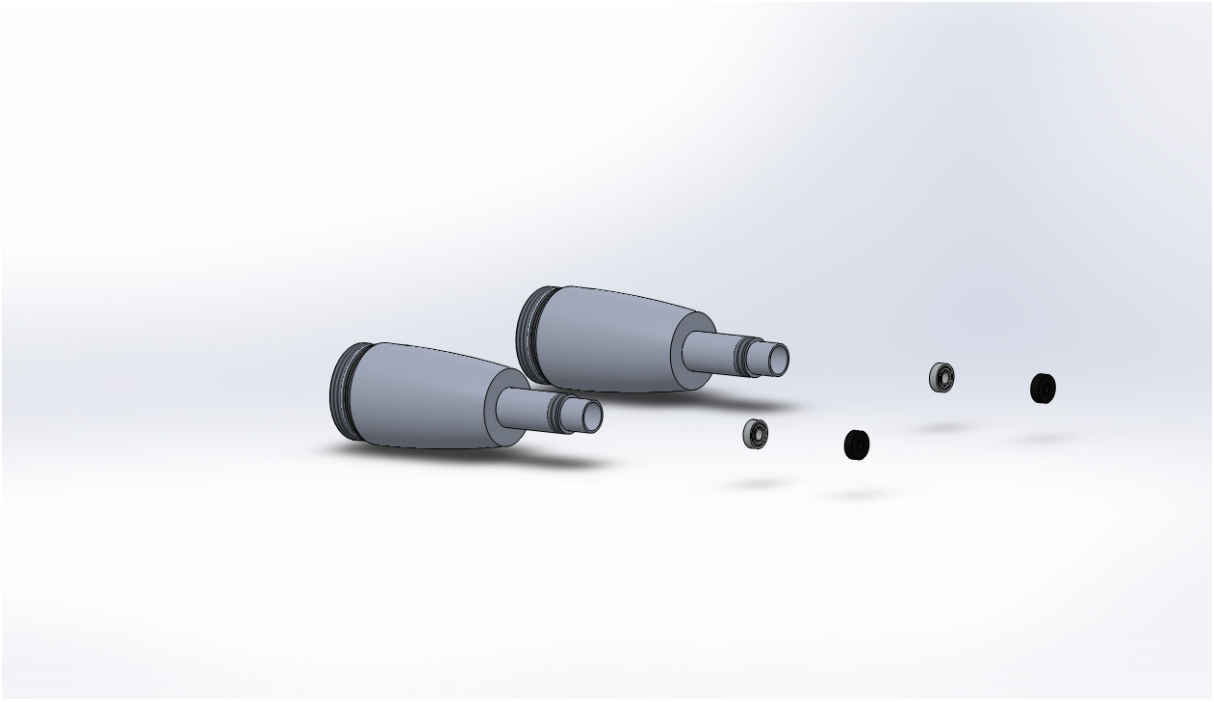
Tools required for this step:

- Wooden Dowel Rod 3/8" x 12"

Parts involved in this step:

GTO-015 Horizontal Thruster Bearing

Quantity	Part Number	Part Description
1	HT-002-GY	Thruster Part Horizontal Cone (Pro 4)
1	GTO-015	Thruster Part Horizontal Bearing (GTO, Deep Blue, Pro 4)
1	GTO-013	Thruster Part Horizontal Bearing Retainer (GTO, Deep Blue, Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Bearings.

1. Insert the dowel or similar instrument into the front (larger) end of the horizontal thruster cone with the tip of the dowel against the horizontal thruster bearing.
2. Press the horizontal thruster bearing and spacer out of the horizontal thruster tube.

Horizontal Thruster Bearing Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 10 Minutes (20 Minutes for both sides)

Tools required:

- Strap Wrench or Rubber Coated Pipe Pliers
- O-Ring Lubricator
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Bearing
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Bearing.

Horizontal Thruster Bearing Replacement Procedures

Time required for this step: Approximately 2 Minutes (4 Minutes for both sides)

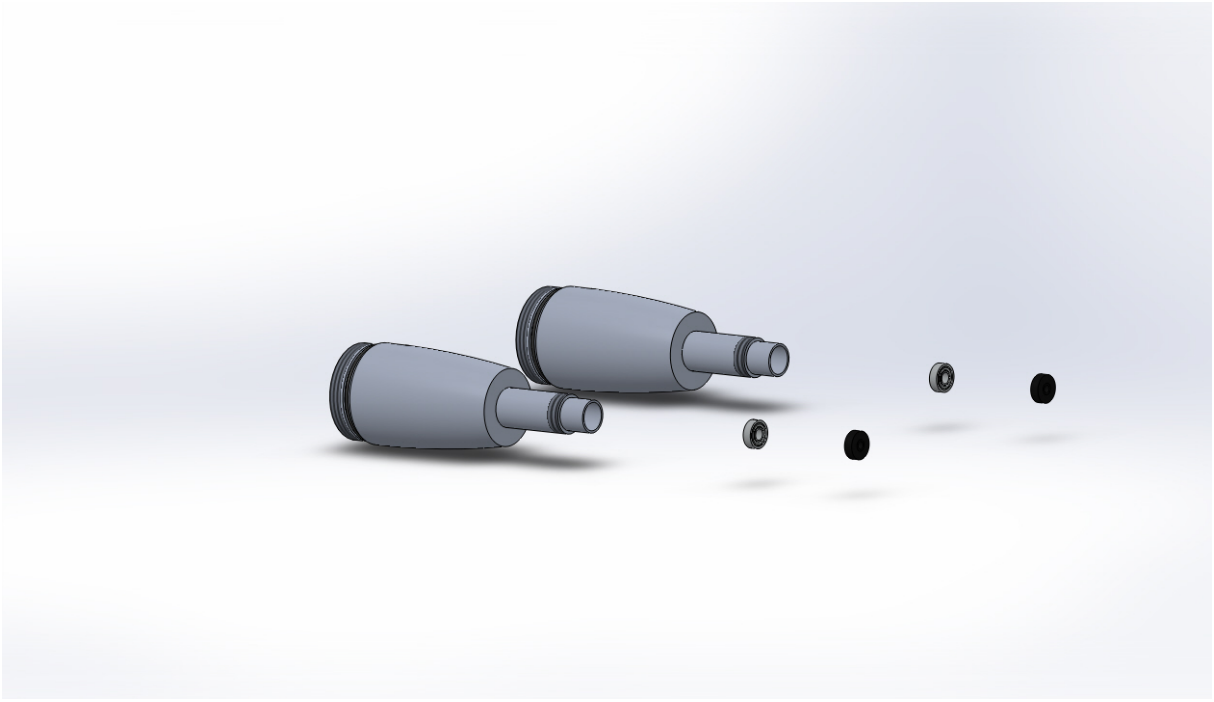
Tools required for this step:

- None

Parts involved in this step:

GTO-015 Horizontal Thruster Bearing

Quantity	Part Number	Part Description
1	HT-002-GY	Thruster Part Horizontal Cone (Pro 4)
1	GTO-015	Thruster Part Horizontal Bearing (GTO, Deep Blue, Pro 4)
1	GTO-013	Thruster Part Horizontal Bearing Retainer (GTO, Deep Blue, Pro 4)



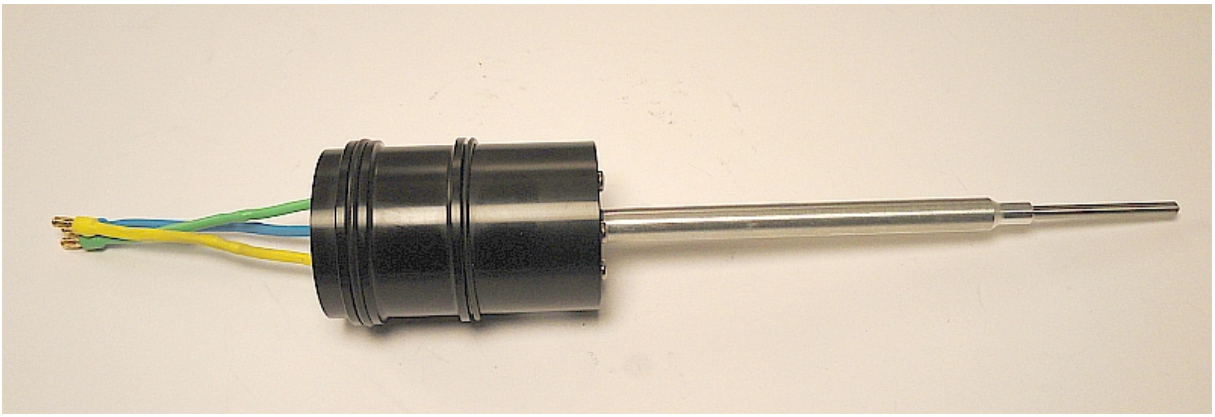
Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Bearings.

1. Place the bearing in the small end of the thruster cone and press it in enough to allow room for the bearing spacer.
2. Align the bearing spacer so that the side with the center recess is towards the bearing.
3. Place the bearing spacer in the small end of the thruster cone.
4. Press the bearing and spacer into the thruster cone. Make sure the bearing and bearing spacer are seated all of the way into the cone. You may need to use a press to ensure complete insertion. Do not press too hard to crush the bearing or damage the cone.

Horizontal Thruster Drive Train Assembly

- Part Number: VR-PRO4-01-0001



Horizontal Thruster Drive Train Assembly Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 12 Minutes (24 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Drive Train Assembly

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Drive Train Assembly.

Horizontal Thruster Drive Train Assembly Removal Procedures

Time required for this step: Approximately 3 Minutes (6 Minutes for both sides)

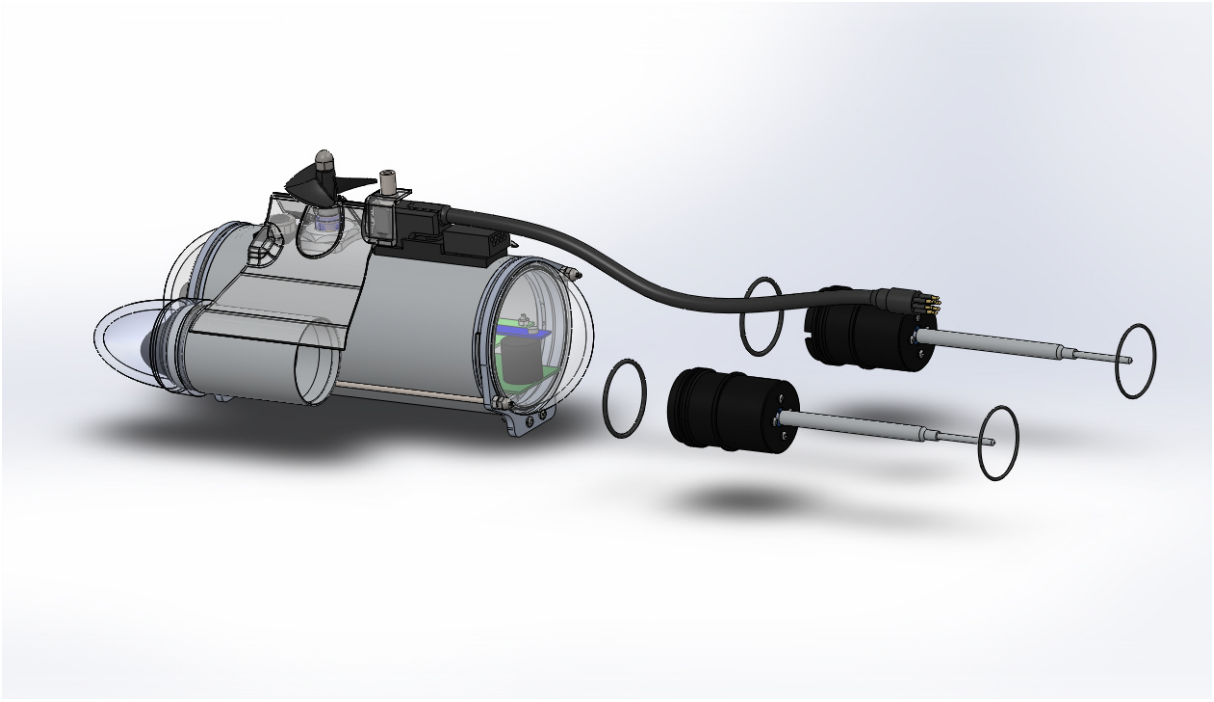
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-01-0001 Horizontal Thruster Drive Train Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-01-0001	Thruster Assembly Horizontal Drive Train Brushless (Pro 4)
1	OR-133	O-Ring #133
1	OR-031	O-Ring #031



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Drive Trains.

1. Pull the horizontal drive train assembly from the horizontal thruster tube. If it does not come out easily, wiggle it gently from side to side while pulling it. Do NOT pull the drive train out too fast, or you could damage the wires.
2. Disconnect the three horizontal drive train wires by pulling apart each connector.

Horizontal Thruster Drive Train Assembly Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 11 Minutes (22 Minutes for both sides)

Tools required:

- O-Ring Lubricator
- Strap Wrench or Rubber Coated Pipe Pliers
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Drive Train Assembly.

Horizontal Thruster Drive Train Assembly Replacement Procedures

Time required for this step: Approximately 3 Minutes (6 Minutes for both sides)

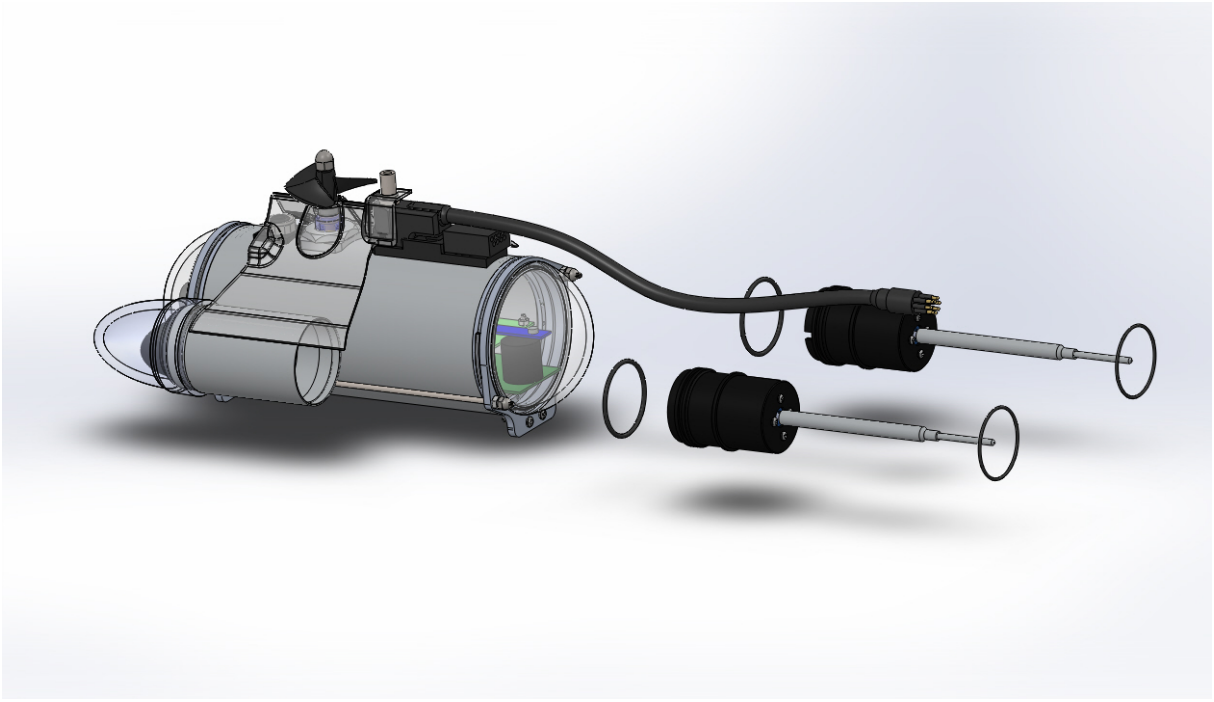
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

VR-PRO4-01-0001 Horizontal Thruster Drive Train Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-01-0001	Thruster Assembly Horizontal Drive Train Brushless (Pro 4)
1	OR-133	O-Ring #133
1	OR-031	O-Ring #031



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Drive Trains.

1. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it in the O-ring groove in the open end of the horizontal motor mount.
2. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it over the closed end of the of the horizontal motor mount and slide it up to the stop.
3. Orient the horizontal thruster drive train at the rear of the horizontal thruster tube so that the shaft is to the rear of the ROV and the notch at the front is facing toward the main hull. This notch has to engage with the screw that holds the horizontal thruster tube to the main hull.
4. Connect the like-colored wires from the horizontal motor to the ROV wire harness connector for the motors
   .
5. Make sure the wires are inserted into the horizontal thruster tube and will not be pinched by the horizontal thruster drive train when it is inserted.
6. Slide the horizontal thruster drive train into the horizontal thruster tube until the drive train seats inside the tube.

Tip

It may be easier to connect the horizontal motor wires and keep them being pinched by accessing the wires from the front of the horizontal thruster tubes. In order to do this, you need to remove the light domes and LED light modules. See the instructions for removing and replacing the LED light modules for more information.

Horizontal Thruster Motor Mount

- Part Number: MAR-004

Horizontal Thruster Motor Mount Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 17 Minutes (34 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers
- #2 Phillips Head Screw Driver

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Motor Mount

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Motor Mount.

Horizontal Thruster Motor Mount Removal Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

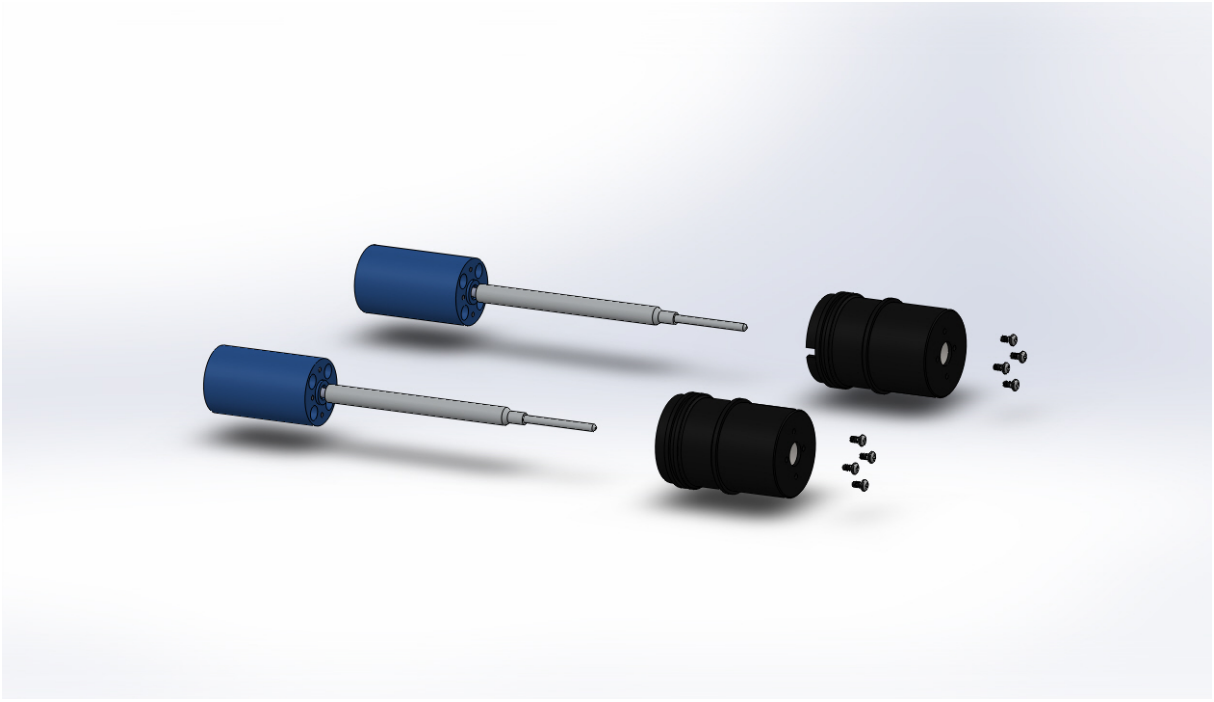
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

MAR-004 Horizontal Thruster Motor Mount

Quantity	Part Number	Part Description
1	MAR-004	Thruster Part Horizontal Motor Mount (Pro 4)
1	GTO-018	Thruster Part GTO Motor Shield Brushed (GTO, Deep Blue)
4	92000A116	Screw M3 x 0.5mm x 6mm Pan Head Phillips SS



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Motor Mounts.

1. Unscrew the four 3 X 6 mm Phillips head screws that hold the horizontal motor mount to the horizontal motor assembly.
2. Slide the horizontal motor mount off of the horizontal motor assembly.

Horizontal Thruster Motor Mount Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 16 Minutes (32 Minutes for both sides)

Tools required:

- #2 Phillips Head Screw Driver
- O-Ring Lubricator
- Strap Wrench or Rubber Coated Pipe Pliers
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Motor Mount
- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Motor Mount.

Horizontal Thruster Motor Mount Replacement Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

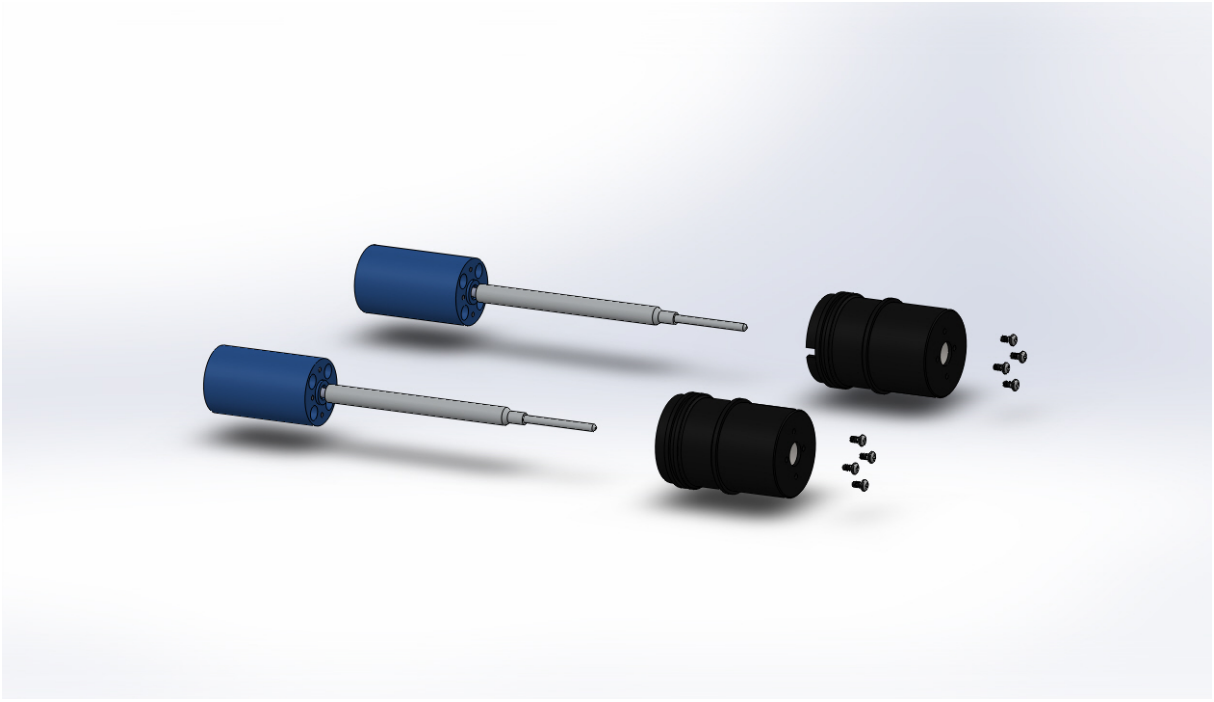
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

MAR-004 Horizontal Thruster Motor Mount

Quantity	Part Number	Part Description
1	MAR-004	Thruster Part Horizontal Motor Mount (Pro 4)
1	GTO-018	Thruster Part GTO Motor Shield Brushed (GTO, Deep Blue)
4	92000A116	Screw M3 x 0.5mm x 6mm Pan Head Phillips SS



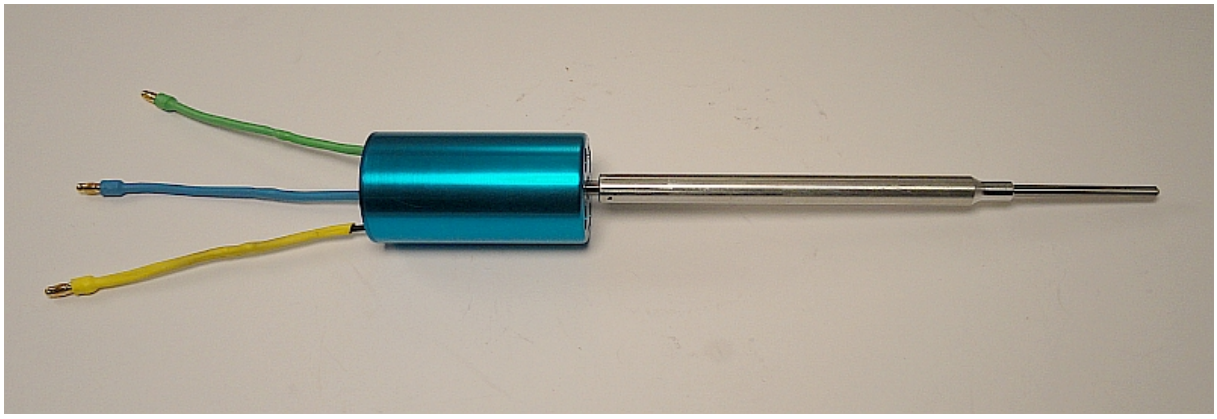
Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Motor Mounts.

1. Orient the horizontal motor mount so that the open end is facing toward the shaft end of the horizontal thruster motor assembly.
2. Slide the horizontal motor mount over the horizontal thruster motor shaft and onto the horizontal thruster motor assembly.
3. Align the screw holes of the horizontal motor mount and horizontal motor assembly. Note the hole pattern is diamond shaped, not square.
4. Replace the screws through the motor mount into the motor and tighten the screws.

Horizontal Thruster Motor Assembly

- Part Number: VR-PRO4-01-0002



Horizontal Thruster Motor Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 17 Minutes (34 Minutes for both sides)

Tools required:

- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers
- #2 Phillips Head Screw Driver

The following components must be removed:

- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Motor Mount
- Horizontal Thruster Motor Assembly

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Motor Assembly.

Horizontal Thruster Motor Assembly Removal Procedures

Time required for this step: Approximately 0 Minutes (0 Minutes for both sides)

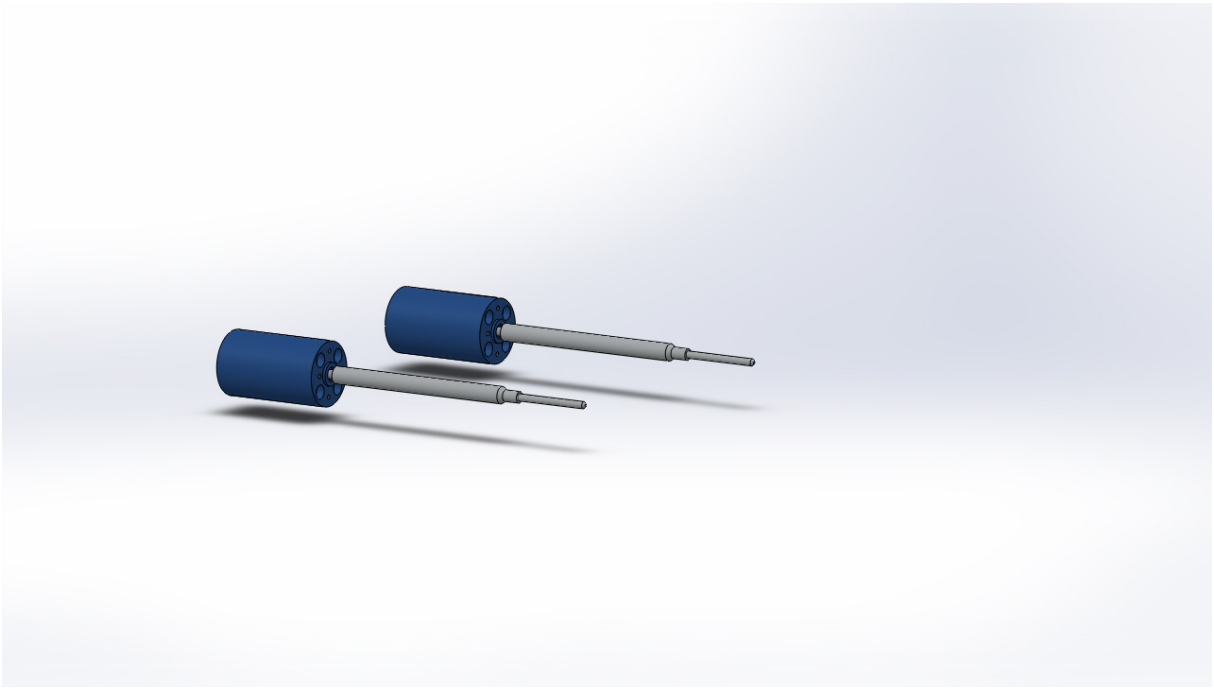
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-01-0002 Horizontal Thruster Motor Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-01-0002	Thruster Assembly Horizontal Motor and Shaft Brushless (Pro 4)



Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Motors.

1. After removing the horizontal motor mount, the horizontal motor assembly is considered removed.

Horizontal Thruster Motor Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 16 Minutes (32 Minutes for both sides)

Tools required:

- #2 Phillips Head Screw Driver
- O-Ring Lubricator
- Strap Wrench or Rubber Coated Pipe Pliers
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Horizontal Thruster Motor Assembly
- Horizontal Thruster Motor Mount
- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Motor Assembly.

Horizontal Thruster Motor Assembly Replacement Procedures

Time required for this step: Approximately 0 Minutes (0 Minutes for both sides)

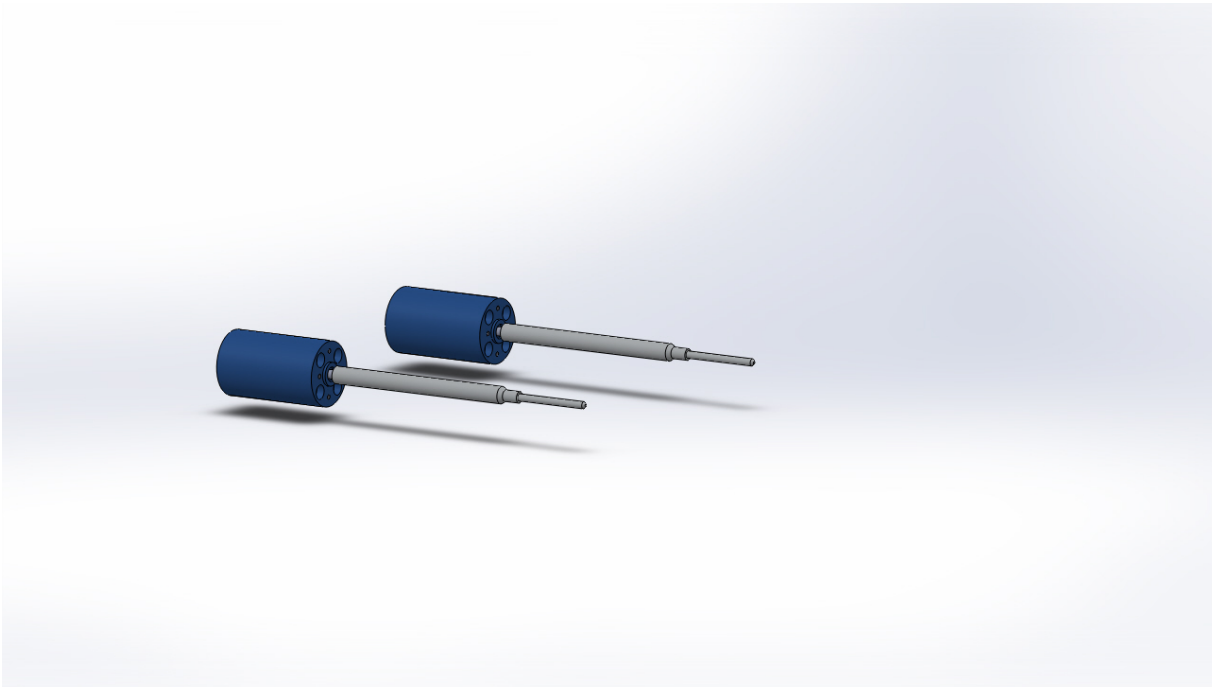
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-01-0002 Horizontal Thruster Motor Assembly

Quantity	Part Number	Part Description
1	VR-PRO4-01-0002	Thruster Assembly Horizontal Motor and Shaft Brushless (Pro 4)



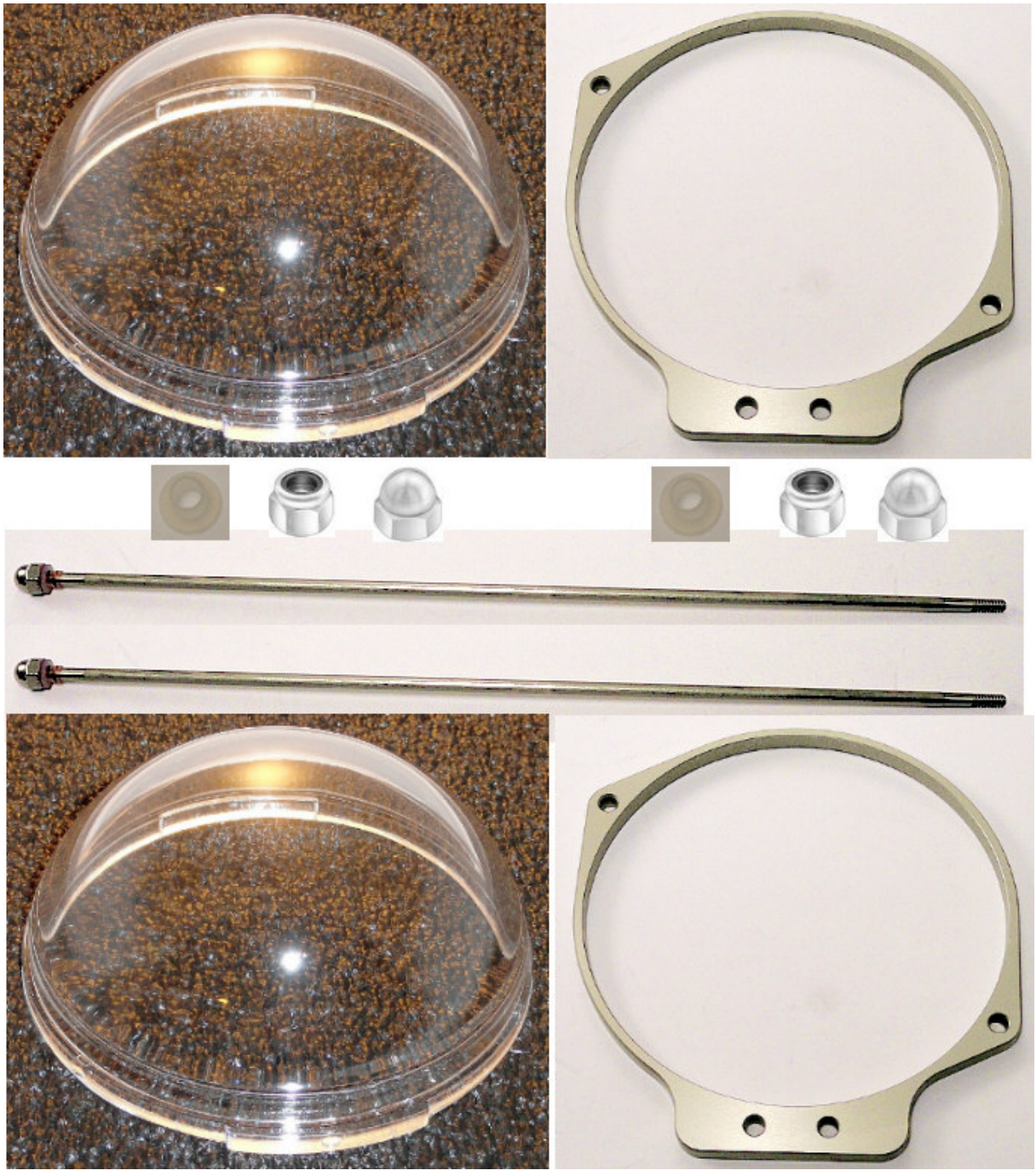
Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Motors.

1. To begin the replacement of the horizontal thruster motor assembly, proceed to the next step and install the horizontal thruster motor mount on the motor assembly.

Dome Retaining Rings and Main Hull Rods

- Part Number: MHU-002-GY-KIT



Dome Retaining Rings and Main Hull Rods Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 20 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods

See the corresponding sections of this manual for instructions for parts other than the Dome Retaining Rings and Main Hull Rods.

Dome Retaining Rings and Main Hull Rods Removal Procedures

Time required for this step: Approximately 5 Minutes

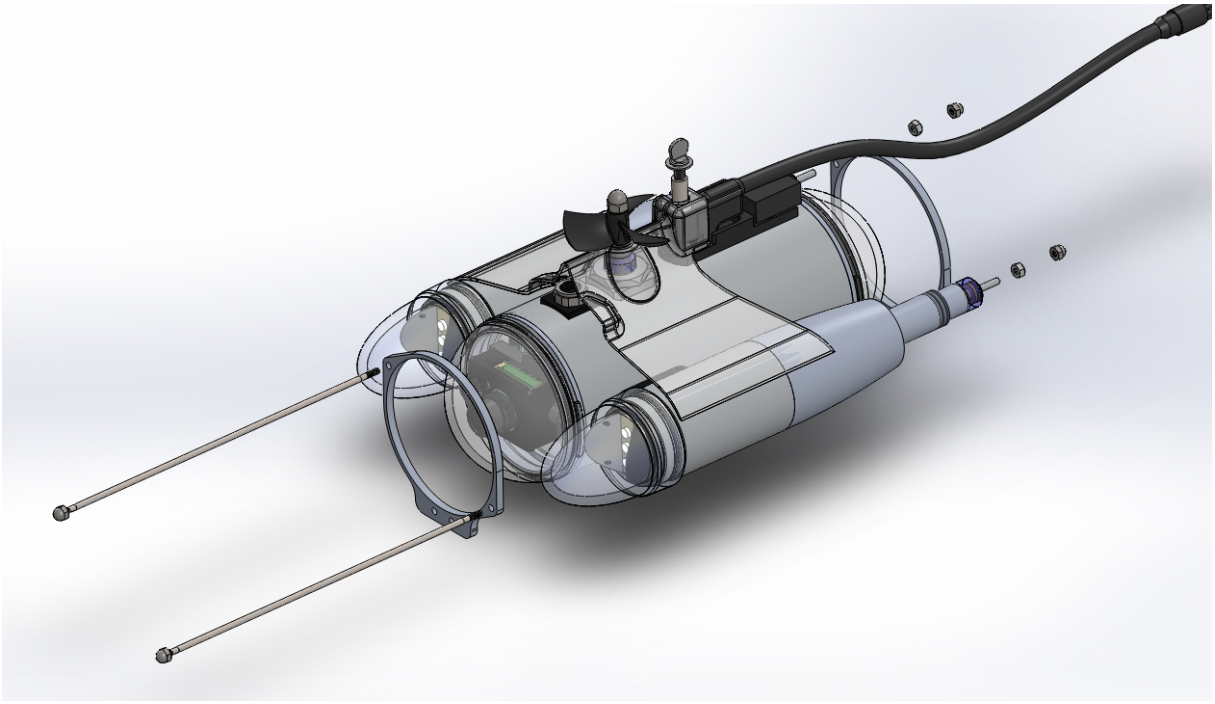
Tools required for this step:

- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)

Parts involved in this step:

MHU-002-GY-KIT Dome Retaining Rings and Main Hull Rods

Quantity	Part Number	Part Description
2	MHU-002-GY	Main Hull Part Dome Retaining Ring (Pro 4)
2	MHU-005	Main Hull Part Rod
4	91855A271	Nut #6-32 x 5/16" Acorn SS
2	91831A007	Nut #6-32 x 5/16" Nylock
4	561-06012	Washer #6 Insulating Nylon



Steps

1. Unscrew the 6-32 acorn nuts from the main hull rods at the rear of the ROV.
2. Unscrew the 6-32 Nylock nuts from the main hull rods at the rear of the ROV.
3. Remove the rear dome retaining ring from the main hull rods. Make sure to keep track of the plastic inserts.
4. Remove the front dome retaining ring and main hull rods from the front of the main hull.

Tip

It is usually best to leave the main hull rods in the front dome retaining ring unless you are replacing the retaining ring or rods.

Dome Retaining Rings and Main Hull Rods Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 20 Minutes

Tools required:

- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Dome Retaining Rings and Main Hull Rods.

Dome Retaining Rings and Main Hull Rods Replacement Procedures

Time required for this step: Approximately 5 Minutes

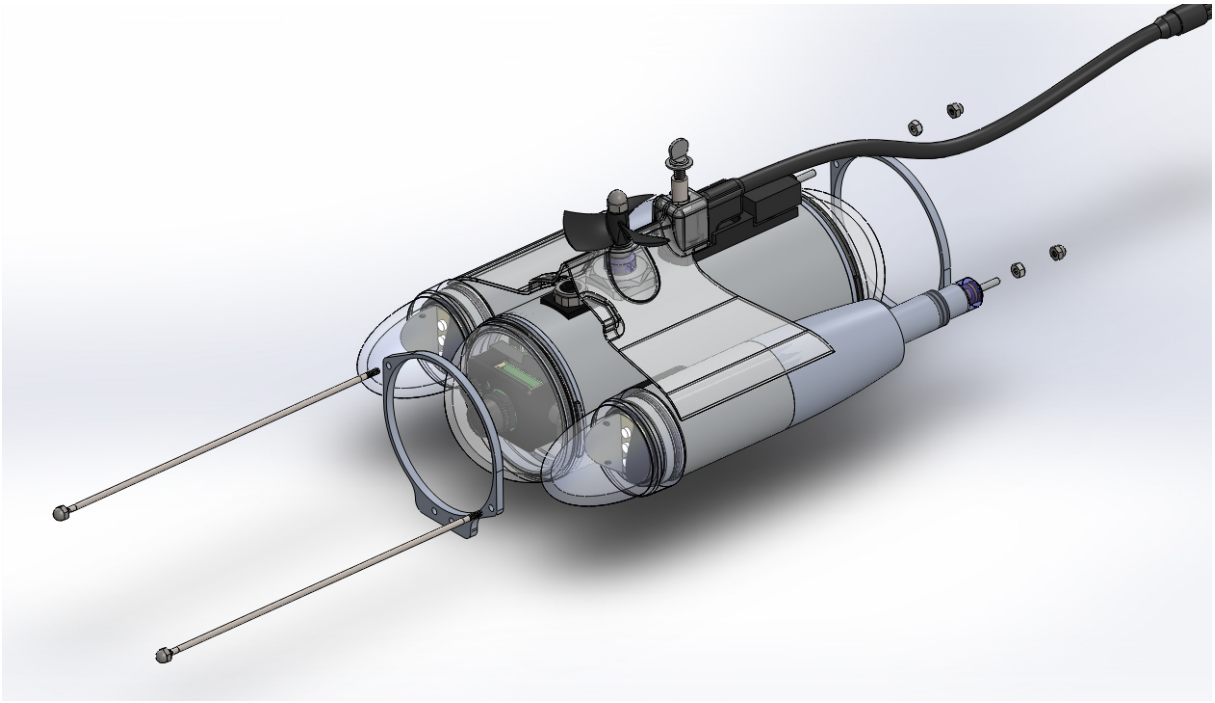
Tools required for this step:

- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent

Parts involved in this step:

MHU-002-GY-KIT Dome Retaining Rings and Main Hull Rods

Quantity	Part Number	Part Description
2	MHU-002-GY	Main Hull Part Dome Retaining Ring (Pro 4)
2	MHU-005	Main Hull Part Rod
4	91855A271	Nut #6-32 x 5/16" Acorn SS
2	91831A007	Nut #6-32 x 5/16" Nylock
4	561-06012	Washer #6 Insulating Nylon



Steps

1. Makes sure the tabs on the front and rear domes are aligned horizontally so they do not interfere with the rods.
2. If the 6-32, 5/8 inch acorn nuts are installed on one end of the main hull rods, proceed to the next numbered step. Otherwise, follow these two lettered steps:
    a. Place a plastic isolation insert, with the narrow end first, on each hull rod.
    b. Apply red Loctite to the threads on the rod.
    c. Replace an acorn nut on the end of each hull rod with the plastic isolation insert installed and tighten the nut.
3. If the hull rods are inserted in the front dome retaining ring, proceed to the next numbered step. Otherwise, follow this lettered step.
    a. Insert the rods with plastic isolation inserts and acorn nuts through the diagonal holes in the front dome retaining ring until the isolation inserts are seated in the holes.
4. Orient the front dome retaining ring and rods assembly at the front of the ROV so that the ends of the rods without nuts are facing toward the rear of the ROV and the skid screw holes in the ring are oriented toward the bottom of the ROV.
5. Slide the front dome retaining ring and rods assembly in place over the main hull.
6. Press the front dome retaining ring onto the front dome until is seats against the rim at the base of the front dome.

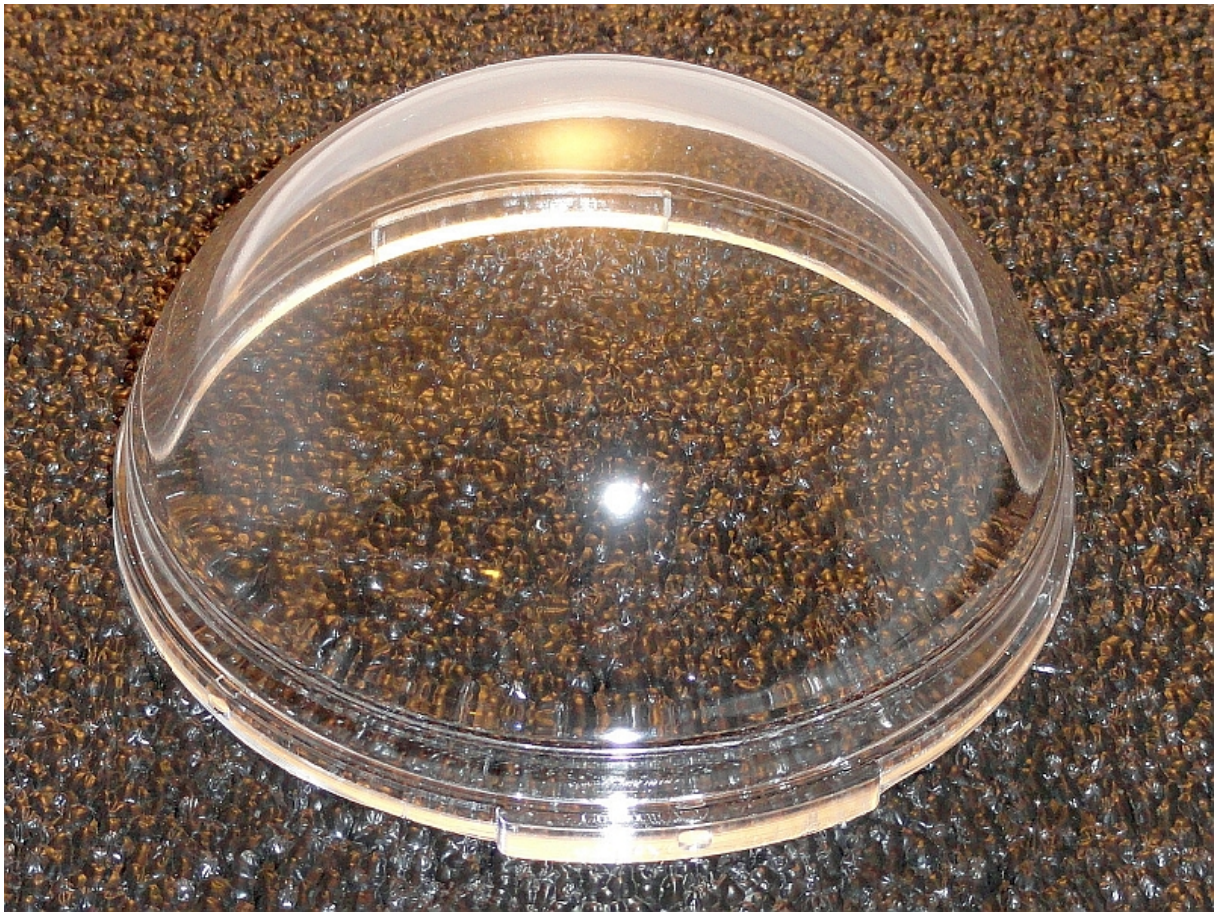
7. Orient the rear dome retaining ring at the rear of the ROV and with its hole orientation matching the front dome retaining ring.
8. Position the rear dome retaining ring over the rear dome making sure the hull rods come through the corresponding holes in the ring.
9. Press the rear dome retaining ring onto the rear dome until is seats against the rim at the base of the dome.
10. Place the plastic isolation inserts, narrow end first, over the rear of the hull rods and press the inserts into the holes in the rear dome retaining ring.
11. Replace the Nylock nuts on the rear of the hull rods, but do not tighten the nuts all of the way.
12. Place the ROV on a flat surface and make sure that the bases of both dome retaining rings sit flat on the surface and that the ROV is level from side to side.
13. Tighten the Nylock nuts at the rear of the hull rods until they seat against the plastic isolation inserts. Torque the nuts to4 inch-pounds (0.45 Nm). Do NOT over tighten the Nylock nuts. Over tightening the Nylock nuts can bend the dome retaining rings or crack the domes.
14. Install the acorn nuts on the rear of the hull rods and snug them tight against the Nylock nuts.

Tip

The front and rear dome rings are identical and can be interchanged.

Front Dome

- Part Number: MHU-004



Front Dome Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 22 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome

See the corresponding sections of this manual for instructions for parts other than the Front Dome.

Notes:

- Do NOT use solvents, including alcohol, to clean the dome. Doing so may cause the dome to haze or crack. Use mild soap and water to clean the dome.
- Do NOT use any metal tools to pry the rear dome from the rear hull ring.

Front Dome Removal Procedures

Time required for this step: Approximately 2 Minutes

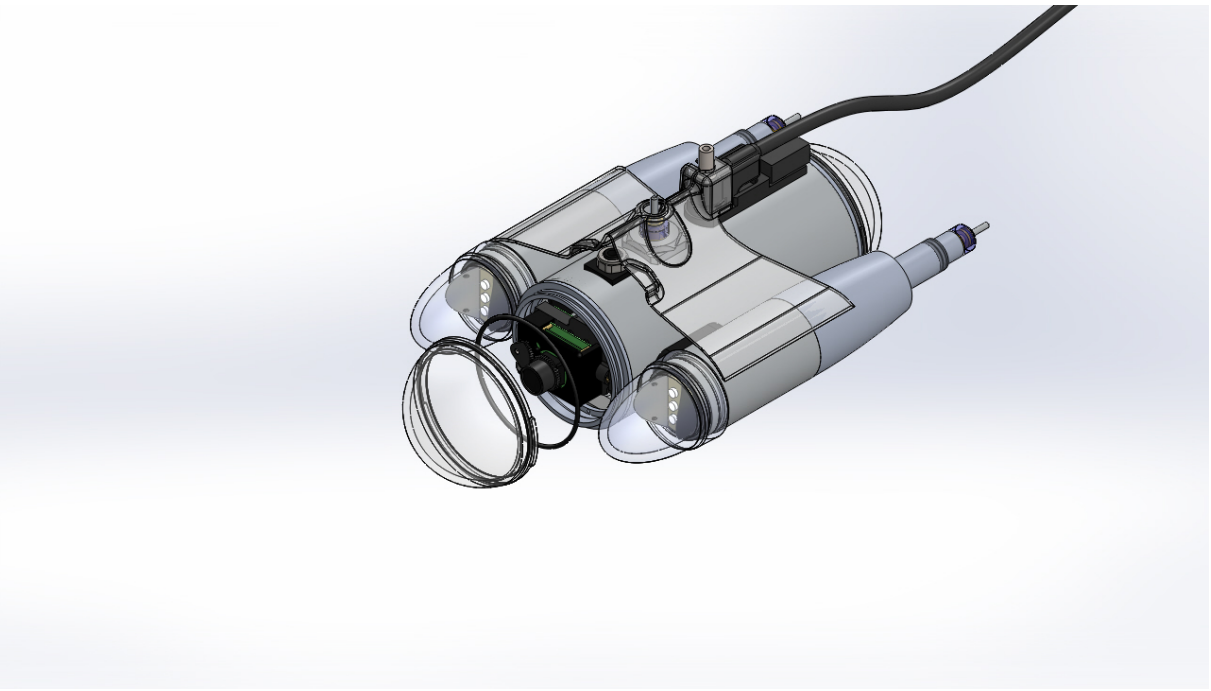
Tools required for this step:

- Wooden Dowel Rod 3/8" x 12"

Parts involved in this step:

MHU-004(f) Front Dome

Quantity	Part Number	Part Description
1	MHU-004(r)	Main Dome
1	OR-152	O-Ring #152



Steps

1. Using the tabs on the side of the front dome, gently pull the dome from the front hull ring.
2. If you plan to replace the O-ring, remove it by pinching it around the front hull ring to create a slack section that can be grabbed. Do NOT use a metal tool to remove the O-ring.

Tips

If the front dome is stuck, you can try to force it off using a wooden dowel against the back side of one of the tabs on the dome and tapping on the dowel.

Sometimes the front hull ring assembly will come off while trying to remove the front dome. If this happens, remove the front dome after the front hull ring assembly is removed. Follow the instructions for replacing the front hull ring assembly before replacing the front dome.

Front Dome Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 22 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Front Dome.

Notes:

- Do NOT use solvents, including alcohol, to clean the dome. Doing so may cause the dome to haze or crack. Use mild soap and water to clean the dome.
- Before installing the front dome, clean any finger prints or other marks and inspect it for scratches or cracks.
- Do NOT use a scratched or cracked dome, because it may fail under pressure.

Front Dome Replacement Procedures

Time required for this step: Approximately 2 Minutes

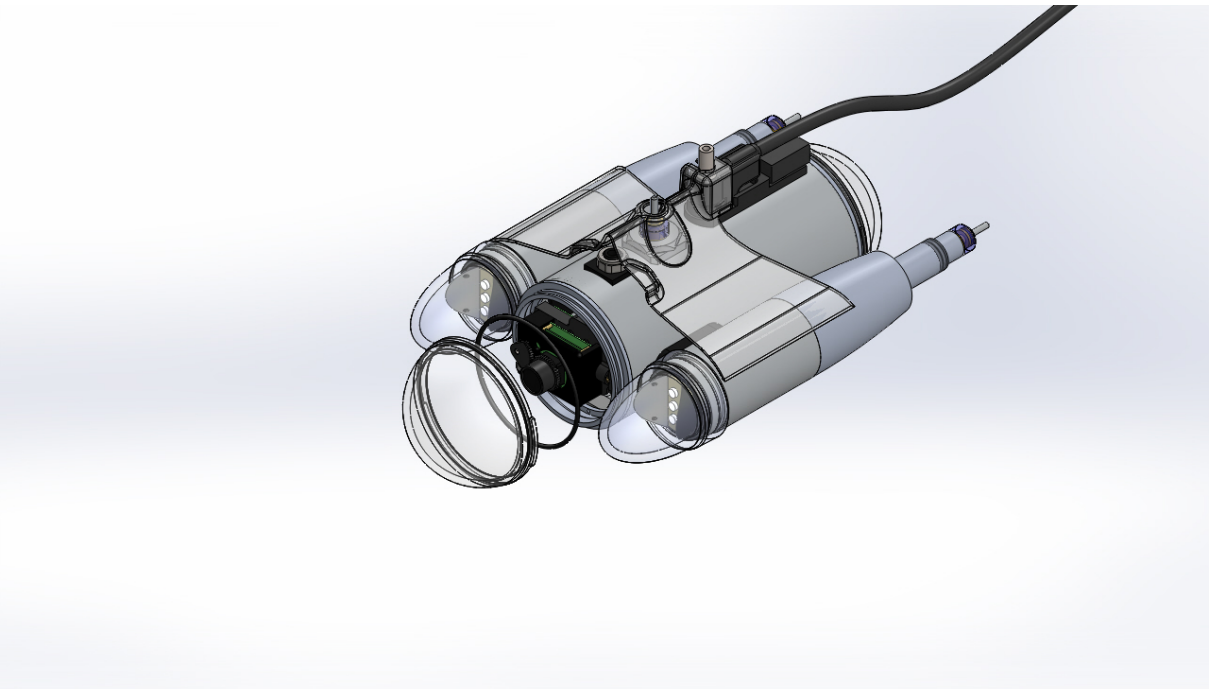
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

MHU-004(f) Front Dome

Quantity	Part Number	Part Description
1	MHU-004(r)	Main Dome
1	OR-152	O-Ring #152



Steps

1. Use a new lubricated o-ring, or remove and lubricate the existing o-ring, and install it in the o-ring groove of the front hull ring.
2. Orient the front dome so that the tabs horizontally so that they will not interfere with the main hull rods, skid or float block when these components are installed.
3. Being careful not to pinch the o-ring, press the front dome onto the front hull ring until is seats against the hull ring.

Tip

The front and rear domes are the same. If the front dome is mildly scratched or marred, you can replace it with the rear dome.

Front Hull Ring Assembly with Camera

- Part Number: VR-PRO4-13-0001-N

Front Hull Ring Assembly with Camera Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 26 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera

See the corresponding sections of this manual for instructions for parts other than the Front Hull Ring Assembly with Camera.

Front Hull Ring Assembly with Camera Removal Procedures

Time required for this step: Approximately 4 Minutes

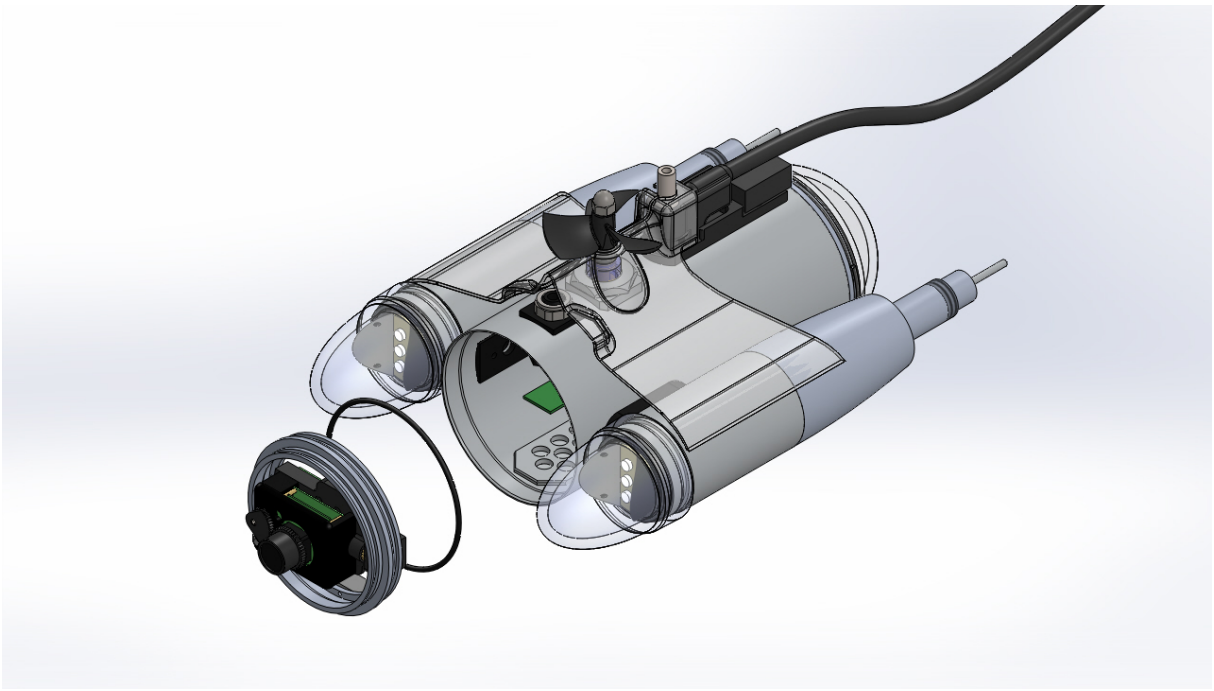
Tools required for this step:

- None

Parts involved in this step:

VR-PRO4-13-0001-N Front Hull Ring Assembly with Camera

Quantity	Part Number	Part Description
1	VR-PRO4-13-0001-N	Camera Assembly Front with Port Ring (Pro 4) (NTSC)
1	OR-154	O-Ring #154



Steps

1. Place your index and middle fingers under the inside top of the front hull ring assembly and your thumb against the pressure sensor nut, and gently pull the hull ring assembly from the main hull. If the hull ring assembly binds while pulling the top, you may need to pull the bottom to even it up for easier removal. Do NOT pull it out too fast, or you could damage the camera ribbon cable.
2. Disconnect the camera ribbon cable from the rear of the camera by pulling the cable from the clip and then the connector.
3. If you plan to replace the O-ring, remove it by pinching it around the front hull ring to create a slack section that can be grabbed. Do NOT use a metal tool to remove the O-ring.

Front Hull Ring Assembly with Camera Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 27 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Front Hull Ring Assembly with Camera.

Front Hull Ring Assembly with Camera Replacement Procedures

Time required for this step: Approximately 5 Minutes

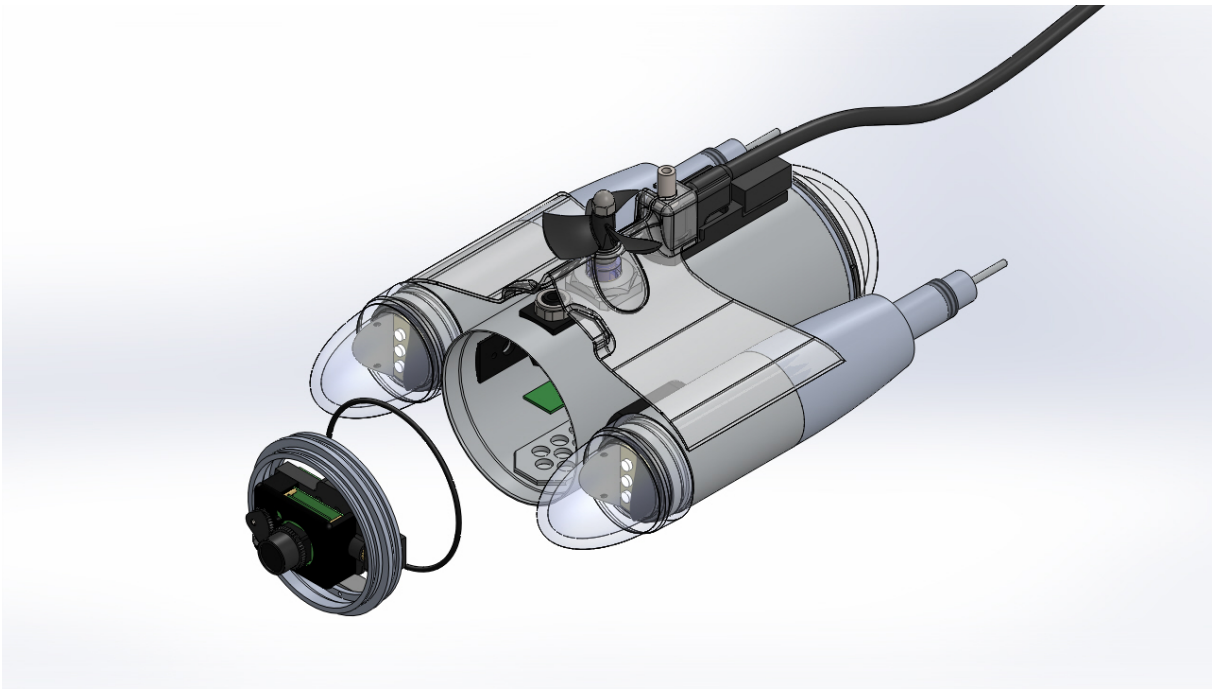
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

VR-PRO4-13-0001-N Front Hull Ring Assembly with Camera

Quantity	Part Number	Part Description
1	VR-PRO4-13-0001-N	Camera Assembly Front with Port Ring (Pro 4) (NTSC)
1	OR-154	O-Ring #154



Steps

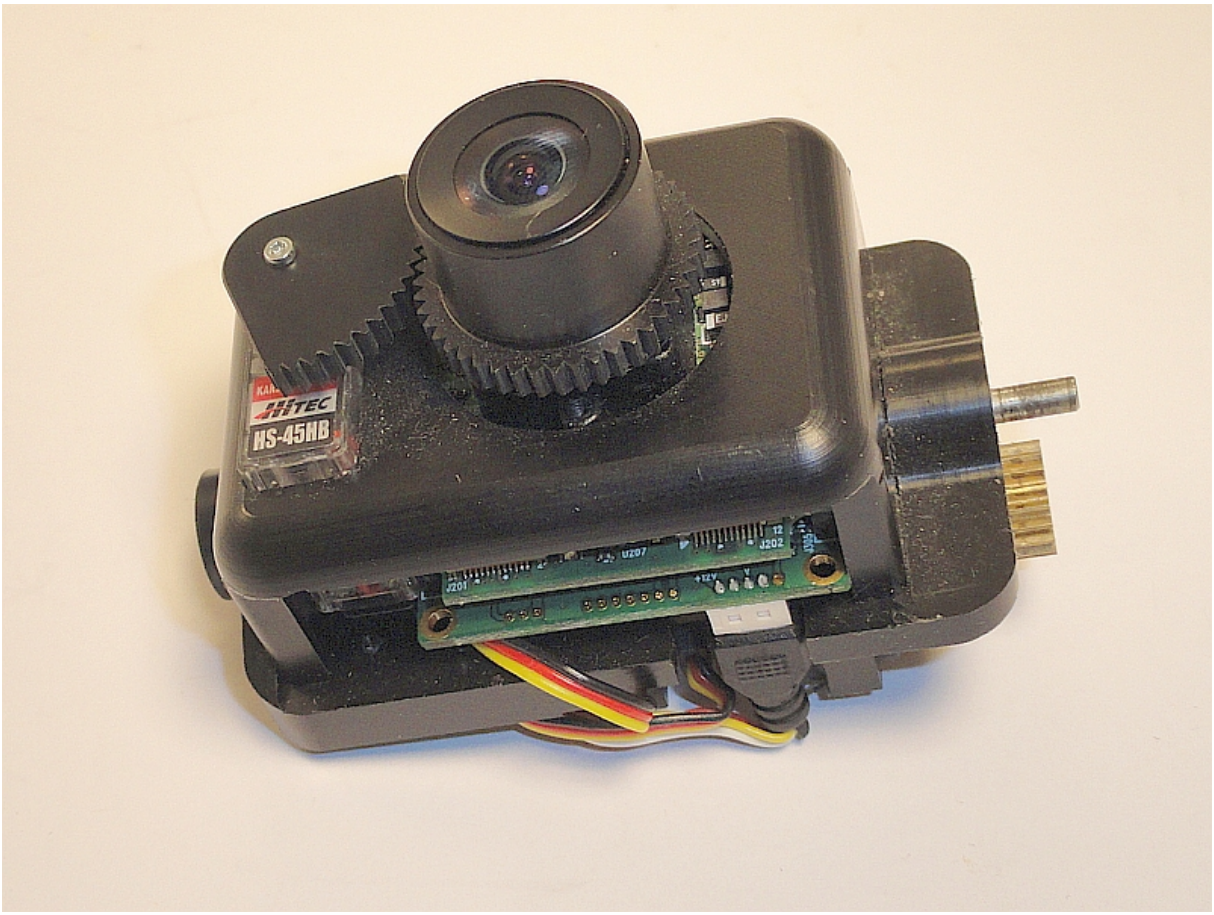
1. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it in the larger diameter O-ring groove of the front hull ring.
2. Orient the front hull ring so that the receiver bracket is facing toward the ROV and at the bottom of the main hull.
3. Thread the camera ribbon cable through the clip on the camera interface. The cable should be inserted so that the free end is pointed towards the rear of the camera and can be easily installed in the connector
4. Insert the camera ribbon cable connector into the socket on the camera interface making sure the contacts are on the same side.
5. Position the front hull ring at the front of the main hull and make sure the camera ribbon cable is routed so that it will not interfere with camera tilt movements.
6. Make sure the camera axis is level with the ROV from side to side.
7. If the ROV board set is in the ROV, make sure the front of the heat sink engages in the receiver bracket at the bottom of the front hull ring.
8. Being careful not to pinch the o-ring, press the front hull ring into the main hull until is seats against the main hull. Make sure that you press the front ring evenly so that it does not bind.

Tip

Before proceeding to the next step, connect the ROV to the control panel and test the camera tilt and focus functions to make sure the camera tilts and focuses smoothly through the entire tilt and focus range.

Camera Assembly

- Part Number: VR-PRO4-13-0002-N



Camera Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 30 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly

See the corresponding sections of this manual for instructions for parts other than the Camera Assembly.

Camera Assembly Removal Procedures

Time required for this step: Approximately 4 Minutes

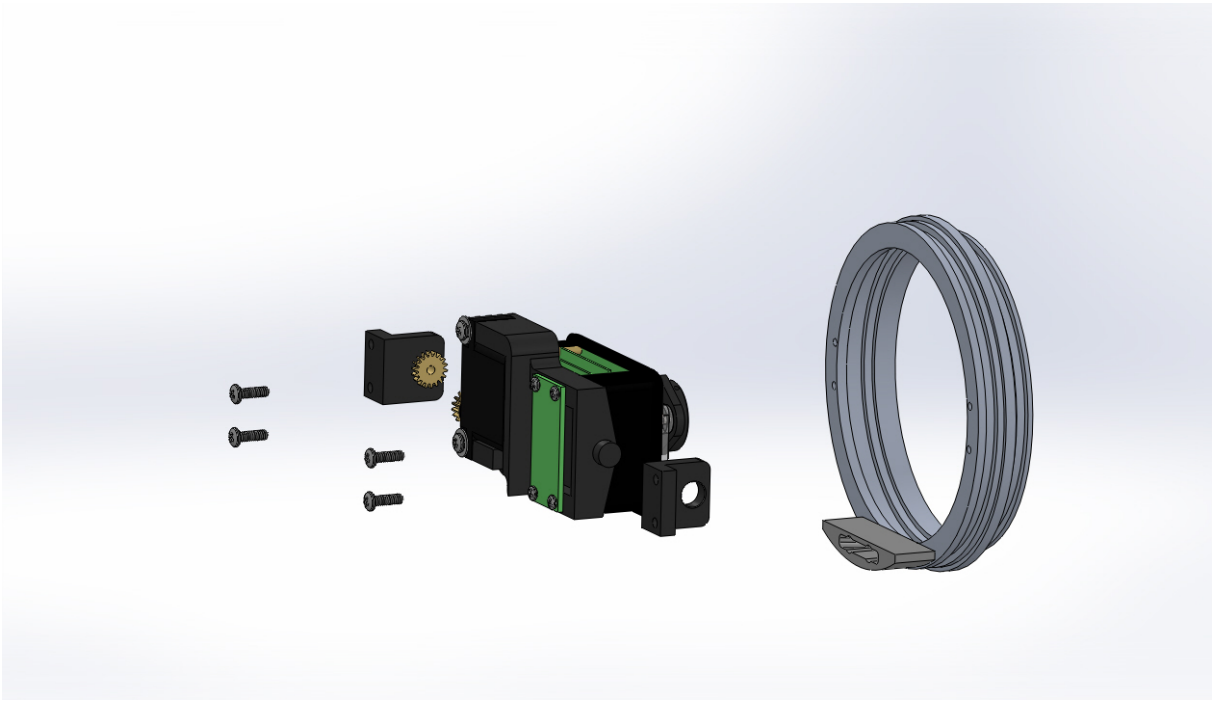
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

VR-PRO4-13-0002-N Camera Assembly

Quantity	Part Number	Part Description
1	MHU-003-GY-KIT	Main Hull Assembly Port Ring (Pro 4)
1	VR-PRO4-13-0002-N	Camera Assembly Front (Pro 4) (NTSC)
1	MAR-016-ASSM	Camera Assembly Tilt Bracket (Pro 4)
1	MAR-016	Camera Part Tilt Bracket (Pro 4)
4	91249A108	Screw #4-40 x 3/8" Pan Head Phillips SS Black



Steps

1. Unscrew the four 4-40 X 3/8 inch Phillips head screws that hold the camera mounting brackets to the front hull ring assembly.
2. Slide the camera assembly and camera mounting brackets to the rear of the hull ring assembly until the camera assembly is free from the ring.
3. Remove the brackets from the sides of the camera assembly by sliding them off of the camera assembly.

Tip

If you do not plan to remove the camera or servo motors it is best not to remove the port camera bracket with the tilt gear from the camera assembly. Otherwise, you will have to re-index the tilt gear when reinstalling it.

Camera Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 32 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Assembly.

Camera Assembly Replacement Procedures

Time required for this step: Approximately 5 Minutes

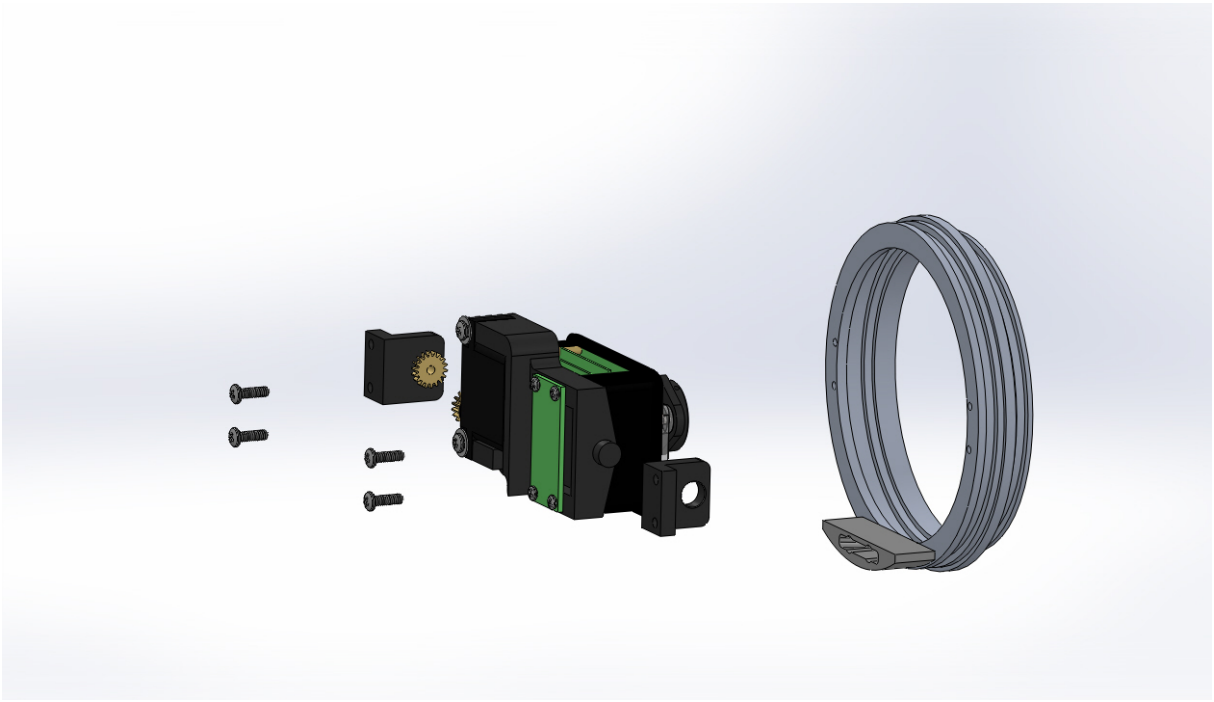
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

VR-PRO4-13-0002-N Camera Assembly

Quantity	Part Number	Part Description
1	MHU-003-GY-KIT	Main Hull Assembly Port Ring (Pro 4)
1	VR-PRO4-13-0002-N	Camera Assembly Front (Pro 4) (NTSC)
1	MAR-016-ASSM	Camera Assembly Tilt Bracket (Pro 4)
1	MAR-016	Camera Part Tilt Bracket (Pro 4)
4	91249A108	Screw #4-40 x 3/8" Pan Head Phillips SS Black



Steps

1. Connect the camera ribbon cable to the camera interface board.
2. Connect the ROV to the control panel, and turn on the control panel briefly and then turn it off. This will center the camera tilt servo motor.
3. Disconnect the camera ribbon cable from the camera interface board.
4. Orient the port camera bracket (the one with the gear) on the port side of the camera assembly (the side with the tilt servo motor). The tab with the two holes should be pointed away from the camera assembly and on the rear side of the camera assembly. The tab with the two holes should also be parallel to the plane of the hull ring.
5. Place the port camera bracket with the tilt gear over the shaft on the port side of the camera mount.
    a. If the tab with the two holes is not parallel to the plane of the hull ring after engaging the gears, remove the bracket, remove the gear from the tilt servo motor shaft and rotate the gear one tooth on the tilt servo motor shaft and try again. Replace the bracket and check the alignment. Repeat this process until the tab with the two holes is parallel to the plane of the hull ring.
6. Orient the starboard camera bracket on the starboard side of the camera assembly with the tab with the two holes pointed away from the camera assembly and on the rear side of the camera assembly. The tab with the two holes should be parallel to the plane of the hull ring.
7. Place the starboard camera bracket over the boss on the starboard side of the camera mount.
8. Orient the front hull ring with the receiver bracket on the bottom.
9. Replace the camera assembly and brackets into the front hull ring from the side with the receiver bracket.

10. Replace the four 4-40 X 3/8 inch Phillips head screws in the camera brackets and tighten the screws.

Tips

If the gears are difficult to engage, you can loosen the two screws that hold the camera tilt servo motor to the camera mount base. This should allow enough clearance for the gears to engage easily. Make sure to tighten the screws after the gears are engaged. Also make sure the washers are positioned over the tilt servo motor to keep it from coming loose.

Before proceeding to the next step, connect the ROV to the control panel and test the camera tilt function to make sure the camera tilts smoothly through the entire tilt range.

Camera Lens-Focus Cam Gear

- Part Number: CAM-LENS-P4

Camera Lens-Focus Cam Gear Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 26 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #0 Phillips Head Screw Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Camera Lens-Focus Cam Gear

See the corresponding sections of this manual for instructions for parts other than the Camera Lens-Focus Cam Gear.

Notes:

- When working on the camera, be careful not to scratch the lens or get it dirty.

Camera Lens-Focus Cam Gear Removal Procedures

Time required for this step: Approximately 4 Minutes

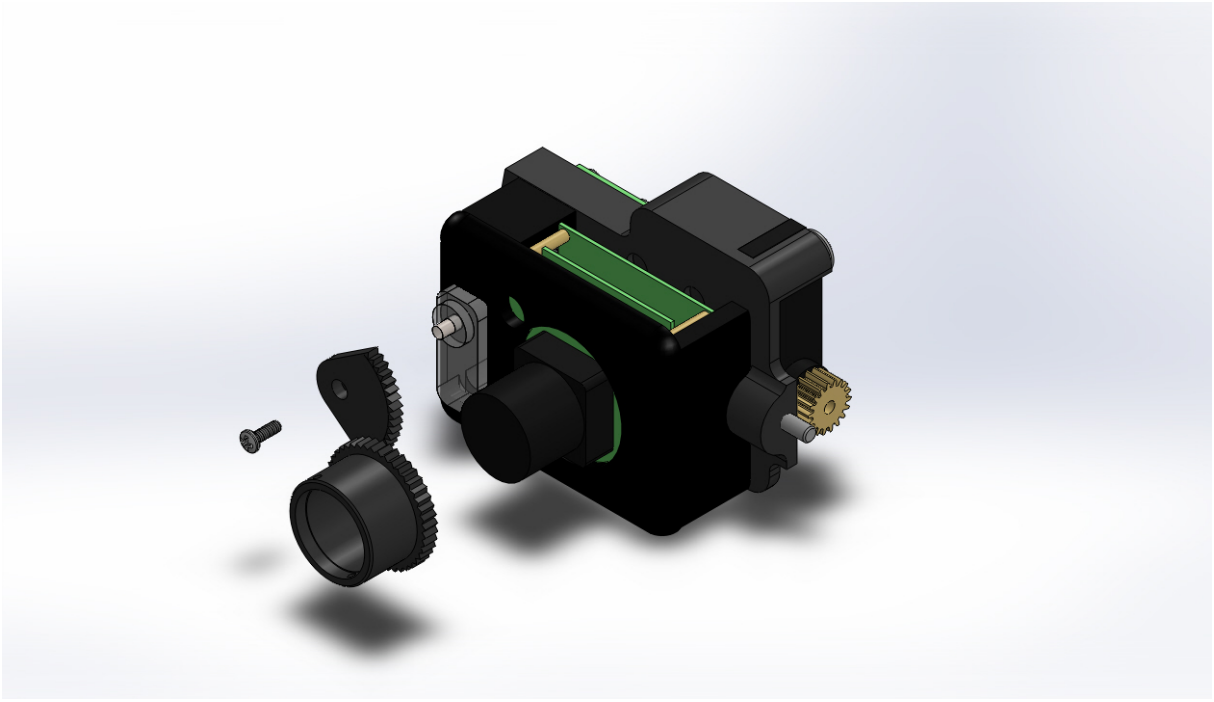
Tools required for this step:

- #0 Phillips Head Screw Driver

Parts involved in this step:

CAM-LENS-P4 Camera Lens-Focus Cam Gear

Quantity	Part Number	Part Description
1	CAM-LENS-P4	Camera Assembly Lens (Pro 4)
2	93574A850	Washer 0.687" x 0.873" Precision Bearing Spacing Shim SS
1	MAR-019	Camera Part Focus Cam Gear (Pro 4)



Steps

1. Unscrew the 1.6 X 3 mm Phillips head screw that holds the camera focus cam gear in place.
2. Pull the camera focus cam gear off of the focus servo motor.
3. Unscrew the camera lens from the camera.

Camera Lens-Focus Cam Gear Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 27 Minutes

Tools required:

- #0 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Camera Lens-Focus Cam Gear
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Lens-Focus Cam Gear.

Notes:

- If the camera lens and camera focus cam gear were not removed, you can skip this step.

Camera Lens-Focus Cam Gear Replacement Procedures

Time required for this step: Approximately 5 Minutes

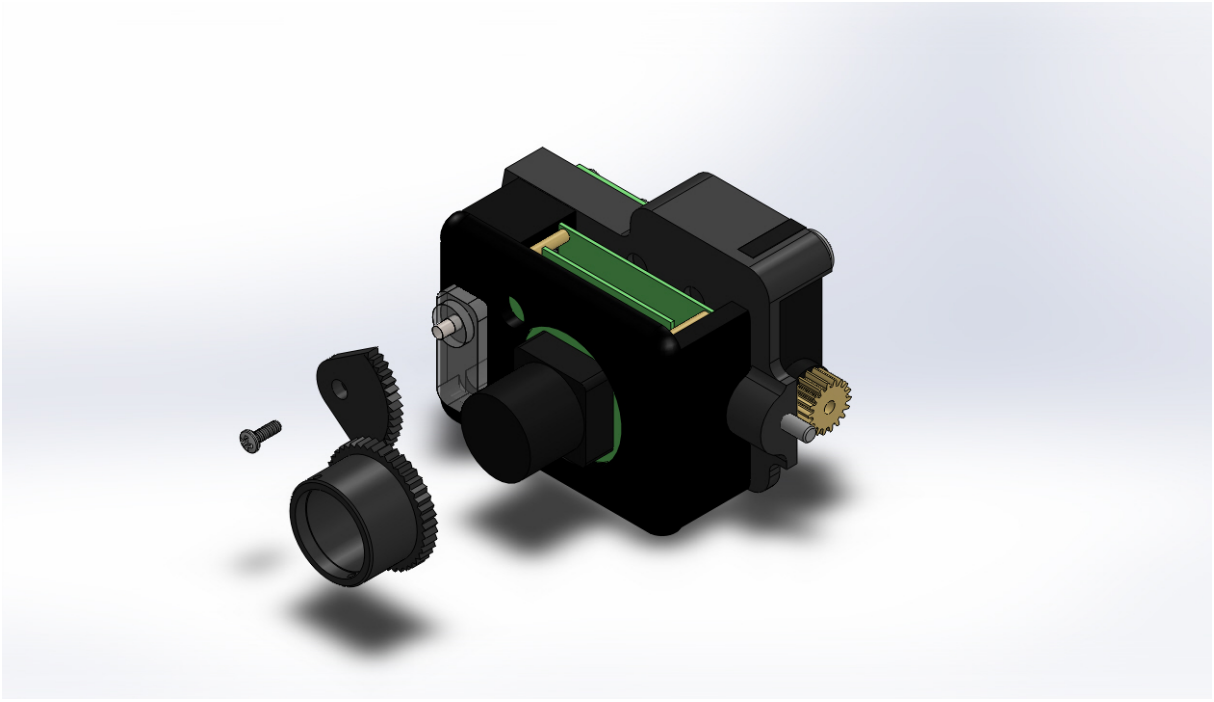
Tools required for this step:

- #0 Phillips Head Screw Driver

Parts involved in this step:

CAM-LENS-P4 Camera Lens-Focus Cam Gear

Quantity	Part Number	Part Description
1	CAM-LENS-P4	Camera Assembly Lens (Pro 4)
1	93574A850	Washer 0.687" x 0.873" Precision Bearing Spacing Shim SS
2	MAR-019	Camera Part Focus Cam Gear (Pro 4)



Steps

1. Screw the lens onto the camera, but do NOT screw the lens all of the way onto the camera.
2. If not already connected, connect the camera ribbon cable to the camera interface board.
3. Connect the ROV to the control panel, and turn on the control panel.
4. Start VideoRay Cockpit.
5. Using the hand controller, set the camera focus to far.
6. Adjust the camera lens manually until a far image is clear.
7. Orient the camera focus cam gear so that the hole is aligned with the focus servo motor shaft and the gear teeth are toward the lens and the top two teeth are engaged with the lens gear teeth.
8. Place the camera focus cam gear on the focus servo motor shaft.
9. Replace the 1.6 X 3 mm Phillips head camera focus cam gear screw and tighten the screw to hold the camera focus cam gear in place.

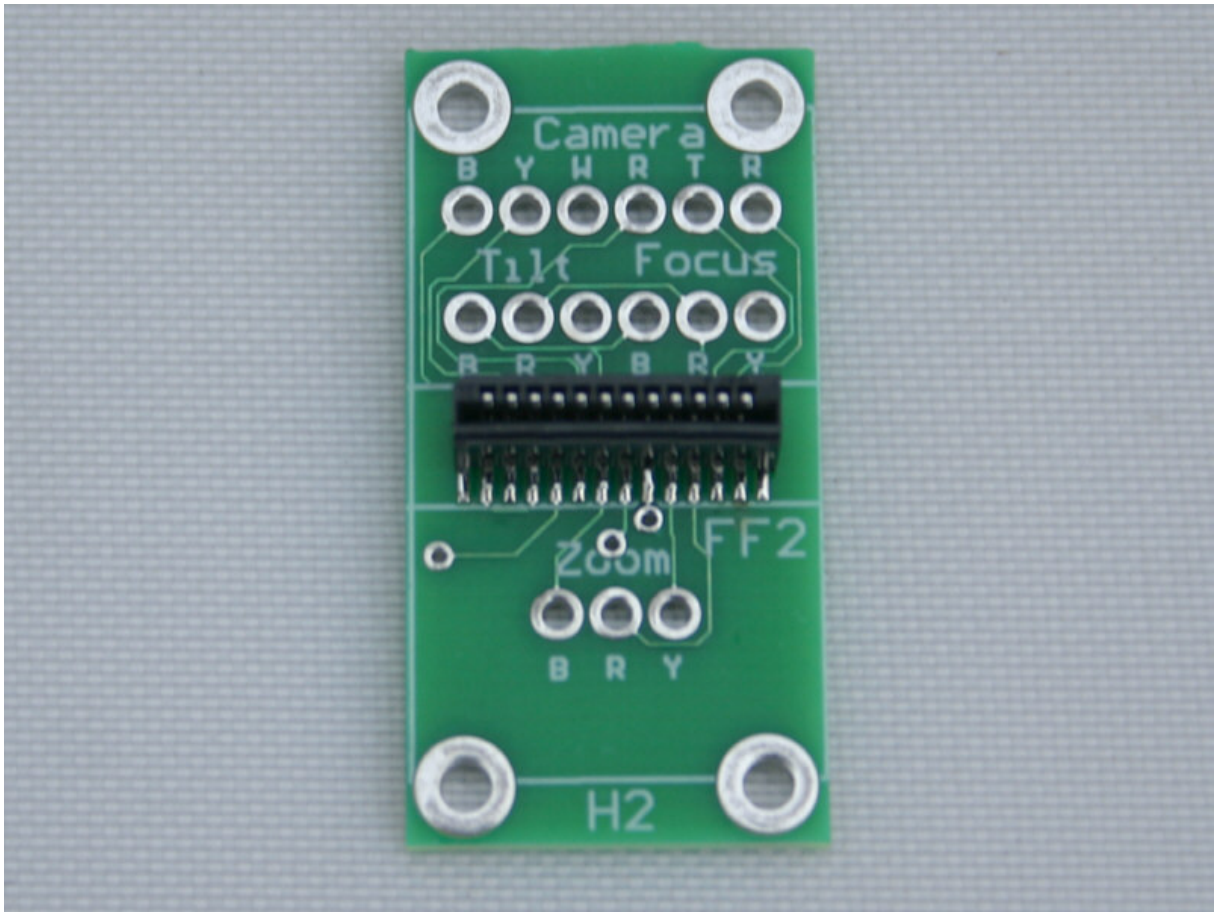
Tips

The camera lens has right-handed threads. Turn the camera lens clockwise, when viewed from the front of the ROV, in order to install it.

Before proceeding to the next step, connect the ROV to the control panel and test the camera focus function to make sure the camera focuses smoothly through the entire focus range and the focus is clear at both extremes.

Camera Interface Printed Circuit Board

- Part Number: CAM-CBA-002



Camera Interface Printed Circuit Board Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 35 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Interface Printed Circuit Board

See the corresponding sections of this manual for instructions for parts other than the Camera Interface Printed Circuit Board.

Camera Interface Printed Circuit Board Removal Procedures

Time required for this step: Approximately 5 Minutes

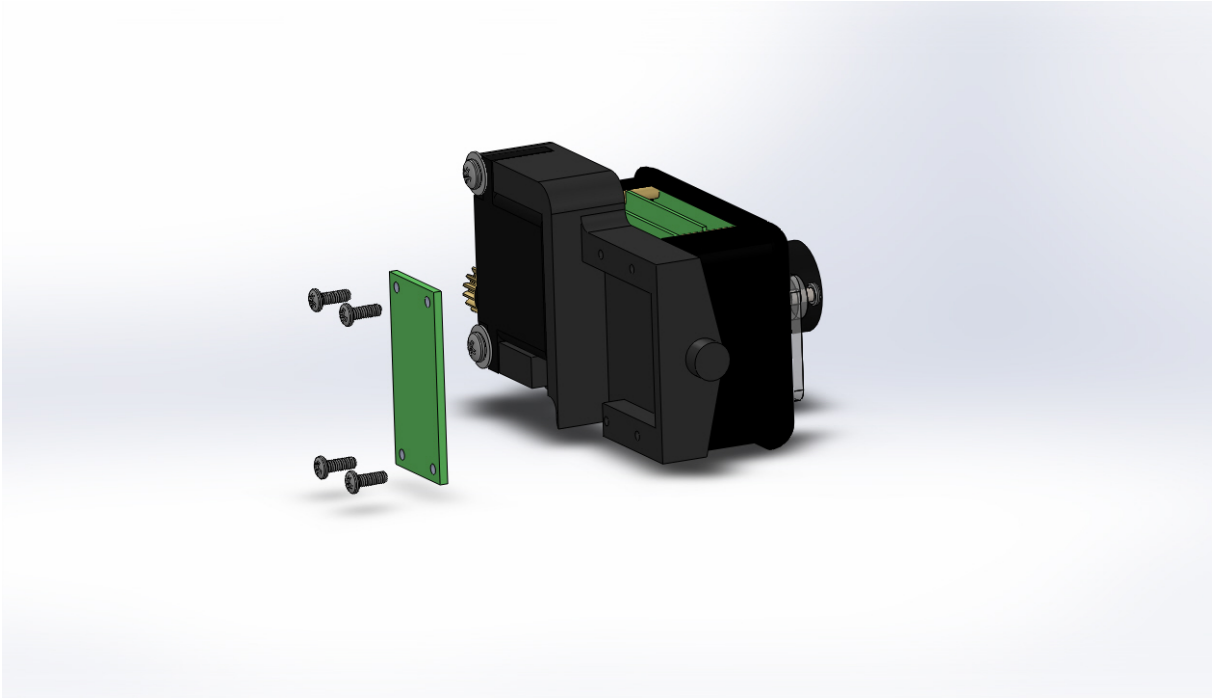
Tools required for this step:

- #1 Phillips Head Screw Driver
- Soldering Iron

Parts involved in this step:

CAM-CBA-002 Camera Interface Printed Circuit Board

Quantity	Part Number	Part Description
4	CAM-CBA-002	Circuit Board ROV Assembly Camera Interface (Pro 4)
4	91249A050	Screw #2-56 x 1/4" Pan Head Phillips SS Black



Steps

1. Unscrew the four 2-56 X 1/4 inch Phillips head screws that hold the camera interface board to the camera mount base.
2. Follow one of the options below:
    - If you are removing the camera interface board, unsolder the wires from the camera connector and camera tilt and camera focus servo motors.
    - If you are removing the camera focus servo motor, unsolder the wires from the focus servo to the interface board.
    - If you are removing the camera tilt servo motor, unsolder the wires from the tilt servo to the interface board.
    - If you are removing the camera, camera mount cover or camera mount base, you do not need to unsolder the wires from the camera interface board. The camera has a connector at the camera and will only need to be unsoldered if you are replacing the camera interface board.

Camera Interface Printed Circuit Board Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 37 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Camera Interface Printed Circuit Board
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Interface Printed Circuit Board.

Camera Interface Printed Circuit Board Replacement Procedures

Time required for this step: Approximately 5 Minutes

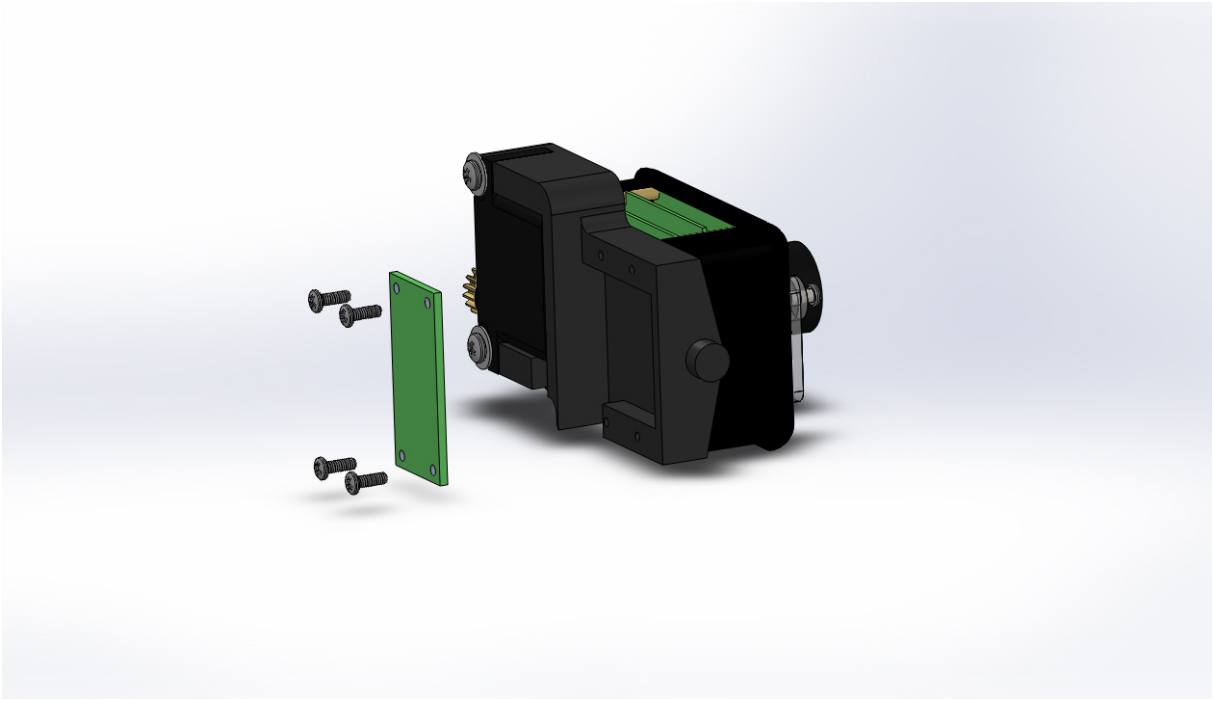
Tools required for this step:

- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder

Parts involved in this step:

CAM-CBA-002 Camera Interface Printed Circuit Board

Quantity	Part Number	Part Description
4	CAM-CBA-002	Circuit Board ROV Assembly Camera Interface (Pro 4)
4	91249A050	Screw #2-56 x 1/4" Pan Head Phillips SS Black

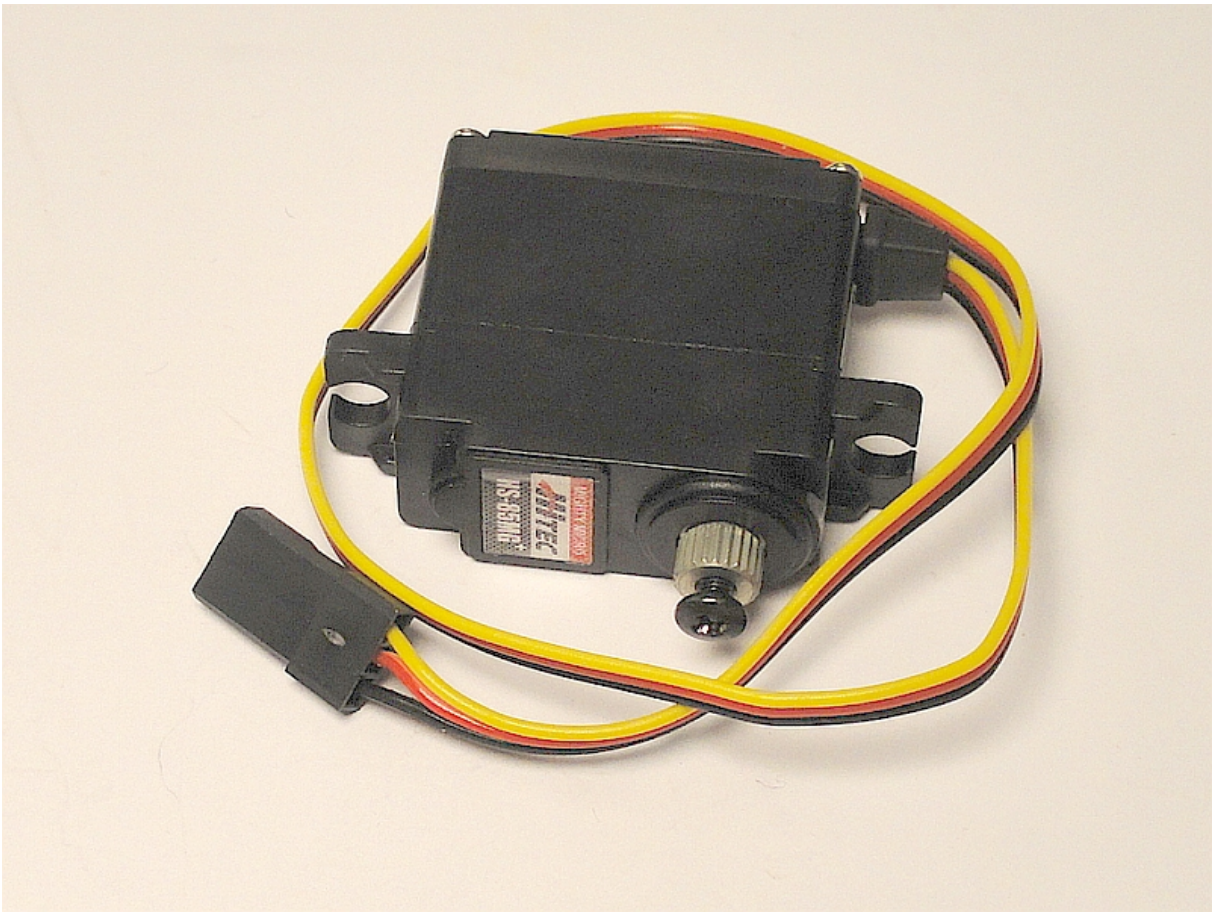


Steps

1. If necessary, solder the wires from the camera connector cable to the camera interface board.
2. If necessary, solder the wires from the camera tilt servo motor to the camera interface board.
3. If necessary, solder the wires from the camera focus servo motor to the camera interface board.
4. Replace the four 2-56 X 1/4 inch Phillips head screws that hold the camera interface board to the camera mount and tighten the screws.
5. Align the camera connector cable's pins with those of the camera connector on the rear of the camera and connect the camera connector cable to the camera.

Camera Tilt Servo Motor Assembly

- Part Number: MAR-012



Camera Tilt Servo Motor Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 35 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Tilt Servo Motor Assembly

See the corresponding sections of this manual for instructions for parts other than the Camera Tilt Servo Motor Assembly.

Camera Tilt Servo Motor Assembly Removal Procedures

Time required for this step: Approximately 5 Minutes

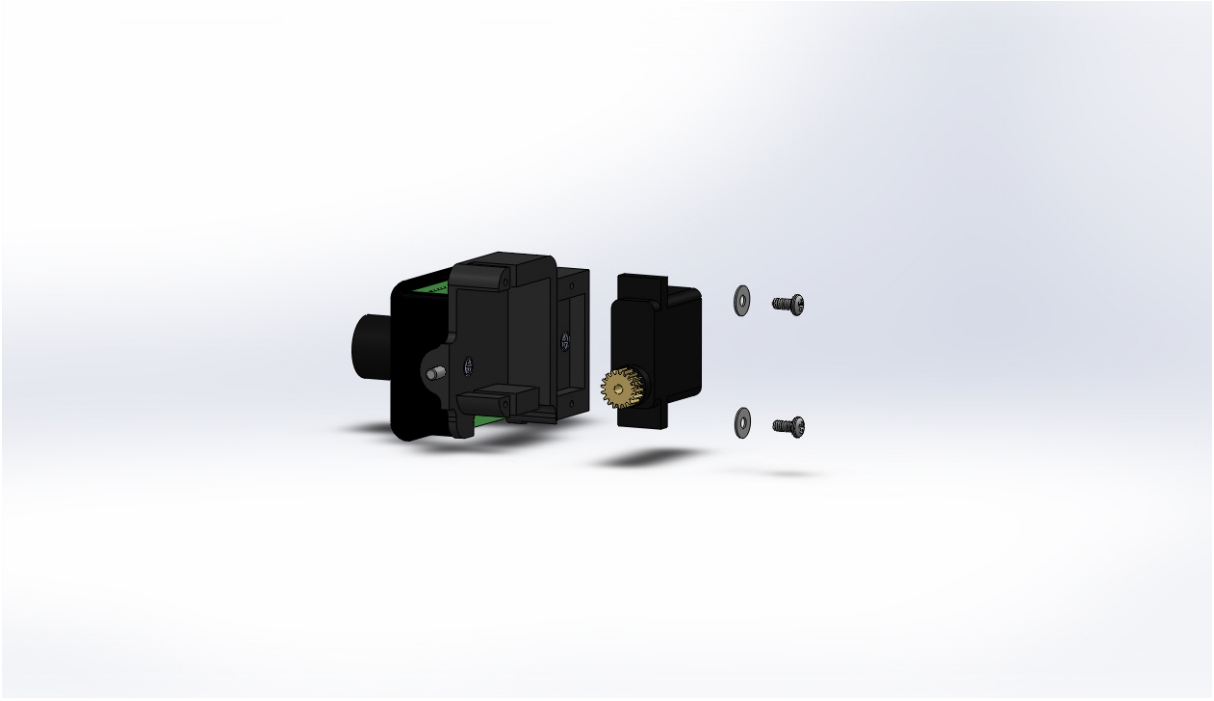
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-012 Camera Tilt Servo Motor Assembly

Quantity	Part Number	Part Description
1	MAR-012	Camera Package Tilt Servo (Pro 4)
2	91772A106	Screw #4-40 x 1/4" Pan Head Phillips SS
2	98017A610	Washer #4 x 0.03" Flat SS
1	MAR-014	Camera Part Tilt Drive Gear (Pro 4)



Steps

1. Unscrew the two 4-40 X 1-4 inch Phillips head screws that hold the camera tilt servo motor into the camera mount base. Make sure to keep track of the washers.
2. Pull the camera tilt servo motor from the camera mount base.
3. Unsolder the camera tilt servo wires from the camera interface board.

Tips

Some camera tilt servo motors have shims underneath of the servo to align the gears. If your camera tilt servo motor has shims, make sure to keep track of the shims and replace them when replacing the motor.

Camera Tilt Servo Motor Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 37 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Camera Tilt Servo Motor Assembly
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Tilt Servo Motor Assembly.

Camera Tilt Servo Motor Assembly Replacement Procedures

Time required for this step: Approximately 5 Minutes

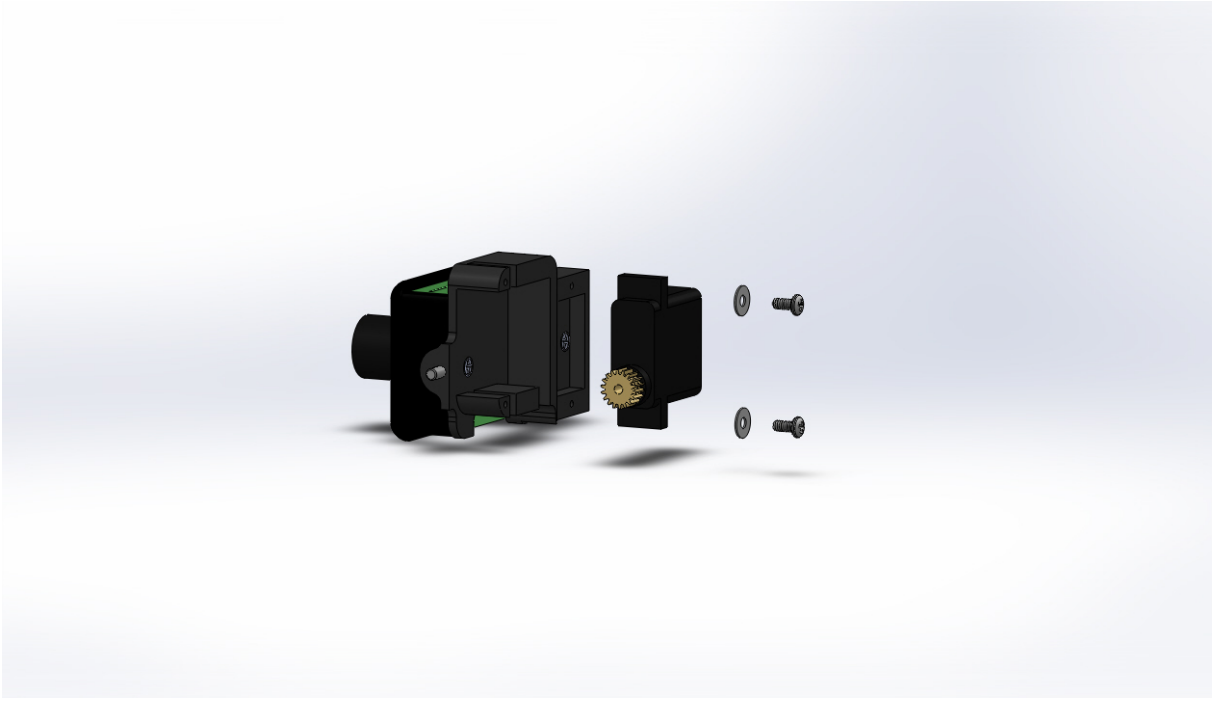
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-012 Camera Tilt Servo Motor Assembly

Quantity	Part Number	Part Description
1	MAR-012	Camera Package Tilt Servo (Pro 4)
2	91772A106	Screw #4-40 x 1/4" Pan Head Phillips SS
2	98017A610	Washer #4 x 0.03" Flat SS
1	MAR-014	Camera Part Tilt Drive Gear (Pro 4)



Steps

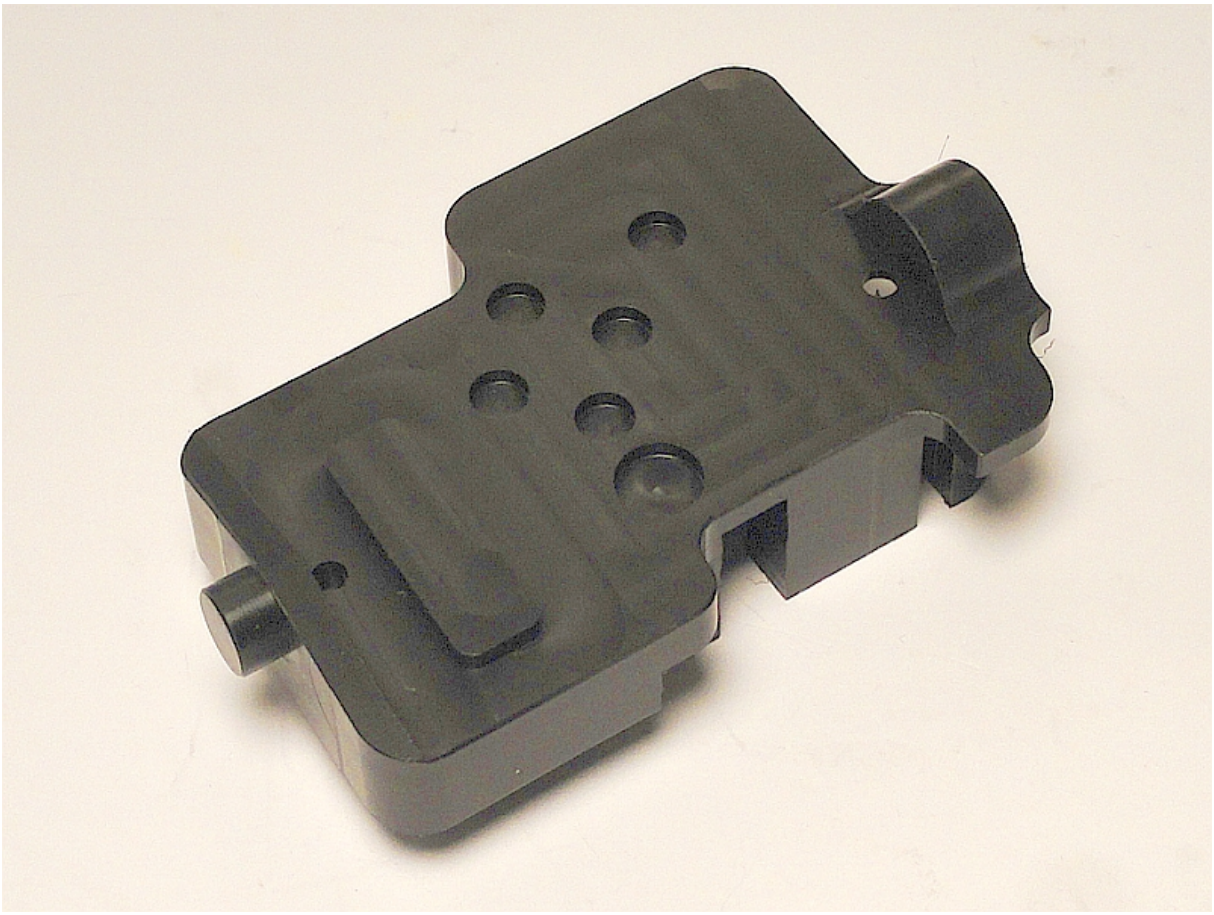
1. If necessary, solder the wires from the camera tilt servo motor to the camera interface board.
2. Orient the camera tilt servo motor at the back of the camera mount base with the gear over the tilt shaft. The tilt servo motor wire should also be aligned with the notch in frame for the tilt servo motor.
3. Place the camera tilt servo motor in the back of the camera mount base.
4. Replace the two 4-40 X 1-14 inch camera tilt servo motor screws with washers. The washers are used to retain the tilt servo motor. Keep the washers toward the camera tilt servo while tightening the screws.

Tip

Some camera tilt servo motors have shims underneath of the servo to align the gears. If your camera tilt servo motor has shims, make sure to replace them when replacing the motor.

Camera Mount Base Assembly

- Part Number: CAM-HSG-R



Camera Mount Base Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 44 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Interface Printed Circuit Board
- Camera Tilt Servo Motor Assembly
- Camera Mount Base Assembly

See the corresponding sections of this manual for instructions for parts other than the Camera Mount Base Assembly.

Camera Mount Base Assembly Removal Procedures

Time required for this step: Approximately 4 Minutes

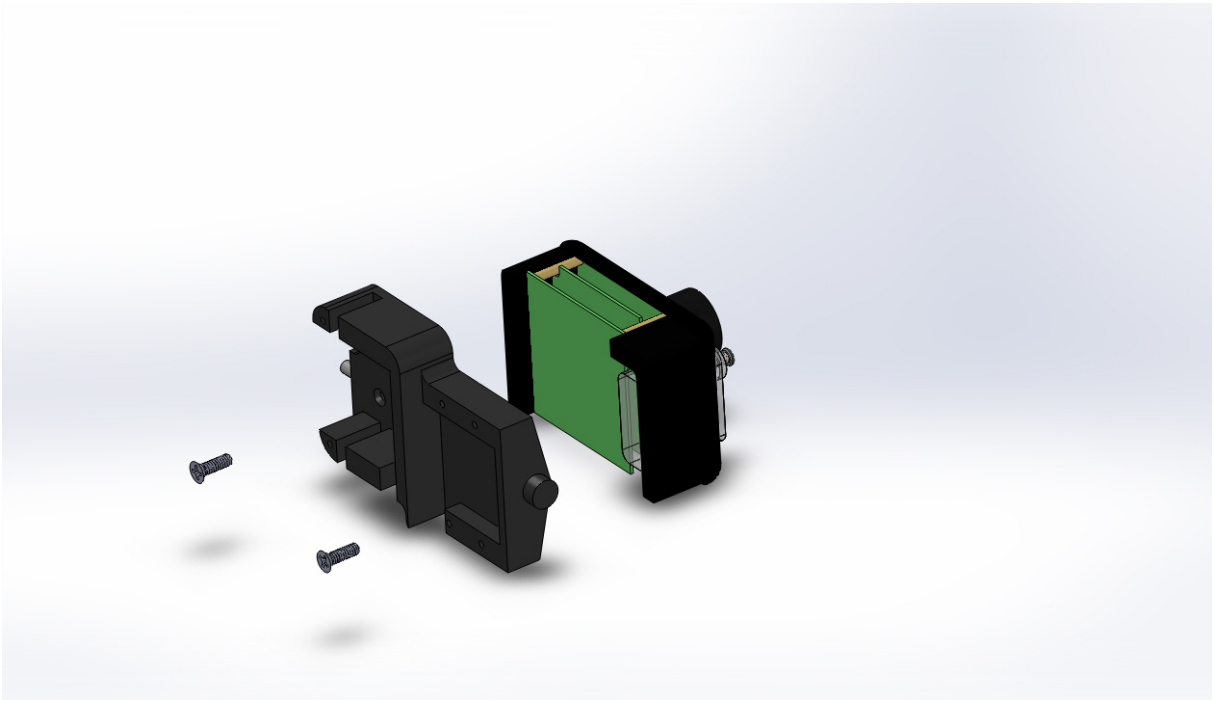
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

CAM-HSG-R Camera Mount Base Assembly

Quantity	Part Number	Part Description
1	CAM-HSG-R	Camera Part Mount Base Pivot Block (Pro 4)
2	96640A056	Screw #4-40 x 3/8" Flat Head Phillips SS Black



Steps

1. Unscrew the two 6-32 X 3/8 inch Phillips flat head screws that hold the camera mount base to the camera mount cover.
2. Remove the camera mount base from the camera mount cover.

Camera Mount Base Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 47 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- O-Ring Lubricator
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Camera Mount Base Assembly
- Camera Tilt Servo Motor Assembly
- Camera Interface Printed Circuit Board
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Horizontal Thruster Motor Assembly
- Horizontal Thruster Motor Mount
- Horizontal Thruster Cartridge Seal
- LED Light Mount
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Mount Base Assembly.

Camera Mount Base Assembly Replacement Procedures

Time required for this step: Approximately 4 Minutes

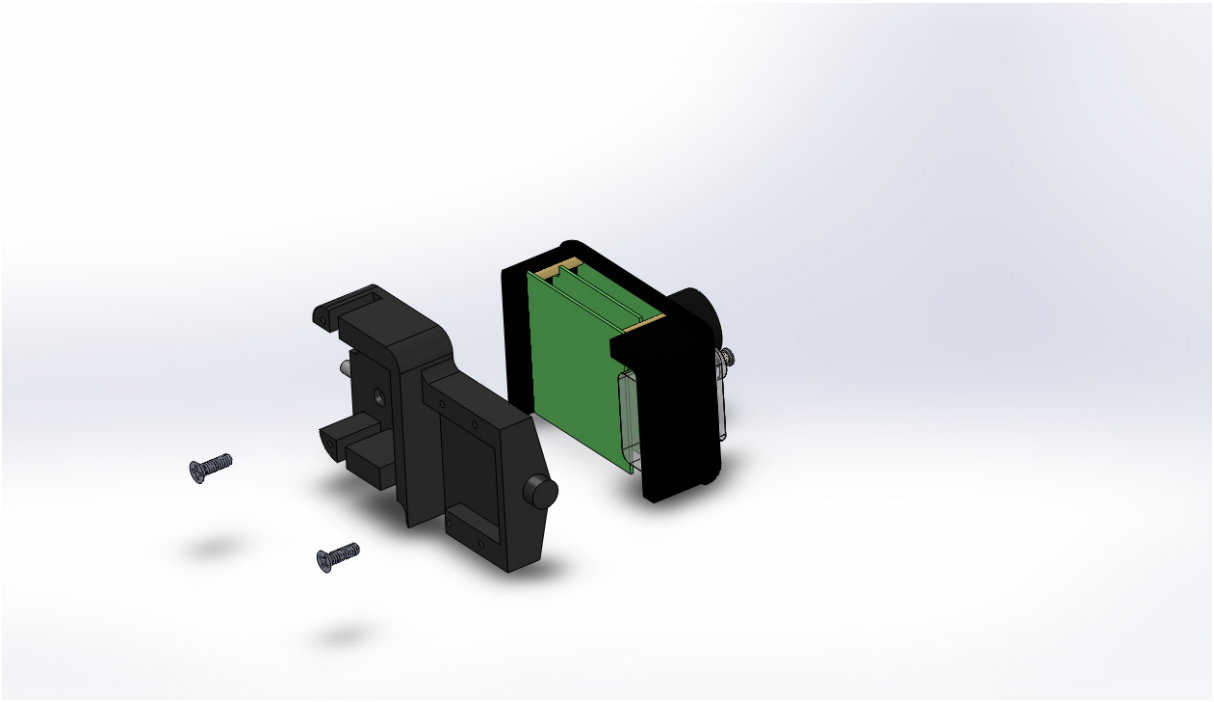
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

CAM-HSG-R Camera Mount Base Assembly

Quantity	Part Number	Part Description
1	CAM-HSG-R	Camera Part Mount Base Pivot Block (Pro 4)
2	96640A056	Screw #4-40 x 3/8" Flat Head Phillips SS Black

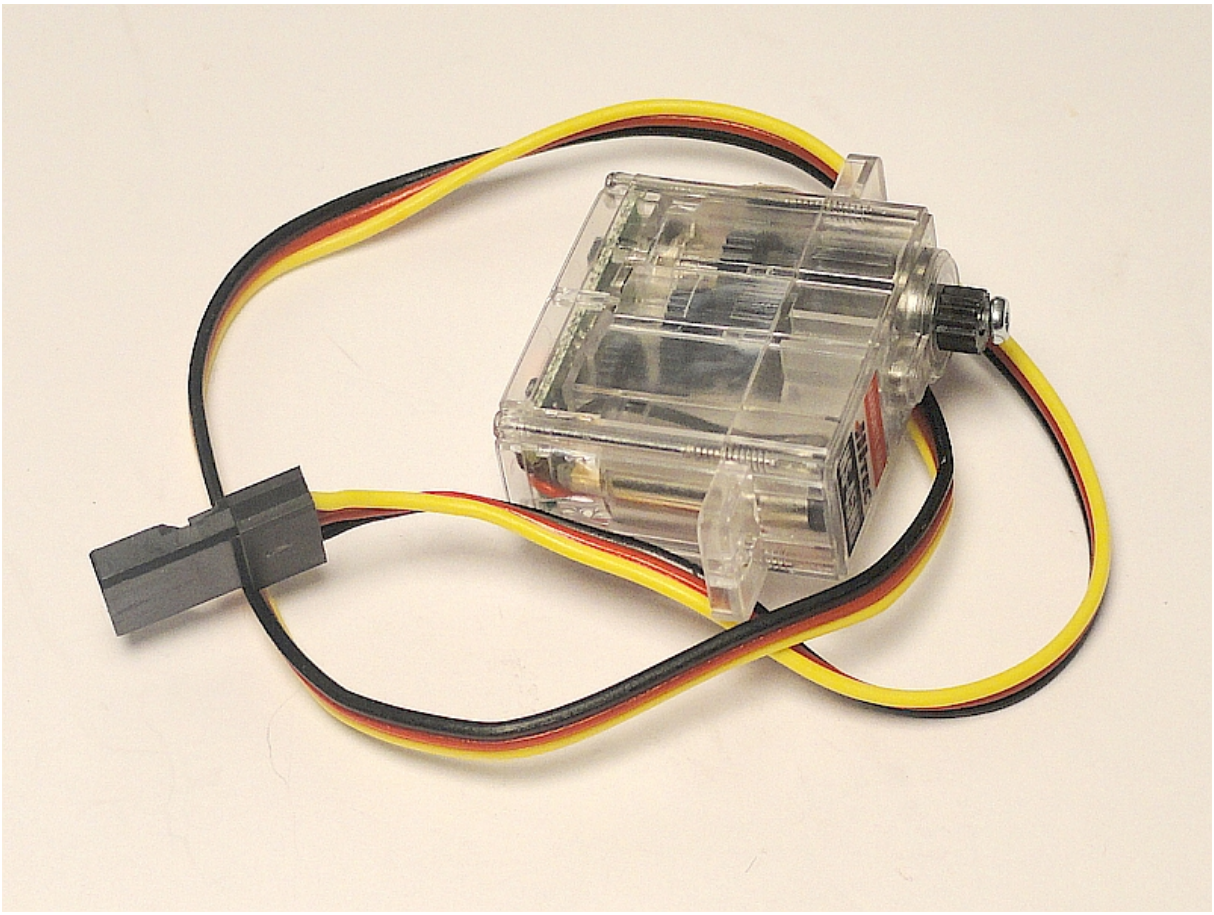


Steps

1. Orient the camera mount cover (with camera and focus servo motor installed) so that the camera is on the left when viewed from the rear.
2. Make sure the camera and camera focus servo motor are fully seated in the camera mount cover and place the camera mount base on the camera mount cover.
3. Orient the camera mount base so that the tilt gear shaft is on the left when viewed from the rear and the interface board is to the rear.
4. Place the camera mount base in position on the camera mount cover. Make sure the focus servo motor wires are routed away from any of the mount bosses or camera components so the wires do not get pinched.
5. Replace the two 6-32 X 3/8 inch Phillips flat head screws that hold the camera mount base to the camera mount cover and tighten them.

Camera Focus Servo Motor Assembly

- Part Number: MAR-013



Camera Focus Servo Motor Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 53 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver
- #0 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Lens-Focus Cam Gear
- Camera Interface Printed Circuit Board
- Camera Tilt Servo Motor Assembly
- Camera Mount Base Assembly
- Camera Focus Servo Motor Assembly

See the corresponding sections of this manual for instructions for parts other than the Camera Focus Servo Motor Assembly.

Camera Focus Servo Motor Assembly Removal Procedures

Time required for this step: Approximately 5 Minutes

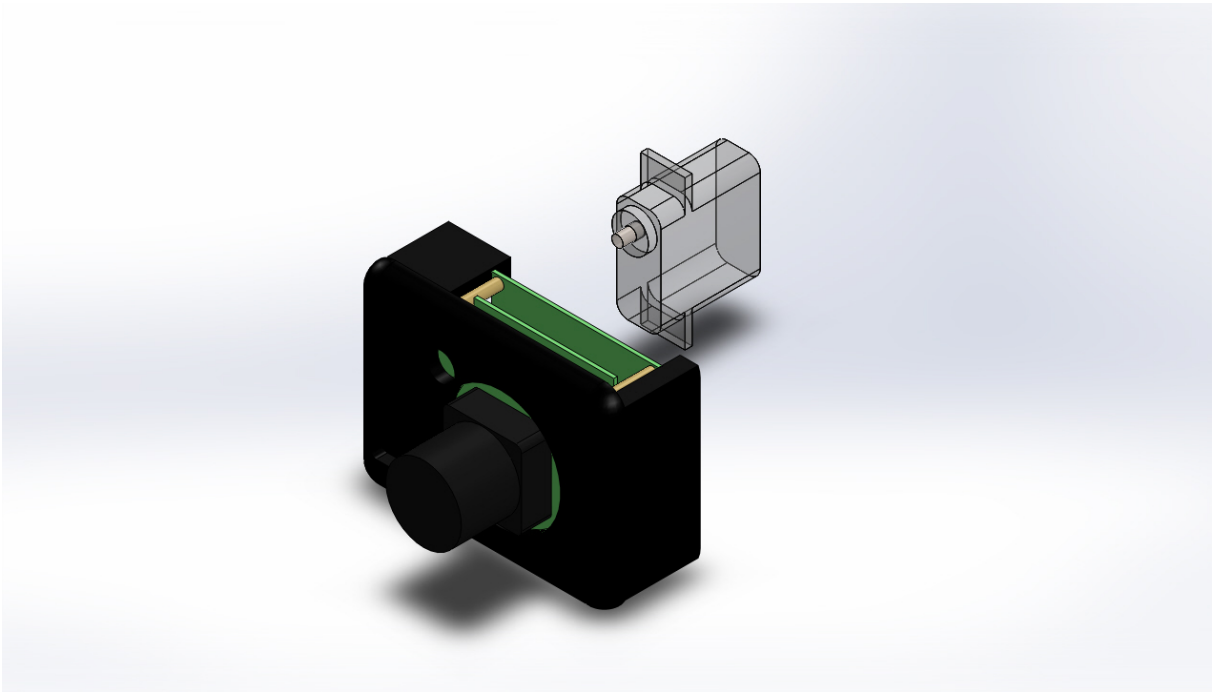
Tools required for this step:

- None

Parts involved in this step:

MAR-013 Camera Focus Servo Motor Assembly

Quantity	Part Number	Part Description
1	MAR-013	Camera Package Focus Servo (Pro 4)



Steps

1. Pull the camera focus servo motor from the camera mount cover.

Camera Focus Servo Motor Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 56 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- #0 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Camera Focus Servo Motor Assembly
- Camera Mount Base Assembly
- Camera Tilt Servo Motor Assembly
- Camera Interface Printed Circuit Board
- Camera Lens-Focus Cam Gear
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Focus Servo Motor Assembly.

Camera Focus Servo Motor Assembly Replacement Procedures

Time required for this step: Approximately 5 Minutes

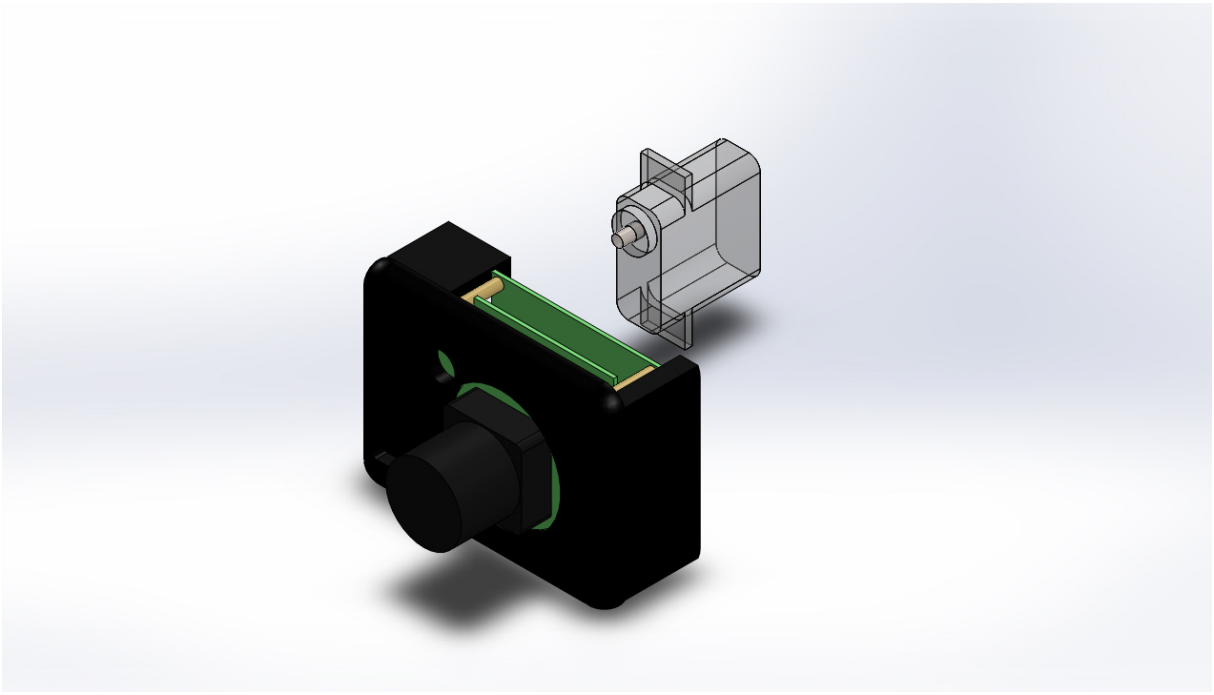
Tools required for this step:

- None

Parts involved in this step:

MAR-013 Camera Focus Servo Motor Assembly

Quantity	Part Number	Part Description
1	MAR-013	Camera Package Focus Servo (Pro 4)



Steps

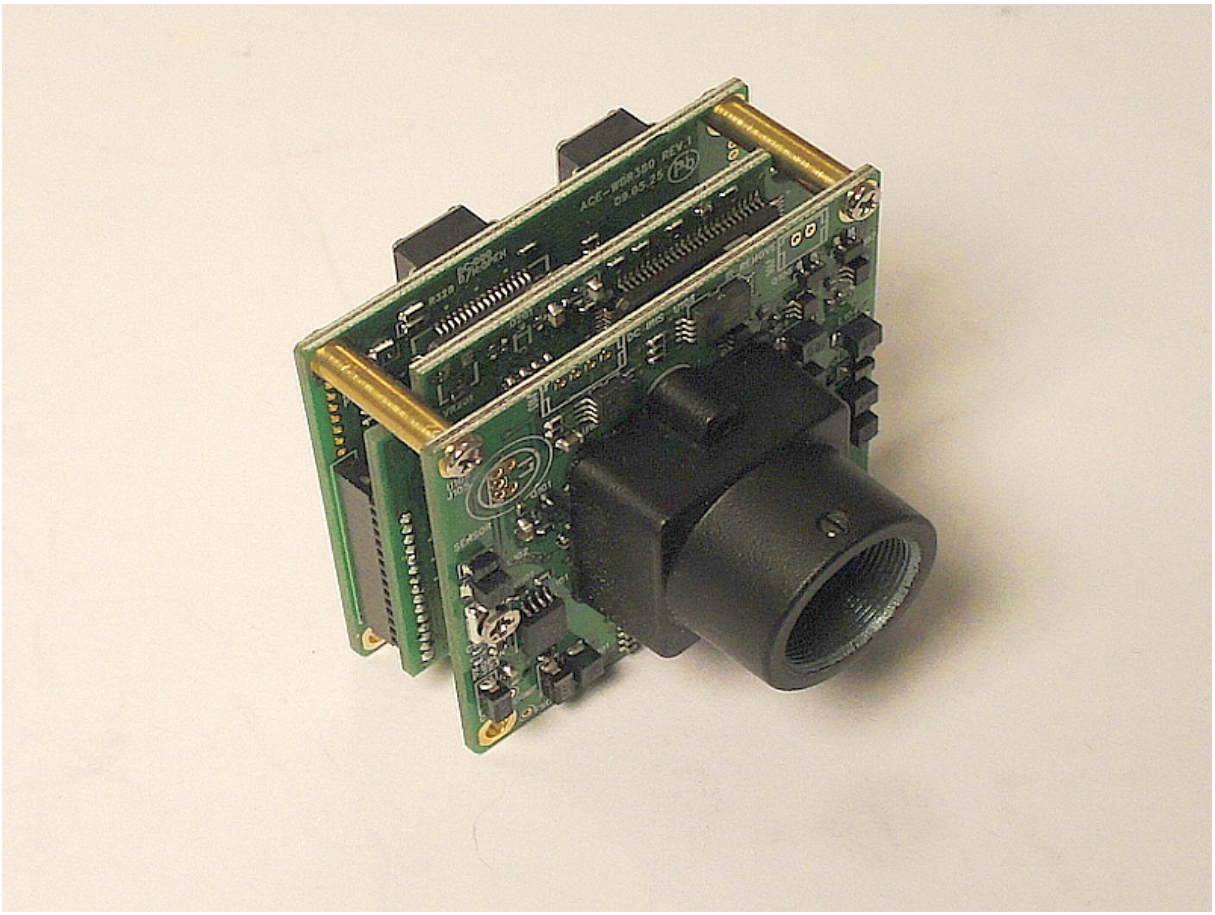
1. Orient the camera mount cover so that the round lens opening is to the left when viewed from the rear.
2. Orient the camera focus servo motor at the rear of the camera mount cover, with the gear toward the front and on the top.
3. Install the camera focus servo motor in the camera mount cover from the rear of the cover.
4. Makes sure the camera focus servo motor is fully seated in the camera mount cover or you will not be able to get the camera mount base on properly.

Tip

The camera focus servo motor is held in place by the camera mount cover and base. At this point there are no fasteners to secure it.

Camera

- Part Number: CAH-001N4



Camera Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 53 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver
- #0 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Lens-Focus Cam Gear
- Camera Interface Printed Circuit Board
- Camera Tilt Servo Motor Assembly
- Camera Mount Base Assembly
- Camera

See the corresponding sections of this manual for instructions for parts other than the Camera.

Camera Removal Procedures

Time required for this step: Approximately 5 Minutes

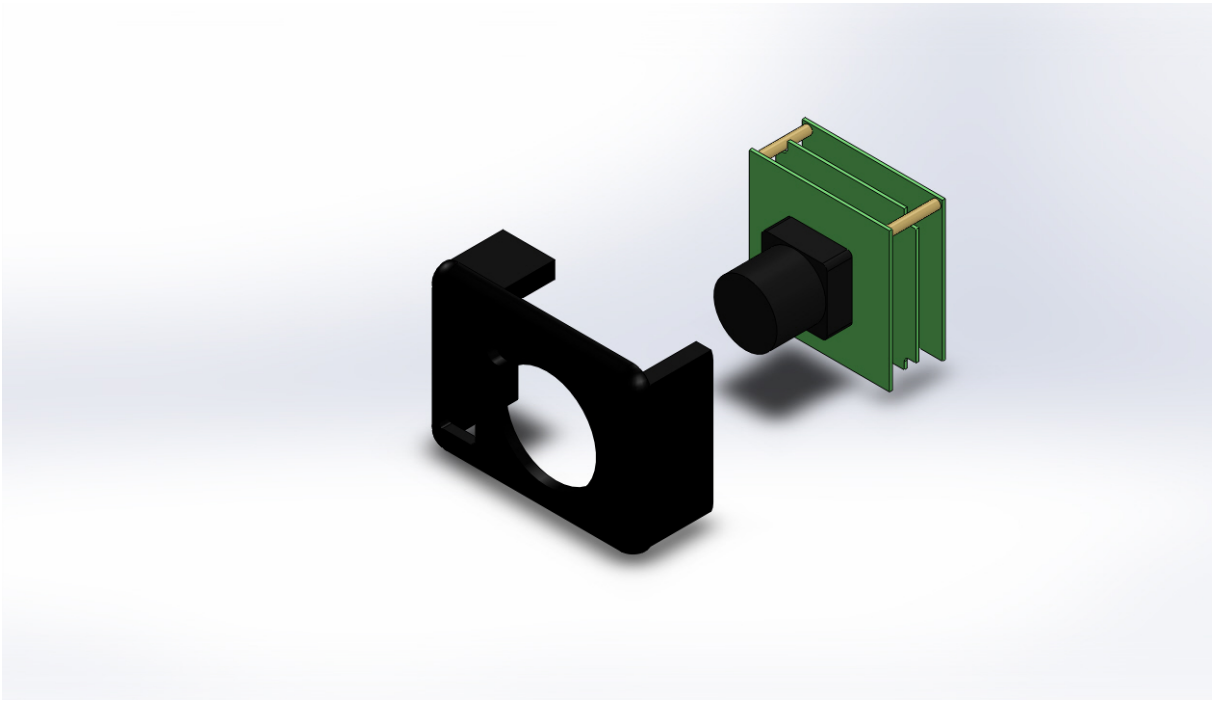
Tools required for this step:

- None

Parts involved in this step:

CAH-001N4 Camera

Quantity	Part Number	Part Description
1	CAH-001N4	Camera Package Front (Pro 4) (NTSC)



Steps

1. Pull the camera from the camera mount cover.

Camera Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 56 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- #0 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Camera
- Camera Mount Base Assembly
- Camera Tilt Servo Motor Assembly
- Camera Interface Printed Circuit Board
- Camera Lens-Focus Cam Gear
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera.

Camera Replacement Procedures

Time required for this step: Approximately 5 Minutes

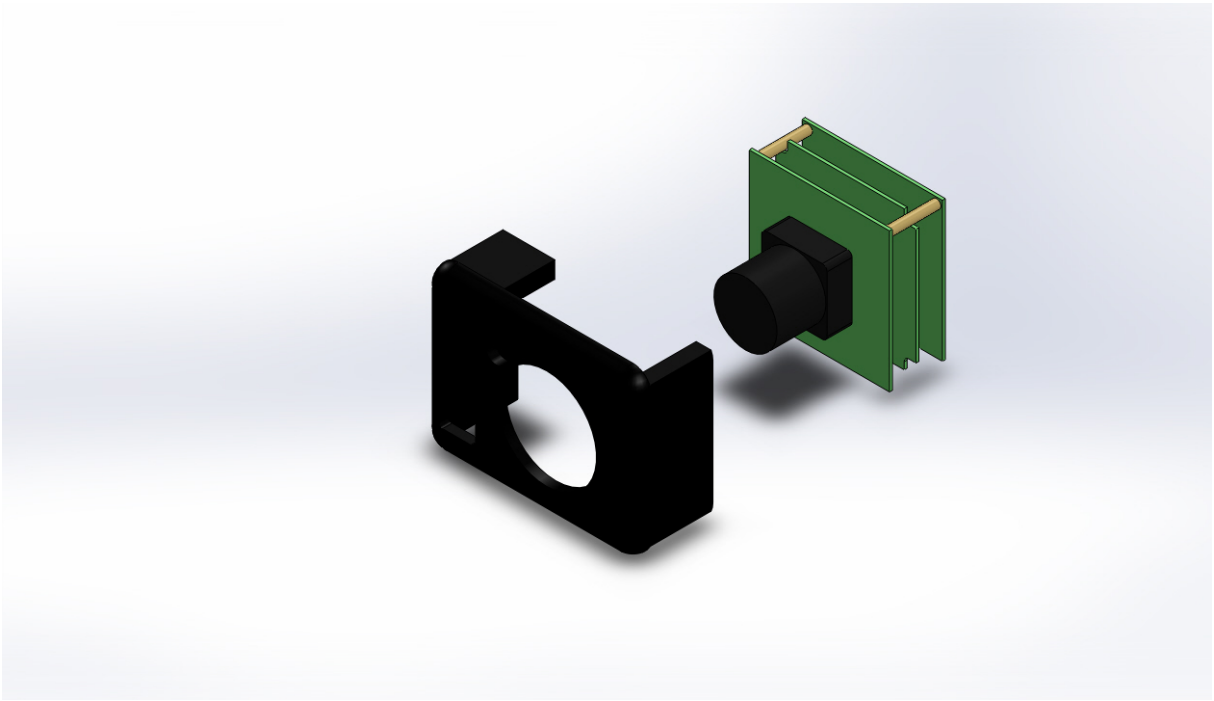
Tools required for this step:

- None

Parts involved in this step:

CAH-001N4 Camera

Quantity	Part Number	Part Description
1	CAH-001N4	Camera Package Front (Pro 4) (NTSC)



Steps

1. Orient the camera mount cover so that the round lens opening is to the left when viewed from the rear.
2. Orient the camera in position at the rear of the camera mount cover with the camera lens toward the cover and the connector on the rear of the camera toward the bottom.
3. Install the camera in the front camera mount cover.
4. Make sure the camera lens board is seated all of the way inside of the camera mount cover or you will not be able to get the camera mount base on properly.

Tip

The camera is held in place by the camera mount cover and base. At this point there are no fasteners to secure it.

Camera Mount Cover

- Part Number: CAM-HSG-F

Camera Mount Cover Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 58 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- #1 Phillips Head Screw Driver
- #0 Phillips Head Screw Driver
- Soldering Iron

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Camera Assembly
- Camera Lens-Focus Cam Gear
- Camera Interface Printed Circuit Board
- Camera Tilt Servo Motor Assembly
- Camera Mount Base Assembly
- Camera Focus Servo Motor Assembly
- Camera
- Camera Mount Cover

See the corresponding sections of this manual for instructions for parts other than the Camera Mount Cover.

Camera Mount Cover Removal Procedures

Time required for this step: Approximately 0 Minute

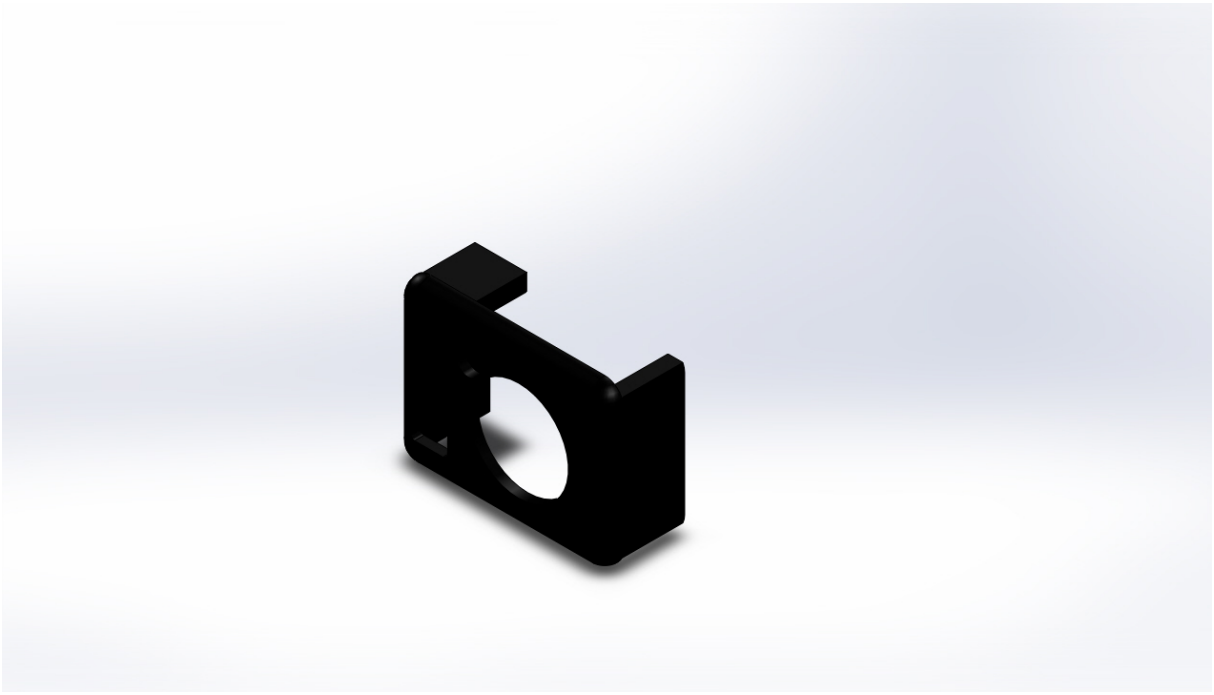
Tools required for this step:

- None

Parts involved in this step:

CAM-HSG-F Camera Mount Cover

Quantity	Part Number	Part Description
1	CAM-HSG-F	Camera Part Mount Cover (Pro 4)



Steps

1. After removing the camera, the camera mount cover is considered removed.

Camera Mount Cover Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 61 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- #1 Phillips Head Screw Driver
- Soldering Iron
- Solder
- #0 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench

The following components must be replaced:

- Camera Mount Cover
- Camera
- Camera Focus Servo Motor Assembly
- Camera Mount Base Assembly
- Camera Tilt Servo Motor Assembly
- Camera Interface Printed Circuit Board
- Camera Lens-Focus Cam Gear
- Camera Assembly
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Mount Cover.

Camera Mount Cover Replacement Procedures

Time required for this step: Approximately 0 Minute

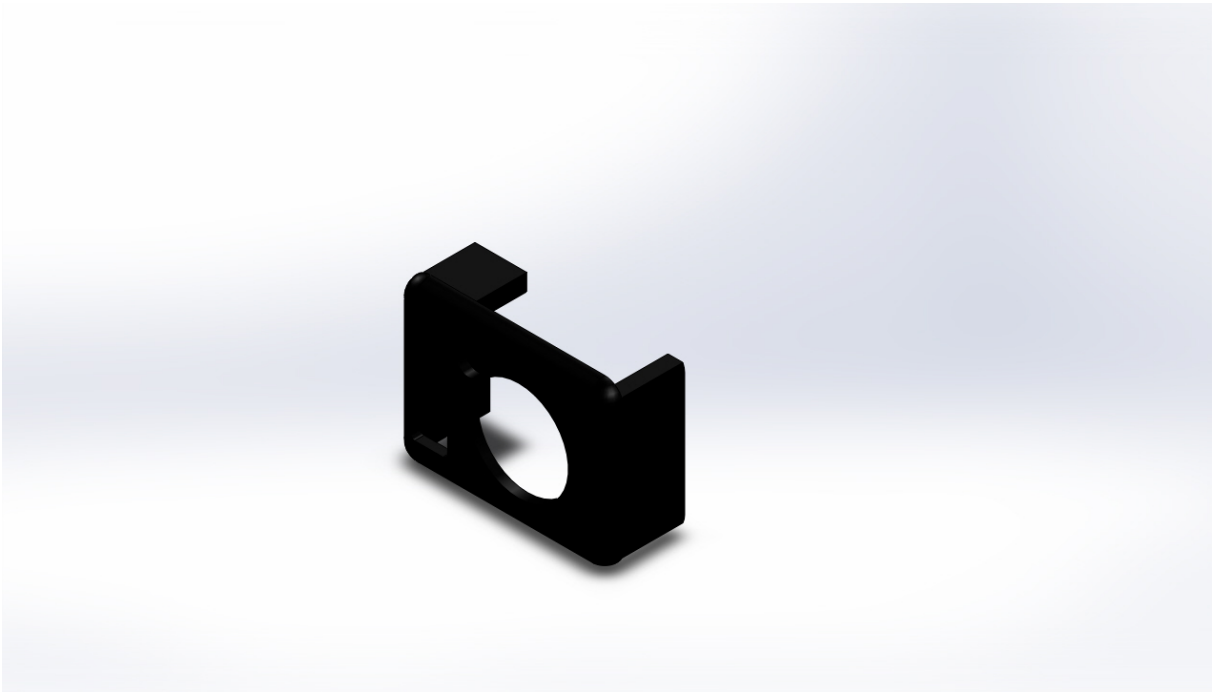
Tools required for this step:

- None

Parts involved in this step:

CAM-HSG-F Camera Mount Cover

Quantity	Part Number	Part Description
1	CAM-HSG-F	Camera Part Mount Cover (Pro 4)

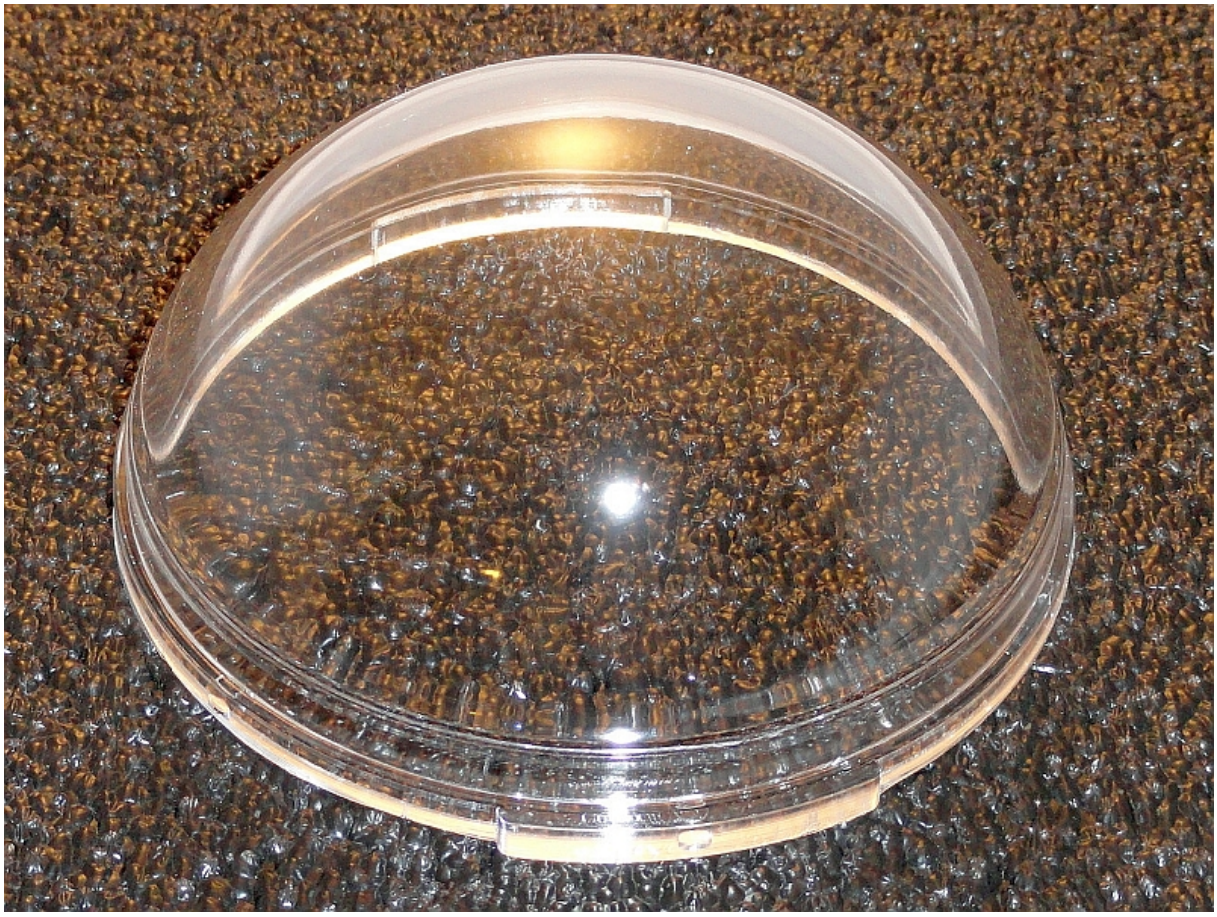


Steps

1. To begin the replacement of the camera mount cover, proceed to the next step and install the camera in the cover.

Rear Dome

- Part Number: MHU-004



Rear Dome Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 22 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome

See the corresponding sections of this manual for instructions for parts other than the Rear Dome.

Notes:

- Do Not use solvents, including alcohol, to clean the dome. Doing so may cause the dome to haze or crack. use mild soap and water to clean the dome.
- Do NOT use any metal tools to pry the rear dome from the rear hull ring.

Rear Dome Removal Procedures

Time required for this step: Approximately 2 Minutes

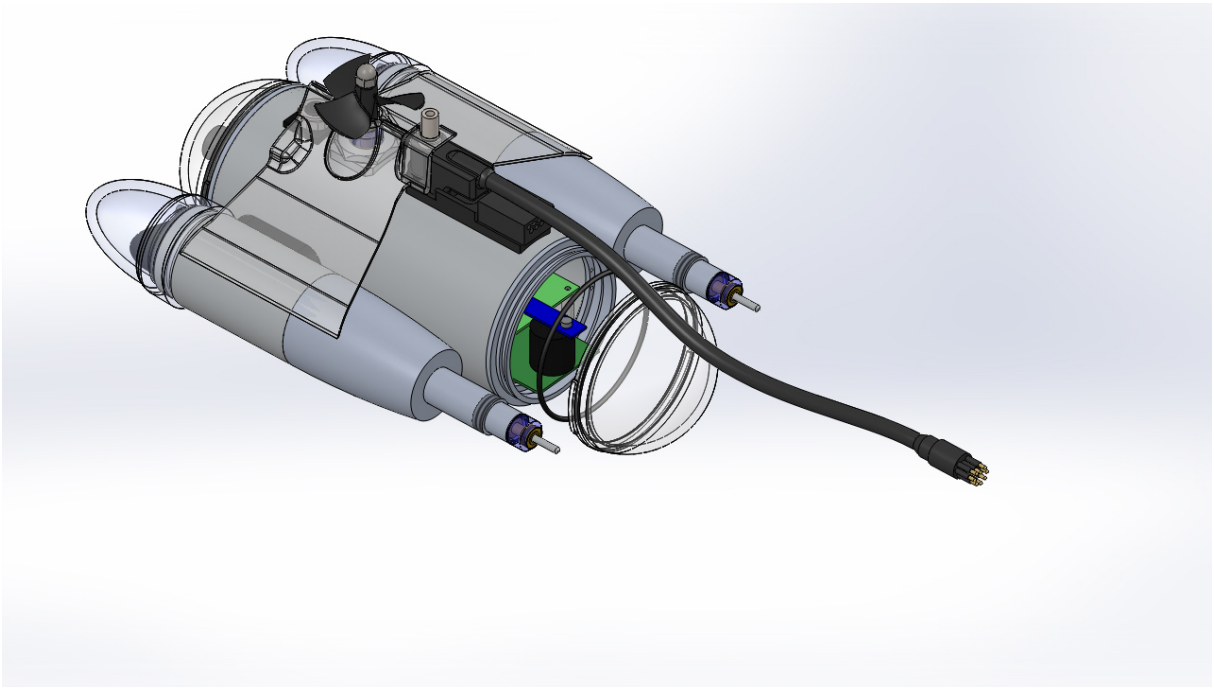
Tools required for this step:

- Wooden Dowel Rod 3/8" x 12"

Parts involved in this step:

MHU-004(r) Rear Dome

Quantity	Part Number	Part Description
1	MHU-004(r)	Main Dome
1	OR-152	O-Ring #152



Steps

1. Using the tabs on the side of the rear dome, gently pull the dome from the rear hull ring.
2. If you plan to replace the O-ring, remove it by pinching it around the rear hull ring to create a slack section that can be grabbed.

Tips

If the rear dome is stuck, you can try to force it off using a wooden dowel against the back side of one of the tabs on the dome and tapping on the dowel.

Sometimes the rear hull ring assembly will come off while trying to remove the rear dome. If this happens, remove the rear dome after the rear hull ring assembly is removed. Follow the instructions for replacing the rear hull ring assembly before replacing the rear dome.

Rear Dome Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 23 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Rear Dome.

Notes:

- Do NOT use solvents, including alcohol, to clean the dome. Doing so may cause the dome to haze or crack. Use mild soap and water to clean the dome.
- Before installing the rear dome, clean any finger prints or other marks and inspect it for scratches or cracks.
- Do NOT use a scratched or cracked dome, because it may fail under pressure.

Rear Dome Replacement Procedures

Time required for this step: Approximately 3 Minutes

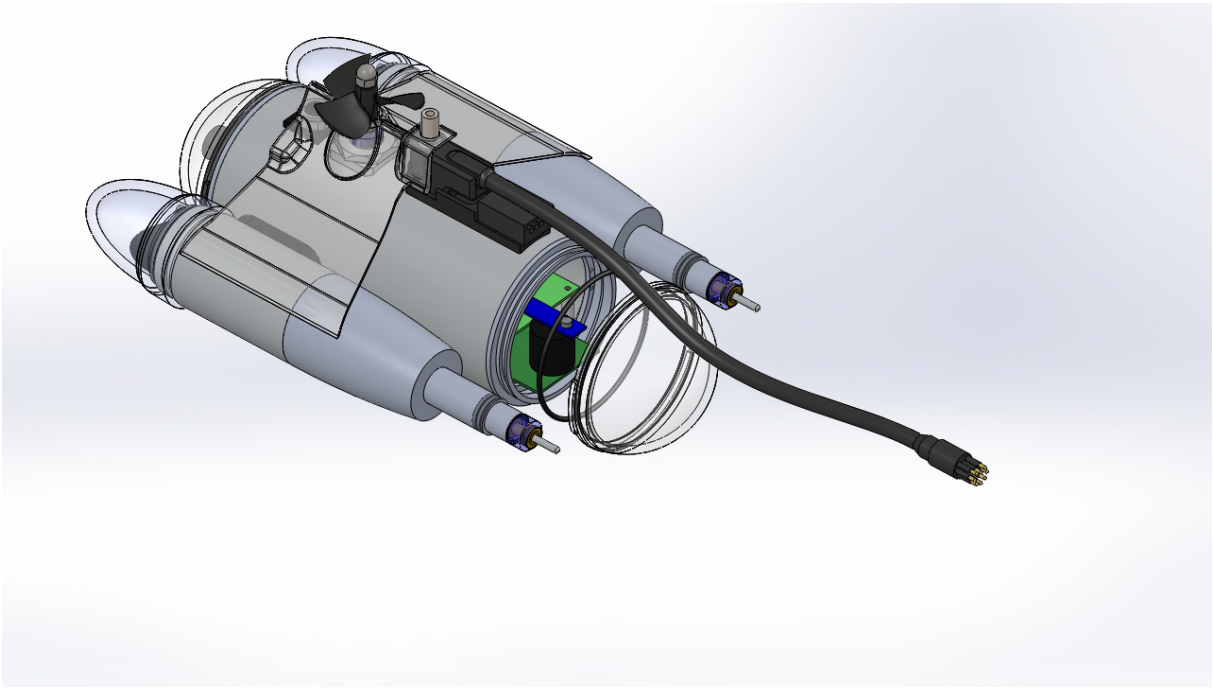
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

MHU-004(r) Rear Dome

Quantity	Part Number	Part Description
1	MHU-004(r)	Main Dome
1	OR-152	O-Ring #152



Steps

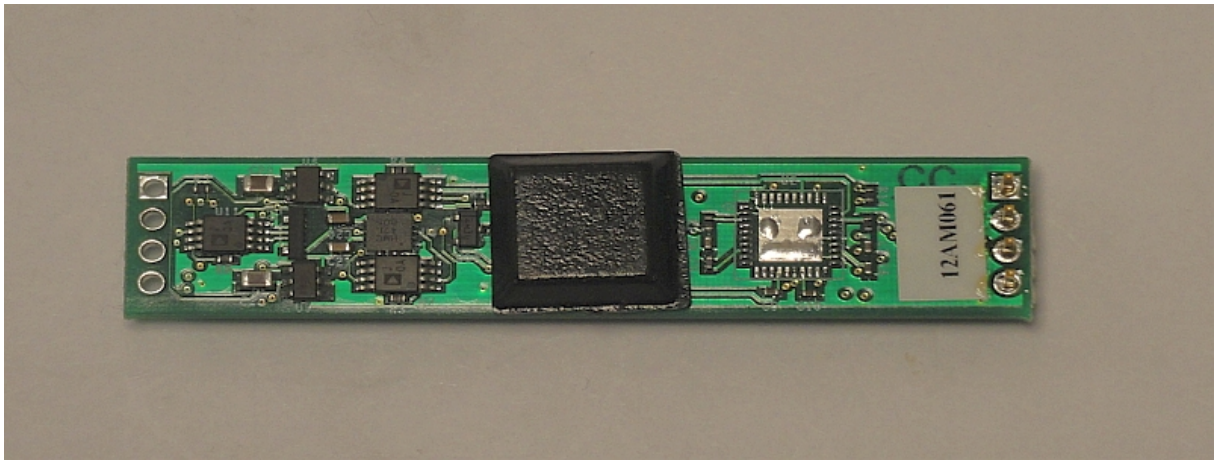
1. Use a new lubricated o-ring, or remove and lubricate the existing o-ring, and install it in the o-ring groove of the rear hull ring.
2. Orient the rear dome so that the tabs horizontally so that they will not interfere with the main hull rods, skid or float block when these components are installed.
3. Being careful not to pinch the O-ring, press the rear dome onto the rear hull ring until is seats against the hull ring.

Tip

The front and rear domes are the same. If the front dome is mildly scratched or marred, you can replace it with the rear dome.

Compass - Navigation Module

- Part Number: CB-002-COMP-GYRO-ASSM



Compass - Navigation Module Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 24 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Side Cutter

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Compass - Navigation Module

See the corresponding sections of this manual for instructions for parts other than the Compass - Navigation Module.

Notes:

- When working on the compass/navigation module, follow standard anti-static practices to avoid damaging the module.

Compass - Navigation Module Removal Procedures

Time required for this step: Approximately 2 Minutes

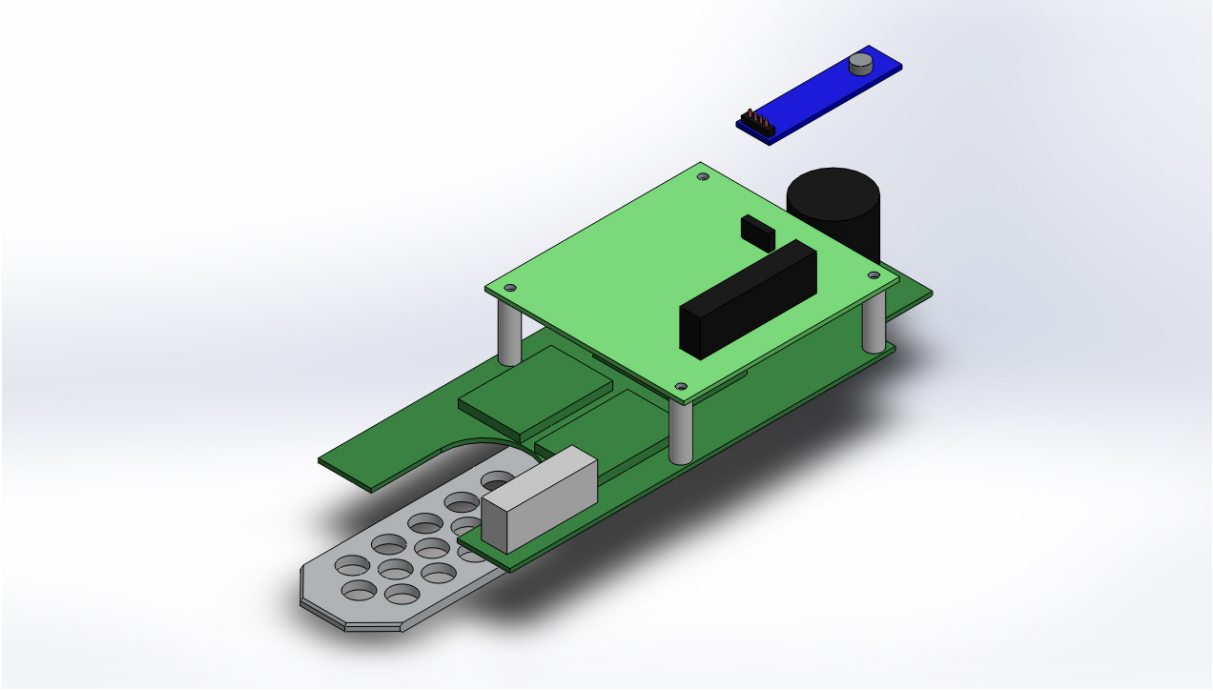
Tools required for this step:

- Side Cutter

Parts involved in this step:

CB-002-COMP-GYRO-ASSM Compass - Navigation Module

Quantity	Part Number	Part Description
1	CB-002-COMP-GYRO-ASSM	Circuit Board ROV Assembly Nav (Pro 4)
1	7130K52	Cable Tie 4" Black



Steps

1. Carefully cut the cable tie that holds the compass/navigation module in place.
2. Gently lift the compass/navigation module straight up from the ROV CPU board. Be careful not to bend the pins as you remove the compass/navigation module from its socket.

Compass - Navigation Module Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 25 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Compass - Navigation Module
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Compass - Navigation Module.

Notes:

- When working on the compass/navigation module, follow standard anti-static practices to avoid damaging the module.

Compass - Navigation Module Replacement Procedures

Time required for this step: Approximately 2 Minutes

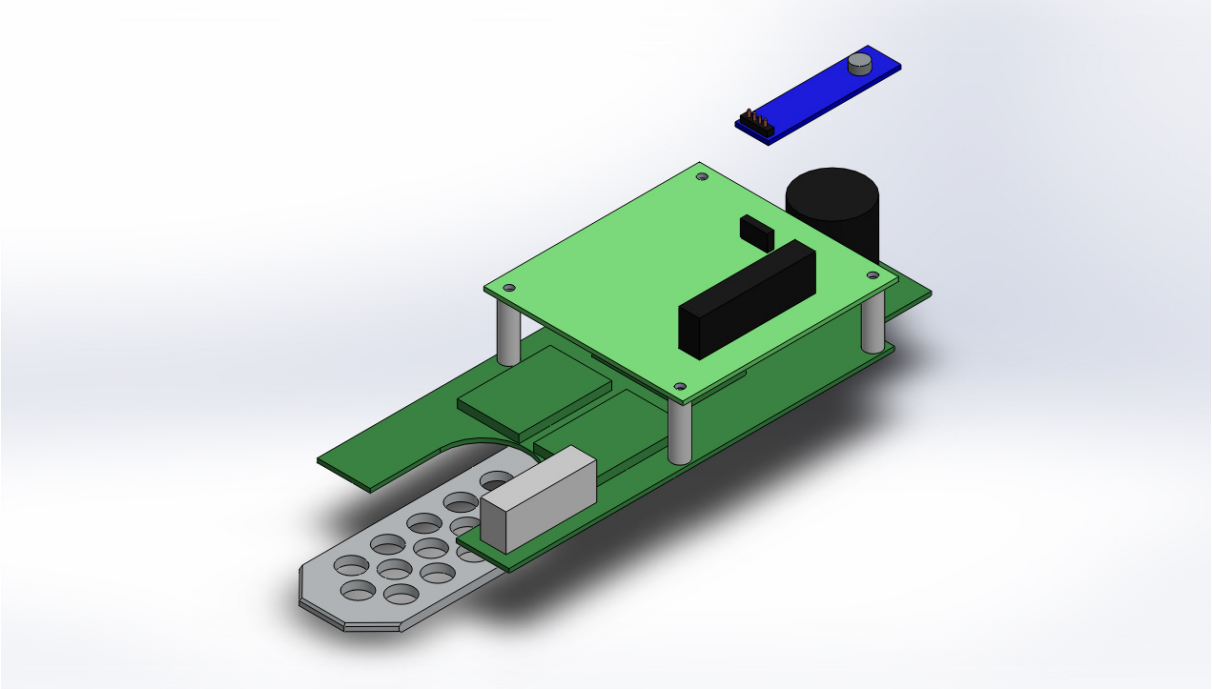
Tools required for this step:

- None

Parts involved in this step:

CB-002-COMP-GYRO-ASSM Compass - Navigation Module

Quantity	Part Number	Part Description
1	CB-002-COMP-GYRO-ASSM	Circuit Board ROV Assembly Nav (Pro 4)
1	7130K52	Cable Tie 4" Black

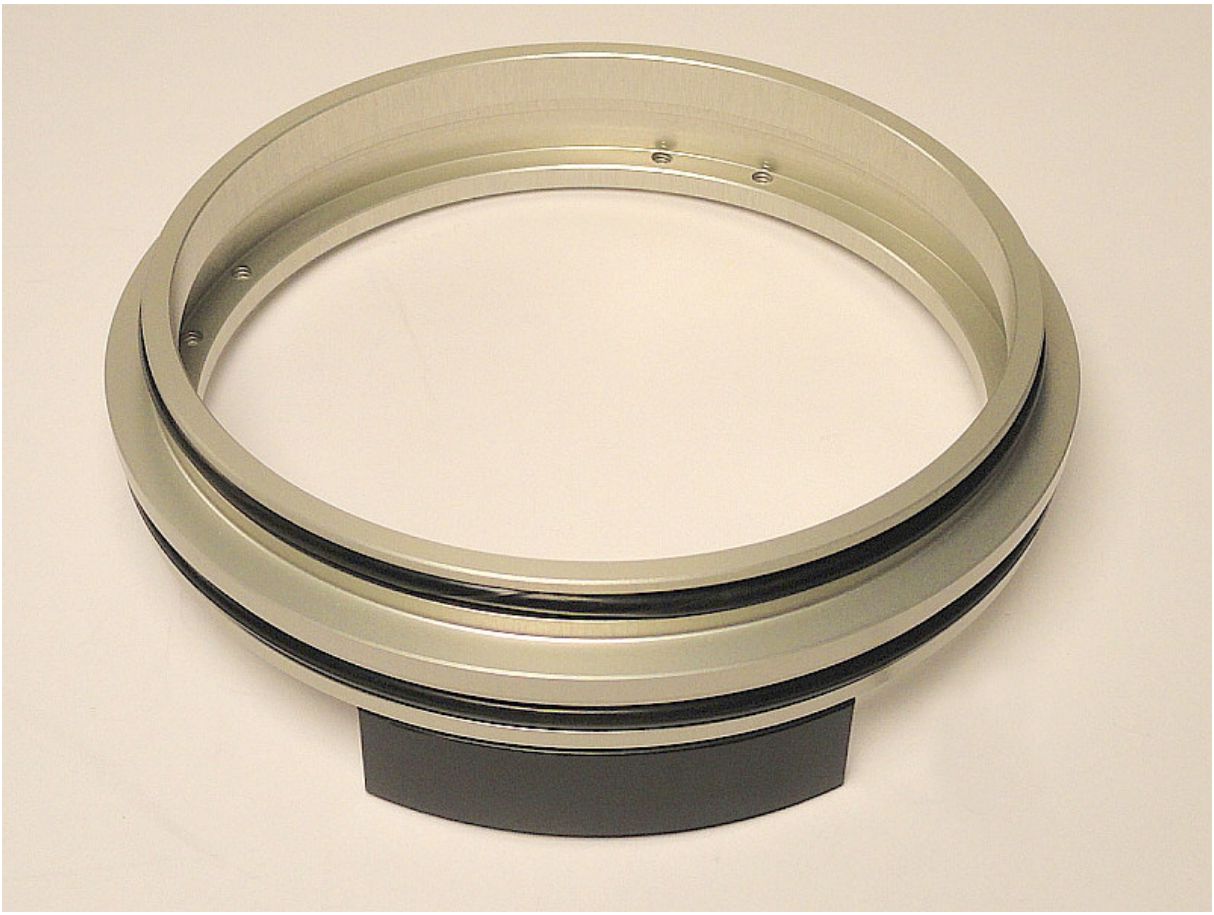


Steps

1. Make sure a compass/navigation module support pad is in place on the underside of the compass/navigation module.
2. Make sure a compass/navigation module support pad is in place on the ROV CPU board behind the compass/navigation connector.
3. Place the compass/navigation module in position over the ROV CPU board with the navigation module connector pins toward the front of the ROV and facing downward. The compass/navigation module should hang over the back edge of the ROV CPU board.
4. Insert the compass module into the connector socket on the ROV CPU board and press it down until it seats firmly in the connector socket.
5. Secure the compass/naviation module with a cable tie.

Rear Hull Ring Assembly

- Part Number: MHU-003-GY-KIT



Rear Hull Ring Assembly Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 26 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly

See the corresponding sections of this manual for instructions for parts other than the Rear Hull Ring Assembly.

Rear Hull Ring Assembly Removal Procedures

Time required for this step: Approximately 4 Minutes

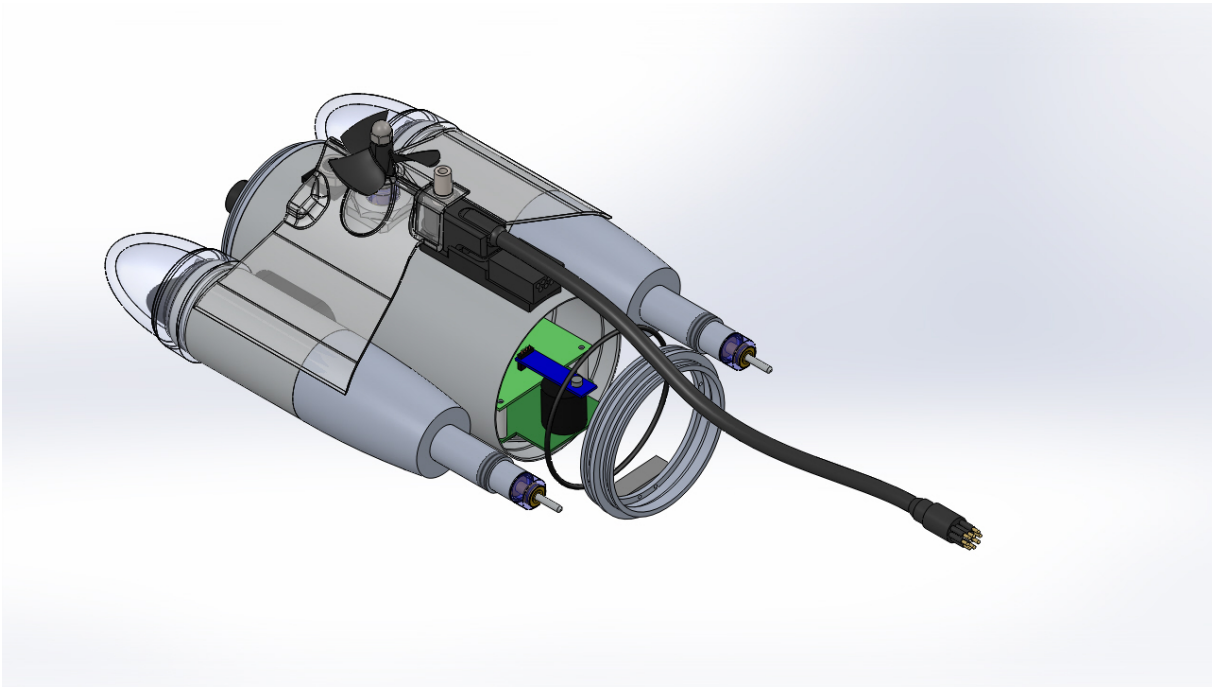
Tools required for this step:

- None

Parts involved in this step:

MHU-003-GY-KIT Rear Hull Ring Assembly

Quantity	Part Number	Part Description
1	MHU-003-GY-KIT	Main Hull Assembly Port Ring (Pro 4)
1	OR-154	O-Ring #154



Steps

1. Using you index finger under the inside top of the rear hull ring and your thumb against the accessory port connector, gently pry the rear hull ring from the main hull. If the rear dome ring binds while pulling the top, you may need to pull the bottom to even it up for easier removal.

2. If you plan to replace the O-ring, remove it by pinching it around the rear hull ring to create a slack section that can be grabbed. Do NOT use a metal tool to remove the O-ring.

Rear Hull Ring Assembly Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 26 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Rear Hull Ring Assembly.

Rear Hull Ring Assembly Replacement Procedures

Time required for this step: Approximately 3 Minutes

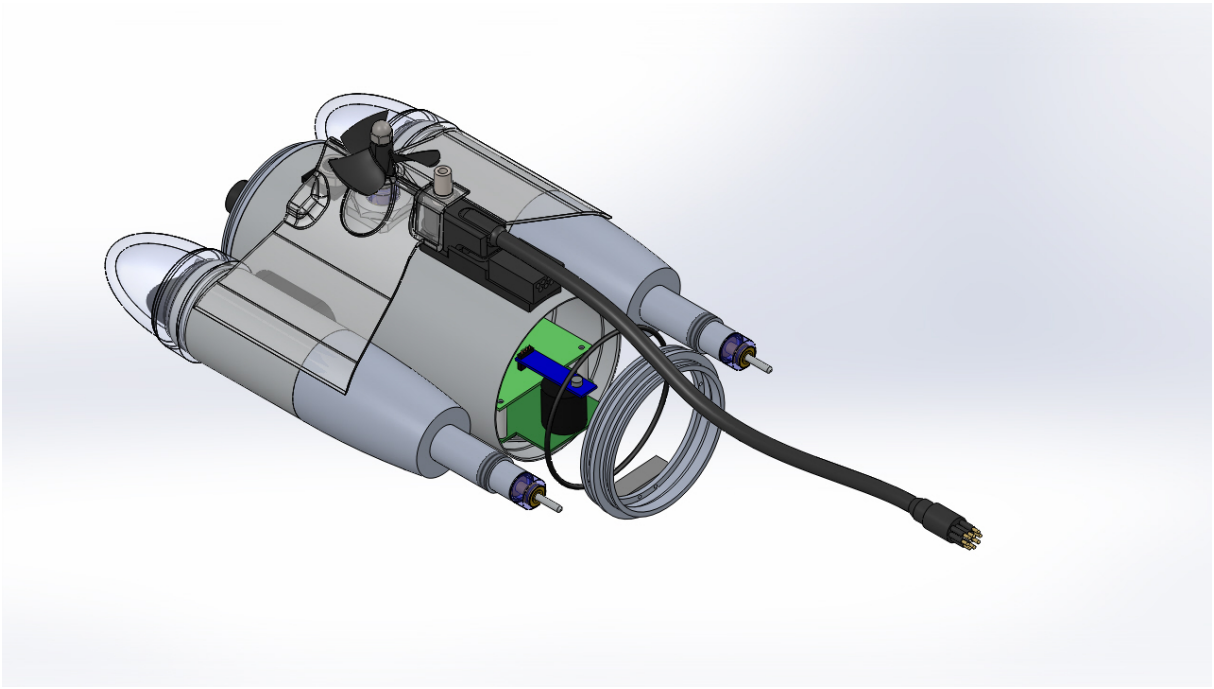
Tools required for this step:

- O-Ring Lubricator

Parts involved in this step:

MHU-003-GY-KIT Rear Hull Ring Assembly

Quantity	Part Number	Part Description
1	MHU-003-GY-KIT	Main Hull Assembly Port Ring (Pro 4)
1	OR-154	O-Ring #154



Steps

1. Use a new lubricated O-ring, or remove and lubricate the existing O-ring, and install it in the larger diameter O-ring groove of the rear hull ring.
2. Orient the rear hull ring so that the receiver bracket is facing toward the ROV and at the bottom of the main hull.
3. Position the rear hull ring at the rear of the main hull and make sure the rear of the heat sink engages in the receiver bracket at the bottom of the rear hull ring.
4. Being careful not to pinch the O-ring, press the rear hull ring into the main hull until is seats against the main hull. Make sure that you press the front ring evenly so that it does not bind.

Desiccant Pack

- Part Number: TLK-005-300-CN

Desiccant Pack Removal Overview

Skill level recommended: Intermediate

Total time required: Approximately 31 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Light Dome
- LED Light Module Assembly
- Desiccant Pack

See the corresponding sections of this manual for instructions for parts other than the Desiccant Pack.

Notes:

- There are three desiccant packs. One is located in the rear of the main hull and the other two are located in each of the LED Light Modules.

Desiccant Pack Removal Procedures

Time required for this step: Approximately 1 Minute

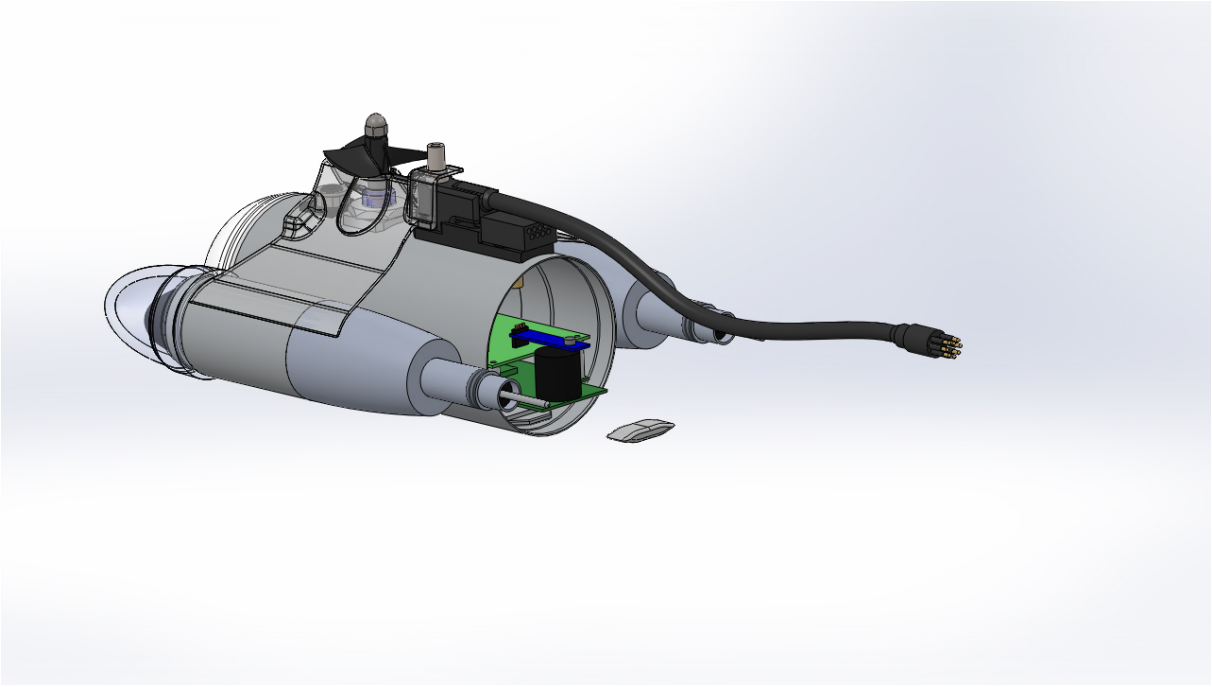
Tools required for this step:

- Dental Pick or equivalent

Parts involved in this step:

TLK-005-300-CN Desiccant Pack

Quantity	Part Number	Part Description
1	TLK-005-300-CN	Desiccant Packet



Steps

There are three desiccant packs.

1. Pull the desiccant pack out from under the rear of the ROV board set.
2. Pull the desiccant pack out from behind the LED Light Modules.

Tip

If you cannot grab the desiccant pack with your fingers, you can use a dental pick or similar instrument to hook it and pull it free. Be careful not rip the desiccant pack bag.

Desiccant Pack Replacement Overview

Skill level recommended: Intermediate

Total time required: Approximately 33 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Desiccant Pack
- LED Light Module Assembly
- Light Dome
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Desiccant Pack.

Notes:

- There are three desiccant packs. One is located in the rear of the main hull and the other two are located in each of the LED Light Modules.

Desiccant Pack Replacement Procedures

Time required for this step: Approximately 2 Minutes

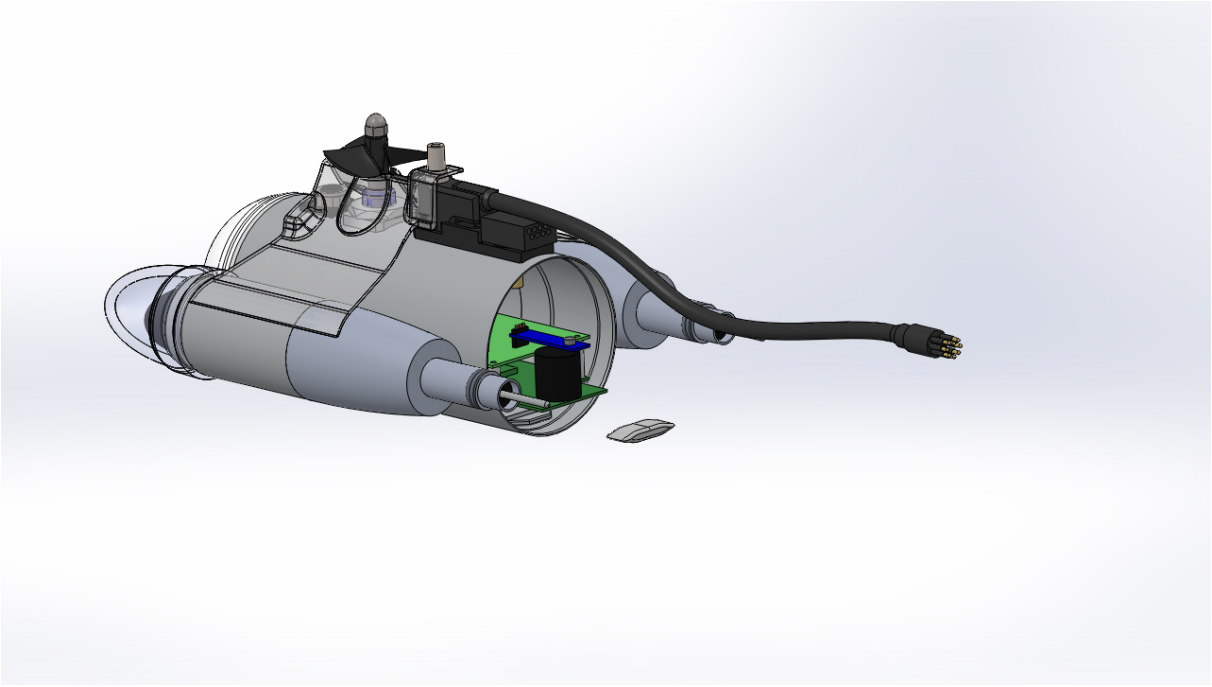
Tools required for this step:

- None

Parts involved in this step:

TLK-005-300-CN Desiccant Pack

Quantity	Part Number	Part Description
1	TLK-005-300-CN	Desiccant Packet



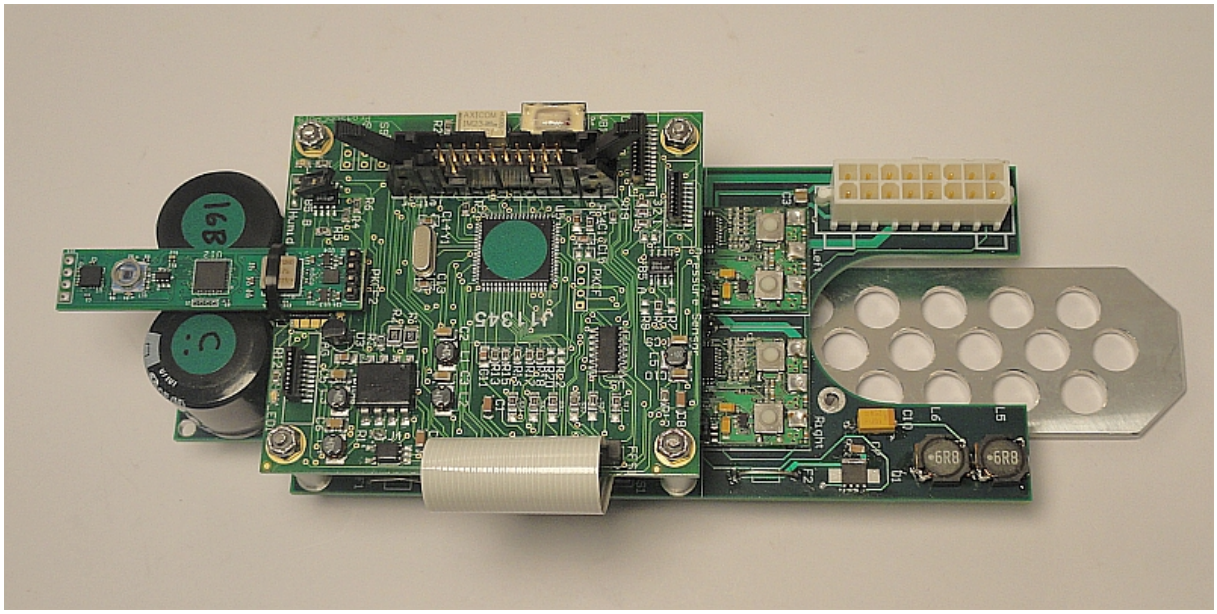
Steps

There are three desiccant packs.

1. Orient the first desiccant pack so that the color stripe can be seen from the rear of the ROV.
2. Flatten the desiccant pack to make insertion easier.
3. Insert the desiccant pack at the rear between the ROV power board and the ROV heat sink.
4. Make sure the desiccant pack it installed far enough within the hull so it does not interfere with the rear hull ring or rear dome.
5. Place the second desiccant pack in the left LED light module.
6. Place the third desiccant pack in the right LED Light module.

ROV Board Set

- Part Number: CB-01-PRO4-SET



ROV Board Set Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 32 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set

See the corresponding sections of this manual for instructions for parts other than the ROV Board Set.

Notes:

- When working on the ROV board set, follow standard anti-static practices to avoid damaging the board set.
- The Pro 4 board set has been updated. Old ROV board set are 25 Amp and can be identified by two large capacitors at the rear of the ROV power board. New ROV board sets are 33 Amp and can be identified by one large capacitor at the rear of the ROV power board.

ROV Board Set Removal Procedures

Time required for this step: Approximately 5 Minutes

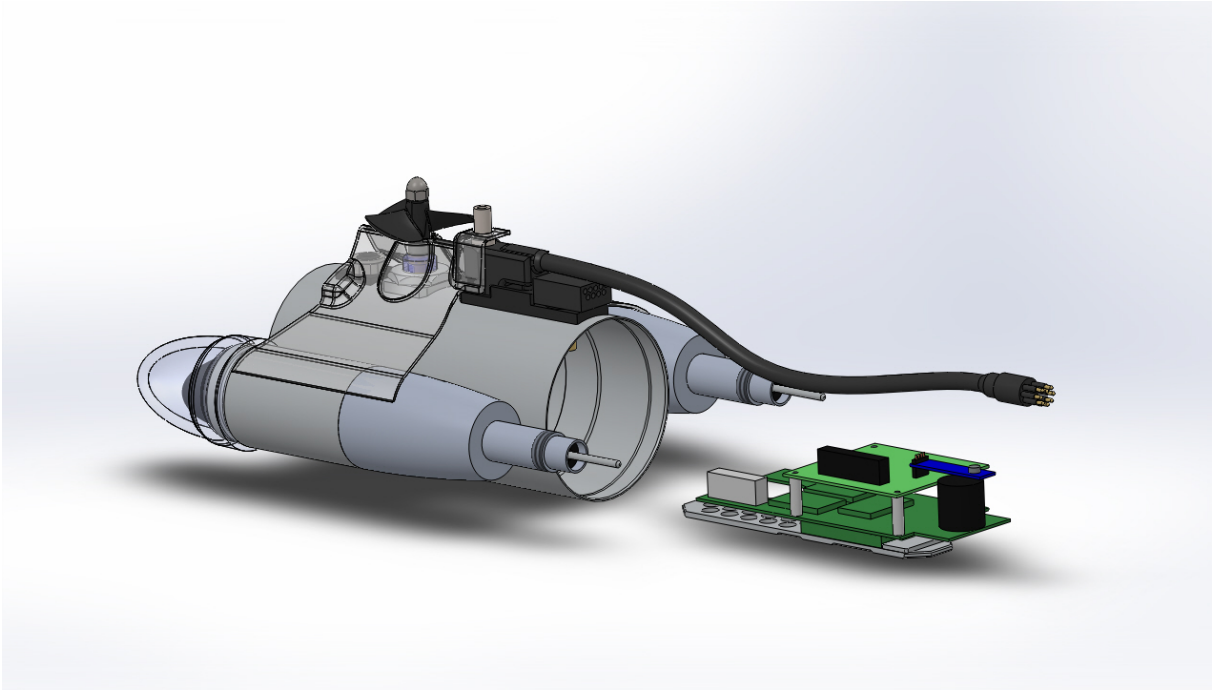
Tools required for this step:

- None

Parts involved in this step:

CB-01-PRO4-SET ROV Board Set

Quantity	Part Number	Part Description
1	CB-01-PRO4-SET	Circuit Board ROV Set (Pro 4)



Steps

1. Gently slide the ROV board set part way out from the rear of the main hull.
2. Release the ROV CPU board connector latches and remove the connector from the ROV CPU board.
3. Slide the ROV board set a little further out of the main hull.
4. Remove the camera ribbon cable from the ROV CPU board.
5. Remove the pressure sensor ribbon cable from the ROV CPU board.
6. Slide the ROV board set a little further out of the main hull.
7. Remove the ROV power board connector from the ROV power control board.
8. Slide the ROV board set completely out of the main hull.

ROV Board Set Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 33 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the ROV Board Set.

Notes:

- When working on the ROV board set, follow standard anti-static practices to avoid damaging the board set.

ROV Board Set Replacement Procedures

Time required for this step: Approximately 5 Minutes

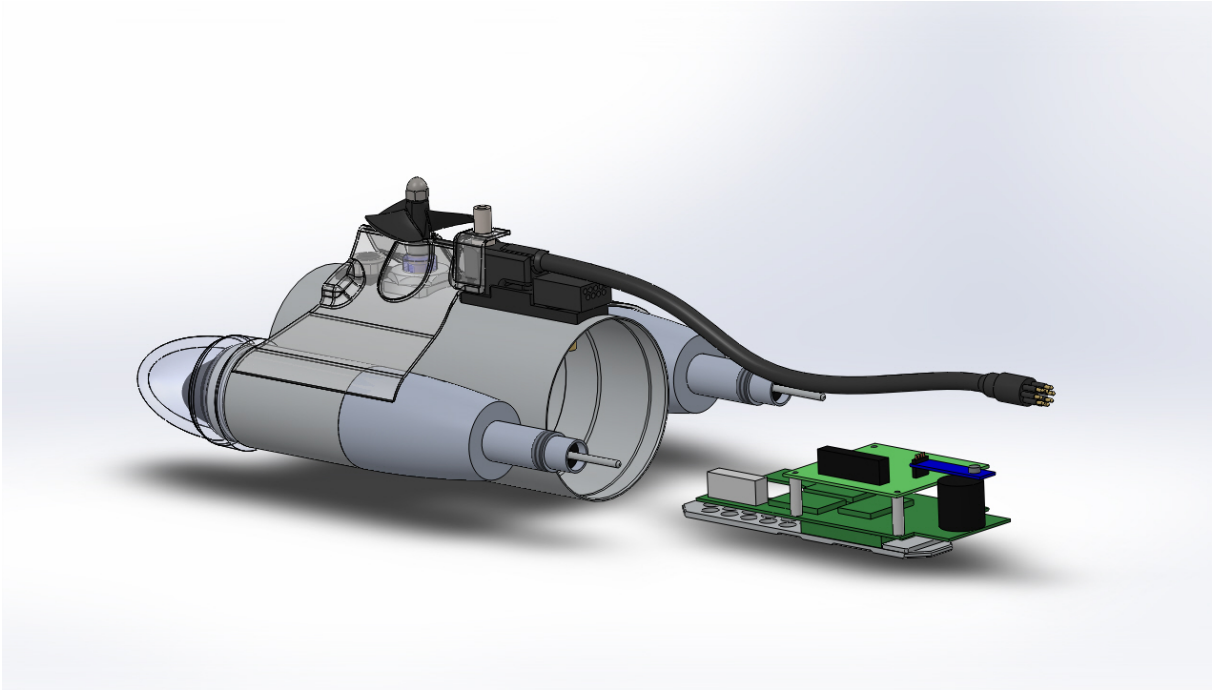
Tools required for this step:

- None

Parts involved in this step:

CB-01-PRO4-SET ROV Board Set

Quantity	Part Number	Part Description
1	CB-01-PRO4-SET	Circuit Board ROV Set (Pro 4)



Steps

1. Orient the ROV board set at the rear of the main hull and with the circular cut out for the vertical motor toward the hull and the heat sink on the bottom.
2. Slide the ROV board set part way into the main hull.
3. Connect the ROV power board connector to the ROV power board.
4. Slide the ROV board set a little further into the main hull.
5. Connect the pressure sensor ribbon cable to the pressure sensor connector on the ROV CPU board.
6. Connect the camera ribbon cable to the camera connector on the ROV CPU board.
7. Slide the ROV board set a little further into the main hull.
8. Connect the ROV CPU board connector to the ROV CPU board and secure the connector latches.
9. Slide the ROV board set the remainder of the way into the main hull.
10. If the front hull ring is installed, make sure the from of the heat sink ROV bar is inserted into the receiver bracket on the back of the front hull ring.

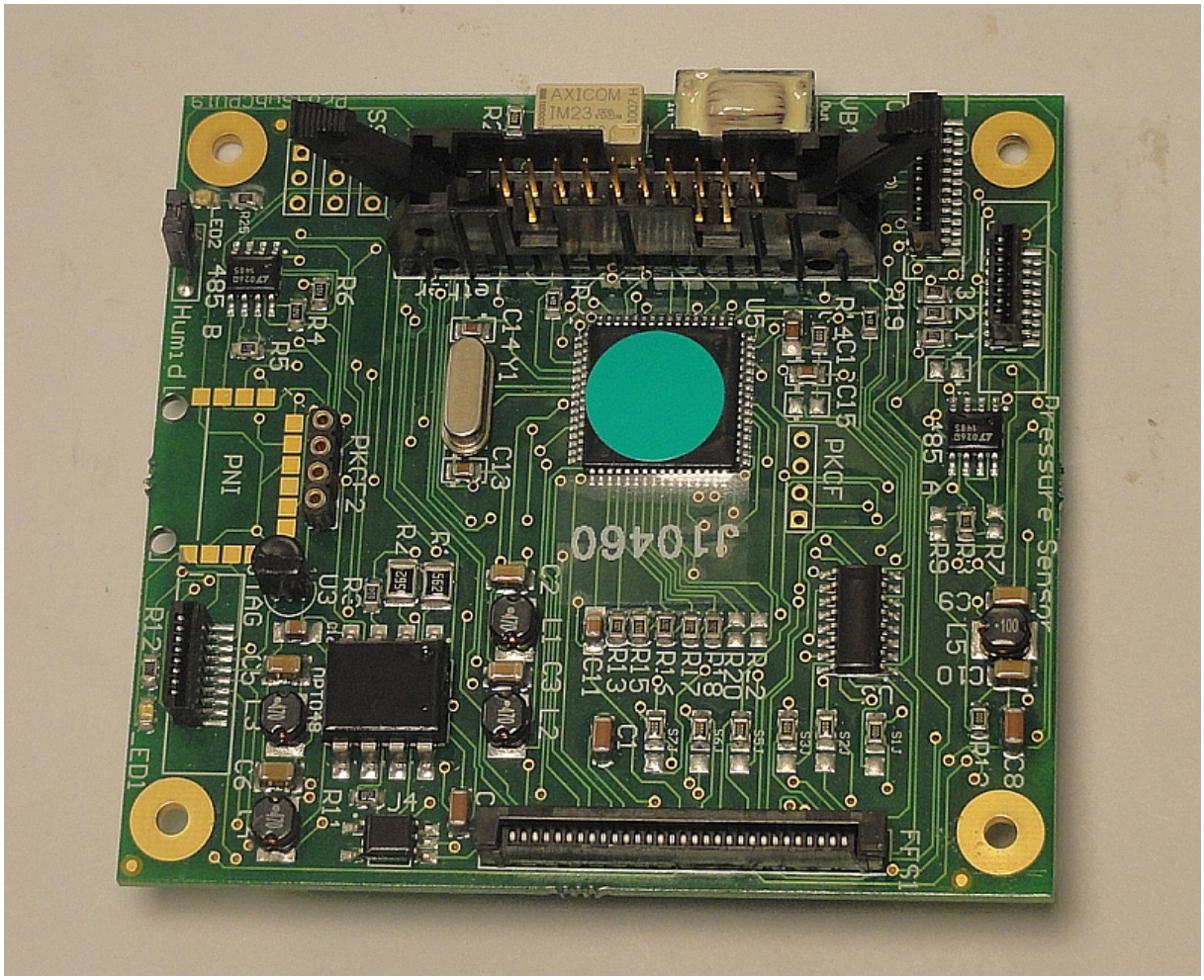
Tip

If the front dome is in place, make sure the front of the ROV heat sink engages in the receiver on the rear of the front hull ring.

If the front dome is removed, there is nothing to secure the ROV Board Set. When assembly is completed the board set is held in place by the receiver brackets in the front and rear hull rings. The wires should hold it in place, but careful not to dislodge the board set while completing the remaining steps of this procedure.

ROV CPU Printed Circuit Board

- Part Number: PRO4-SUB-CPU19



ROV CPU Printed Circuit Board Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 37 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- ROV CPU Printed Circuit Board

See the corresponding sections of this manual for instructions for parts other than the ROV CPU Printed Circuit Board.

Notes:

- When working on the CPU board, follow standard anti-static practices to avoid damaging the board.

ROV CPU Printed Circuit Board Removal Procedures

Time required for this step: Approximately 5 Minutes

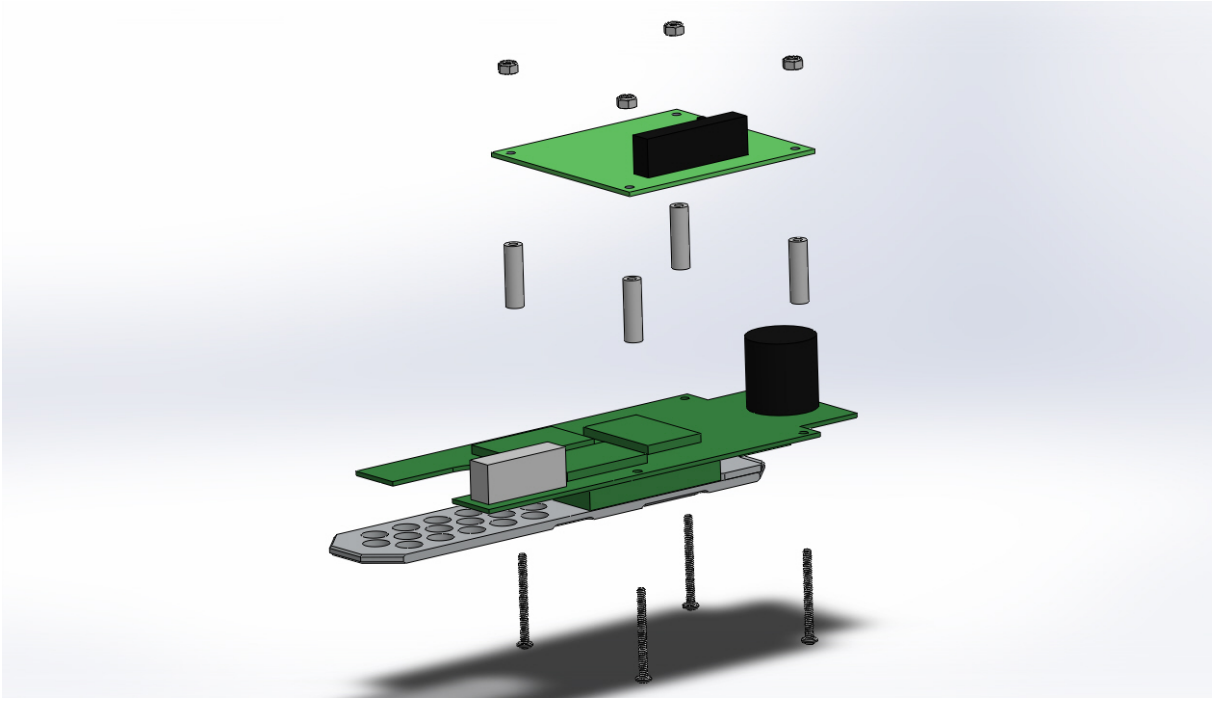
Tools required for this step:

- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver

Parts involved in this step:

PRO4-SUB-CPU19 ROV CPU Printed Circuit Board

Quantity	Part Number	Part Description
1	PRO4-SUB-CPU19	Circuit Board ROV CPU (Pro 4)
1	HF30U-03-ND	Cable 3" Ribbon 30 Conductor
4	91772A116	Screw #4-40 x 1-1/4" Pan Head Phillips SS
4	91831A005	Nut #4-40 x 1/4" Nylock
4	881K-ND	Spacer #4 x 7/8" Nylon



Steps

1. Loosen the ribbon cable connector clamp on the ROV CPU board, and disconnect the ribbon cable from the ROV CPU board.
2. Remove the four 4-40 Nylock nuts that hold the ROV CPU board to the ROV power control board.
3. Separate the ROV CPU board from the ROV power control board.
4. Remove the four #4 X 7/8 inch spacers and 4-40 X 1-1/4 inch Phillips head screws from the ROV power control board.

ROV CPU Printed Circuit Board Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 38 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- ROV CPU Printed Circuit Board
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the ROV CPU Printed Circuit Board.

Notes:

- When working on the CPU board, follow standard anti-static practices to avoid damaging the board.

ROV CPU Printed Circuit Board Replacement Procedures

Time required for this step: Approximately 5 Minutes

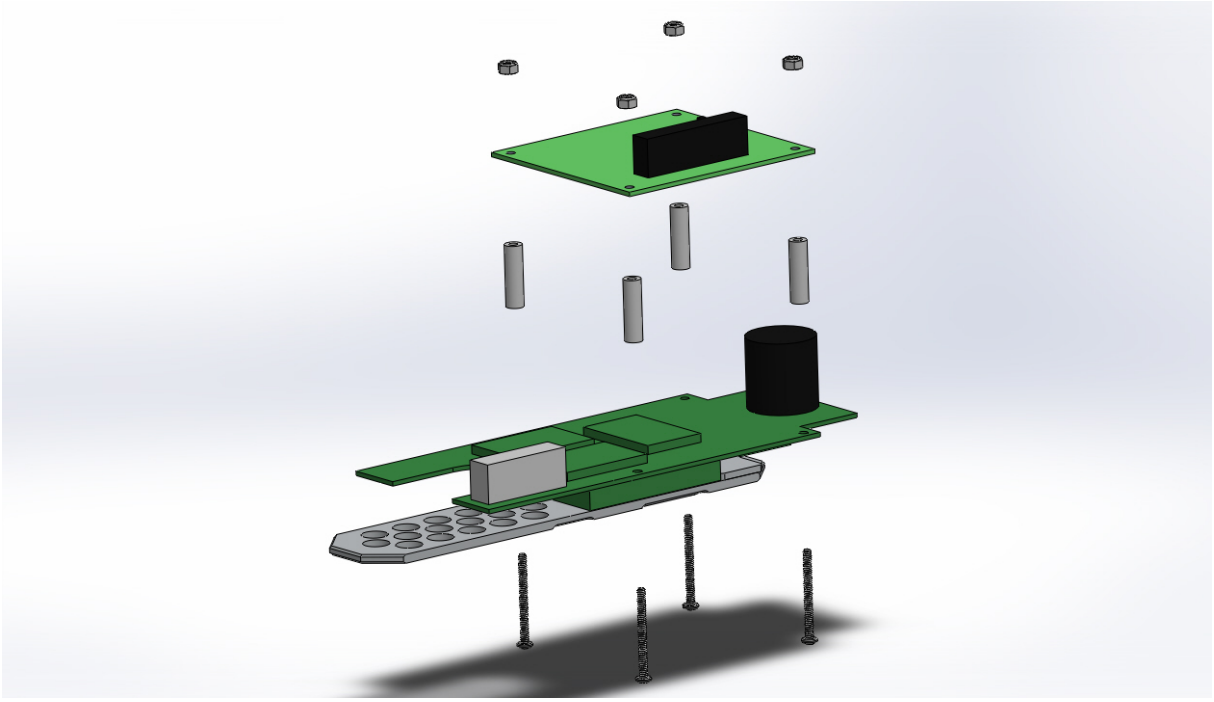
Tools required for this step:

- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver

Parts involved in this step:

PRO4-SUB-CPU19 ROV CPU Printed Circuit Board

Quantity	Part Number	Part Description
1	PRO4-SUB-CPU19	Circuit Board ROV CPU (Pro 4)
1	HF30U-03-ND	Cable 3" Ribbon 30 Conductor
4	91772A116	Screw #4-40 x 1-1/4" Pan Head Phillips SS
4	91831A005	Nut #4-40 x 1/4" Nylock
4	881K-ND	Spacer #4 x 7/8" Nylon

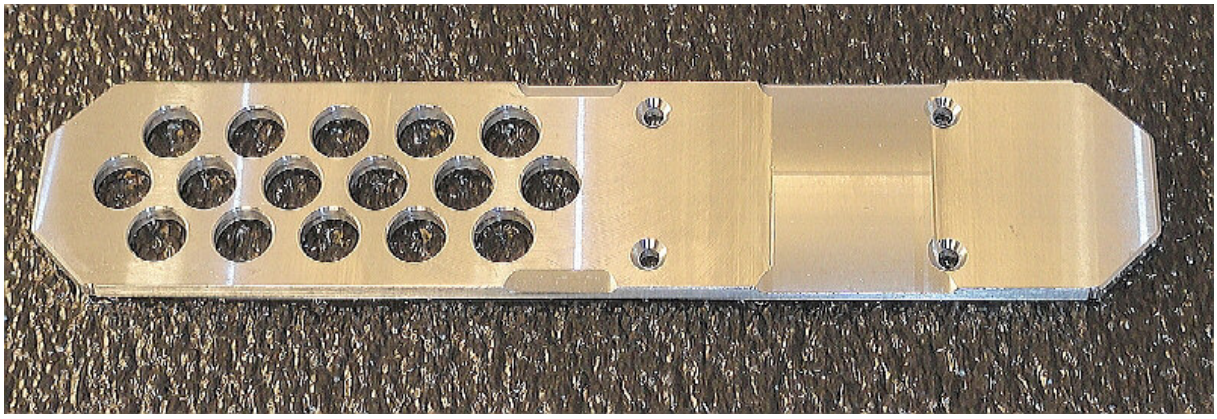


Steps

1. If not installed, install the ribbon cable in the ROV power board and secure the ribbon cable connector clamp.
2. Orient the ROV CPU board above the ROV power board so that the navigation module socket is over the large capacitors and the ribbon cable connectors on the board are both oriented up and on the same side.
3. Align both boards so that the four mounting holes line up.
4. Replace the four 4-40 X 1-1/4 inch Phillips head screws through the ROV power board from the bottom and then through the #4 X 7/8 inch spacers and then through the CPU board.
5. Replace the four 4-40 Nylock nuts on the screws on the top side of the ROV CPU Board and tighten the nuts.
6. Replace the ribbon cable in the ROV CPU board and secure the ribbon cable connector clamp.

ROV Heat Sink

- Part Number: MAR-PCB6



ROV Heat Sink Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 37 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- #1 Phillips Head Screw Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- ROV Heat Sink

See the corresponding sections of this manual for instructions for parts other than the ROV Heat Sink.

Notes:

- When working on the heat sink, follow standard anti-static practices to avoid damaging the ROV power board.

ROV Heat Sink Removal Procedures

Time required for this step: Approximately 5 Minutes

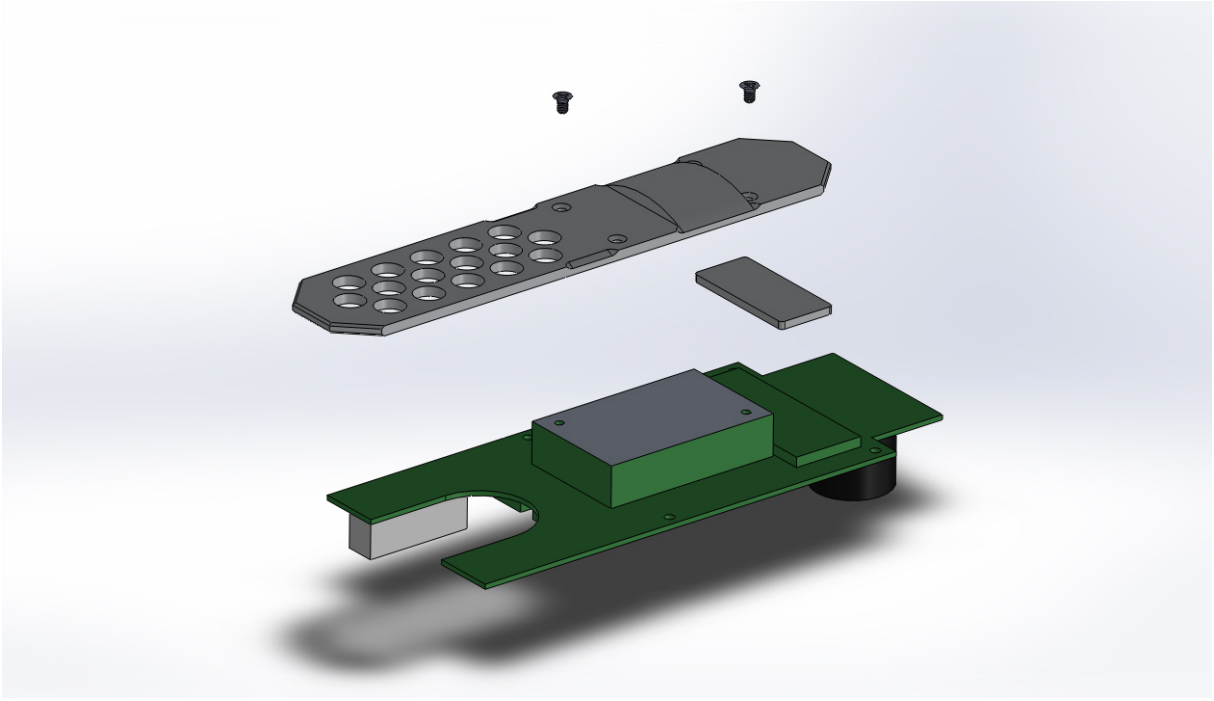
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-PCB6 ROV Heat Sink

Quantity	Part Number	Part Description
1	MAR-PCB6	Heat Sink ROV Bar (Pro 4)
1	MAR-PCB6-SPCR	Heat Sink ROV Bar Spacer (Pro 4)
1	BER170-ND	Heat Sink 36.83mm x 21.08mm x 0.14mm Thermal Pad
2	92010A114	Screw M3 x 0.5mm x 5mm Flat Head Phillips SS



Steps

1. Remove the two 3 X 5 mm Phillips flat head screws that hold the heat sink to the ROV power control board.
2. Lift the heat sink from the ROV power control board. Make sure to keep track of the small heat sink and two small thick heat sink pads.
3. Remove the heat sink spacer and heat sink pad from under where the heat sink was located.

Tips

Some heat sink bars may have four screws instead of two.

ROV Heat Sink Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 38 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- ROV Heat Sink
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the ROV Heat Sink.

Notes:

- When working on the heat sink, follow standard anti-static practices to avoid damaging the ROV power board.

ROV Heat Sink Replacement Procedures

Time required for this step: Approximately 5 Minutes

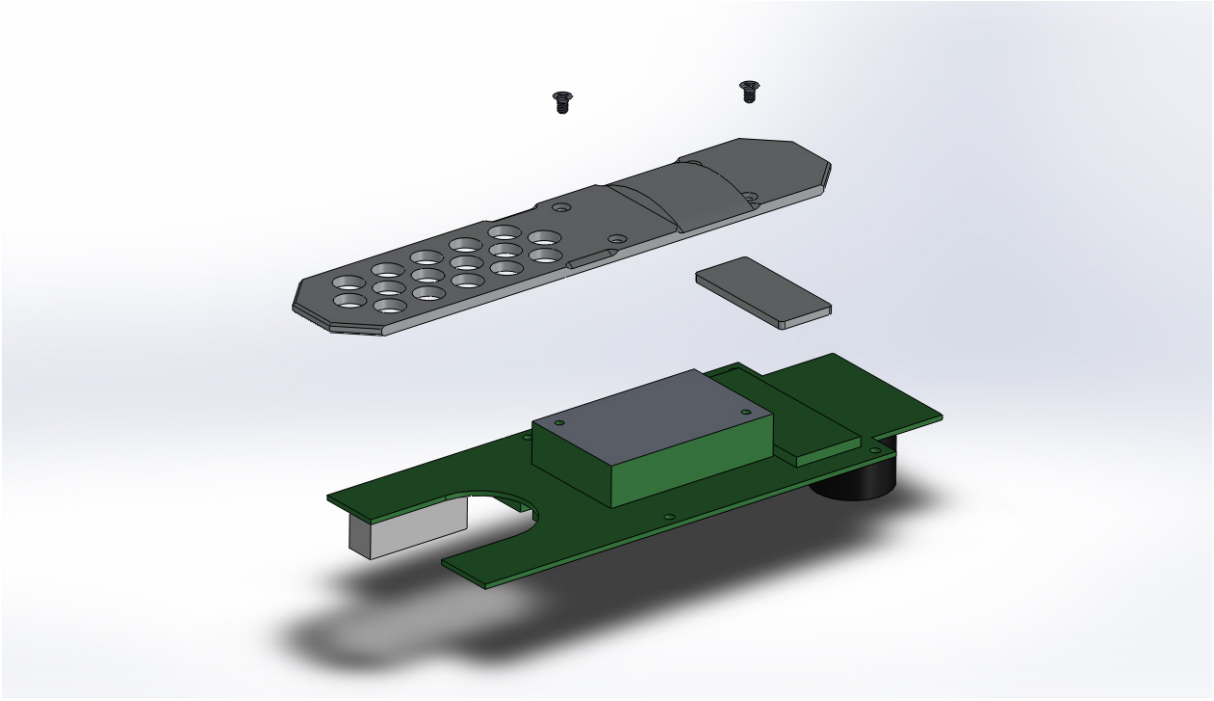
Tools required for this step:

- #1 Phillips Head Screw Driver

Parts involved in this step:

MAR-PCB6 ROV Heat Sink

Quantity	Part Number	Part Description
1	MAR-PCB6	Heat Sink ROV Bar (Pro 4)
1	MAR-PCB6-SPCR	Heat Sink ROV Bar Spacer (Pro 4)
1	BER170-ND	Heat Sink 36.83mm x 21.08mm x 0.14mm Thermal Pad
2	92010A114	Screw M3 x 0.5mm x 5mm Flat Head Phillips SS



Steps

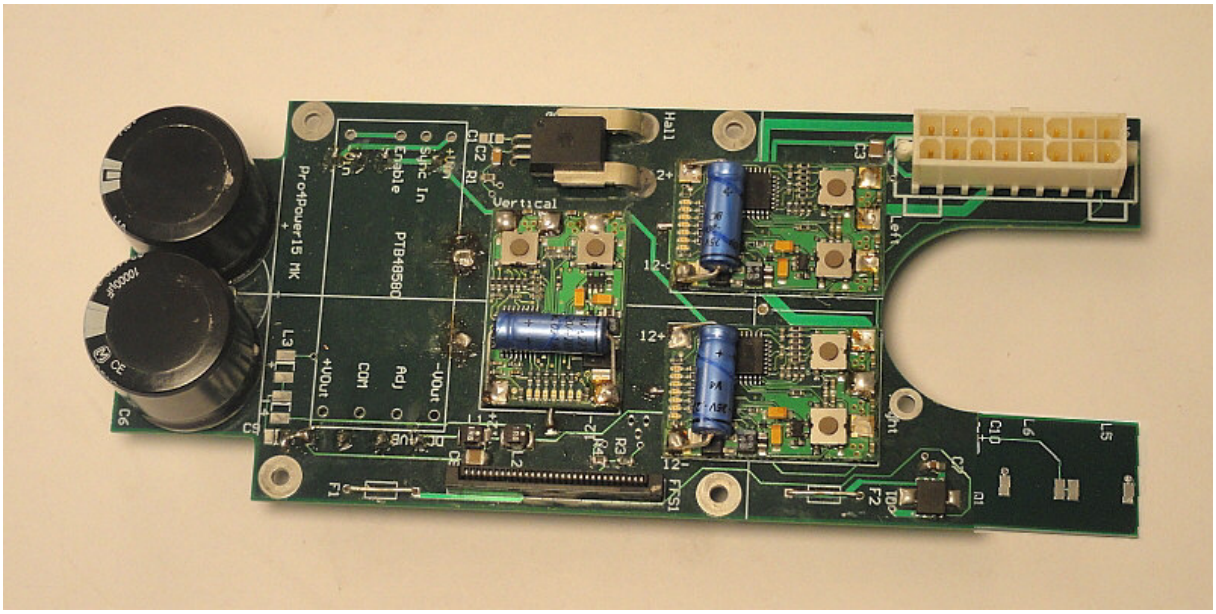
1. Place the two small thick heat sink pads over the shorter component on the bottom of the ROV power board.
2. Place the small aluminum heat sink over the pads and taller component on the bottom of the ROV power board.
3. Orient the heat sink at the bottom of the ROV power board so that the curved surface of the heat sink faces away from the ROV power board and the end of the heat sink with the holes is toward the circular cut out in the ROV power board for the vertical thruster.
4. Align the screw holes in the ROV heat sink and ROV power board.
5. Replace the two 3 X 5 mm Phillips flat head screws and tighten the screws.
6. Make sure the thin heat sink pad is in place on the curved part of the heat sink.

Tips

Some heat sink bars may have four screws instead of two.

ROV Power Control Printed Circuit Board

- Part Number: PRO4-SUB-POWER



ROV Power Control Printed Circuit Board Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 42 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- ROV CPU Printed Circuit Board
- ROV Heat Sink
- ROV Power Control Printed Circuit Board

See the corresponding sections of this manual for instructions for parts other than the ROV Power Control Printed Circuit Board.

Notes:

- When working on the ROV power board, follow standard anti-static practices to avoid damaging the ROV power board.
- The Pro 4 ROV power board has been updated. Old ROV power boards are 25 Amp and can be identified by two large capacitors at the rear of the ROV power board. New ROBV power boards are 33 Amp and can be identified by one large capacitor at the rear of the ROV power board.

ROV Power Control Printed Circuit Board Removal Procedures

Time required for this step: Approximately 0 Minute

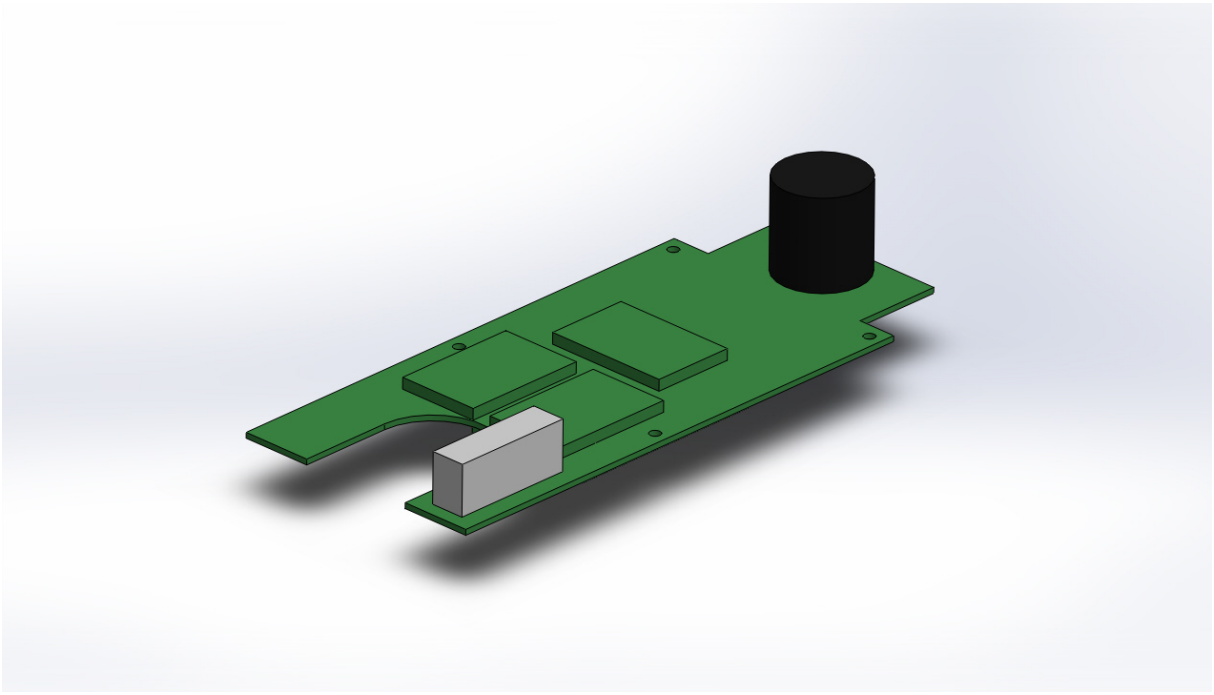
Tools required for this step:

- None

Parts involved in this step:

PRO4-SUB-POWER ROV Power Control Printed Circuit Board

Quantity	Part Number	Part Description
1	PRO4-SUB-POWER	Circuit Board ROV Power (Pro 4)



Steps

1. After removing the ROV heat sink, the ROV power control board is considered removed.

ROV Power Control Printed Circuit Board Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 43 Minutes

Tools required:

- #1 Phillips Head Screw Driver
- 1/4 Inch Open End Wrench or Nut Driver
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- ROV Power Control Printed Circuit Board
- ROV Heat Sink
- ROV CPU Printed Circuit Board
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the ROV Power Control Printed Circuit Board.

Notes:

- When working on the ROV power board, follow standard anti-static practices to avoid damaging the ROV power board.

ROV Power Control Printed Circuit Board Replacement Procedures

Time required for this step: Approximately 0 Minute

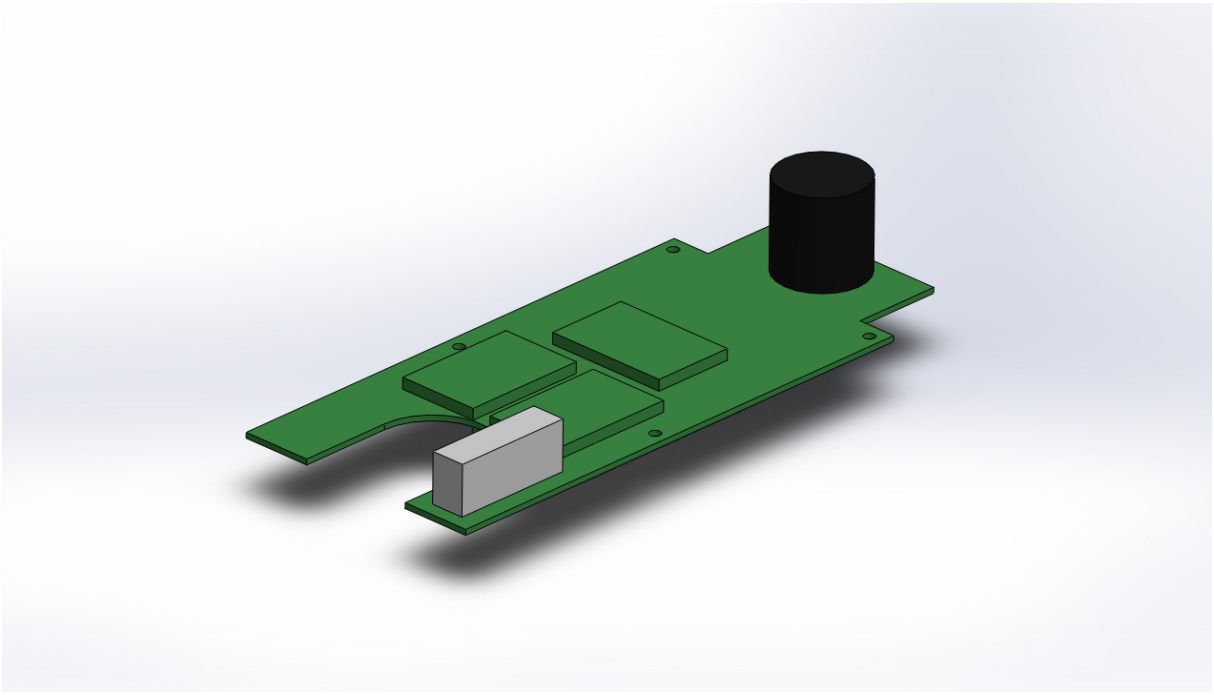
Tools required for this step:

- None

Parts involved in this step:

PRO4-SUB-POWER ROV Power Control Printed Circuit Board

Quantity	Part Number	Part Description
1	PRO4-SUB-POWER	Circuit Board ROV Power (Pro 4)

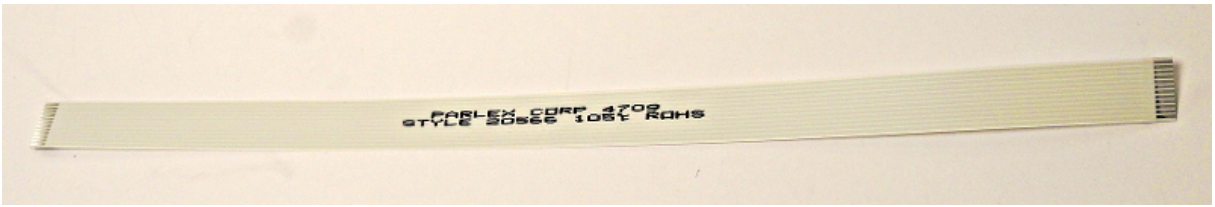


Steps

1. To begin the replacement of the ROV power board, proceed to the next step and install the ROV heat sink.

Camera Ribbon Cable

- Part Number: HF12U-10-ND



Camera Ribbon Cable Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 39 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent

The following components must be removed:

- Float Block Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Camera Ribbon Cable

See the corresponding sections of this manual for instructions for parts other than the Camera Ribbon Cable.

Camera Ribbon Cable Removal Procedures

Time required for this step: Approximately 1 Minute

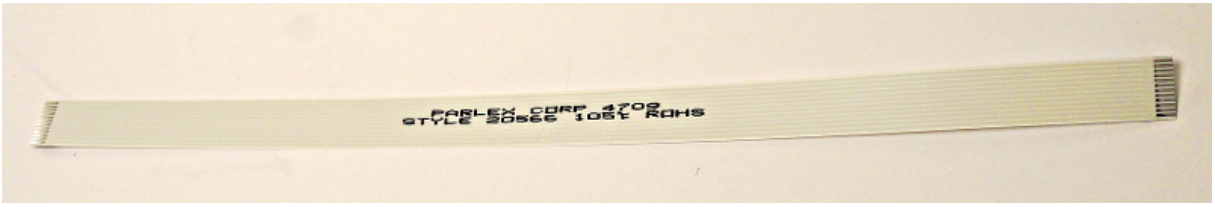
Tools required for this step:

- None

Parts involved in this step:

HF12U-10-ND Camera Ribbon Cable

Quantity	Part Number	Part Description
1	HF12U-10-ND	Cable 10" Ribbon 12 Conductor



Steps

1. Remove the Camera Ribbon Cable from inside the Main Hull.

Camera Ribbon Cable Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 41 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Camera Ribbon Cable
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Camera Ribbon Cable.

Camera Ribbon Cable Replacement Procedures

Time required for this step: Approximately 1 Minute

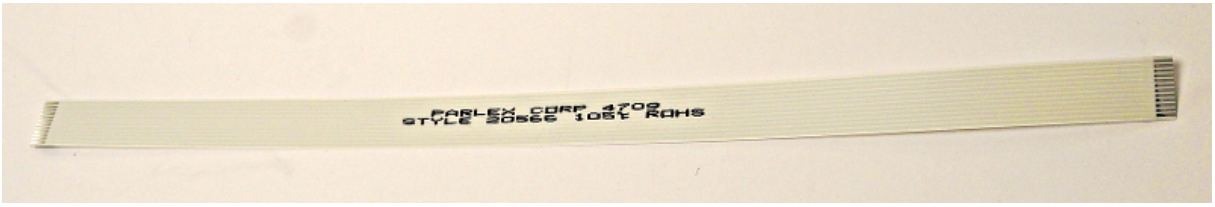
Tools required for this step:

- None

Parts involved in this step:

HF12U-10-ND Camera Ribbon Cable

Quantity	Part Number	Part Description
1	HF12U-10-ND	Cable 10" Ribbon 12 Conductor

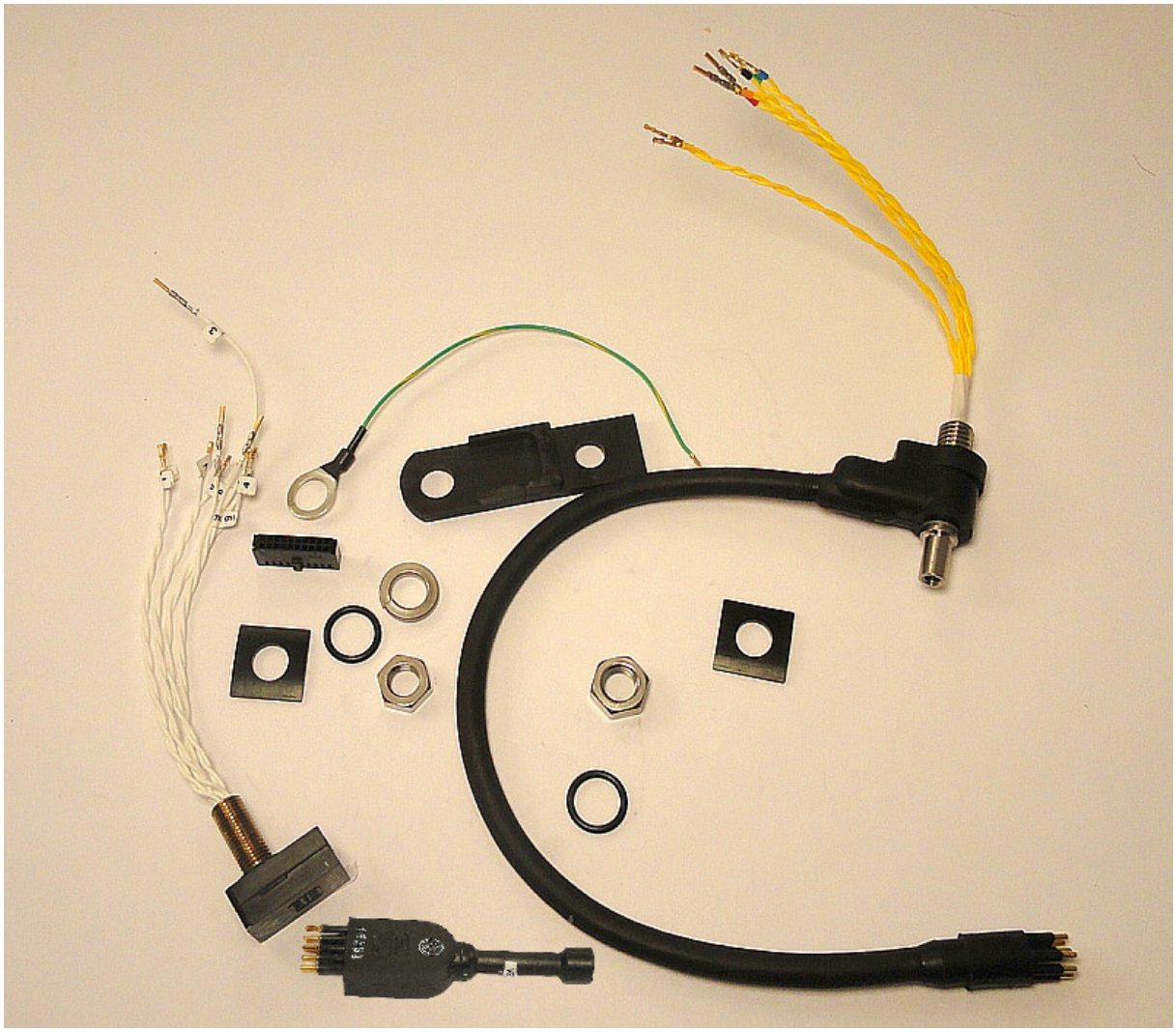


Steps

1. Place the camera ribbon cable inside the main hull. The ribbon cable should pass on the starboard side of the vertical thruster motor assembly. It does not matter which end is installed first, but the ribbon cable should be installed with the contacts should be facing up.
2. At this point the camera ribbon cable is ready to be connected to the camera assembly and ROV board set when these components are installed.

Termination Block and Accessory Port

- Part Number: TB9P-KIT-P4



Termination Block and Accessory Port Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 44 Minutes

Tools required:

- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench

The following components must be removed:

- Float Block Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Strain Relief Cable Kit
- Skid Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Termination Block and Accessory Port

See the corresponding sections of this manual for instructions for parts other than the Termination Block and Accessory Port.

Notes:

- The termination block and accessory port connector need to be removed and replaced as a unit. Do NOT attempt to remove or replace only one at a time.
- During this procedure, you will need to keep track of individual wires and their positions within connectors. The wires should have labels to help reinstall them in the correct connector slots. If you notice a wire does not have a label when you remove it, we recommend that you label it and note the corresponding connector slot.
- Some ROVs may have a green/yellow ground wire connected to the termination block. This has been removed in newer models that have the latest pressure sensor. If the ROV has a white housing pressure sensor, the ground wire should not be used. If the ROV has a black housing pressure sensor, the ground wire must be used.

Termination Block and Accessory Port Removal Procedures

Time required for this step: Approximately 5 Minutes

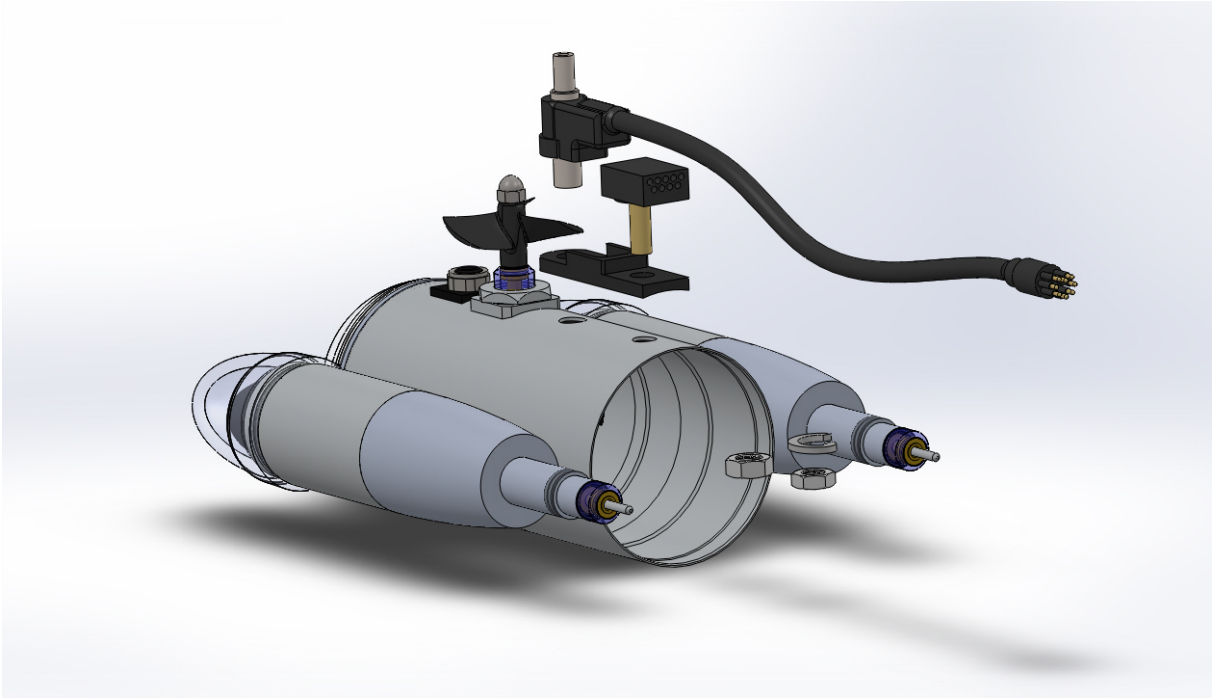
Tools required for this step:

- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench
- Dental Pick or equivalent

Parts involved in this step:

TB9P-KIT-P4 Termination Block and Accessory Port

Quantity	Part Number	Part Description
1	VR-PRO4-10-0001	Termination Block Assembly (Pro 4)
2	OR-114	O-Ring #114
1	OR-014	O-Ring #014
1	OR-017	O-Ring #017
2	TB-003	Termination Block Part Spacer (Inside Main Hull)
1	91847A520	Nut 1/2"-13 x 3/4" SS
1	CB9-001F-ASSM-P4	Accessory Port 9 Pin Bulkhead Assembly Terminated (Pro 4)
1	91475A033	Washer 1/2" Lock SS
1	91847A515	Nut 7/16"-20 x 11/16" SS
1	A25904-ND	Connector 10 x 2 AMPMODU Mod IV Female
1	TB-005	Termination Block Part Plate
1	CB9-001M	Accessory Port 9 Pin Dummy Plug Male



Steps

1. Using a dental pick or similar instrument, remove the termination block and accessory port wires from the ROV CPU board connector.
2. Unlatch the ROV power control board connector latches and remove the termination block and accessory port wires from the ROV power control board connector.
3. From inside the main hull, remove the 7/16-20, 11/16 inch nut and washer from the accessory port connector.
4. From inside the main hull, remove the 1/2-13 and 3/4 inch nut from the termination block.
5. Lift the termination block, accessory port connector and termination block plate from the top of the ROV.
6. Separate the termination block and accessory port connector from the termination block plate.

Tip

Be careful when removing the wires from the connectors. If you break the crimps, you will need to replace them before you can replace the termination block.

Termination Block and Accessory Port Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 50 Minutes

Tools required:

- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench
- Torque Wrench
- Tef-Gel or equivalent
- Blue Loctite or equivalent
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Termination Block and Accessory Port
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Skid Kit
- Strain Relief Cable Kit
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Termination Block and Accessory Port.

Notes:

- The termination block and accessory port connector need to be removed and replaced as a unit. Do NOT attempt to remove or replace only one at a time.
- During this procedure, you will need to keep track of individual wires and their positions within connectors. The wires should have labels to help reinstall them in the correct connector slots. If you notice a wire does not have a label when you remove it, we recommend that you label it and note the corresponding connector slot.
- Some ROVs may have a green/yellow ground wire connected to the termination block. This has been removed in newer models that have the latest pressure sensor. If the ROV has a white housing pressure sensor, the ground wire should not be used. If the ROV has a black housing pressure sensor, the ground wire must be used.

Termination Block and Accessory Port Replacement Procedures

Time required for this step: Approximately 10 Minutes

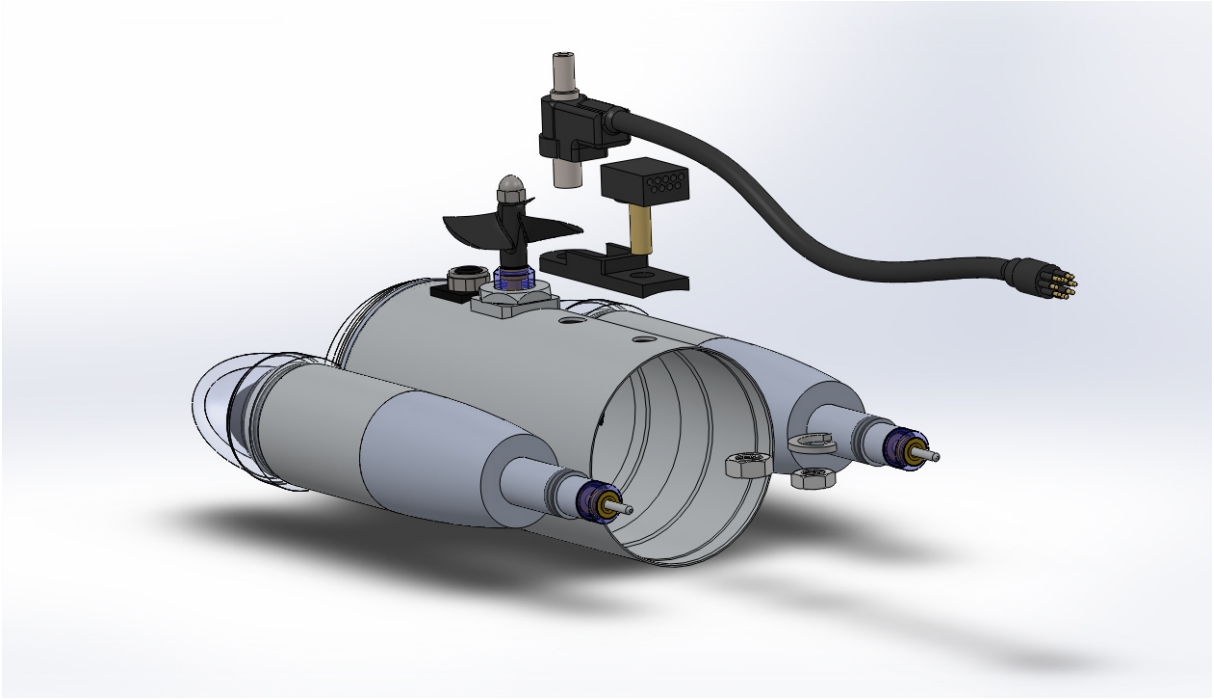
Tools required for this step:

- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench
- Torque Wrench
- Tef-Gel or equivalent
- Blue Loctite or equivalent
- O-Ring Lubricator

Parts involved in this step:

TB9P-KIT-P4 Termination Block and Accessory Port

Quantity	Part Number	Part Description
1	VR-PRO4-10-0001	Termination Block Assembly (Pro 4)
2	OR-114	O-Ring #114
1	OR-014	O-Ring #014
1	OR-017	O-Ring #017
2	TB-003	Termination Block Part Spacer (Inside Main Hull)
1	91847A520	Nut 1/2"-13 x 3/4" SS
1	CB9-001F-ASSM-P4	Accessory Port 9 Pin Bulkhead Assembly Terminated (Pro 4)
1	91475A033	Washer 1/2" Lock SS
1	91847A515	Nut 7/16"-20 x 11/16" SS
1	A25904-ND	Connector 10 x 2 AMPMODU Mod IV Female
1	TB-005	Termination Block Part Plate
1	CB9-001M	Accessory Port 9 Pin Dummy Plug Male



Steps

1. Apply Tef-Gel to the outside of the main hull in the area where the termination block plate will contact the hull. Do NOT get Tef-Gel too close to the holes.
2. Lubricate and install the #014 O-ring over the accessory port connector stud.
3. Place the accessory port connector through rear hole of the termination block plate, with the connector facing toward the rear. The rear hole is closer to the straight edge. The wires should come through the termination block plate on the side with the curved face.

4. Lubricate and install the #017 O-ring over the termination block stud.
5. Place the termination block through the front hole of the termination block plate, with the ROV whip over the accessory port connector. The front hole is closer to the curved edge. The wires should come through the termination block plate on the side with the curved face.
6. Lubricate and install an #114 O-ring over the accessory port connector stud.
7. Lubricate and install an #114 O-ring over the termination block stud.
8. Feed the wires from both connectors through the top holes in the main hull.
9. Pass the wires from the termination block through a termination block spacer and place the spacer over the termination block stud the curved surface of the spacer towards the hull.
10. Apply blue Loctite to the threads of the termination block stud.
11. Pass the wires from the termination block through the termination block 1/2-13, 3/4 inch nut and place the nut over the termination block stud, but do not tighten it all of the way.
12. Pass the wires from the accessory port connector through a termination block spacer and place the spacer over the accessory port connector stud the curved surface of the spacer towards the hull.
13. Apply blue Loctite to the threads of the accessory port connector stud.
14. Pass the wires from the accessory port connector through the accessory port connector washer and place the washer over the accessory port connector stud.
15. Pass the wires from the accessory port connector through the accessory port 7/16-20, 11/16 inch nut and place the nut over the accessory port connector stud, but do not tighten it all of the way.
16. Tighten each nut equally a small amount at a time to 60 inch-pounds (6.8 Nm).
17. Replace the wires into the appropriate slots in the connectors using the tables below.

Connector 10 x 2	Wire
1	Termination Block (8 wires) Pin 1 (Video -)
2	Termination Block (8 wires) Pin 2 (Video +
3	No Connection
4	Termination Block (8 wires) Pin 4 (AUX)
5	No Connection
6	Termination Block (8 wires) Pin 6 (AUX)
7	Termination Block (8 wires) Pin 8 (RS-485 -)
8	Termination Block (8 wires) Pin 7 (RS-485 +)
9	Ground Wire
10	No Connection
11	Accessory Port Connector (9 wires) Socket 1 (Video -)
12	Accessory Port Connector (9 wires) Socket 2 (Video +)
13	No Connection
14	Accessory Port Connector (9 wires) Socket 4 (AUX)
15	No Connection
16	Accessory Port Connector (9 wires) Socket 6 (AUX)
17	Accessory Port Connector (9 wires) Socket 7 (RS-485 +)
18	Accessory Port Connector (9 wires) Socket 8 (RS-495 -)
19	No Connection
20	No Connection

Connector 8 x 2 (ROV Wire Harness)	Wire
1	Right (Starboard) Thruster Yellow
2	Right (Starboard) Thruster Green
3	Vertical Thruster Blue
4	Left (Port) Thruster Blue
5	Left (Port)thruster Green
6	Lights Red
7	Accessory Port Connector (9 wires) Socket 9 (12 V DC)
8	Termination Block (8 wires) Pin 3 (73 V DC)
9	Accessory Port Connector (9 wires) Socket 3 (24 V DC)
10	Right (Starboard) Thruster Blue
11	Vertical Thruster Yellow
12	Vertical Thuster Green
13	Left (Port) Thruster Yellow
14	Lights Black
15	Accessory Port Connector (9 wires) Socket 5 (Ground)

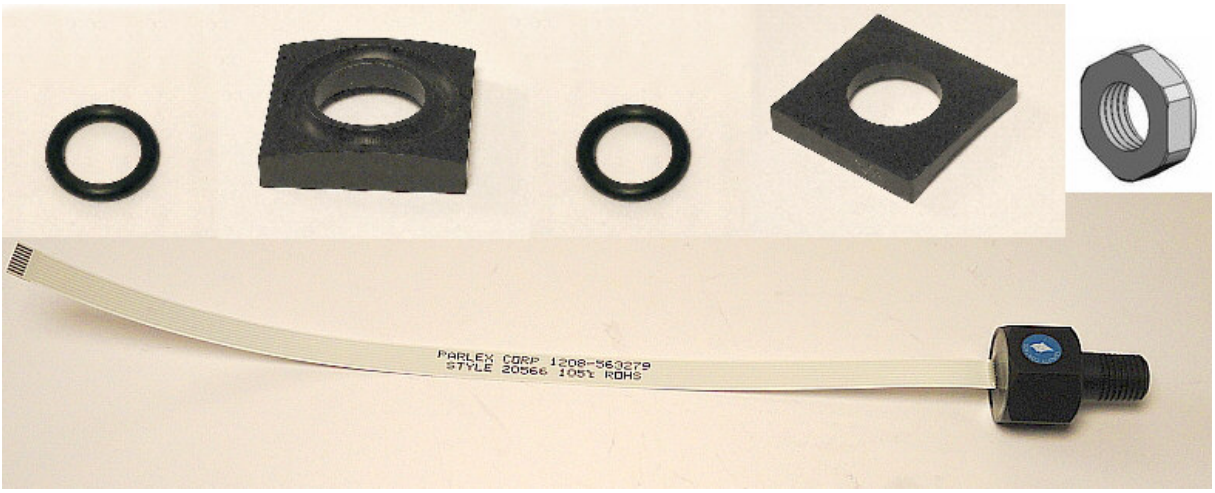
16	Termination Block (8 wires) Pin 5 (Ground)

Product Update

Some ROVs may have a green/yellow ground wire connected to the termination block. This has been removed in newer models that have the latest pressure sensor. If the ROV has a white housing pressure sensor, the ground wire should not be used. If the ROV has a black housing pressure sensor, the ground wire must be used.

Pressure Sensor Kit

- Part Number: VR-PRO4-15-0001



Pressure Sensor Kit Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 47 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit

See the corresponding sections of this manual for instructions for parts other than the Pressure Sensor Kit.

Notes:

- The pressure sensor has been updated to eliminate a need for a ground to the hull. New pressure sensors have a white housing. If replacing a black housing pressure sensor with a white housing pressure sensor, it is important to remove or cut the green/yellow ground wire connected to the termination block.

Pressure Sensor Kit Removal Procedures

Time required for this step: Approximately 5 Minutes

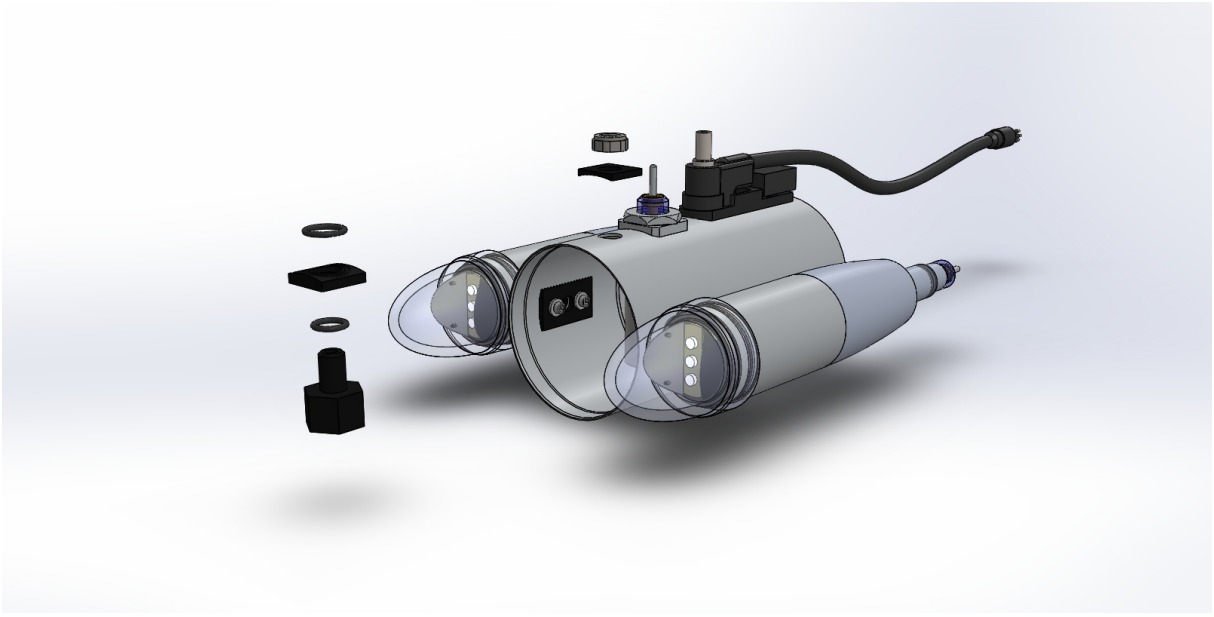
Tools required for this step:

- 3/4 Inch Open End Wrench

Parts involved in this step:

VR-PRO4-15-0001 Pressure Sensor Kit

Quantity	Part Number	Part Description
1	PS-001-ASSM-P4	Pressure Sensor Assembly (Pro 4)
1	OR-112	O-Ring #112
1	PSL-001	Pressure Sensor Part Spacer Lower (Inner)
1	OR-114	O-Ring #114
1	PSU-001	Pressure Sensor Part Spacer Upper (Outer)
1	5530K38	Nut 1/4" NPT x 3/4" Locknut PTFE



Steps

1. Using the 3/4 inch open end wrench, unscrew the pressure sensor 1/4 inch PTFE nut from the top of the pressure sensor.
2. Remove the upper spacer from the top of the pressure sensor.
3. Pull the pressure sensor assembly from the inside of the main hull.

Pressure Sensor Kit Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 49 Minutes

Tools required:

- 3/4 Inch Socket
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Pressure Sensor Kit.

Notes:

- The pressure sensor has been updated to eliminate a need for a ground to the hull. New pressure sensors have a white housing. If replacing a black housing pressure sensor with a white housing pressure sensor, it is important to remove or cut the green/yellow ground wire connected to the termination block stud.

Pressure Sensor Kit Replacement Procedures

Time required for this step: Approximately 5 Minutes

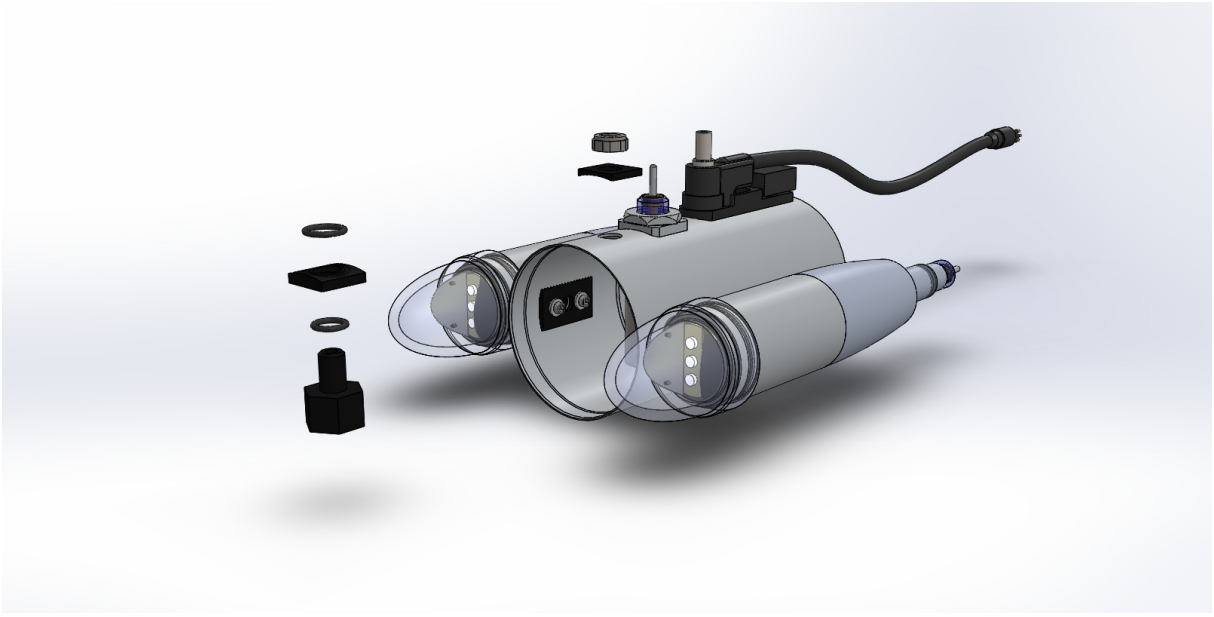
Tools required for this step:

- 3/4 Inch Socket
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator

Parts involved in this step:

VR-PRO4-15-0001 Pressure Sensor Kit

Quantity	Part Number	Part Description
1	PS-001-ASSM-P4	Pressure Sensor Assembly (Pro 4)
1	OR-112	O-Ring #112
1	PSL-001	Pressure Sensor Part Spacer Lower (Inner)
1	OR-114	O-Ring #114
1	PSU-001	Pressure Sensor Part Spacer Upper (Outer)
1	5530K38	Nut 1/4" NPT x 3/4" Locknut PTFE



Steps

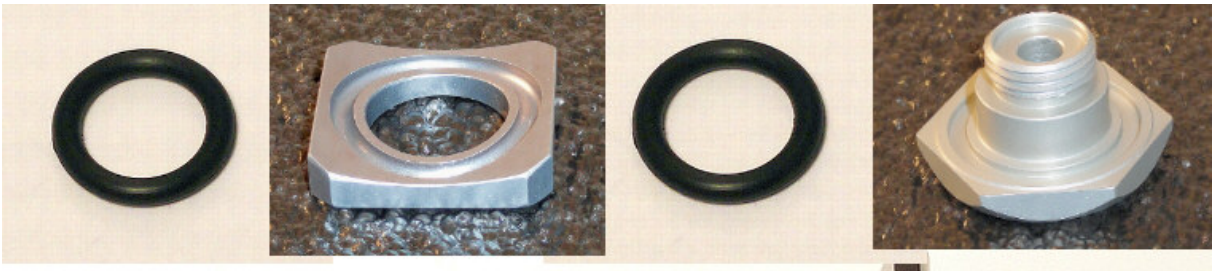
1. Clean the area around the opening for the pressure sensor on the inside and outside of the main hull. Spread a thin layer of Tef-Gel to completely cover the area under the upper spacer on the outside of the main hull.
2. Lubricate and install the #112 O-ring over the pressure sensor.
3. Place the lower pressure sensor spacer in position over the pressure sensor, with the curved surface away from the pressure sensor.
4. Lubricate and install the #114 O-ring in the groove on the top side of the lower pressure sensor spacer.
5. Replace the pressure sensor and lower pressure sensor spacer from the inside of the main hull through the pressure sensor hole in the hull.
6. Replace the upper pressure sensor spacer over the pressure sensor stud, with the curved surface towards the hull.
7. Orient the pressure sensor so that the connectors in its ribbon cable are facing toward the rear of the ROV.
8. Make sure the upper and lower pressure sensor spacers are oriented so the curved surface of each aligns with the curvature of the main hull.
9. Replace the pressure sensor nut in position over the pressure sensor stud and tighten the nut to 26 inch-pounds (2.5 Nm). Use your hand to hold the pressure sensor housing inside the main hull to prevent it from rotating. Do not use any tools to hold the pressure sensor housing.

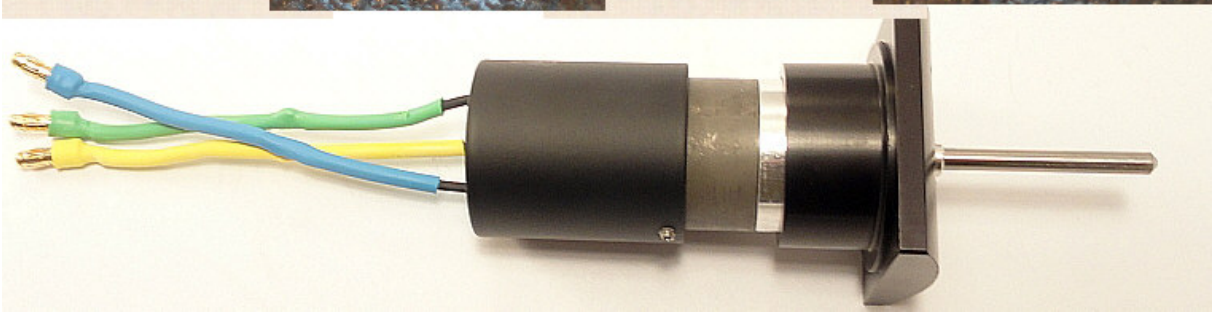
Product Update

The pressure sensor has been updated to eliminate a need for a ground to the hull. New pressure sensors have a white housing. If replacing a black housing pressure sensor with a white housing pressure sensor, it is important to remove or cut the green/yellow ground wire connected to the termination block.

Vertical Thruster Kit

- Part Number: VR-PRO4-02-KIT





Vertical Thruster Kit Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 54 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Kit.

Vertical Thruster Kit Removal Procedures

Time required for this step: Approximately 5 Minutes

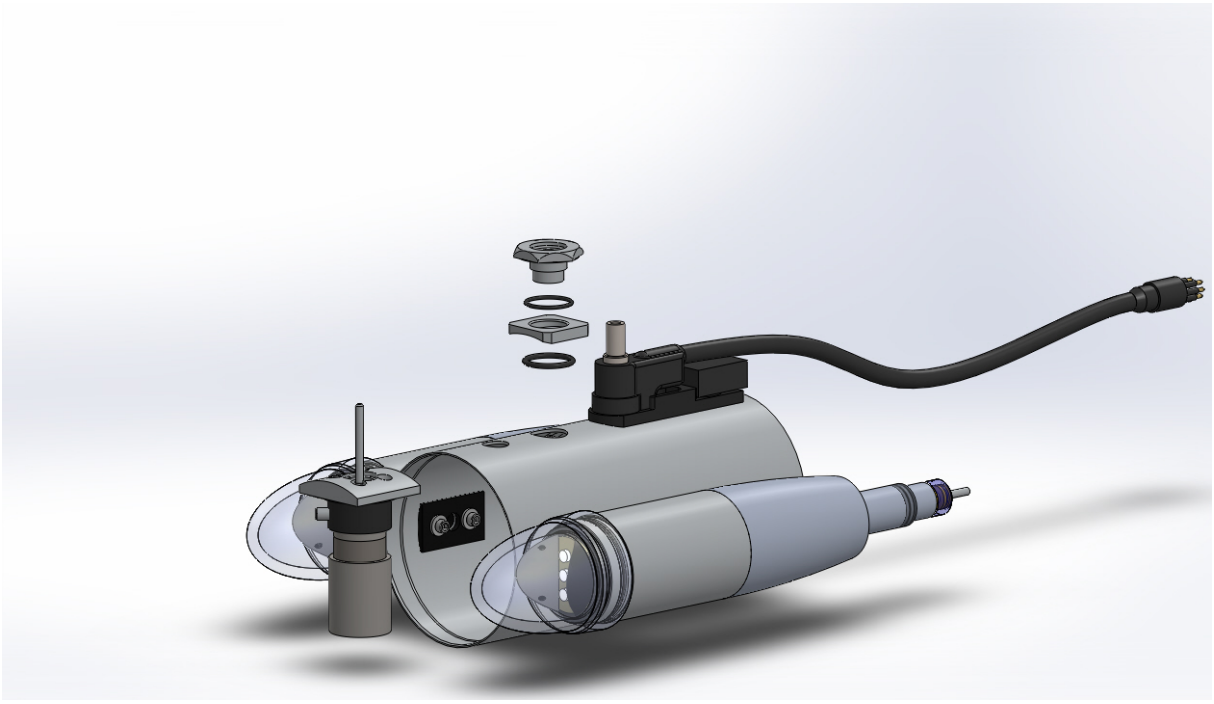
Tools required for this step:

- 1-1/4 Inch Open End or Deep Socket Wrench

Parts involved in this step:

VR-PRO4-02-KIT Vertical Thruster Kit

Quantity	Part Number	Part Description
1	VR-PRO4-02-0001	Thruster Assembly Vertical Drive Train Brushless (Pro 4)
1	VTH-001-GY	Thruster Part Vertical Cone (Pro 4)
1	VTH-003-GY	Thruster Part Vertical Cone Spacer (Pro 4)
1	OR-020	O-Ring #020
1	OR-118	O-Ring #118



Steps

1. From inside the main hull, cut the cable tie that holds the wires to the vertical thruster motor.
2. From inside the main hull, disconnect the wires from the vertical thruster motor.
3. Unscrew the vertical thruster dome nut from the top of the vertical thruster drive train.
4. Remove vertical thruster motor spacer from the top of the vertical motor drive train.
5. Pull the vertical drive train from the inside of the main hull.

Vertical Thruster Kit Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 56 Minutes

Tools required:

- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- Lint-Free Tissue or Rag
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Kit.

Vertical Thruster Kit Replacement Procedures

Time required for this step: Approximately 5 Minutes

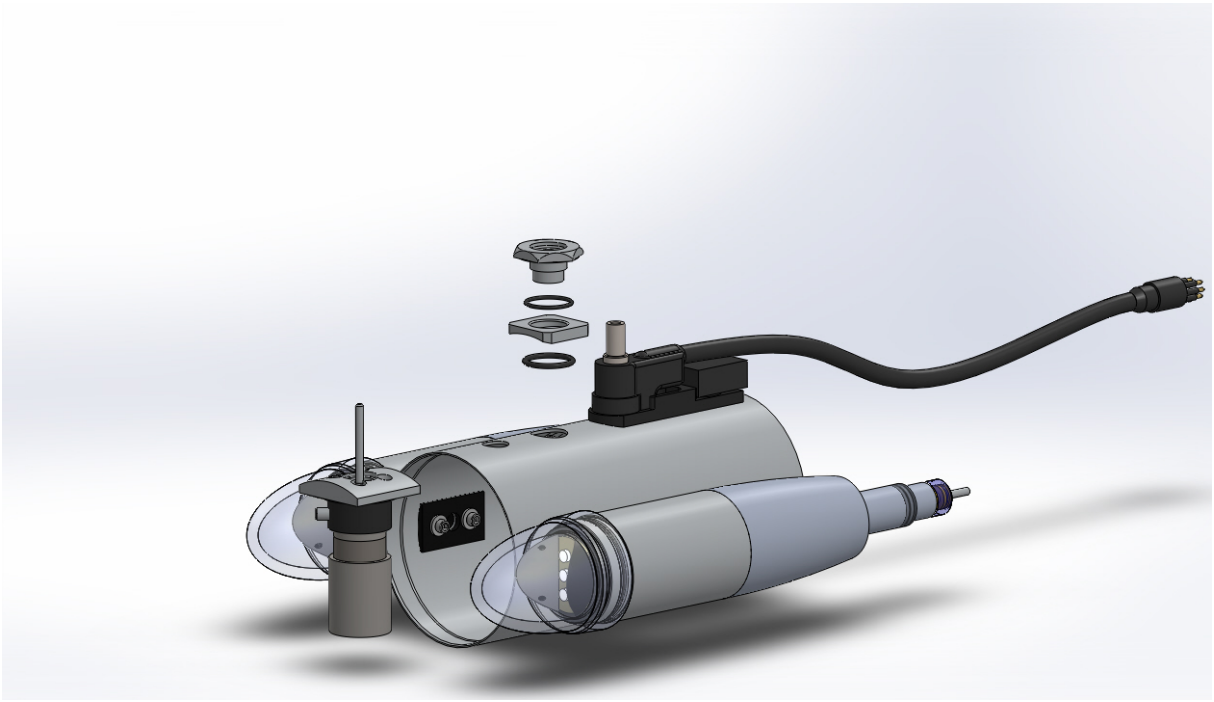
Tools required for this step:

- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator

Parts involved in this step:

VR-PRO4-02-KIT Vertical Thruster Kit

Quantity	Part Number	Part Description
1	VR-PRO4-02-0001	Thruster Assembly Vertical Drive Train Brushless (Pro 4)
1	VTH-001-GY	Thruster Part Vertical Cone (Pro 4)
1	VTH-003-GY	Thruster Part Vertical Cone Spacer (Pro 4)
1	OR-020	O-Ring #020
1	OR-118	O-Ring #118

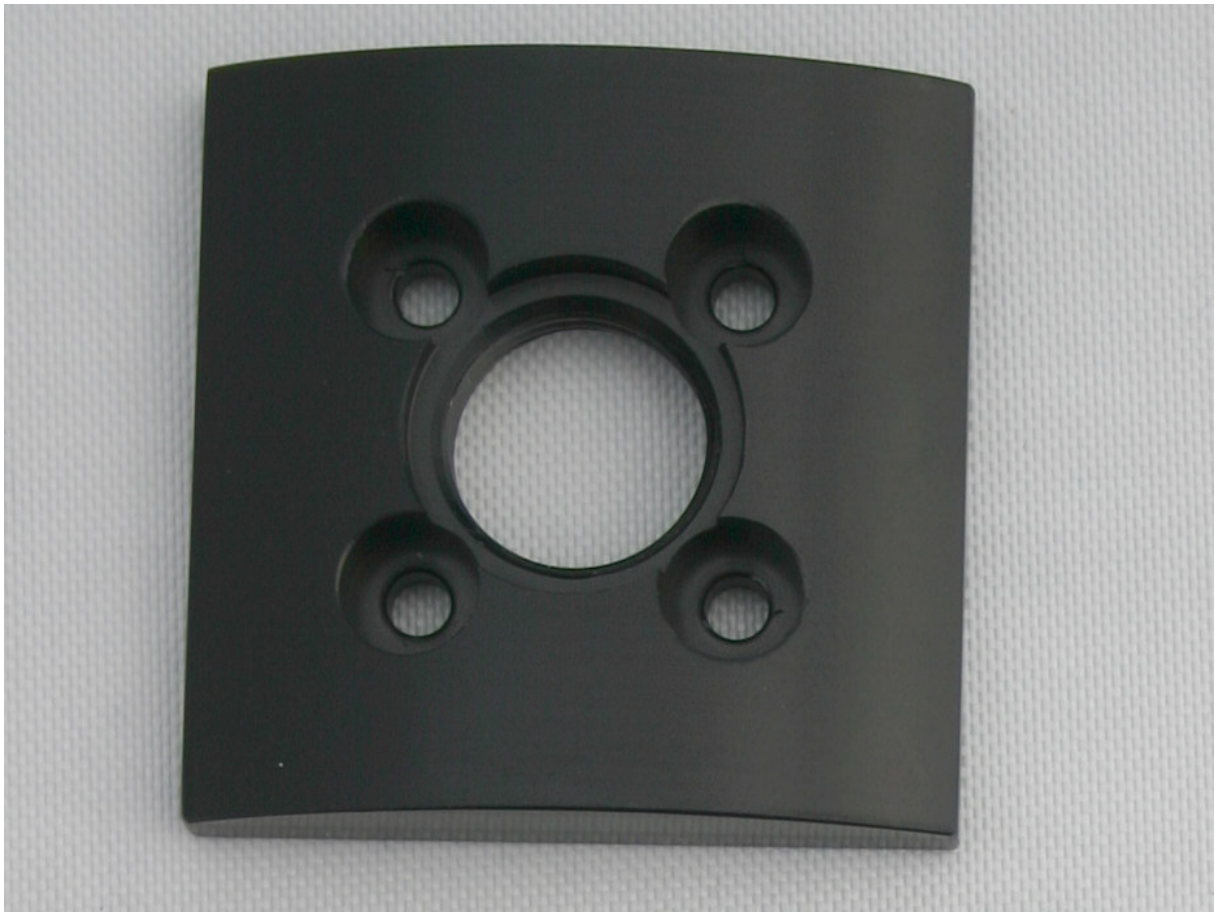


Steps

1. Apply Tef-Gel to the main hull in the area where the vertical thruster cone spacer will contact the hull. Do NOT get Tef-Gel too close to the hole.
2. Install the vertical thruster drive train from the inside of the main hull with the motor wires toward the front of the ROV and the thruster shaft through the vertical thruster hole in the main hull.
3. Lubricate and install the #118 O-ring in the vertical thruster spacer.
4. Replace the vertical thruster spacer over the vertical thruster drive train, with the curved surface towards the hull.
5. Lubricate and install the #020 O-ring in the vertical thruster dome nut.
6. Make sure the vertical thruster drive train and spacer are aligned concentrically with the vertical thruster hole in the hull.
7. Replace the vertical thruster dome nut over the vertical thruster drive train and tighten the nut to 70 inch-pounds (7.9 Nm).
8. Connect the wires from the vertical motor assembly to the corresponding wires of the ROV wire harness.
9. Secure the wires to vertical thruster motor assembly using the cable tie.

Vertical Thruster Motor Mount

- Part Number: VTH-002



Vertical Thruster Motor Mount Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 59 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit
- Vertical Thruster Motor Mount

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Mount.

Vertical Thruster Motor Mount Removal Procedures

Time required for this step: Approximately 5 Minutes

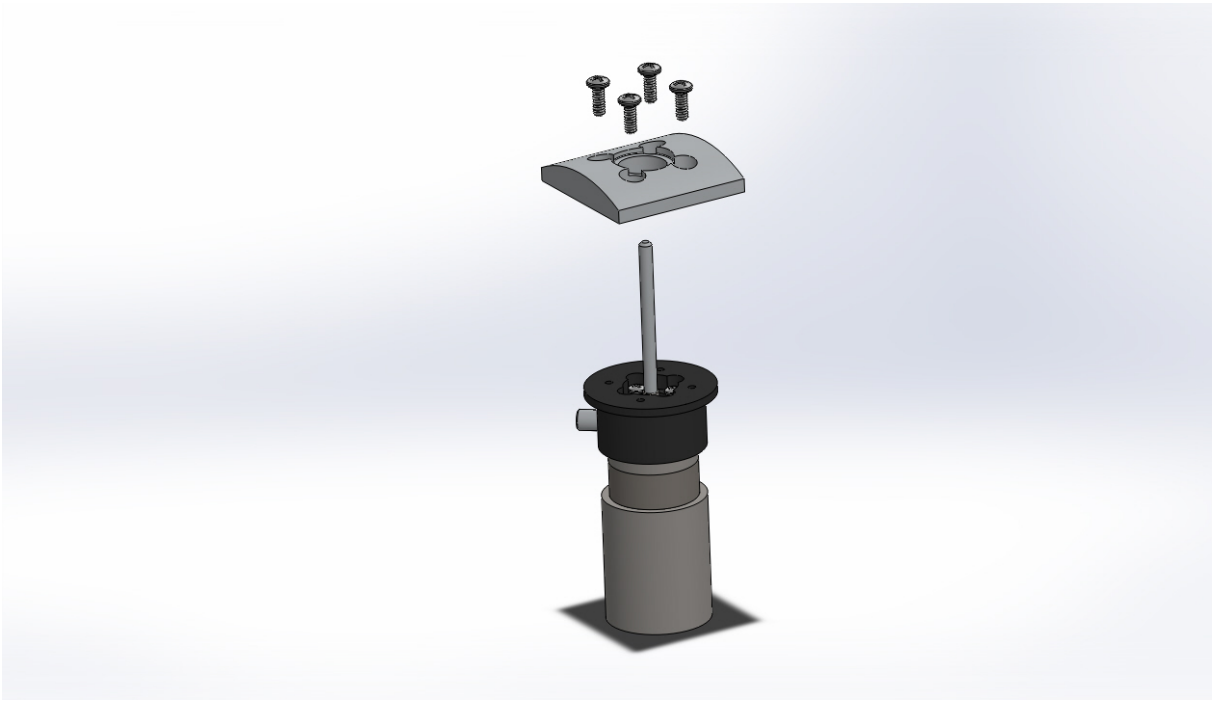
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

VTH-002 Vertical Thruster Motor Mount

Quantity	Part Number	Part Description
1	VTH-002	Thruster Part Vertical Motor Mount
4	91772A146	Screw #6-32 x 3/8" Pan Head Phillips SS



Steps

1. Remove the four 6-32 X 3/8 inch Phillips head screws that hold the vertical motor mount to the vertical motor assembly.
2. Pull the vertical motor mount off of the vertical motor assembly.

Vertical Thruster Motor Mount Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 61 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- Lint-Free Tissue or Rag

The following components must be replaced:

- Vertical Thruster Motor Mount
- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Mount.

Vertical Thruster Motor Mount Replacement Procedures

Time required for this step: Approximately 5 Minutes

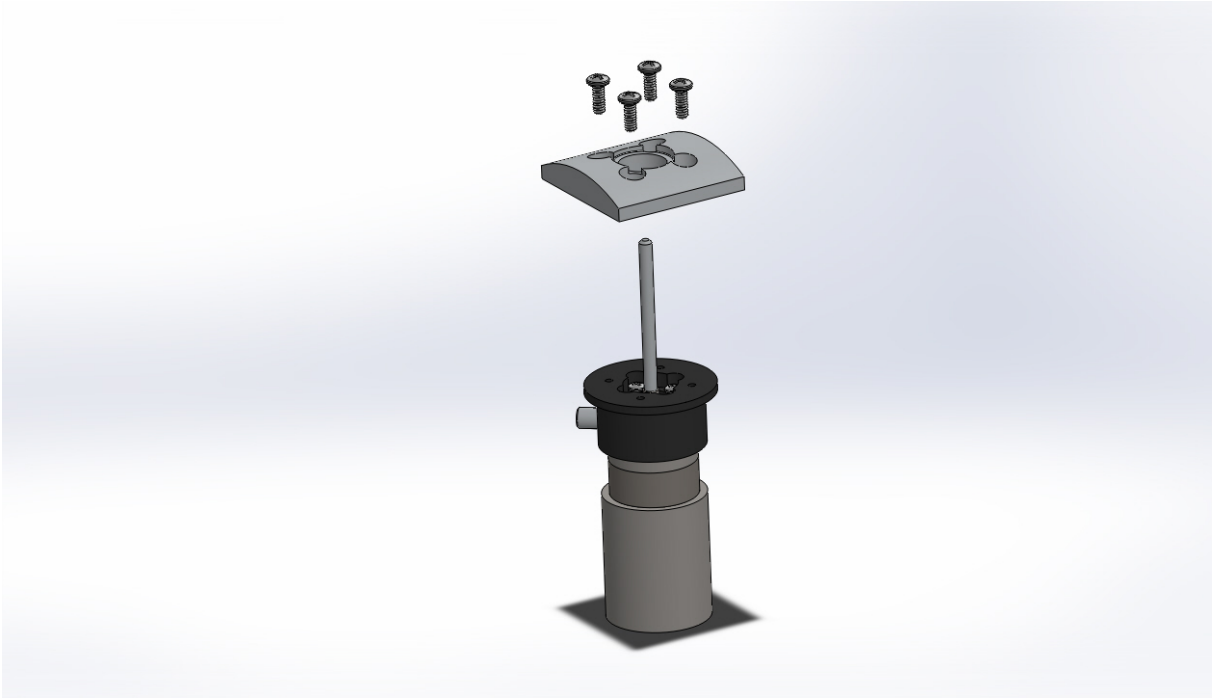
Tools required for this step:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent

Parts involved in this step:

VTH-002 Vertical Thruster Motor Mount

Quantity	Part Number	Part Description
1	VTH-002	Thruster Part Vertical Motor Mount
4	91772A146	Screw #6-32 x 3/8" Pan Head Phillips SS



Steps

1. Orient the vertical thruster motor mount at the shaft end of the vertical motor assembly and the curved surface away from the vertical motor.
2. The curved upper edge of the vertical thruster motor mount must be aligned with the wires of vertical motor assembly.
3. slide the vertical thruster motor mount over the vertical thruster motor shaft and onto the vertical thruster motor assembly.
4. Align the screw holes of the vertical thruster motor mount and vertical motor assembly.
5. Apply blue Loctite to the 6-32 X 3/8 inch Phillips head screw threads.
6. Replace the four 6-32 X 3/8 inch Phillips head screws through the vertical thruster motor mount and into the vertical thruster motor assembly and tighten the screws.

Vertical Thruster Motor Adapter

- Part Number: MAR-006

Vertical Thruster Motor Adapter Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 64 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit
- Vertical Thruster Motor Mount
- Vertical Thruster Motor Adapter

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Adapter.

Vertical Thruster Motor Adapter Removal Procedures

Time required for this step: Approximately 5 Minutes

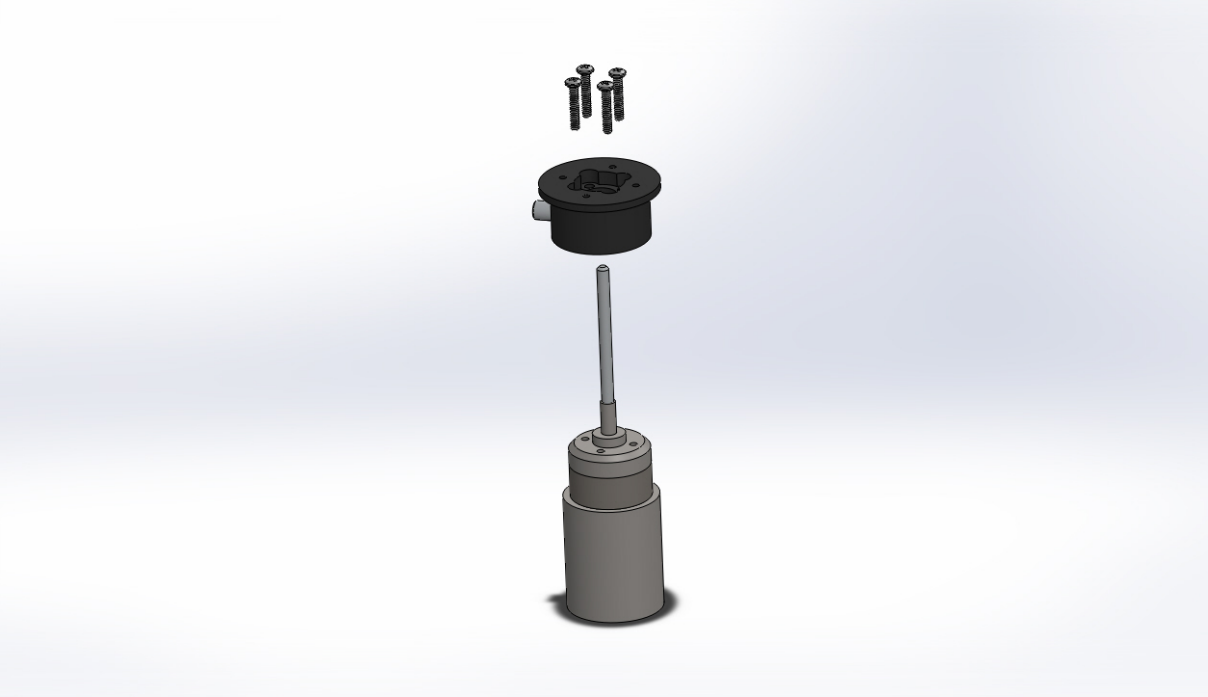
Tools required for this step:

- #2 Phillips Head Screw Driver

Parts involved in this step:

MAR-006 Vertical Thruster Motor Adapter

Quantity	Part Number	Part Description
1	MAR-006	Thruster Part Vertical Motor Adapter (Pro 4)
4	91772A112	Screw #4-40 x 5/8" Pan Head Phillips SS



Steps

1. Remove the four 4-40 X 5/8 inch Phillips head screws that hold the vertical motor adapter to the vertical motor assembly.
2. Pull the vertical motor adapter off of the vertical motor assembly.

Vertical Thruster Motor Adapter Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 66 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- Lint-Free Tissue or Rag

The following components must be replaced:

- Vertical Thruster Motor Adapter
- Vertical Thruster Motor Mount
- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Adapter.

Vertical Thruster Motor Adapter Replacement Procedures

Time required for this step: Approximately 5 Minutes

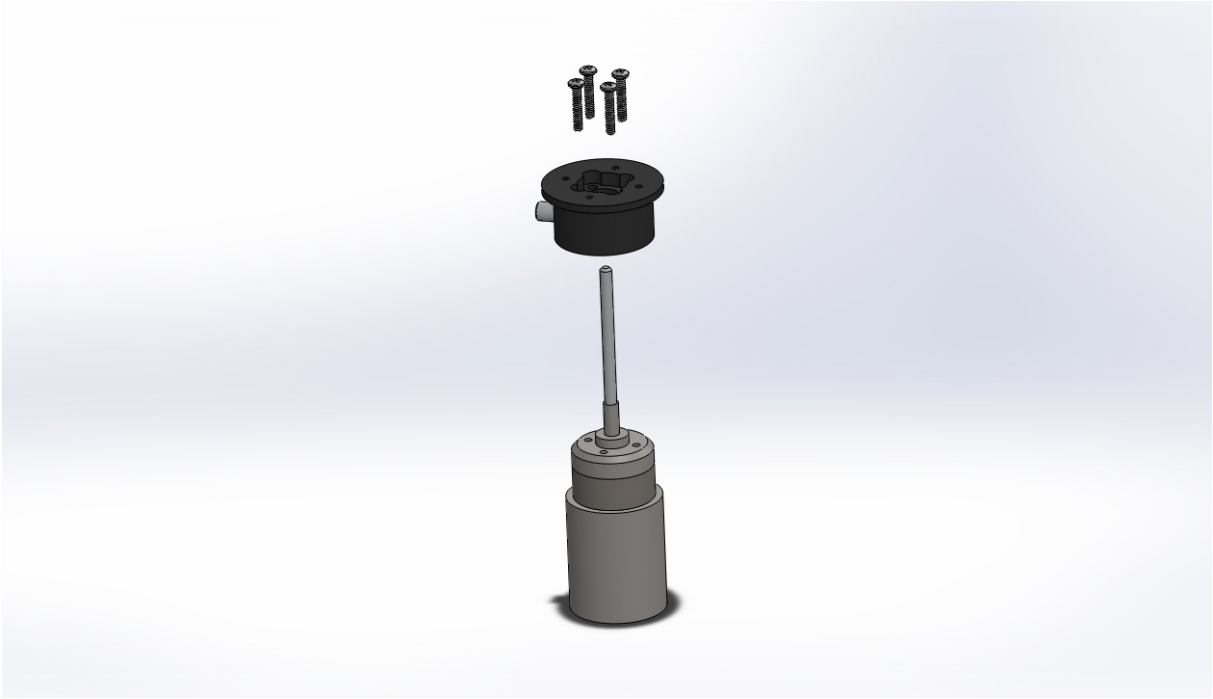
Tools required for this step:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent

Parts involved in this step:

MAR-006 Vertical Thruster Motor Adapter

Quantity	Part Number	Part Description
1	MAR-006	Thruster Part Vertical Motor Adapter (Pro 4)
4	91772A112	Screw #4-40 x 5/8" Pan Head Phillips SS

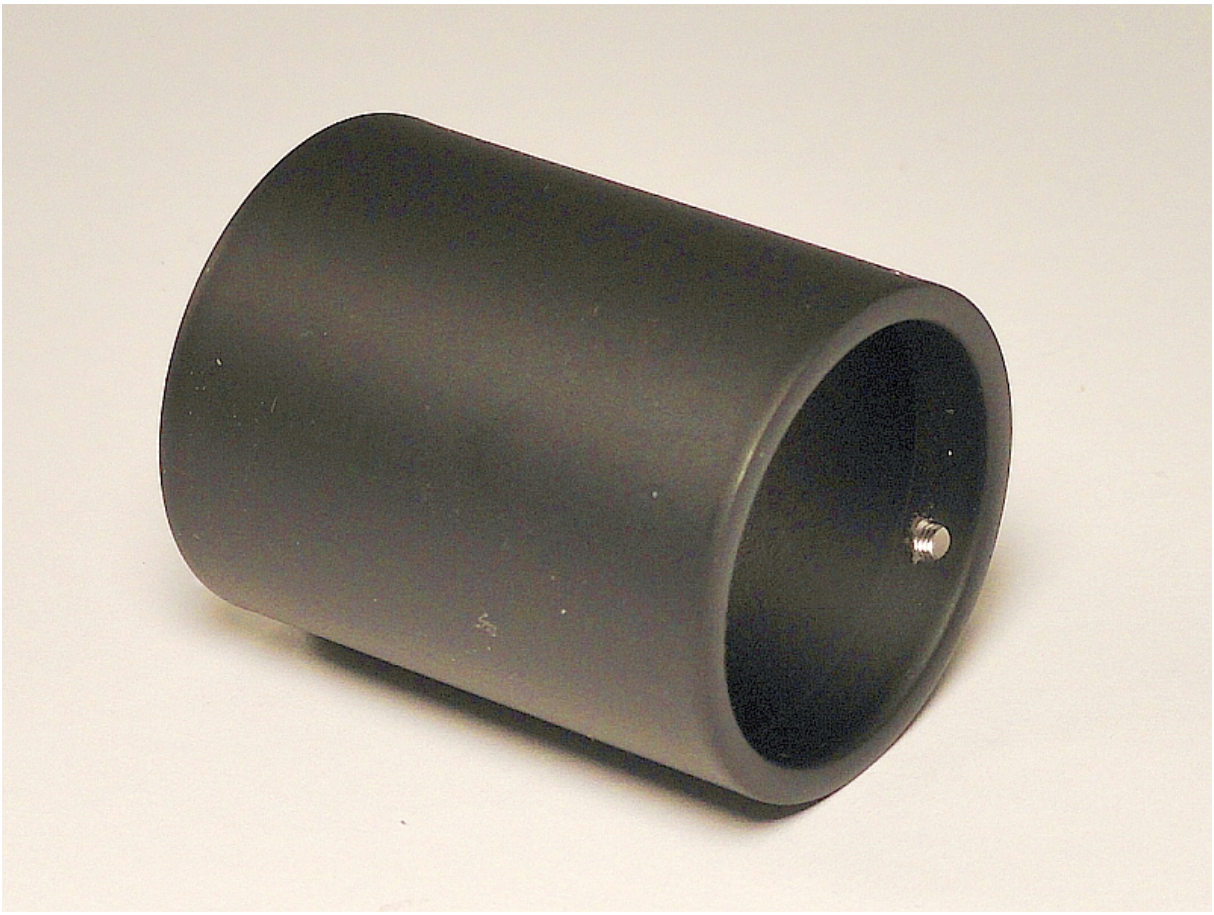


Steps

1. Orient the vertical thruster motor adapter at the shaft end of the vertical motor assembly with the adapter shoulder away from the vertical motor.
2. Slide the vertical thruster motor adapter over the vertical thruster motor shaft and onto the vertical thruster motor assembly.
3. Align the screw holes of the vertical motor adapter and vertical motor assembly.
4. Apply blue Loctite to the 4-40 X 5/8 inch Phillips head screw threads.
5. Replace the four 4-40 X 5/8 inch Phillips head screws through the vertical thruster motor adapter and into the vertical thruster motor assembly and tighten the screws.

Vertical Thruster Motor Shield

- Part Number: MAR-010



Vertical Thruster Motor Shield Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 68 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit
- Vertical Thruster Motor Mount
- Vertical Thruster Motor Adapter
- Vertical Thruster Motor Shield

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Shield.

Vertical Thruster Motor Shield Removal Procedures

Time required for this step: Approximately 4 Minutes

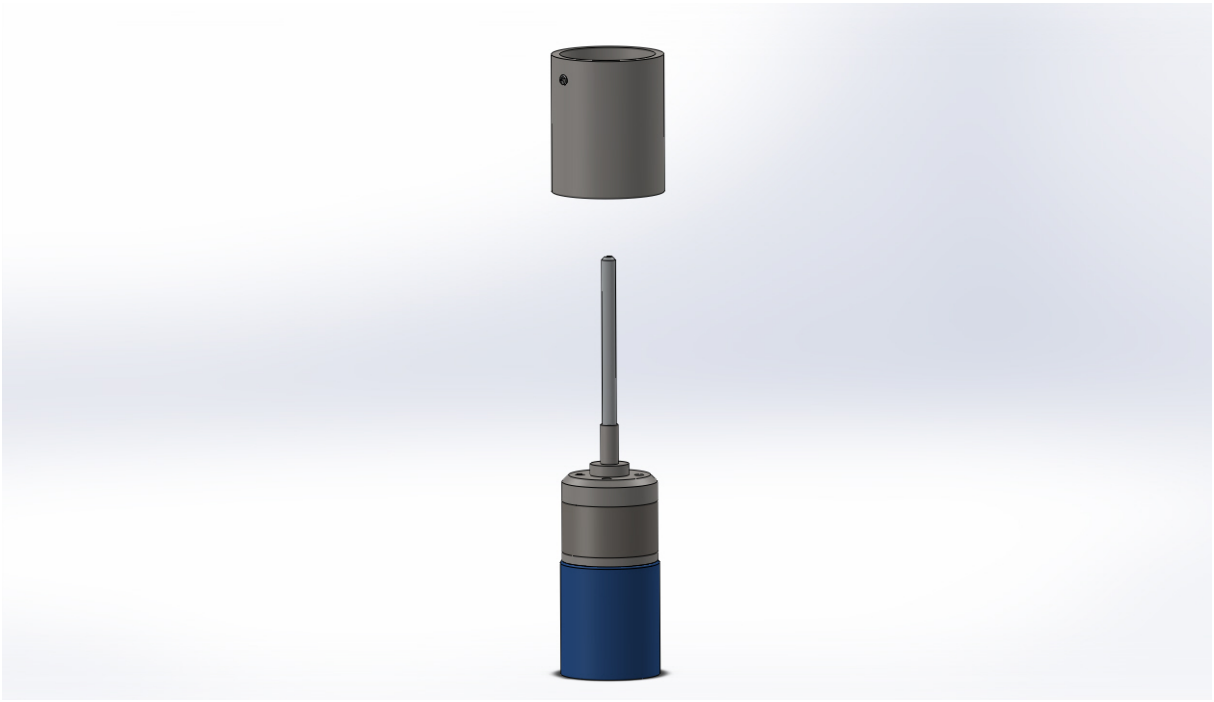
Tools required for this step:

- None

Parts involved in this step:

MAR-010 Vertical Thruster Motor Shield

Quantity	Part Number	Part Description
1	MAR-010	Thruster Part Vertical Motor Shield Brushless (Pro 4)
2	93445A170	Screw #4-40 x 1/8" Set Knurled Cup SS



Steps

1. Loosen, but do not remove, the two 4-40 X 1/8 inch set screws that hold the vertical motor shield to the vertical motor assembly.
2. Slide the vertical motor shield toward the shaft and off of the vertical motor assembly.

Vertical Thruster Motor Shield Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 70 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- Lint-Free Tissue or Rag

The following components must be replaced:

- Vertical Thruster Motor Shield
- Vertical Thruster Motor Adapter
- Vertical Thruster Motor Mount
- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Shield.

Vertical Thruster Motor Shield Replacement Procedures

Time required for this step: Approximately 4 Minutes

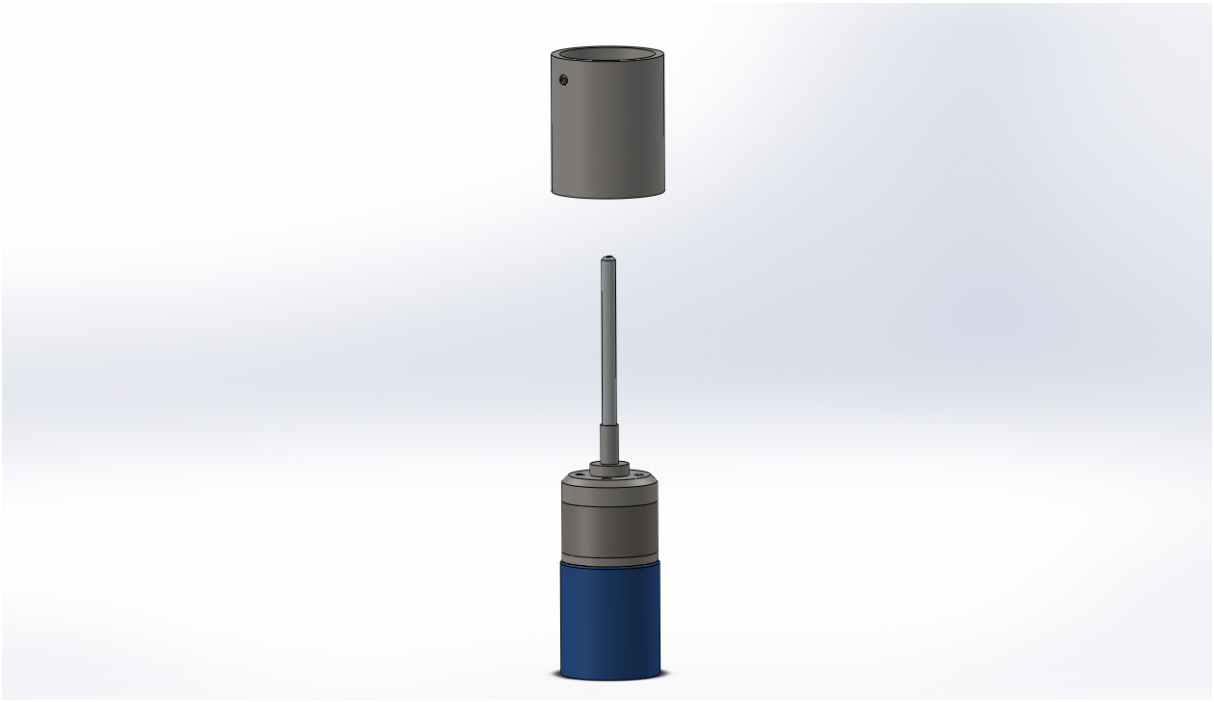
Tools required for this step:

- None

Parts involved in this step:

MAR-010 Vertical Thruster Motor Shield

Quantity	Part Number	Part Description
1	MAR-010	Thruster Part Vertical Motor Shield Brushless (Pro 4)
2	93445A170	Screw #4-40 x 1/8" Set Knurled Cup SS

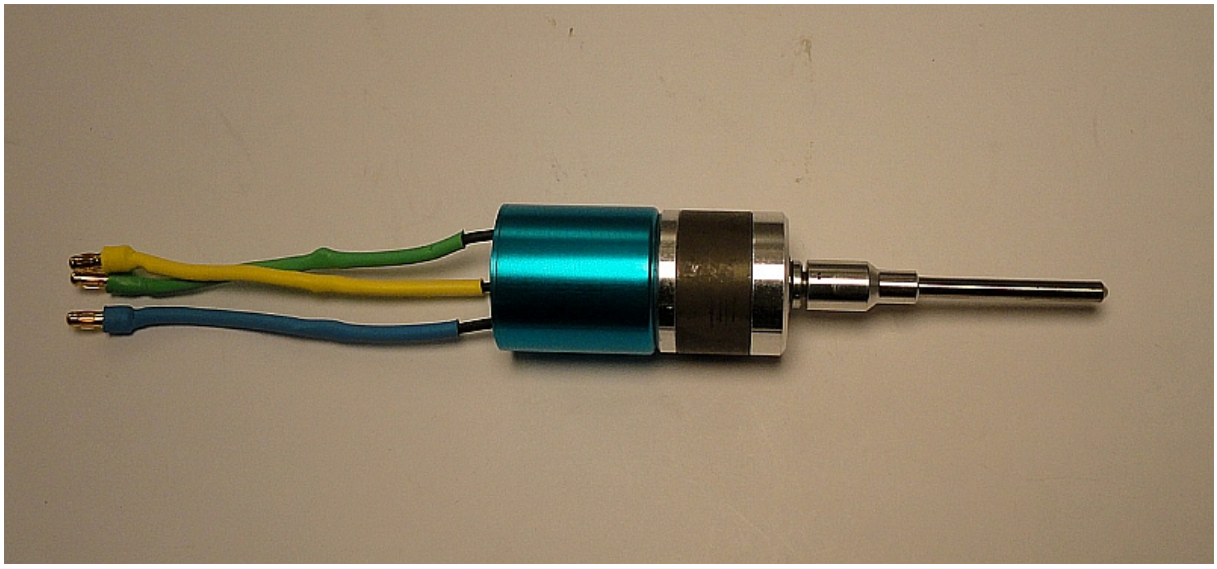


Steps

1. Orient the vertical thruster motor shield at the shaft end of the vertical thruster motor assembly with the retaining screw end of the shield away from the motor assembly.
2. Slide the vertical thruster motor shield over the vertical motor wires and onto the vertical thruster motor assembly until the shield is over the motor as far as it can go. The set screws should be aligned with the base of the gearbox.
3. Tighten the two vertical thruster motor shield 4-40 X 1/8 inch set screws.

Vertical Thruster Motor Assembly

- Part Number: MAR-025-MG



Vertical Thruster Motor Assembly Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 68 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit
- Vertical Thruster Motor Mount
- Vertical Thruster Motor Adapter
- Vertical Thruster Motor Shield
- Vertical Thruster Motor Assembly

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Assembly.

Vertical Thruster Motor Assembly Removal Procedures

Time required for this step: Approximately 0 Minute

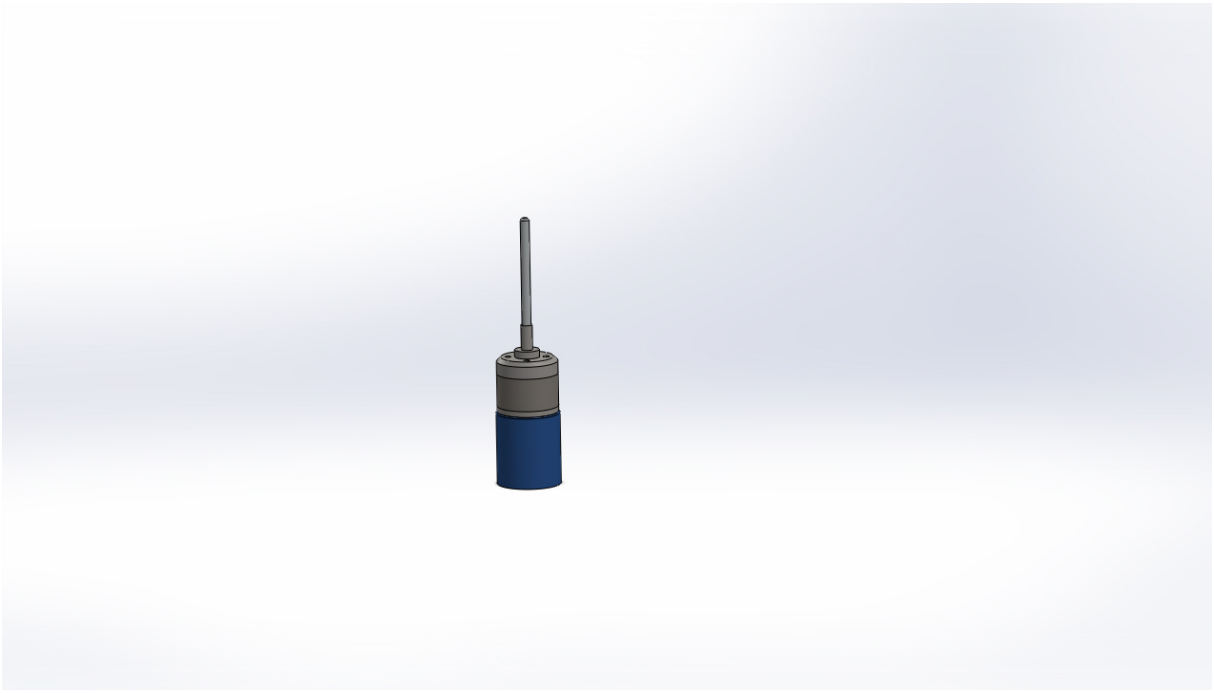
Tools required for this step:

- None

Parts involved in this step:

MAR-025-MG Vertical Thruster Motor Assembly

Quantity	Part Number	Part Description
1	MAR-025-MG	Thruster Assembly Vertical Motor and Gearbox (Pro 4)



Steps

1. After removing the vertical thruster motor shield, the vertical thruster motor assembly is considered removed.

Vertical Thruster Motor Assembly Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 70 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- Torque Wrench
- Tef-Gel or equivalent
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- Lint-Free Tissue or Rag

The following components must be replaced:

- Vertical Thruster Motor Assembly
- Vertical Thruster Motor Shield
- Vertical Thruster Motor Adapter
- Vertical Thruster Motor Mount
- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- Vertical Thruster Cartridge Seal
- Vertical Thruster Cartridge Seal
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Vertical Thruster Motor Assembly.

Vertical Thruster Motor Assembly Replacement Procedures

Time required for this step: Approximately 0 Minute

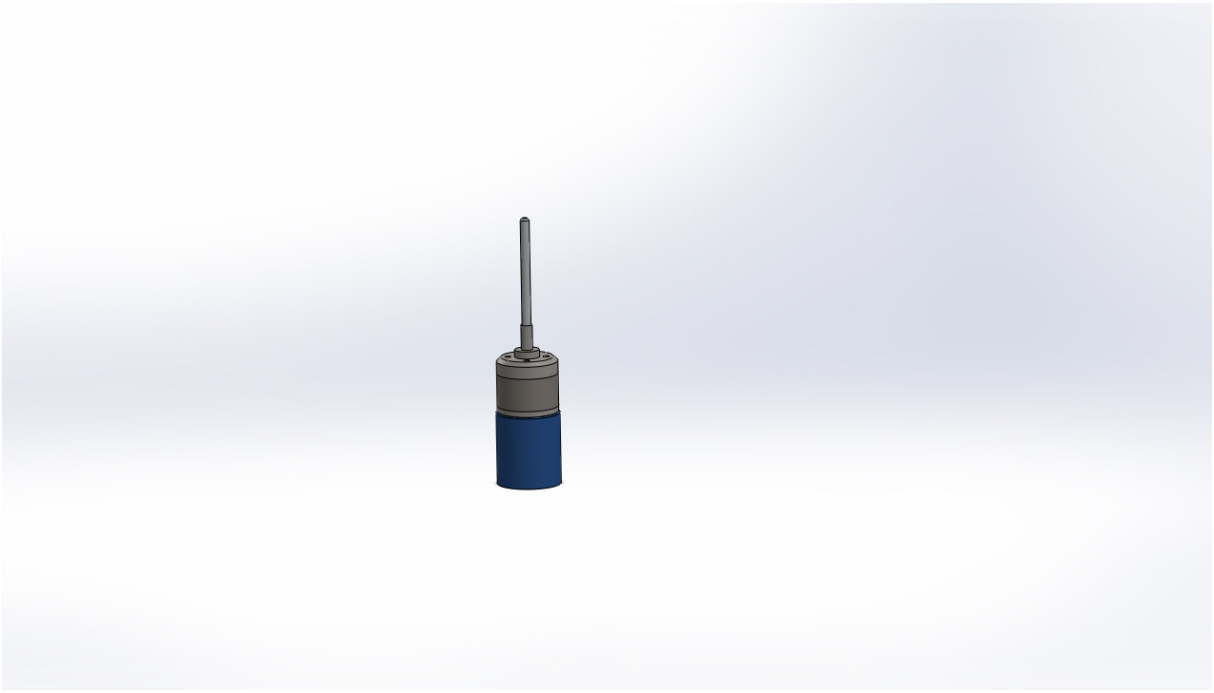
Tools required for this step:

- None

Parts involved in this step:

MAR-025-MG Vertical Thruster Motor Assembly

Quantity	Part Number	Part Description
1	MAR-025-MG	Thruster Assembly Vertical Motor and Gearbox (Pro 4)

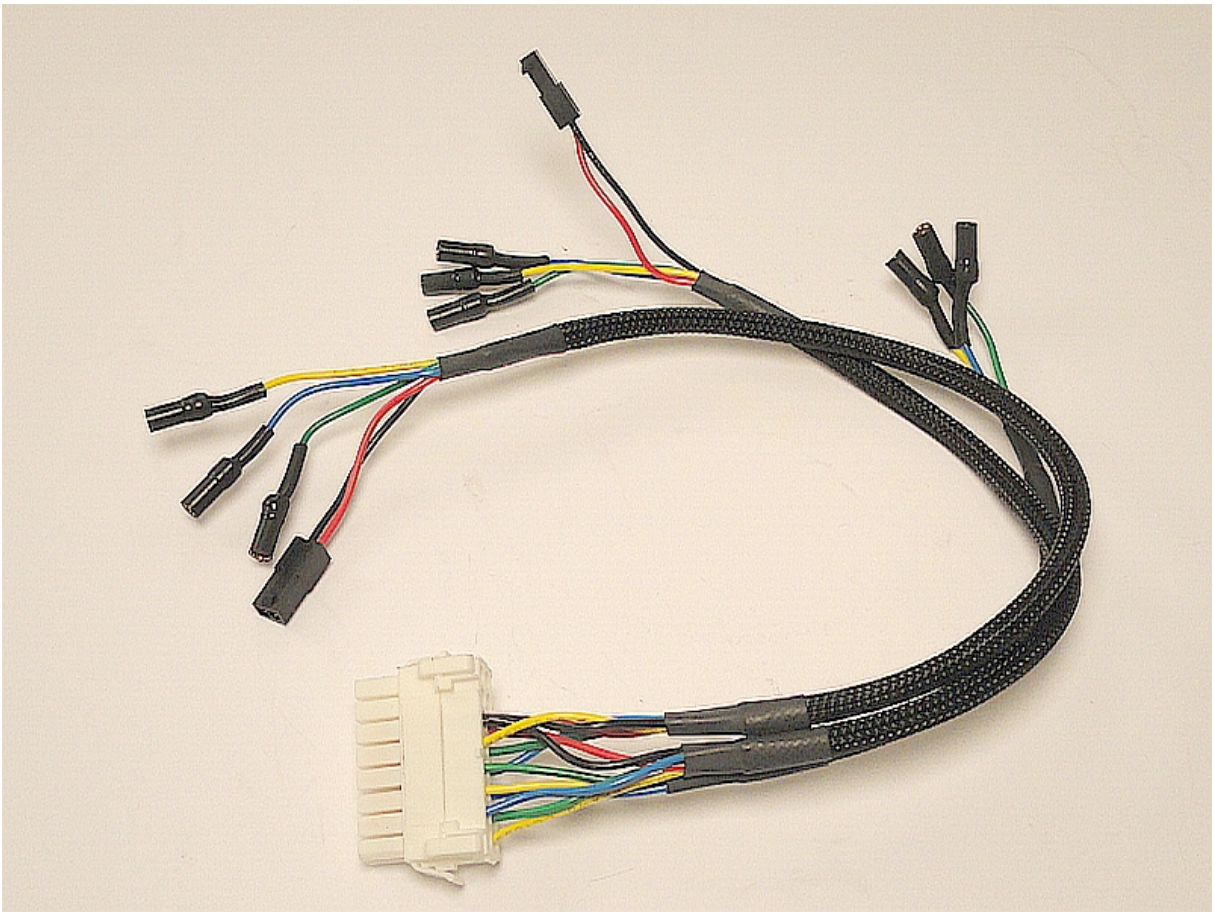


Steps

1. To begin the replacement of the vertical thruster motor assembly, proceed to the next step and replace the vertical thruster motor shield on the motor assembly.

ROV Wire Harness

- Part Number: VTH-0054



ROV Wire Harness Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 57 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent

The following components must be removed:

- Float Block Kit
- Skid Kit
- Light Dome
- LED Light Module Assembly
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- ROV Wire Harness

See the corresponding sections of this manual for instructions for parts other than the ROV Wire Harness.

ROV Wire Harness Removal Procedures

Time required for this step: Approximately 5 Minutes

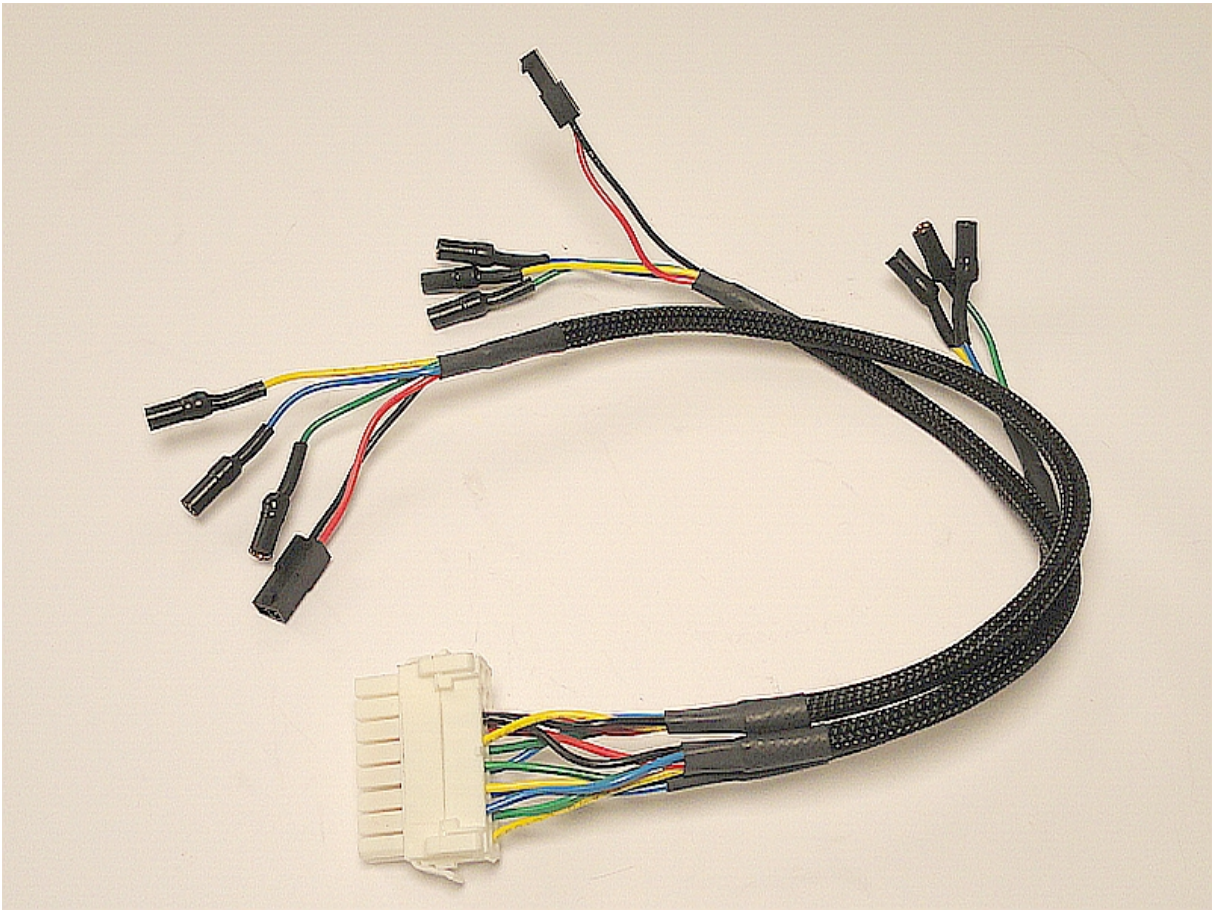
Tools required for this step:

- None

Parts involved in this step:

VTH-0054 ROV Wire Harness

Quantity	Part Number	Part Description
1	VTH-0054	Wire Harness Assembly (Pro 4)



Steps

1. Carefully feed the wires from the lights and horizontal thruster motors out of the horizontal thruster tubes and into the main hull.
2. Remove the wire harness from the main hull.

ROV Wire Harness Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 62 Minutes

Tools required:

- O-Ring Lubricator
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Torque Wrench
- Red Loctite or equivalent
- Strap Wrench or Rubber Coated Pipe Pliers
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- ROV Wire Harness
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- LED Light Module Assembly
- Light Dome
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the ROV Wire Harness.

ROV Wire Harness Replacement Procedures

Time required for this step: Approximately 10 Minutes

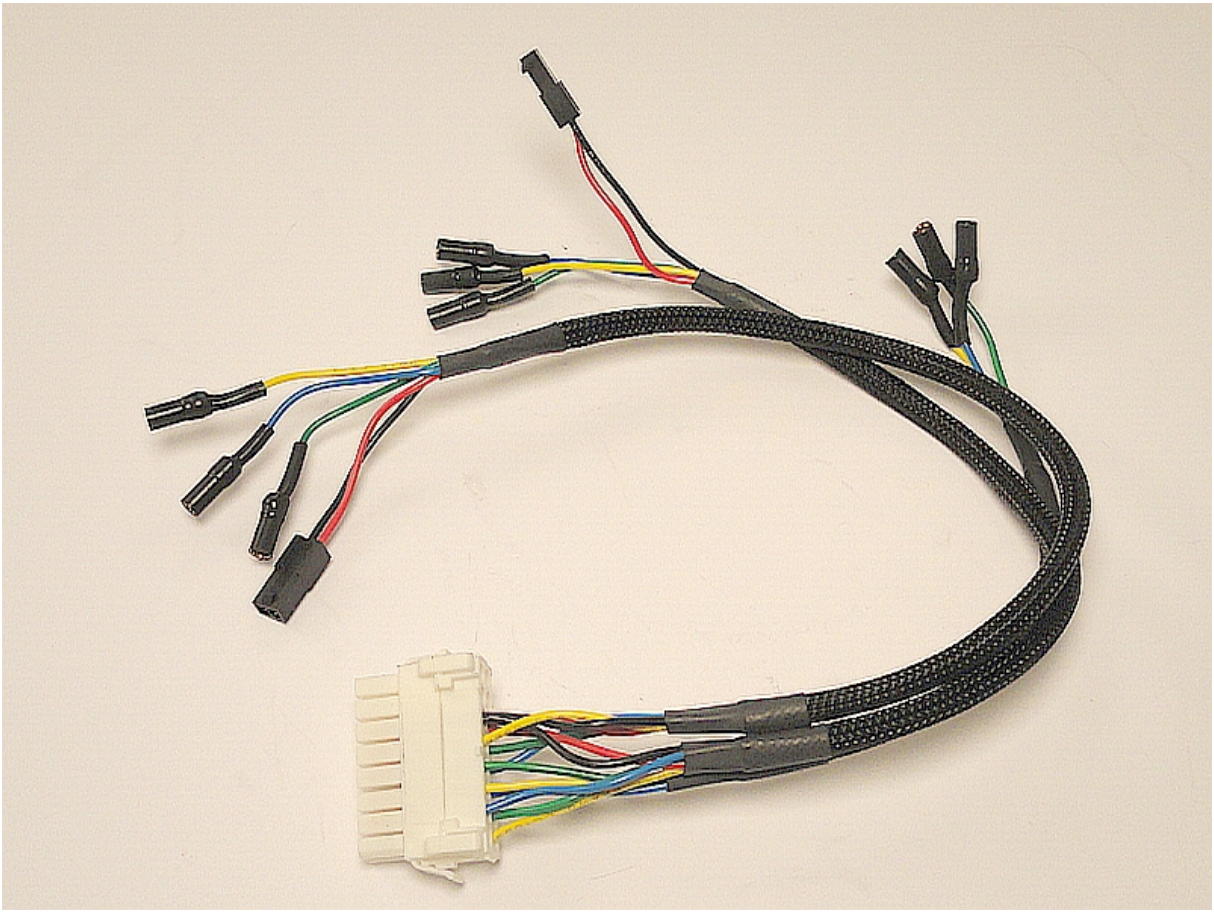
Tools required for this step:

- None

Parts involved in this step:

VTH-0054 ROV Wire Harness

Quantity	Part Number	Part Description
1	VTH-0054	Wire Harness Assembly (Pro 4)



Steps

1. Insert the wire harness into the main hull.
2. The wires for the port (left) horizontal thruster tube are longer than the wires for the starboard side.
3. Feed the port light and motor wires through the port horizontal thruster tubes.
4. Feed the starboard (right) light and motor wires through the starboard horizontal thruster tubes.
5. Orient the connector towards the rear of the ROV.

Tip

When viewed from the rear toward the front of the ROV, the port side is on the left and the starboard side is on the right.

Horizontal Thruster Tube

- Part Number: HT-001-GY

Horizontal Thruster Tube Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 87 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- Strap Wrench or Rubber Coated Pipe Pliers
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench
- 9/64 Inch Allen Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Light Dome
- LED Light Module Assembly
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Drive Train Assembly
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Pressure Sensor Kit
- Vertical Thruster Kit
- ROV Wire Harness
- Horizontal Thruster Tube

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Tube.

Horizontal Thruster Tube Removal Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

Tools required for this step:

- 9/64 Inch Allen Wrench

Parts involved in this step:

HT-001-GY Horizontal Thruster Tube

Quantity	Part Number	Part Description
1	HT-001-GY	Thruster Part Horizontal Tube (Pro 4)
1	MHU-006	Thruster Part Horizontal Tube Spacer
2	OR-122	O-Ring #122
1	HT-003	Thruster Part Horizontal Tube Spacer (Inside Main Hull)
2	91274A064	Screw #8-32 x 3/4" Socket Cap Steel Ultra Corrosion Resistant
2	98370A011	Washer #8 x 0.075" Flat SS

Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you plan to remove both Horizontal Thrust Tubes.

1. From inside the main hull, remove the two 8-32 X 3/4 inch socket cap screws that hold the horizontal thruster tube to the main hull tube.
2. Remove the horizontal thruster tube from the main hull.

Horizontal Thruster Tube Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 92 Minutes

Tools required:

- 9/64 Inch Allen Wrench
- Torque Wrench
- Tef-Gel or equivalent
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- O-Ring Lubricator
- 3/4 Inch Socket
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- Strap Wrench or Rubber Coated Pipe Pliers
- Lint-Free Tissue or Rag
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver

The following components must be replaced:

- Horizontal Thruster Tube
- ROV Wire Harness
- Vertical Thruster Kit
- Pressure Sensor Kit
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Drive Train Assembly
- Horizontal Thruster Cone Assembly
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Cartridge Seal
- Horizontal Thruster Propeller Kit (Left and Right)
- LED Light Module Assembly
- Light Dome
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Horizontal Thruster Tube.

Horizontal Thruster Tube Replacement Procedures

Time required for this step: Approximately 5 Minutes (10 Minutes for both sides)

Tools required for this step:

- 9/64 Inch Allen Wrench
- Torque Wrench
- Tef-Gel or equivalent
- Blue Loctite or equivalent

Parts involved in this step:

HT-001-GY Horizontal Thruster Tube

Quantity	Part Number	Part Description
1	HT-001-GY	Thruster Part Horizontal Tube (Pro 4)
1	MHU-006	Thruster Part Horizontal Tube Spacer
2	OR-122	O-Ring #122
1	HT-003	Thruster Part Horizontal Tube Spacer (Inside Main Hull)
2	91274A064	Screw #8-32 x 3/4" Socket Cap Steel Ultra Corrosion Resistant
2	98370A011	Washer #8 x 0.075" Flat SS

Steps

Note: The following step-by-step instructions apply to one side. Repeat these steps on both sides if you are replacing both Horizontal Thrust Tubes.

1. Apply Tef-Gel to the main hull in the areas where the horizontal thruster tube spacers will contact the hull. Do NOT get Tef-Gel too close to the screw holes.
2. Place the two #8 SS washers on the two 8-32 X 3/4 inch socket cap screws and insert the socket screws with washers through the flat side of the "inside" horizontal thruster tube spacer.
3. From inside the main hull, install the two socket screws and spacer. The curved side of the spacers should be towards the hull.
4. Apply blue Loctite to the screw threads
5. Lubricate and install the #122 O-rings on both sides of the "between hulls" thruster tube spacers.
6. Orient the "between hulls" horizontal thruster tube spacers so that the notch is facing toward the front of the ROV and away from the main hull. The "between hulls" thruster tube spacer has two concave diameters to match the main hull and the thruster tube diameters. If installed incorrectly, the spacer will leak. When oriented with the notch away from the main hull, the "between hulls" thruster tube spacer's concave surfaces will match the corresponding component diameter.

7. Place the "between hulls" horizontal thruster tube spacer in position over the two socket screws.
8. Orient the horizontal thruster tube along side of the main hull with the holes for the wire harness aligned and the external threads for the light dome towards the front of the ROV.
9. Make sure the #122 O-rings are in position and will not be pinched.
10. Thread the socket screws into the horizontal thruster tube and tighten them evenly to 35 inch-pounds (3.95 Nm).

Main Hull Tube

- Part Number: MHU-001-4

Main Hull Tube Removal Overview

Skill level recommended: Advanced

Total time required: Approximately 86 Minutes

Tools required:

- #2 Phillips Head Screw Driver
- 7/16 Inch Open End or Socket Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Wooden Dowel Rod 3/8" x 12"
- Dental Pick or equivalent
- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench
- 1-1/4 Inch Open End or Deep Socket Wrench
- 9/64 Inch Allen Wrench

The following components must be removed:

- Float Block Kit
- Skid Kit
- Vertical Thruster Propeller Kit
- Vertical Thruster Splitter
- Vertical Thruster Cartridge Seal
- Strain Relief Cable Kit
- Light Dome
- LED Light Module Assembly
- Horizontal Thruster Propeller Kit (Left and Right)
- Horizontal Thruster Nozzle Kit
- Dome Retaining Rings and Main Hull Rods
- Front Dome
- Front Hull Ring Assembly with Camera
- Rear Dome
- Rear Hull Ring Assembly
- Desiccant Pack
- ROV Board Set
- Camera Ribbon Cable
- Termination Block and Accessory Port
- Pressure Sensor Kit
- Vertical Thruster Kit
- ROV Wire Harness
- Horizontal Thruster Tube
- Main Hull Tube

See the corresponding sections of this manual for instructions for parts other than the Main Hull Tube.

Main Hull Tube Removal Procedures

Time required for this step: Approximately 0 Minute

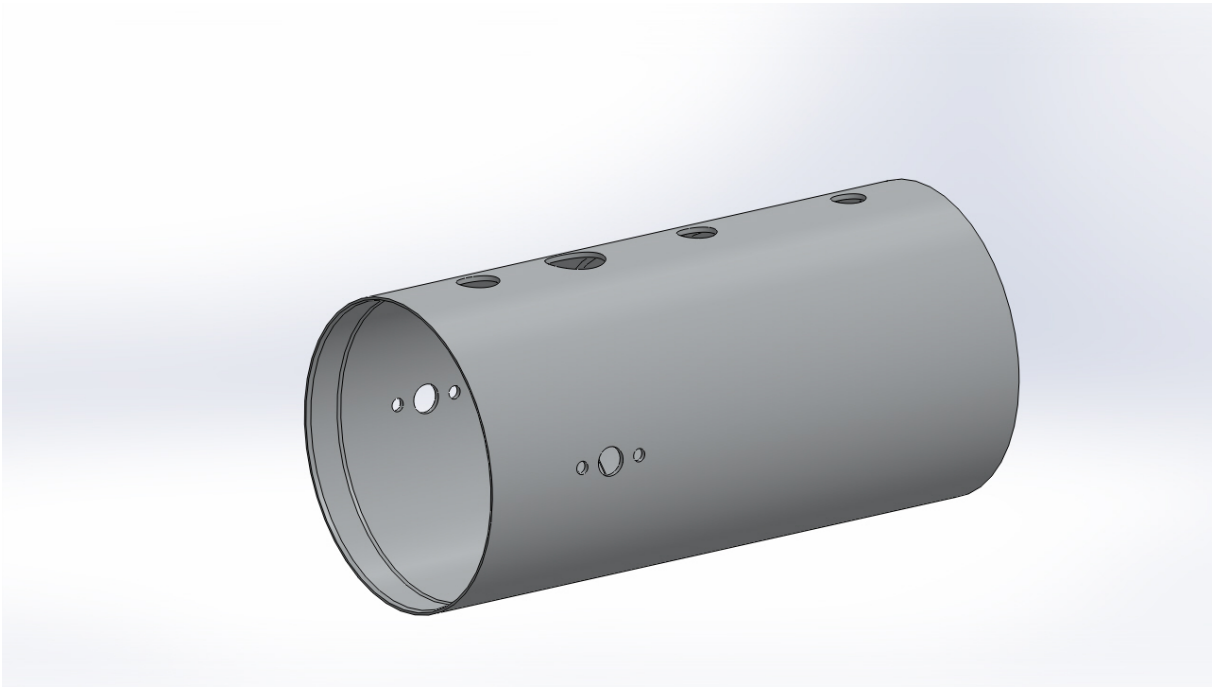
Tools required for this step:

- None

Parts involved in this step:

MHU-001-4 Main Hull Tube

Quantity	Part Number	Part Description
1	MHU-001-4	Main Hull Part Main Tube (Pro 4)



Steps

1. After removing the horizontal thruster tubes, the main hull tube is considered removed.

Main Hull Tube Replacement Overview

Skill level recommended: Advanced

Total time required: Approximately 98 Minutes

Tools required:

- 9/64 Inch Allen Wrench
- Torque Wrench
- Tef-Gel or equivalent
- Blue Loctite or equivalent
- 1-1/4 Inch Open End or Deep Socket Wrench
- O-Ring Lubricator
- 3/4 Inch Socket
- 3/4 Inch Open End Wrench
- 11/16 Inch Open End Wrench
- 5/16 Inch Open End Wrench or Nut Driver
- 5/16 Inch Open End Wrench or Nut Driver (Additional)
- Red Loctite or equivalent
- 7/16 Inch Open End or Socket Wrench
- #2 Phillips Head Screw Driver
- Lint-Free Tissue or Rag

The following components must be replaced:

- Main Hull Tube
- Horizontal Thruster Tube
- ROV Wire Harness
- Vertical Thruster Kit
- Pressure Sensor Kit
- Termination Block and Accessory Port
- Camera Ribbon Cable
- ROV Board Set
- Desiccant Pack
- Rear Hull Ring Assembly
- Rear Dome
- Front Hull Ring Assembly with Camera
- Front Dome
- Dome Retaining Rings and Main Hull Rods
- Horizontal Thruster Nozzle Kit
- Horizontal Thruster Propeller Kit (Left and Right)
- LED Light Module Assembly
- Light Dome
- Strain Relief Cable Kit
- Vertical Thruster Cartridge Seal
- Vertical Thruster Splitter
- Vertical Thruster Propeller Kit
- Skid Kit
- Float Block Kit

See the corresponding sections of this manual for instructions for parts other than the Main Hull Tube.

Main Hull Tube Replacement Procedures

Time required for this step: Approximately 0 Minute

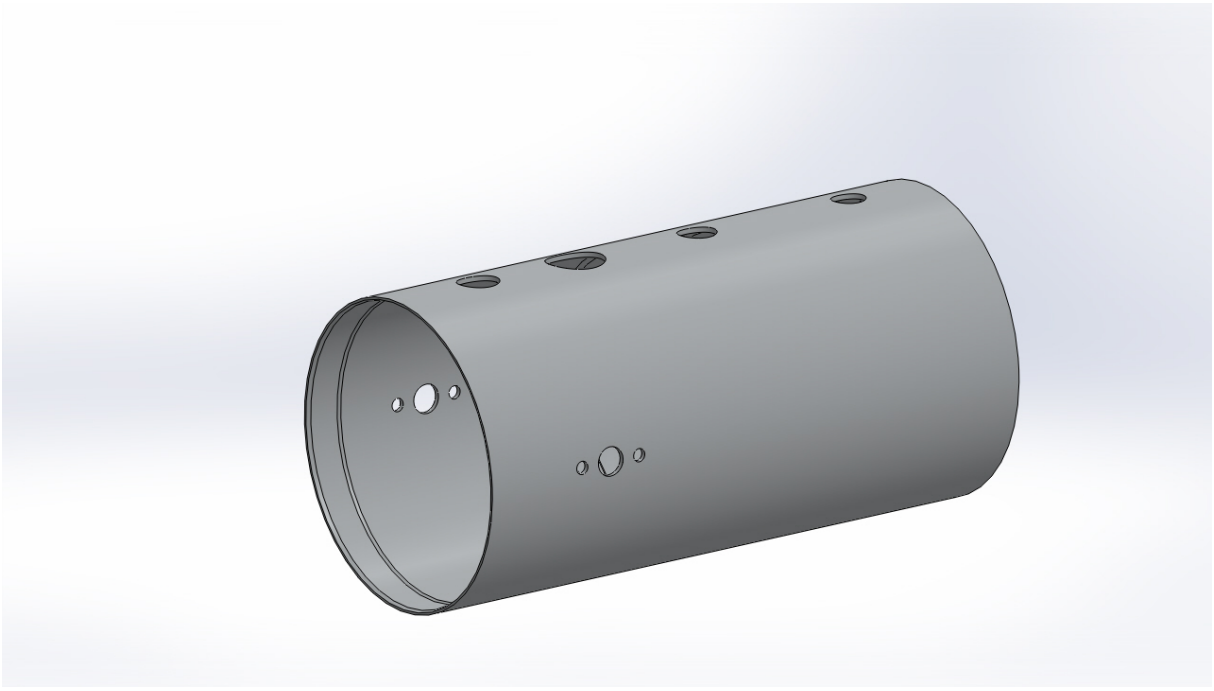
Tools required for this step:

- None

Parts involved in this step:

MHU-001-4 Main Hull Tube

Quantity	Part Number	Part Description
1	MHU-001-4	Main Hull Part Main Tube (Pro 4)



Steps

1. To begin the replacement of the main hull, proceed to the next step and install the horizontal thruster tubes on the main hull.