

Sea Perch

Construction Manual

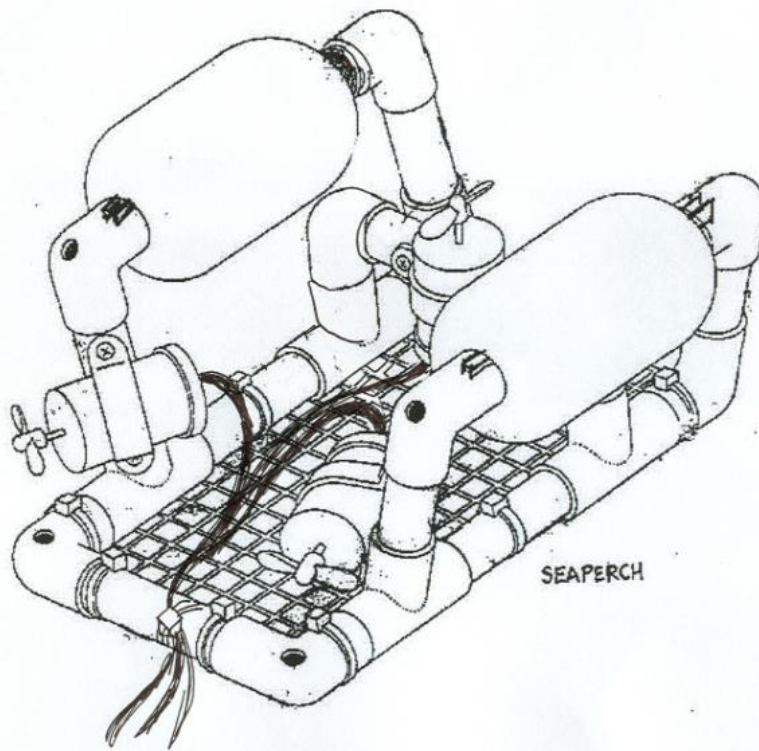


Table of Contents

Unit 1 Assembly of Subsystem One: The Vehicle Frame	page 1
Step 1: To measure cut and assemble the vehicle frame.....	2
Step 2: To create Drain holes in vehicle frame.....	4
Step 3: To assemble float supports.....	5
Step 4: To attach motor mounts to frame.....	6
Step 5: To attach payload netting.....	7
Unit 2 Assembly of Subsystem Two: The Thruster Assembly	8
Step 1: To assemble the potting holder.....	9
Step 2: To test the motors.....	10
Step 3: To seal the motors.....	11
Tether Wire Color Code	12
Step 4: To wire the motors.....	13
Step 5: To pot the motor.....	14
Step 6: To complete the thrusters.....	16
Step 7: To mount the motors.....	17
Step 8: To water proof the tether.....	19
Unit 3 Assembly of Subsystem Three: The Control Box	20
Control Box Items	21
Step 1: To assemble the power cable.....	22
Step 2: To prepare the control box.....	24
Step 3: To wire the button switches (vertical thrusters).....	25
Step 4: To wire the pole switches (port and starboard thrusters).....	27
Step 5: Finishing the control box.....	29
Finished Sea Perch	31

UNIT 1

ASSEMBLY OF SUBSYSTEM ONE

THE VEHICLE FRAME



FOR THIS UNIT YOU WILL NEED:

Tools	Materials
Ruler	5 ft. of 1 / 2" PVC pipe
Marker	10 1 / 2" PVC elbows
PVC pipe cutter or razor saw	4 1 / 2" PVC T's
Phillips Screwdriver	15" Plastruct H-beam
Drill	2 Football Floats
1/4" drill bit	3 Motor Mounts
3/32" drill bit	10 #6 x 1 / 2" Screws
	Netting
	Tie Wraps (zip ties)

STEP 1

PURPOSE: To assemble the vehicle frame

MATERIALS:

5' of 1/2" PVC pipe
10 1/2" PVC
elbows

4 1/2" PVC T's

TOOLS:

Ruler
Marker
PVC Pipe cutter
(or razor saw)



Figure 1:
PVC pipe cutter, Cut sections of PVC pipe, Elbows and T's

PROCEDURE:

1. From straight end of pipe measure and cut:
 - Two – 2 1/2" long
 - Two – 4" long
 - Two – 4 1/2" long
 - Four – 1 1/2" long
 - Four – 5" long

Try to cut straight, so that the ends of each piece are square with the sides.
You may want to write the length on each piece to keep track.

2. Dry assemble all parts as shown in Figure 2 on the following page.

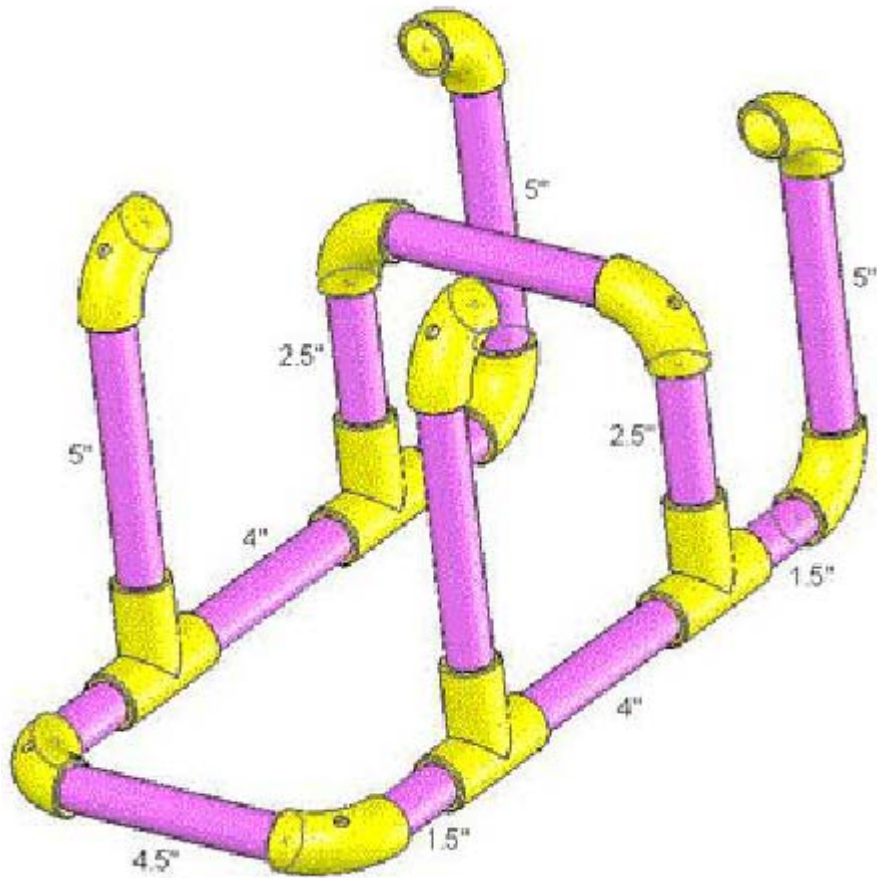


Figure 2: Frame Assembly

STEP 2

PURPOSE: To create drain holes in vehicle frame

MATERIALS:

Vehicle frame

TOOLS:

Hand drill or
drill press

1 / 4" drill bit

Vise



Figure 3A: drain holes drilled with 1/4" drill bit

PROCEDURE:

Refer to figures 2 and 3 for help. Remove ALL of the PVC elbows, secure them in the vise and drill holes with 1/4" drill bit. (See figures 3A and 3B)

A

B



Figure 3: Drain holes in elbows drilled with 1 / 4" drill bit

STEP 3

PURPOSE: To assemble float supports

MATERIALS:

15" Plastruct H-beam
2 Football Floats
PVC pipe scraps

TOOLS:

PVC Pipe Cutter



Figure 4: H-beam Assembly for floats

PROCEDURE:

1. Cut 15" Plastruct H-beam into two 7 1/2" pieces.
2. Cut Four 3/4" pieces of PVC pipe.
3. Insert one of the 3/4" PVC pipe pieces into the open end of each of the four PVC angles on the top of your vehicle.
4. Insert an H-beam through each of your floats and between each pair of PVC angles.
5. Push the bottom of your vehicle frame together tightly, so that H-beams cannot fall out of the PVC angles.



Figure 4: Assembly of H-beam float supports.

Note: Most of the images in this manual (except those on this page) depict a previous, more complicated method of float assembly: screw the H-beams onto the top of each angle using extra screws and a 3/32" drill bit to create the holes.

STEP 4

PURPOSE: To attach motor mounts to frame

MATERIALS:

Vehicle frame
3 Motor Mounts
6 #6 x 1 / 2" Screws
Washers

TOOLS:

Marker
Phillips Screwdriver
Drill
3/32" drill bit

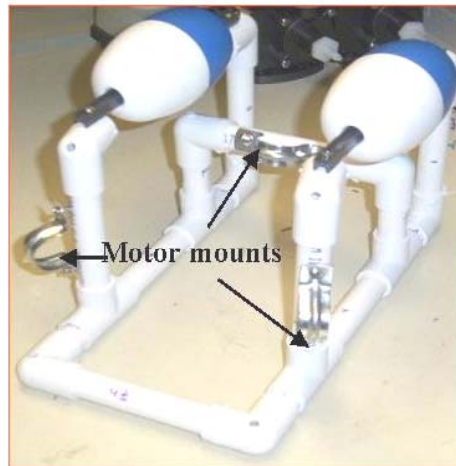



Figure 5: Motor mount placement

PROCEDURE:

1. Hold motor mounts against frame in locations shown in Figure 5.
2. Mark vehicle frame through holes in motor mounts.
3. Take 3/32" drill bit, and drill holes through the marks on the frame.
4. Place washers over the holes in the motor mounts, and place a screw through each washer and motor mount hole into hole in vehicle frame.
5. Using the screwdriver, LOOSELY attach motor mounts to the frame. (**Don't over-tighten and strip the plastic**).

STEP 5

PURPOSE: To attach payload netting

<p>MATERIALS: Netting Tie wraps (zip ties) Assembled Vehicle frame</p> <p>TOOLS: Scissors</p>	 <p>Figure 6: Net attached to frame</p>
---	---

PROCEDURE:

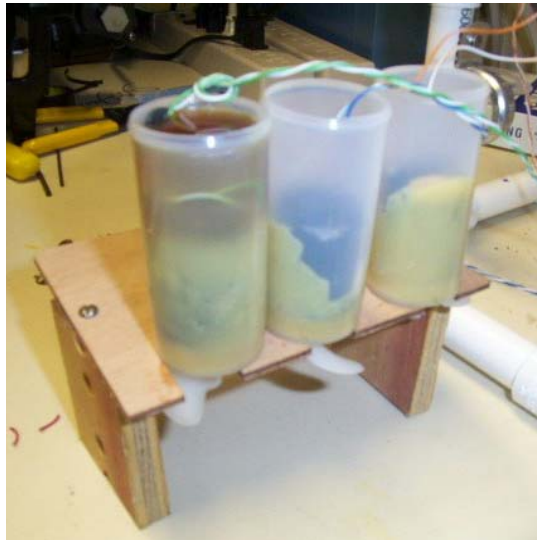
1. Place netting underneath vehicle frame and trim to size with scissors if necessary
2. Attach with 6 to 8 tie wraps (aka. cable ties or zip ties). Make sure to pull them tight, using pliers if necessary.
3. Trim off tie wrap ends with scissors.

NOTE: If you wish to paint your vehicle's frame, do so before attaching netting.

UNIT 2

ASSEMBLY OF SUBSYSTEM TWO:

THE THRUSTER ASSEMBLY



FOR THIS TASK YOU WILL NEED:

Tools	Materials
Assembled potting holder (see step 1)	Tether wire
Drill	Solder
Drill Bit: 3/32"	3 film cans with caps
Electric hot plate	3 12VDC motors
Metal cups	3 Bushings
Lead sinkers	3 Propellers
Pliers	Anchor bowl ring (Bowl Wax)
Vise	Electrical tape
Razor saw or Band saw	Butyl Rubber tape
Marker	#24 stranded hook up wire, Red
Ruler	#24 stranded hook up wire, Black
Soldering Iron	If potting holder not yet assembled, include:
Phillips Screwdriver	Scrap wood
Machinist's Scraper (triangular blade)	2 #6 x 1/2" screws

STEP 1

PURPOSE:

To assemble the potting holder (if not already available).

MATERIALS:

3 scrap pieces of wood
2 self tapping screws

TOOLS:

Razor saw or Band Saw
Phillips Screwdriver
Marker
Ruler

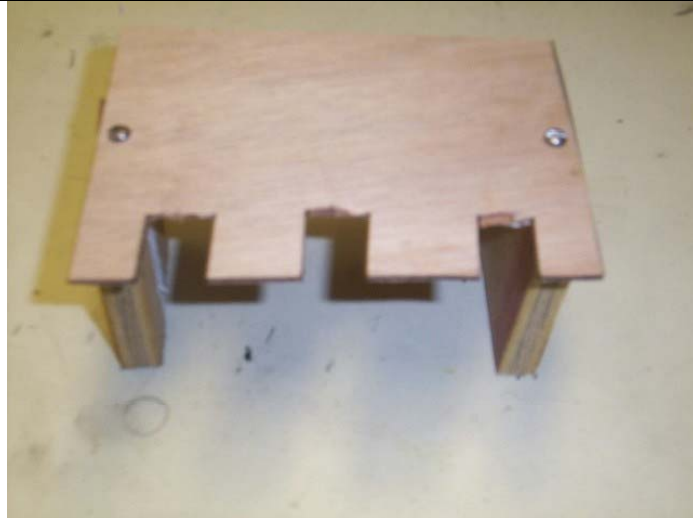


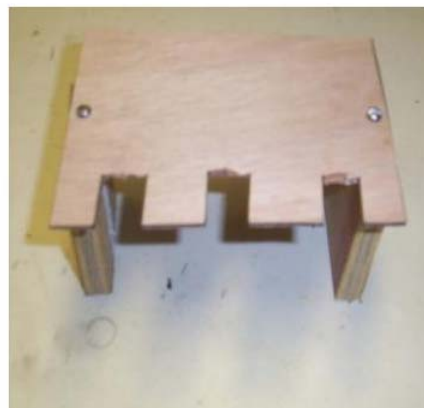
Figure 7B: Assembled potting holder

PROCEDURE:

1. Measure and Cut a 6" x 4" piece of wood.
2. Make three 3/4" notches in 6" x 4" piece of wood.
3. Measure and cut two 2 1/2" x 1 1/2" legs.
4. Using screws, attach legs to the notched piece of wood.



A: Potting holder materials



B: Assembled Potting Holder

Figure 7: Potting holder assembly

STEP 2

PURPOSE:

To test the motors and mark polarity of the terminals.

MATERIALS:

- 3 motors
- 2 Alligator clips
- 12-Volt Battery

TOOLS:

Marker

PROCEDURE:

1. Strip 1/4" from both sides of the loose black wire. Connect the loose black wire to the back of the black alligator clip (**DO NOT SOLDER**).
2. Strip 1/4" from both sides of loose red wire. Connect the loose red wire to the back of the red alligator clip (**DO NOT SOLDER**).
3. Locate the positive (+) brass terminal on the motor, mark the terminal with a red marker (if available), and connect the exposed end of the red (+) wire to the positive (+) motor terminal.
4. Mark the negative (-) terminal of the motor with a black marker, and connect the exposed end of the black wire (-) to the negative (-) motor terminal.
5. Connect the alligator clips to the corresponding battery terminals and ensure the motor is in good working order. The shaft should spin counter-clockwise.
6. Repeat steps 3 through 5 with the other 2 motors. If any motor is not working ask your instructor for a replacement.

TROUBLE SHOOTING

IF you cannot see the + and – signs near the terminals of the motors,
THEN follow this procedure to find the + and – motor terminals:

- Put a small piece of tape on the shaft of the motor, so you can easily see it spin.
- Connect the black wire to one terminal and the red wire to the other, and connect the alligator clips to the proper battery terminals (red on +, black on -)
- Observe the rotation direction of the motor.
- If the motor shaft turns *counter-clockwise*, then you have chosen the correct terminals: black wire on negative (-) and red wire on positive (+).
- If the motor shaft turns *clockwise*, then the wires are reversed. Switch them around and make sure the motor turns counter-clockwise
- Mark at least one motor terminal with the correct color(s): red (+) and black (-)

*****MOTORS SHOULD SPIN COUNTER CLOCKWISE*****

WARNING, TO AVOID ELECTRIC SHOCK AND SEVERE BURNS:

- **DO NOT touch exposed wires onto the battery.**
- **DO NOT simultaneously touch both battery terminals with your hands, or ANY type of metal.**

STEP 3

PURPOSE:

To seal the motors

MATERIALS:

3 12VDC Motors
Electrical tape

TOOLS:

Marker



Figure 8: 12VDC Motors sealed with electrical tape

PROCEDURE:

- 1. (Very Important)** Make sure the negative and/or positive terminals are marked on each motor (see previous step), so that you can tell them apart after covering the motor in tape.
- 2.** Completely wrap each motor with electrical tape to seal the holes. It may be easiest to cover the ends of the motor first and then wrap around the sides. Leave the motor shaft and the electrical terminals outside the tape. Make sure **ALL** holes are sealed.

TETHER WIRE COLOR CODE

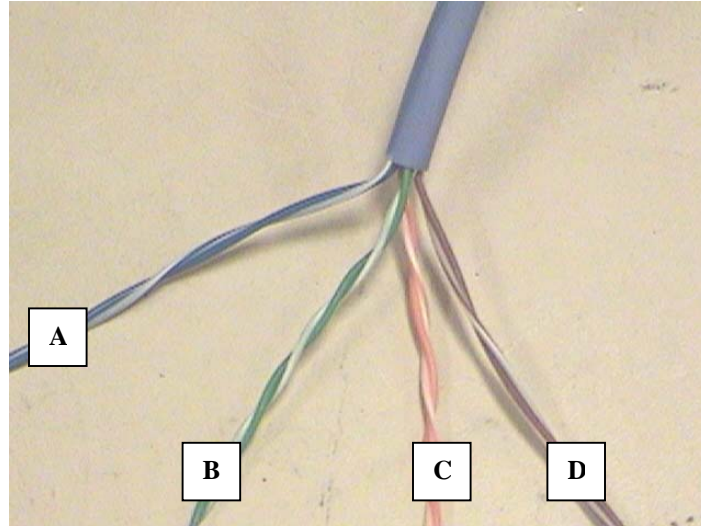


Figure 9: Tether Wire Color Code

- A. Blue = Port Thruster (Left)
- B. Green = Starboard Thruster (Right)
- C. Orange = Vertical Thruster
- D. Brown = NOT USED

POSITIVE	NEGATIVE
Green Blue Orange	White White White

WIRE	DIRECTION
Green Blue Orange	Star board (right) Port (left) Vertical

STEP 4

PURPOSE:

To wire the motors

MATERIALS:

3 sealed motors
3 film cans with caps
Tether wire
Solder

TOOLS:

Drill
3/32" drill bit
Soldering iron



Figure 10C: Tether wire soldered to motor

PROCEDURE:

1. Take 3/32" drill bit and drill holes in the center of the bottom of the 3 film cans and the centers of the 3 film caps (Fig 10A).
2. Strip about 15" of sheath from the tether wire, being careful not to nick any of the inner wires. Separate the four twisted pairs as shown on previous page.
3. Thread 6" of twisted pair through the hole in each film cap, and tie a knot inside the cap for strain relief (Fig 10B).
4. Strip 1/4" of insulation from the end of each wire. Solder wires to terminals of the sealed motor: Colored wire to (+), white wire to (-) (Fig 10C). Repeat for each motor/tether wire. (Brown wire does not get attached to a motor).



A:
Film cans drilled with
3/32" drill bit



B:
Tether wire threaded
through film cap



C:
Tether wire soldered to
motor

Figure 10: Wiring the 12VDC motors

STEP 5

PURPOSE:

To pot the motors

MATERIALS:

3 Drilled Film cans
Wax (Anchor bowl ring, *one ring pots about 6 motors)

Electrical tape
Sealed motors
Rubbing alcohol
Paper towels

TOOLS:

2 Metal cups
Lead Sinkers
Electric hotplate
Potting holder
Pliers

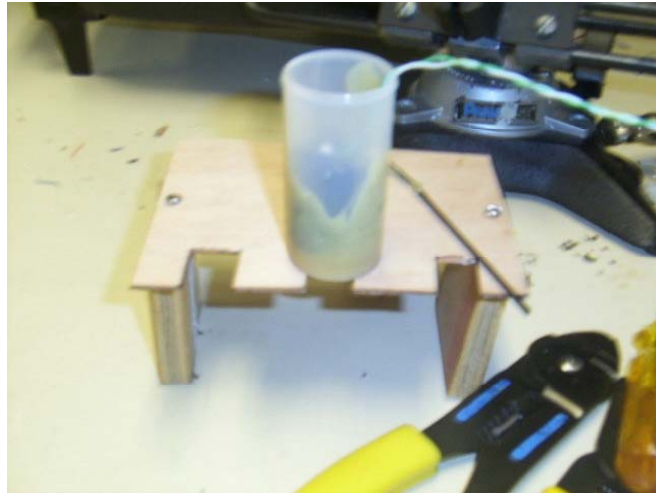


Figure 11D: Motor placed into wax

PROCEDURE:

Note: One wax ring will pot about 6 motors (2 vehicles).

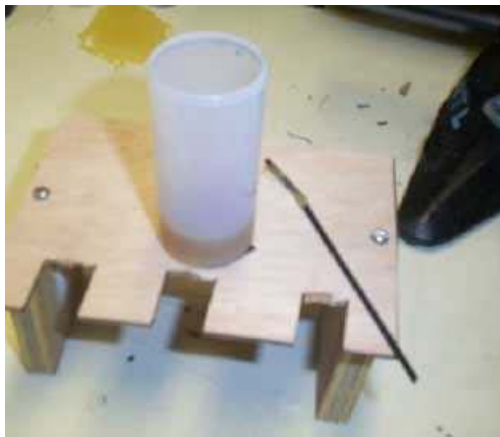
1. Fill electric hot plate with SMALL amount of water (1/2"), turn on to lowest heat setting.
2. Place lead sinkers along with wax into the 2 metal cups, place cups into hotplate. The wax will melt slowly. (Fig 11A)
3. Put electrical tape over the holes in the 3 film cans. (Fig 11B)
4. Once the wax has melted, fill the film can about 1/4" (not more!)
USE PLIERS TO GRAB HOT METAL CUP! (Fig 11C)
5. Place sealed motor in the wax, push the motor shaft through the hole in the bottom of the film can. This must be done relatively quickly, as the wax cools and hardens rapidly when the cold motor touches it (Fig 11D).
6. Wipe off motor shaft with rubbing alcohol and a paper towel.



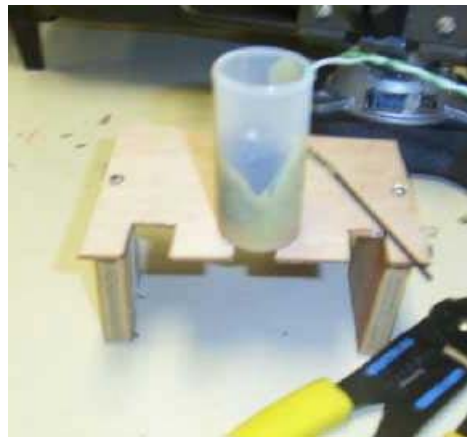
A: Melted wax in metal cups with Sinkers



B: Film cans with tape over holes



C: Film can partially filled with wax



D: Motor placed into wax

Figure 11: Potting the motors

STEP 6

PURPOSE:

To complete the thrusters

MATERIALS:

3 propellers
3 bushings
Wax

TOOLS:

2 Metal cups
Lead Sinkers
Electric hotplate
Potting holder
Pliers
Vise
Machinist's Scraper
(triangular blade)
Eye Protection

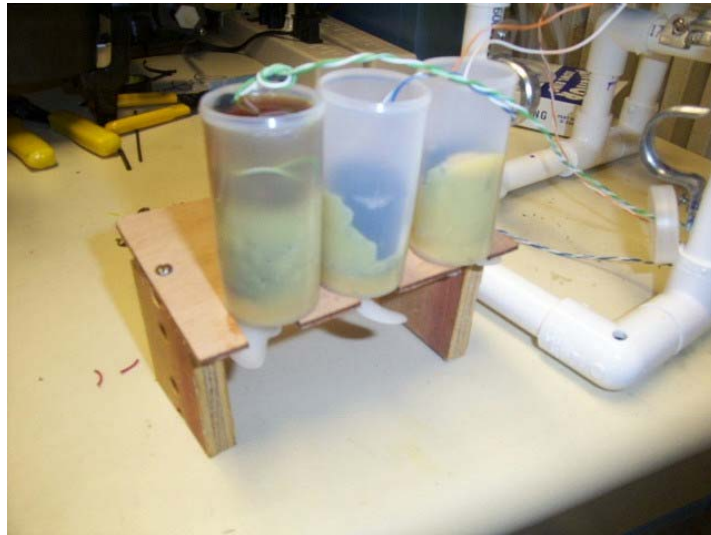


Figure 12C: film cans filled the rest of the way up after attaching propellers

PROCEDURE (figures on next page):

1. Chamfer the grooved end of each propeller with the triangular blade of the machinist's scraper. (A chamfer means drilling just a TINY bit around the top edge of the hole: just enough to round the edge of the hole so the bushing can slip inside. This can also be done ****carefully**** with a 5/32" drill bit.)
2. Chamfer the wide end of each bushing with scraper or 1/8" drill bit. (Scrape just a tiny bit off the edge of the hole so that the motor shaft can be pushed in).
3. Using pliers or a vise, push the bushings into the propellers. Be careful that they go in straight!
4. Put a small (2") piece of PVC pipe on the back of the motor and press the propeller/bushing onto the motor shaft with a vise (Fig. 12B). Be careful not to bend the terminals, and make sure the propeller goes on straight and tight.
5. Once all the propellers are attached, place the three thrusters into the potting holder and fill the film cans with wax to the top, creating a positive meniscus (see figure 12D). **(USE PLIERS TO GRAB HOT METAL CUPS!)**
6. Put caps on the film cans (be sure wax does not have air pockets).

WARNING! HOT WAX CAN SQUIRT OUT! WEAR EYE PROTECTION!



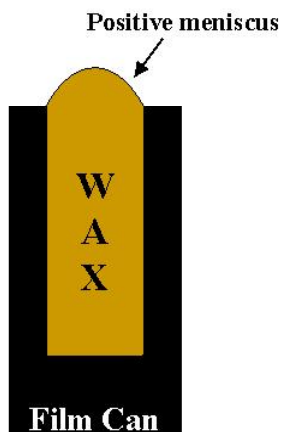
A: Propellers and bushings



B: Attach propellers to motors with a vise



C: Fill the film cans to the top with wax



D: Positive Meniscus

Figure 12: Final thruster assembly

STEP 7

PURPOSE:

To mount the thrusters

MATERIALS:

Assembled thrusters
Assembled frame

TOOLS:

Phillips Screwdriver

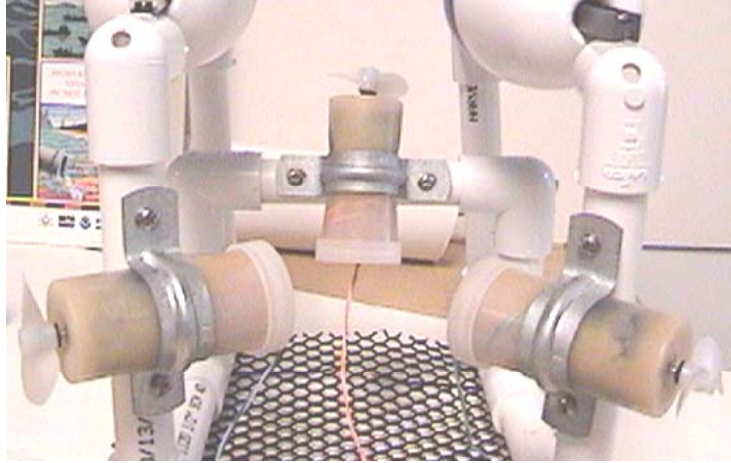


Figure 13: Mounted thrusters

PROCEDURE:

1. Unscrew one end of each motor mount and loosen
2. Place thrusters inside motor mount.
3. Reattach motor mounts to the frame. Tighten screws just enough to hold motor firmly, but not enough to strip the hole.

STEP 8

PURPOSE:

To water proof the tether

MATERIALS:

Completed frame

Butyl Rubber
tape

Electrical tape



Figure 14: Waterproofed tether tied in strain relief loop

PROCEDURE:

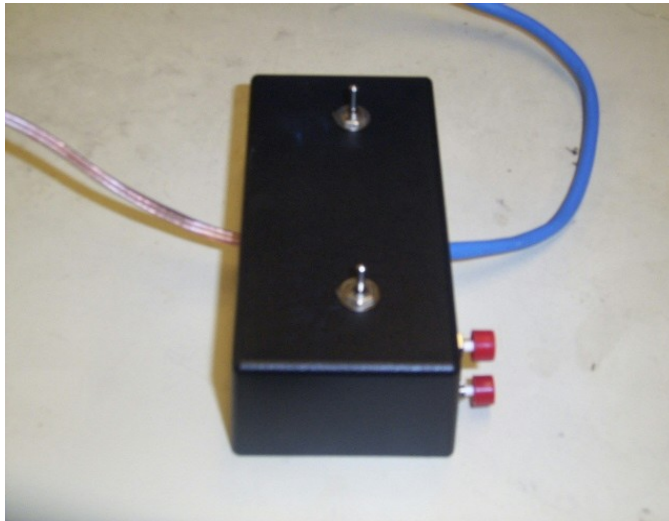
1. Once the thrusters have been mounted, follow the wire pairs from the thrusters, to where they meet inside the tether sheath.
2. Take some Butyl Rubber tape and press it over the wire pairs and the sheath. Work it in well, so that it seals both around and between the wires and sheath.
3. Wrap electrical tape over the Butyl Rubber tape.
4. After water proofing the tether, make a loop in the tether (refer to figure 14), and attach to the vehicle frame with tie wraps (zip ties).

Note: Make sure Butyl Rubber tape DOES NOT touch any exposed wires.

UNIT 3

ASSEMBLY OF SUBSYSTEM THREE:

THE CONTROL BOX



FOR THIS TASK YOU WILL NEED:

TOOLS	MATERIALS
Soldering iron Drill 1/4" drill bit Nut driver Wire cutter Wire stripper Small Phillips Screwdriver	Control box 2 button switches 2 pole switches 2 alligator clips with sleeves (one red one black) Fuse cap wire Fuse (10 A slow blow fuse) Ribbed speaker wire 1 loose red wire (#24 stranded hookup wire) 1 loose black wire (#24 Stranded hookup wire)

WIRING DIAGRAMS are available in the appendix at the end of this document.

WARNING:

**SOLDERING IRONS GET VERY HOT AND CAN CAUSE SERIOUS BURNS.
HOT SOLDER MAY SPATTER. WEAR EYE PROTECTION!!!
TAKE CARE TO NOT SHORT BATTERIES OR SHOCK YOURSELF!**

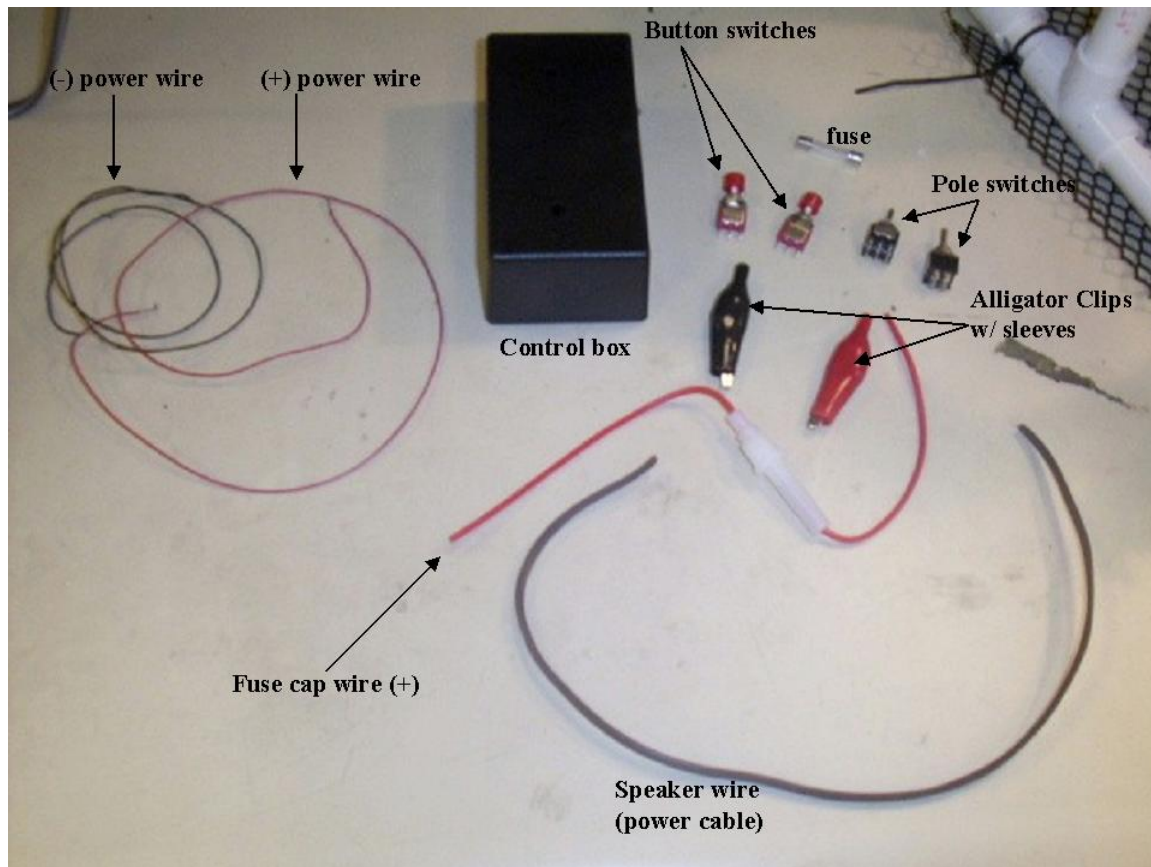


Figure 15: Control box items

RED WIRES = positive(+)
BLACK WIRES = negative(-)

THE RIBBED SIDE OF THE SPEAKER WIRE IS positive (+)
THE SMOOTH SIDE OF THE SPEAKER WIRE IS negative (-)

WIRING DIAGRAMS are available in the appendix at the end of this document.

STEP 1

PURPOSE:

To assemble the power cable

MATERIALS:

Ribbed speaker wire (5-10' long)
2 alligator clips with sleeves
Fuse cap wire
Solder
Electrical tape
Loose red wire
Loose black wire

TOOLS:

Soldering iron
Wire cutter
Wire strippers
Small scissors

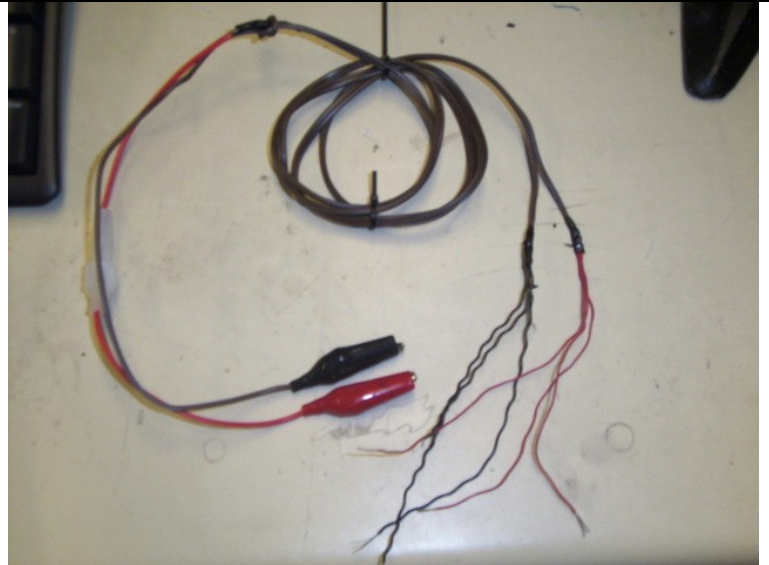


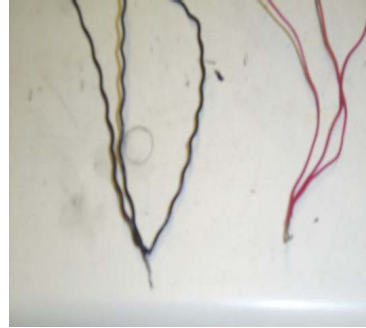
Figure 16D: Completed power cable

PROCEDURE:

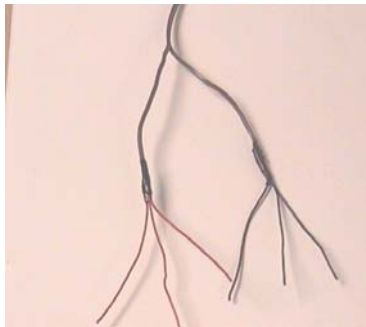
1. Take one end of the power cord (speaker wire), and with a small pair of scissors, snip apart about 1" of the two wires. Pull the two wires apart until you have separated about 14" of the wire.
2. Cut 13" off the ribbed (+) side of the speaker wire that you just separated. (This will be replaced by the fuse wire).
3. Strip 1/2" off both ends of the fuse cap wire and both the (+) and (-) sides of the speaker wire. Solder Fuse cap wire (+) to the ribbed (+) side of the speaker wire. Cover connection with electrical tape.
4. Remove alligator clips from sleeves and place sleeves on corresponding sides of the power cable (i.e. red sleeve over fuse cap wire). Attach and solder alligator clips (fig 16A).
5. Slide sleeves back on alligator clips. Put fuse into fuse cap.
6. Take the loose red (+) wire and the loose black (-) wire and cut each wire into 4 equal lengths. Strip 1/2" from one end of each length.
7. Take 3 of the loose red (+) wires and twist them together. Repeat for loose black wires (-). (fig 16B) (you will need 4th pieces later on in steps 3 and 4).
8. Take the 3 attached loose red (+) wires and solder them to the ribbed (+) side of the speaker wire. Take the 3 attached loose black (-) wires and solder them to the smooth (-) side of the speaker wire (fig 16C). Cover connections with electrical tape (fig 16D).



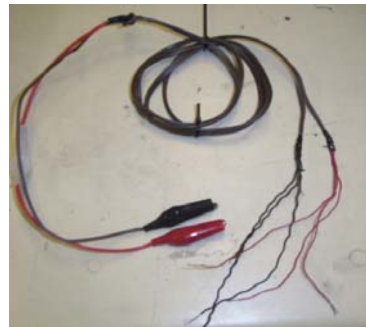
A: Attach fuse wire and alligator clips to power Cable



B: Wire Splices



C: Wire splices attached to power cable



D: Completed power cable

Figure 16: Power Cable assembly

STEP 2

PURPOSE:

To prepare the control box

MATERIALS:

Control box
Completed power cable
Tether wire

TOOLS:

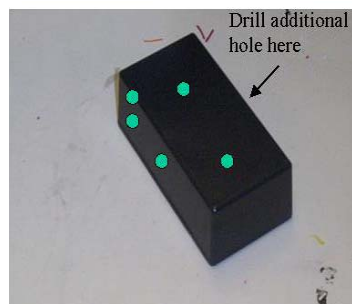
Drill
1/4" drill bit



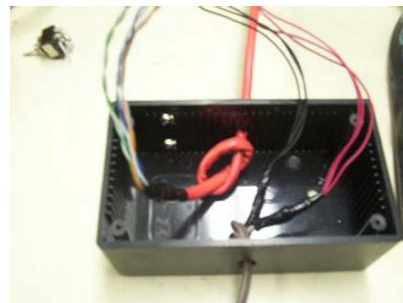
Figure 17A: Control Box

PROCEDURE:

1. Drill holes with 1/4" drill bit in locations shown in Figure 17A. (2 in top for horizontal thruster switches, two on front, right hand side, for up/down switches, one in center front for tether cable, and one in back for power cable.
2. Remove about 6" of the tether sheath, exposing the wire pairs.
3. Pull tether wire through the front of the control box, tie knot for strain relief.
4. Pull the end of the power cable with the small loose wires through the back of the control box and tie a knot for strain relief. (Fig 17B)



A: Control Box



B: Drilled control box with tether and power cable

Figure 17: Control box preparation

STEP 3

PURPOSE:

To wire the button switches (vertical thrusters)

MATERIALS:

2 button switches
Prepared control box
Solder

TOOLS:

Soldering iron
Vise

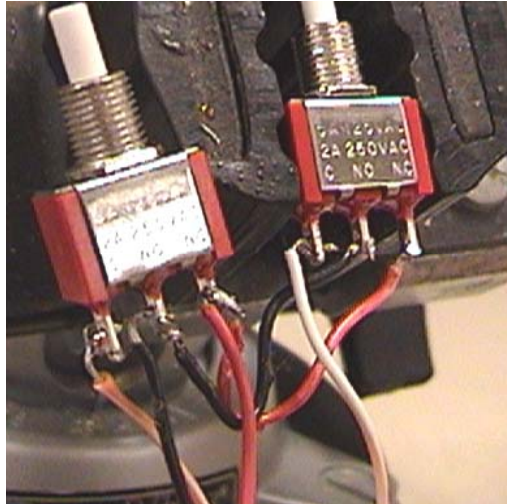


Figure 19D: Vertical thrusters with tether wire and power connections.

PROCEDURE:

1. Refer to Figures 18 and 19 (next page) for instructions on wiring the switches. Wiring Diagrams are also available in the appendix.
2. Locate the **(C, NO, NC)** box above the wire terminals on each switch.
3. Cut about 2" from both left over loose red (+) and black wires (-). (Fig 19A)
4. Solder the small **red** (+) wire between the two **NC** terminals. (Fig 19B)
5. Solder the small **black** (-) wire between the two **NO** terminals. (Fig 19B)
6. Take ONE **red** (+) wire splice from the power cable, and solder it to one of the **NC** terminals. (Fig 19C)
7. Take ONE **black** (-) wire splice from the power cable, and solder it to the **NO** terminal on the same switch. (Fig 19C)
8. Separate about 2" of the orange tether wire pair.
9. Solder the **orange** (+) wire to the **C** terminal on ONE of the switches. (This switch will move the sea perch upward.) (Fig 19D)
10. Solder the **white** (-) wire to the **C** terminal on the other switch. (This switch will move the sea perch downward.) (Fig 19D)

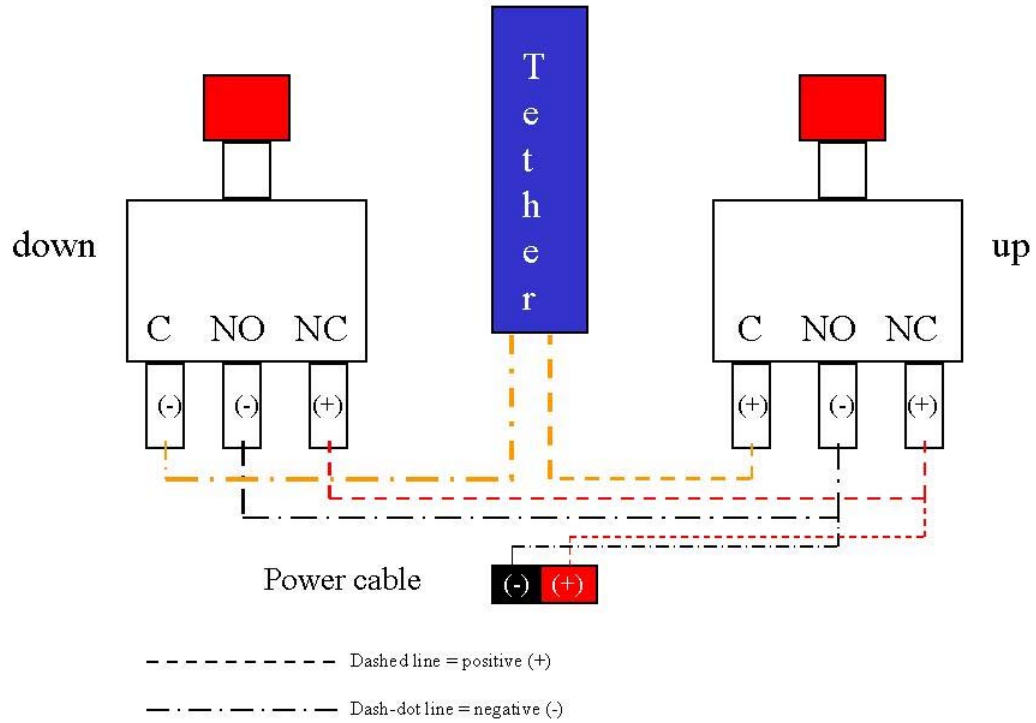


Figure 18: Button switch/Vertical thruster wiring diagram (above)



A: Vertical thruster interconnecting wires



B: Connected vertical thrusters



C: Vertical thrusters with power cable connections



D: Vertical thrusters with power cable and tether connections

Figure 19: Button Switch/Vertical Thruster wiring summary

STEP 4

PURPOSE:

To wire the pole switches (port and starboard thrusters)

MATERIALS:

2 pole switches
Prepared control box
Solder

TOOLS:

Soldering iron
Vise

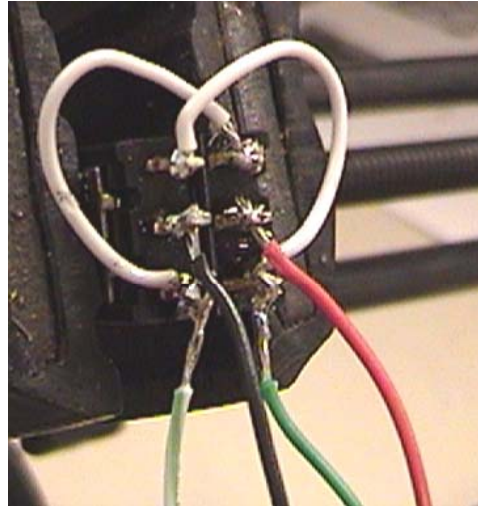


Figure 21C: Cross wired pole switch with tether and power cable connections

PROCEDURE:

1. Refer to Figures 20 & 21 (next page) for instructions on wiring pole switches. Wiring Diagrams are also available in the appendix.
2. Cut 4 small pieces (1 1/4") from one of the left over loose wires. Solder them to opposite corner terminals of the pole switches. (Fig 21A)
3. The pole switch terminals are arranged into 2 columns with 3 terminals in each column. Use the RIGHT column for positive (+) connections, and use the LEFT column for negative (-) connections.
4. Separate about 2" from the **blue** (+) and **green** (+) wire pairs. Solder the **blue** (+) wire to the bottom right terminal on your **FIRST** pole switch. Repeat with **green** (+) wire for the **SECOND** switch. (Fig 21B)
5. Solder one **white** wire to each of the terminals on the bottom left side of each switch. (Fig 21B)
6. Solder the Power wire splices to the middle terminals: Solder one **red** (+) wire splice to each of the middle-right terminals. Solder one **black** (-) wire splice to each of the middle-left terminals. (Fig 21C)

STEP 5

PURPOSE:

Finishing the control box

MATERIALS:

Control box
Wired Switches

TOOLS:

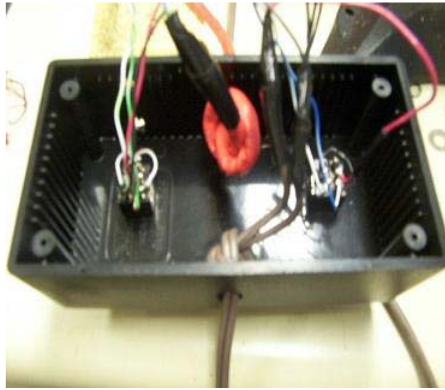
5/16" Nut driver
Phillips Screwdriver



Figure 22C: Completed control box

PROCEDURE:

1. Place pole switches in corresponding holes. Tighten into place with nut driver. (Fig 22A)
2. Remove red buttons from button switches. Place button switches through the 2 holes next to the tether cable. Tighten with nut driver. Place red buttons back onto the switches. (Fig 22B)
3. Screw on the back of the control box. (Fig 22C)



A: Control box with power cable, Tether, and pole switches



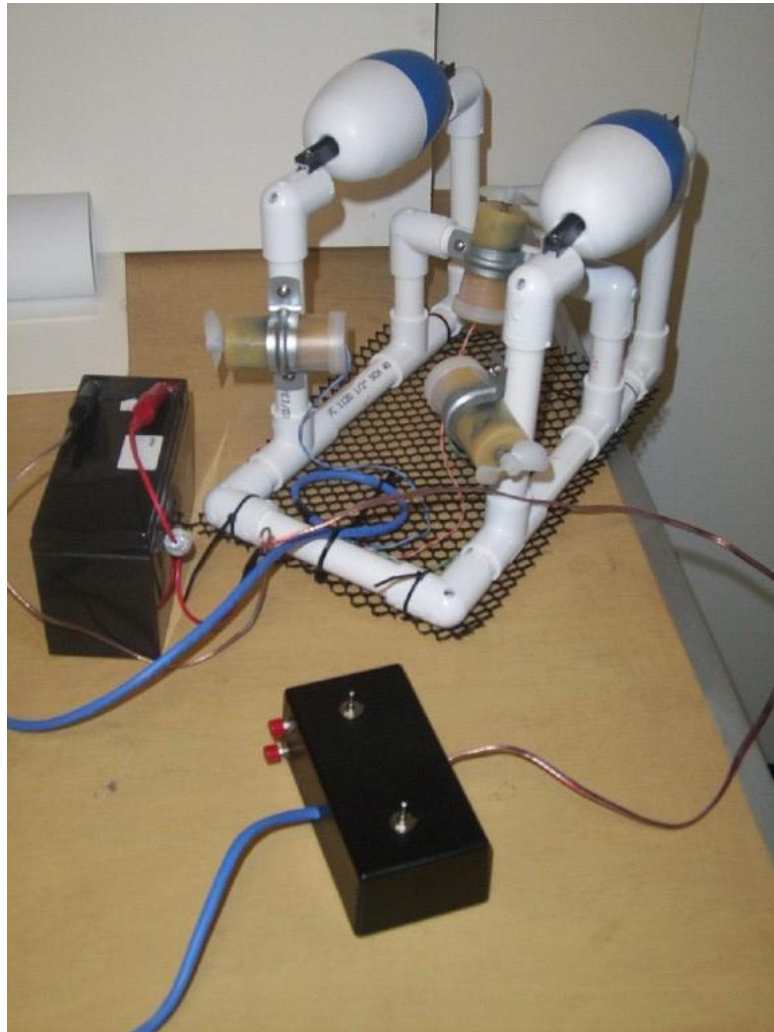
B: Control box with completed thruster switches



C: Completed control box

Figure 22: Final control box assembly

Figure 23: Finished Sea Perch








To run the Sea Perch, clip the alligator clips onto the corresponding terminals on the battery (red +, black -). Test the switches to see that all the motors turn in the expected directions. Be careful not to short the battery. If the Sea Perch stops working, first check the fuse to see if it has blown.

Place Sea Perch in the water and attach weights to the payload netting until it has just slightly positive buoyancy, meaning that it floats with the floats just out of the water (about 1/4" to 1/2"). The motor angles can be adjusted for optimal thrust, maneuverability, or stability.

Have fun!

Control Box Diagram Appendix

Key to understanding electrical diagrams

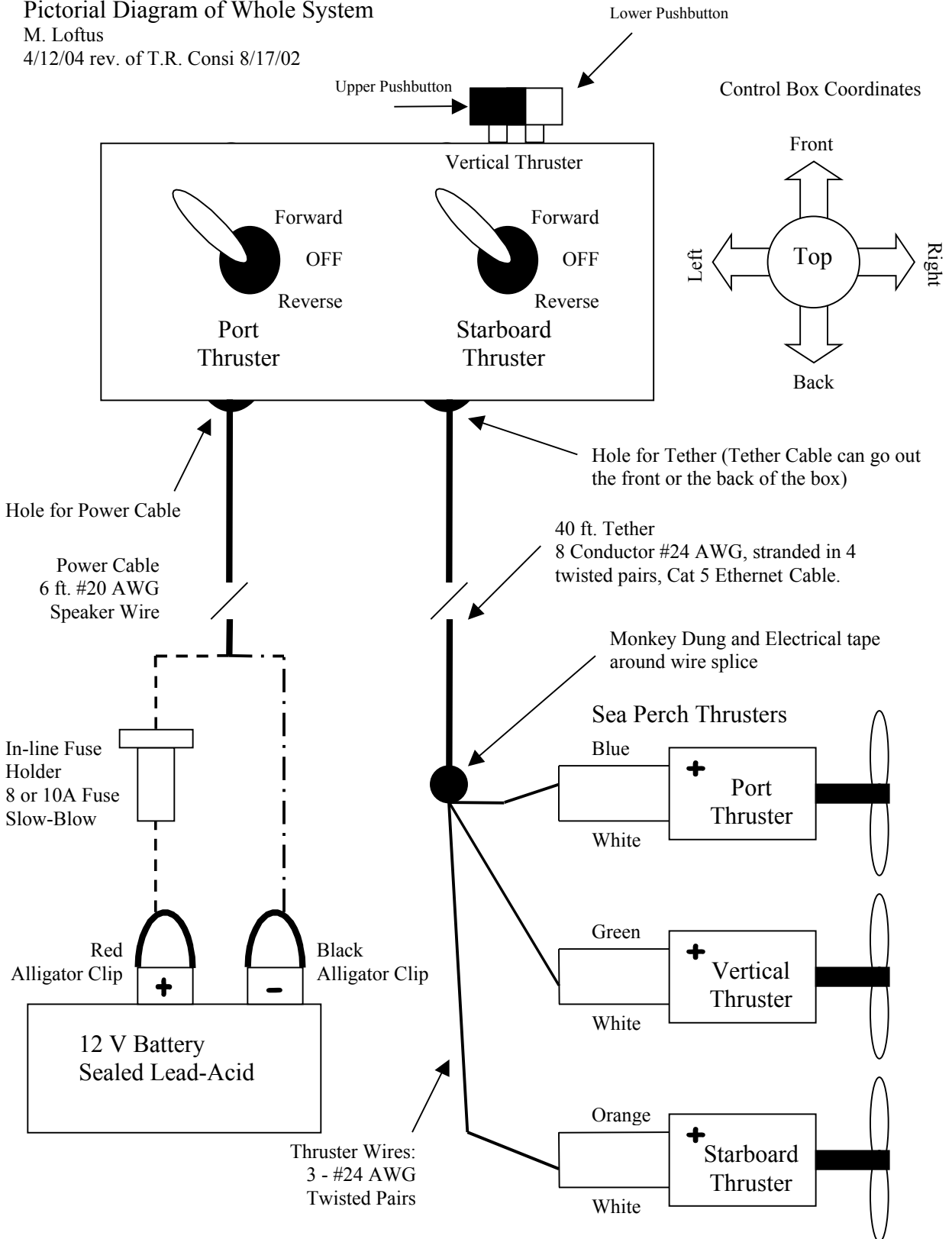
-  This black dot signifies a connection between two wires. Any two wires that cross but do not have a dot like this one are not connected.
-  The dotted line represents a strong connection between the two C terminals. This means that both C connections move together.
-  The dashed lines represent wires coming from the positive terminal of the battery.
-  The dash-dot lines represent wires coming from the negative terminal of the battery.
-  A plain line represents any wire. When thicker lines separate into several thinner lines, this represents a wire splitting or being spliced.

Splicing a wire is when several smaller wires are soldered onto the end of one wire so it can be connected to many things.
- NC “Normally Closed”: This symbolizes the terminal that is normally connected to the common in the inner circuitry of the switch.
- NO “Normally Open”: This symbolizes the terminal that is normally connected to the common in the inner circuitry of the switch
- C “Common”: This symbolizes the common terminal within the switch. This terminal is not equivalent to ground.

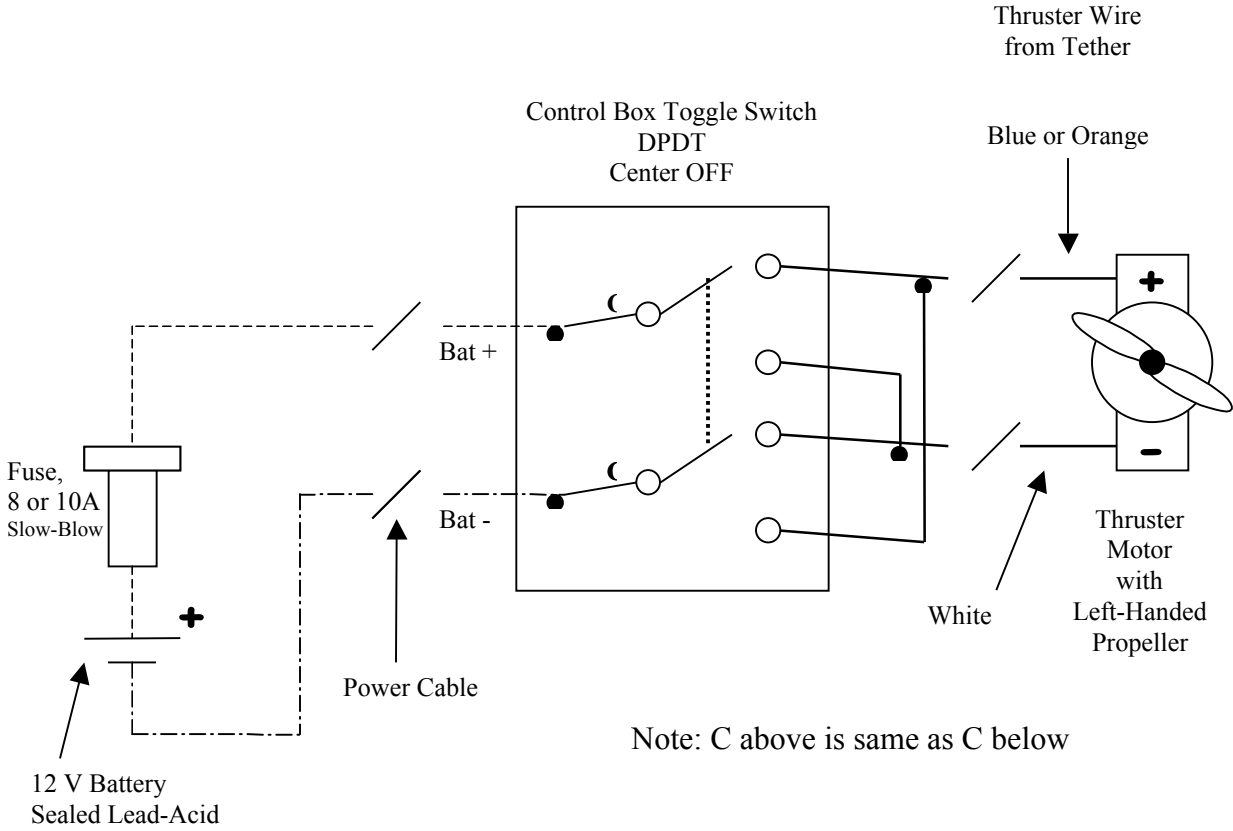
DOE – Sea Perch Control Box & Tether
 Pictorial Diagram of Whole System

M. Loftus

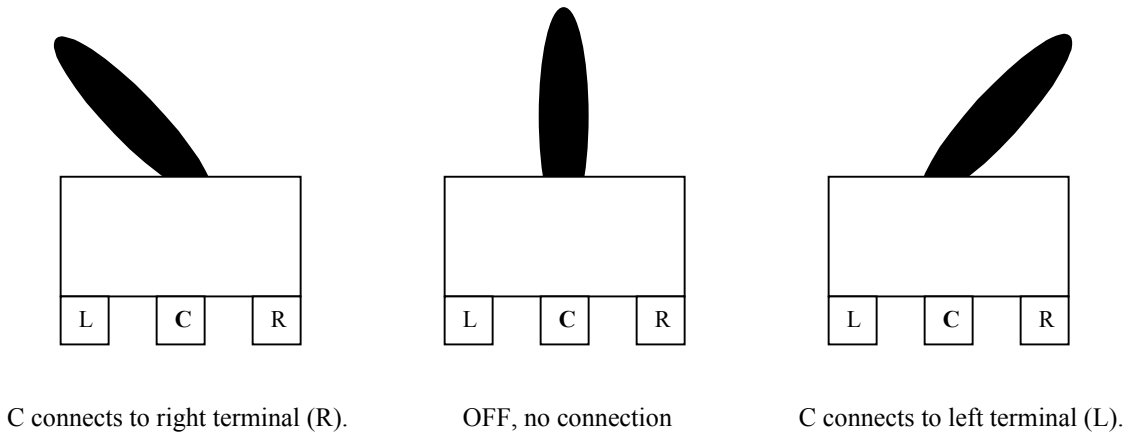
4/12/04 rev. of T.R. Consi 8/17/02



Sea Perch Control Box & Tether
 Schematic Diagram for Port or Starboard Thruster Control Circuits
 M. Loftus
 Rev of T.R. Consi 8/17/02

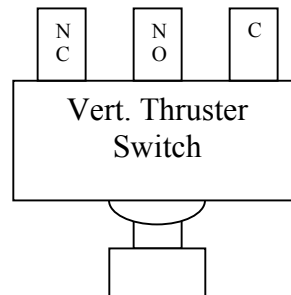
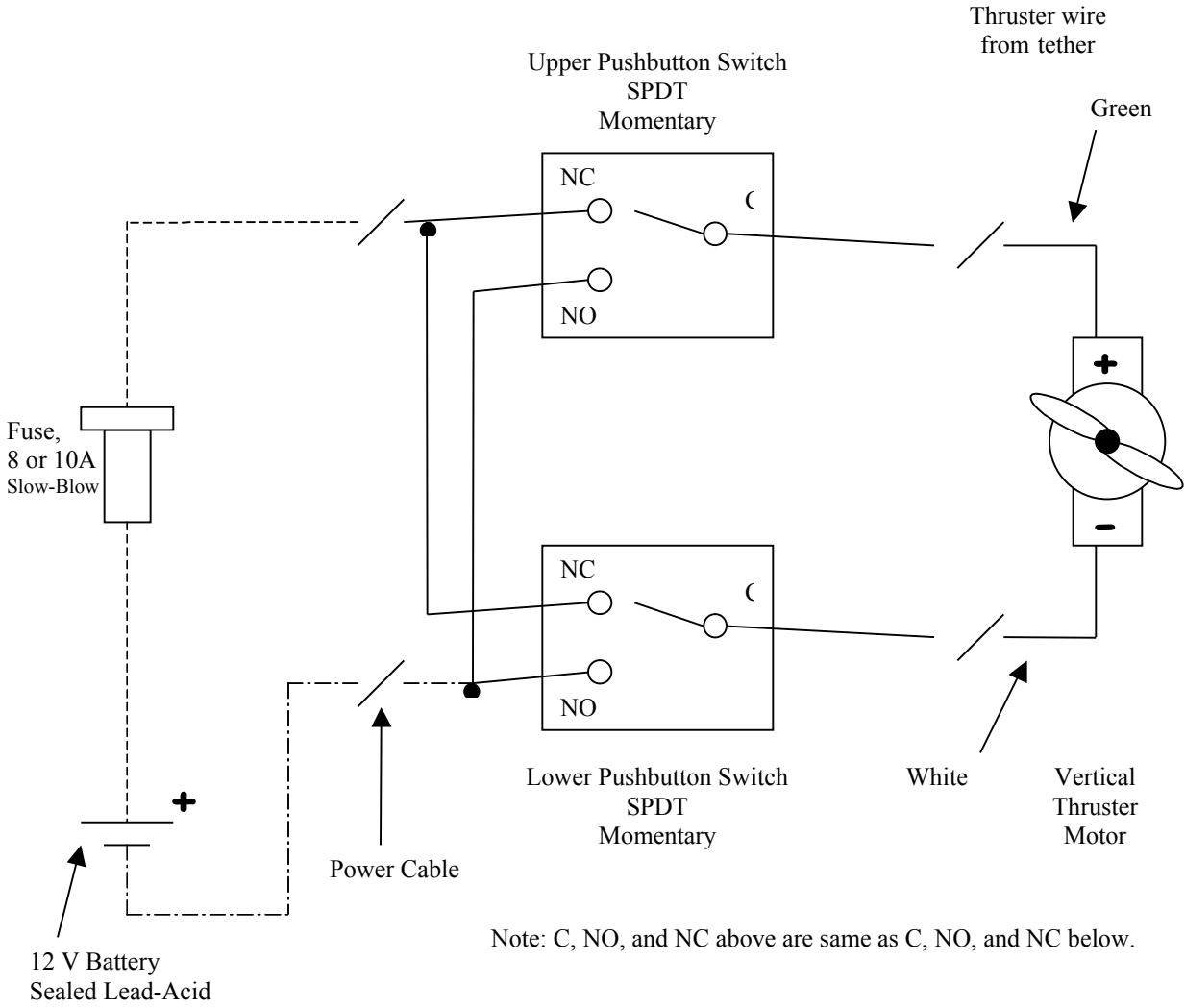


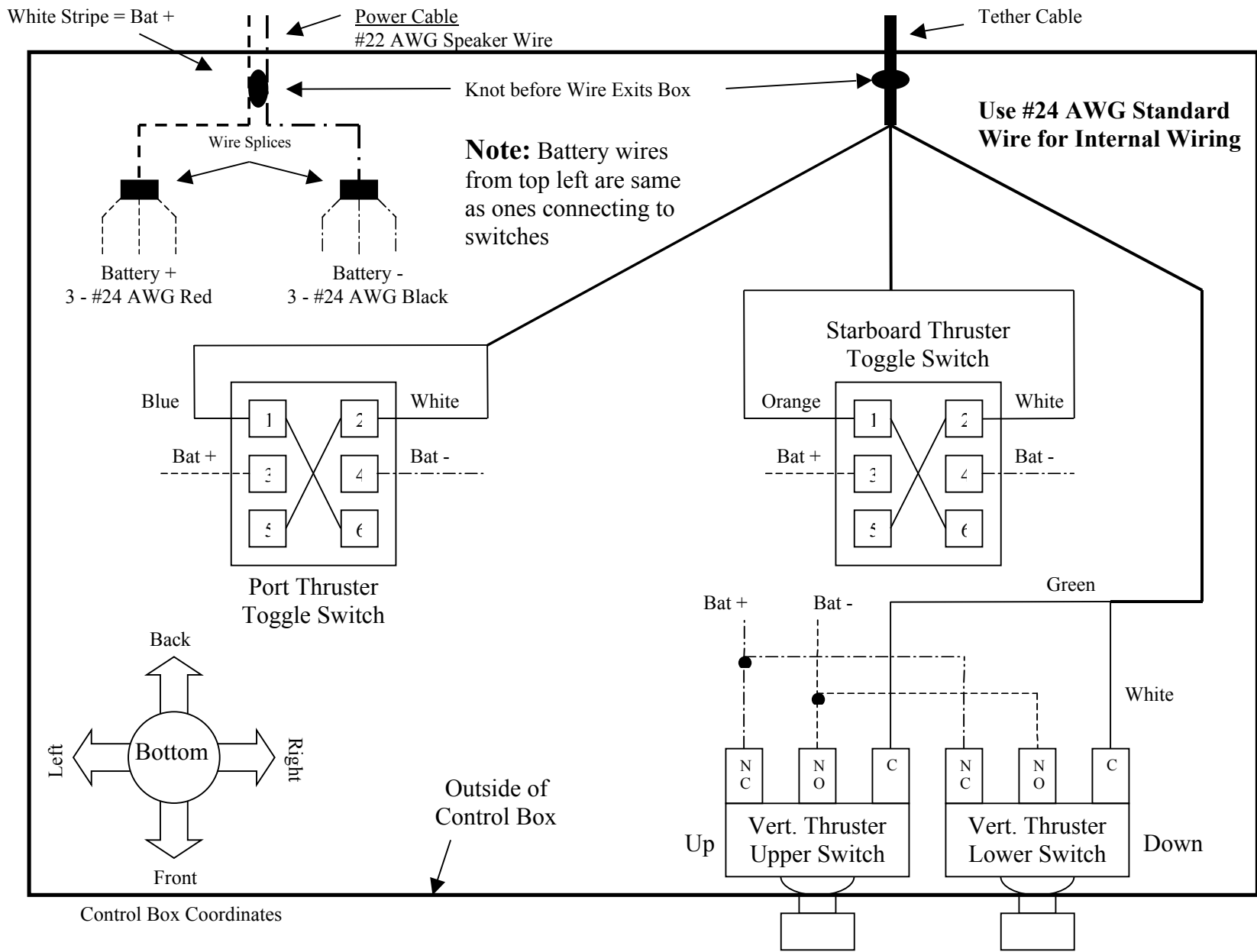
Toggle Switch Action



Sea Perch Control Box & Tether
 Schematic Diagram for Vertical Thruster

M. Loftus
 4/12/04 rev. of T.R. Consi 8/17/02





Sea Perch ROV

Parts and Tools Lists

These lists have been compiled in order to assist you in building the Sea Perch in your classroom and in ordering the necessary parts and tools. Please consult the construction manual and reference your Sea Perch training to verify what you will need.

The suggested vendors have been selected for convenience, price, and/or ease of use. Many of the items may be available at lower cost from other sources, or may be already available at your school (especially tools). Many items come in bulk, or are only available in quantities or packages larger than that needed for a single Sea Perch kit. In these cases, the cost per kit is calculated as a fraction of the minimum order quantity and price. When ordering for multiple kits, verify the quantity needed to order with the quantity needed for each kit and the minimum order quantity. Do not rely solely on the quantity column for the number to order. Many vendors have significant quantity discounts available, and some may have educational discounts.

Key

Qty.	Quantity - number of items needed for 1 kit, or length needed for items such as wire.
Size	Size or amount of item required, or unit of measure.
Item	Description of item.
Suggested Vendor	Suggested source for purchase of items.
Cat.No.	Catalog Number of item in suggested vendor's catalog
Minimum Package Quantity	Minimum amount available from vendor in a single order - may be more or less than needed for 1 kit
Per Package Cost	Cost of minimum order.
Order Quantity (# Pack.)	Number of packages of minimum order size needed for 1 kit.
Cost	Cost of quantity needed to order
Per Kit Cost	Cost of material needed for 1 kit.
Notes	Additional information, including quantity discounts and alternative sources

These lists were last updated in June 2005. All items were available from the suggested vendors at that time, but availability may change.

Sea Perch

Master List - Parts for 1 vehicle

Qty.	Size	Item	Suggested Vendor	Cat. No.	Minimum Package Quantity	Per Package Cost	Order Quantity (# Pack.)	Cost	Per Kit Cost	Notes
Vehicle Frame										
1	14 in	3/8", ABS H-Column	Plastruct	H-12	1	\$ 1.30	1	\$ 1.30	\$ 1.30	
1	5 ft	1/2", Sch. 40 PVC Pipe	McMaster-Carr	48925K91	1	\$ 1.20	1	\$ 1.20	\$ 1.20	
10	each	PVC elbows, 1/2" Sch. 40	McMaster-Carr	4880K21	1	\$ 0.27	10	\$ 2.70	\$ 2.70	
4	each	PVC Tees, 1/2" Sch. 40	McMaster-Carr	4880K41	1	\$ 0.33	4	\$ 1.32	\$ 1.32	
1	12"x8"	Polyethylene Mesh (per foot)	McMaster-Carr	9314T33	1	\$ 1.09	1	\$ 1.09	\$ 1.09	
3	each	Conduit straps (motor mounts)	McMaster-Carr	9429T36	50	\$ 6.56	1	\$ 6.56	\$ 0.39	
10	each	#6 x 1/2" stainless steel sheet metal screws	McMaster-Carr	92465A148	100	\$ 6.13	1	\$ 6.13	\$ 0.61	
6	each	#6 stainless steel flat washers	McMaster-Carr	90107A007	100	\$ 2.71	1	\$ 2.71	\$ 0.16	
2	each	Football floats 3"x5"	Aquatic Ecosystems	NF7	1	\$ 1.80	2	\$ 3.60	\$ 3.60	
4	each	1 oz. and/or 2 oz. Lead fishing sinkers								
Thruster Assembly										
3	each	35 mm plastic film cans - option 1	Any photo developer	often free	1	\$ -	3	\$ -	\$ -	
		35 mm plastic film cans - option 2 (sample vials)	US Plastics	81037	1	\$ 1.25	3	\$ 3.75		Quantity Discount available
3	12 v	Motors	Jameco	232021	1	\$ 2.25	3	\$ 6.75	\$ 6.75	100+ @ \$1.79ea.
3	each	plastic bushing	Jameco	162392	10	\$ 2.50	1	\$ 2.50	\$ 0.75	
3	each	1/8" plastic propeller .19 .35	Tower Hobbies	DUMB1860	1	\$ 1.15	3	\$ 3.45	\$ 3.45	
Tether Cable (40ft. long each)										
40	ft. long	Cat 5 cable, 4 twisted pair, stranded (by the foot)	Jameco	201582	100	\$ 18.00	1	\$ 18.00	\$ 7.20	Quantity discounts available
Control Box										
1	each	Plastic box 4.9"x2.5"x1.5"	Jameco	18913	1	\$ 3.69	1	\$ 3.69	\$ 3.69	10+ @ \$3.32ea.
2	each	DPDT center off toggle switches	Jameco	21952	1	\$ 1.29	2	\$ 2.58	\$ 2.58	Quantity Discount available
2	each	SPDT mom. push button switches	Jameco	28062	1	\$ 3.69	2	\$ 7.38	\$ 7.38	Quantity Discount available
2	each	Alligator clips	Jameco	256524	2	\$ 0.45	1	\$ 0.45	\$ 0.45	Quantity Discount available
1	each	Insulator for alligator clip - Red	Jameco	248971	2	\$ 0.21	1	\$ 0.21	\$ 0.11	Quantity Discount available
1	each	Insulator for alligator clip - Black	Jameco	248962	2	\$ 0.21	1	\$ 0.21	\$ 0.11	Quantity Discount available
1	each	Fuseholder, In-line, 1.25"x.25" fuse	Jameco	151917	1	\$ 0.99	1	\$ 0.99	\$ 0.99	Quantity Discount available
1	10 A	10 A slow-blow fuse	Jameco	69569	1	\$ 0.74	1	\$ 0.74	\$ 0.74	Quantity Discount available
6	ft. long	#18AWG speaker wire, 6 foot length	McMaster-Carr	70405K34	1	\$ 0.12	6	\$ 0.72	\$ 0.72	250+ @ \$.09/ft.
Expendable Supplies										
0.5	ring	Wax Toilet Bowl Ring (1/2 ring for each vehicle)	McMaster-Carr	2793K31	1	\$ 1.35	1	\$ 1.35	\$ 0.68	@ HomeDepot: 8 rings for \$3.35
2	ft. long	#24 stranded hookup wire, red (by 100' roll)	McMaster-Carr	7587K921	100	\$ 5.83	1	\$ 5.83	\$ 0.12	
2	ft. long	#24 stranded hookup wire, black (by 100' roll)	McMaster-Carr	7587K922	100	\$ 5.83	1	\$ 5.83	\$ 0.12	
15	6 in.	6" cable ties (aka: zip-ties or tie-wraps), black	McMaster-Carr	7130K42	100	\$ 3.39	1	\$ 3.39	\$ 0.51	
3	inches	Butyl Rubber Tape ("Monkey Dung") 16yard roll	McMaster-Carr	76385A15	576	\$ 12.57	1	\$ 12.57	\$ 0.07	
1	roll	Electrical tape	Jameco	285587	1	\$ 0.95	1	\$ 0.95	\$ 0.95	Higher quality tape also available
1	roll	Solder, 60/40 rosin core (contains lead)	Jameco	170456	1	\$ 1.39	1	\$ 1.39	\$ 1.39	
Total for ROV					Total for minimum order quantity		\$ 109.34	\$ 51.11	per kit, w/o battery or charger	

Sea Perch

Battery & Charger										
1	12 v	Battery, Sealed Lead Acid (SLA), 12 volt, 7 AH	Jameco	264057		\$ 16.95				Quantity Discount available
1		Charger - 12v, 4-10AH SLA (PSC-12800A)	McMaster-Carr	7448K67		\$ 41.14				
		Alternative Source for battery	batterymart.com	SLA-12V7-F1			\$ 9.95			
		Alternative Source for charger*	batterymart.com	ACC12BC0500D-1			\$ 9.95			
		*Cord required for alternative charger	batterymart.com	ACC-D-1766			\$ 1.95			
Total for Battery and Charger						Standard - \$ 58.09	\$ 21.85	- Alternative source		

Individual Tools (suggested for each Sea Perch kit)										
1		4.9 gal plastic tub (carrying case for Sea Perch)	IWP	rhp2222		\$ 5.26				
1		PVC pipe ratchet cutters	PlumbingStore.com	4657		\$ 17.88				@ McMaster: #8336A13, \$44.37
1		Screwdriver, flat, medium	McMaster-Carr	5682A18		\$ 4.17				
1		Screwdriver, phillips, small	McMaster-Carr	5682A27		\$ 3.11				
1		Scissors	McMaster-Carr	3608A14		\$ 11.51				
1		Slip joint pliers	McMaster-Carr	5624A8		\$ 7.50				
1		Needle nose pliers	McMaster-Carr	53895A19		\$ 13.67				
1		Diagonal cutter pliers	McMaster-Carr	3621A11		\$ 5.54				
1		Wire strippers (26-16 AWG Stranded)	McMaster-Carr	7294K58		\$ 9.43				
1		Eyeguards	McMaster-Carr	52755T9		\$ 4.81				Quantity Discount available, 10+
1		Soldering Iron	Jameco	224611		\$ 7.95				Many options available, for +/- \$
1		Soldering Stand	Jameco	36329		\$ 4.95				
1		Soldering Iron Tip, conical	Jameco	226018		\$ 0.95				
1		Sharpie (marker)	Office Depot, etc.							
1		Ruler	Office Depot, etc.							
1		Pen	Office Depot, etc.							
1		Pencil	Office Depot, etc.							
1		Pad of paper (as lab notebook)	Office Depot, etc.							
1		Paint set, enamel, regular colors (optional)	Tower Hobbies	LXHH93		\$ 7.19				
1		Paint brush set (optional)	Tower Hobbies	LXB838		\$ 3.39				
Shared Tools (shared by multiple Sea Perch kits)										
1		Bench vise, 4"	McMaster-Carr	5310A42		\$ 48.87				cheaper @ HomeDepot, etc.
1		Drill bit, 1/4"	McMaster-Carr	2901A124		\$ 1.86				Quantity Discount available, 12+
1		Drill bit, 1/8"	McMaster-Carr	2901A115		\$ 1.01				Quantity Discount available, 12+
1		Drill bit, 3/32"	McMaster-Carr	2901A113		\$ 0.88				Quantity Discount available, 12+
1		Machinist's Scraper (Triangular Blade, 4" blade)	McMaster-Carr	4291A16		\$ 10.76				
1		Twisted Pair Cable Stripper (for tether sheath)	McMaster-Carr	4333K26		\$ 21.10				@ Jameco: #230447, \$18.89
1		Digital Multimeter for debugging	Jameco	220812		\$ 9.79				
1		Solder wick	Jameco	41081		\$ 1.49				
1		Hand drill, variable speed - corded or cordless	Sears, Home Depot, etc.	various		\$ 29.99				Many types available: \$30-\$200
1		Electric Skillet (by Presto)	Ace Hardware	65987		\$ 29.99				Any Hot plate and pan will do
1		Metal cup or beaker for melting wax								cups with handles suggested
1		Thruster potting holder (wood, fine nails, wood glue)	Hardware store							
Total for Tools						\$ 263.05				

Sea Perch

Web Addresses of Vendors

Ace Hardware	www.acehardwareoutlet.com
Allied Electronics	www.alliedelec.com
Aquatic Ecosystems	www.aquaticeco.com
BatteryMart.com	www.batterymart.com
Home Depot	www.homedepot.com
IWP	www.rubbermaidproducts.com
Jameco	www.jameco.com
McMaster-Carr	www.mcmastercarr.com
Plastruct	www.plastruct.com
The Plumbing Store	www.PlumbingStore.com
Sears	www.sears.com
Tower Hobbies	www.towerhobbies.com
US Plastics	www.usplastic.com

Old Suppliers (no longer used in this list, but still useful as backup)

Radio Shack	www.radioshack.com
Small Parts Inc.	www.smallparts.com
Newark Electronics	www.newark.com
Contact East	www.contacteast.com
DataComm Warehouse	www.warehouse.com
Go Fishin	gofishin.com

Optional Accessories for the Sea Perch

Sensors

Hobo Data Loggers	http://www.iscienceproject.com/	K-12 teachers can sign them out for free!
-------------------	---	---

Underwater cameras

Resources Unltd	http://www.resunltd4u.com/	part# GM-300KX-10	\$179
Security labs	http://spycorder.com/waterproof.htm	Model # SLC-131	\$150
Polaris	www.polarisusa.com		
Matco	www.matco.com		

Tank for testing ROV (allows for testing during adverse weather)

Aquatic Eco Systems	http://www.aquaticeco.com/	QT502, \$352, Portable Tank, 450 gallons - 30 inches high, 6ft diameter
		QT110, \$75, Oval tank, 110 gallons - 52.5 x 36.5 x 21
		QT 160, \$92, Oval tank, 160 gallons - 59 x 40 x 21