

# Emergency Shutoff Valve

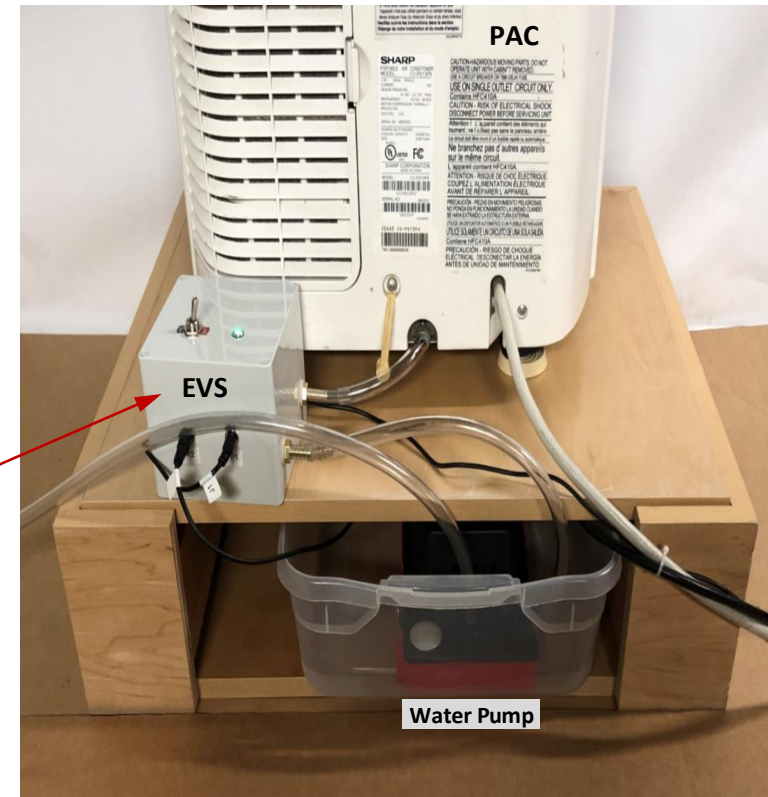
## Overview



The Diversitech CP-22LP Water Pump provides a convenient way to automatically dispose of drain water coming out of a PAC. However, there is a possibility that the pump could overflow if something goes wrong (e.g. power failure, kinked hose, plugged drain, equipment malfunction). To help protect against accidental water damage, the CP-22LP has a built in sensor to detect an overflow condition. The sensor is linked to external terminals that can be connected to the PAC's shut-down system.

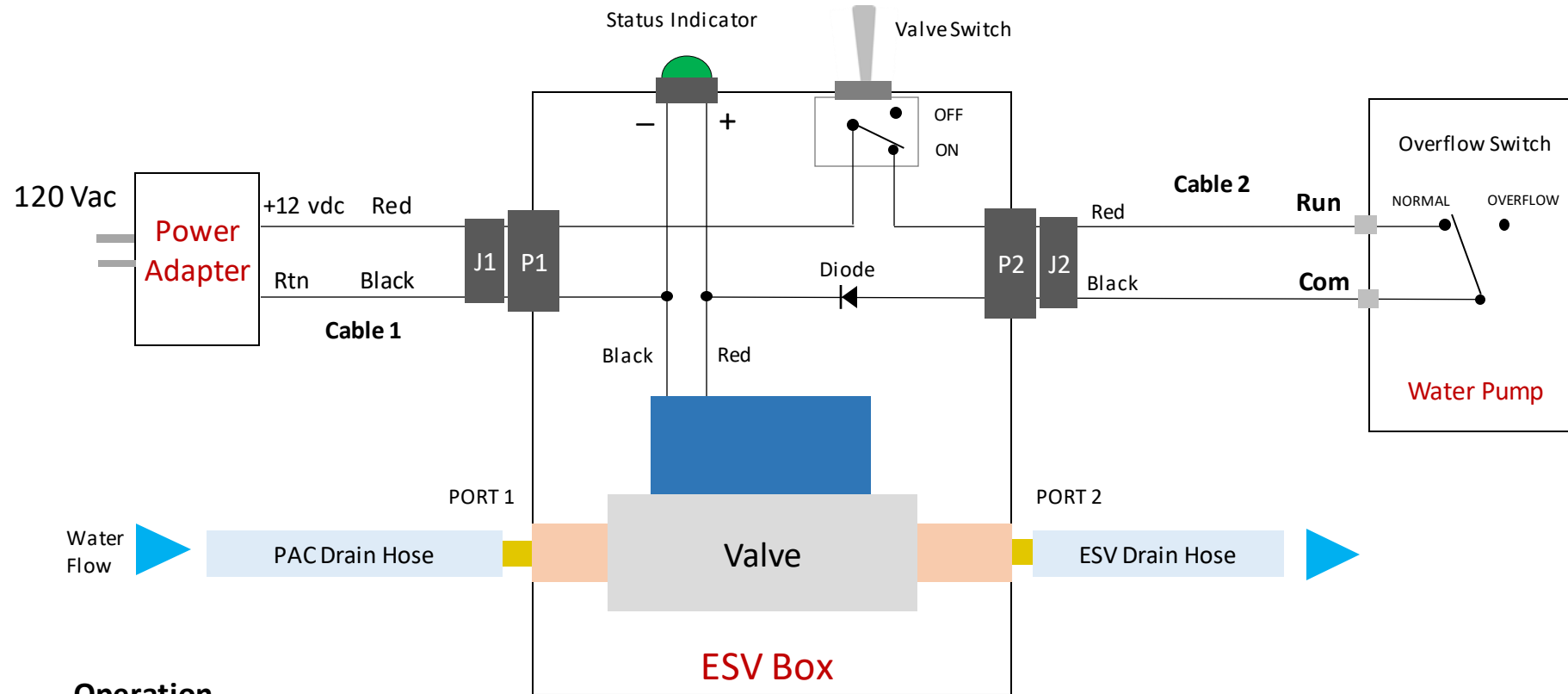
If your PAC does not provide external access to its shut down circuits, you can build your own Emergency Shutoff Valve (ESV) to accomplish the same thing by using the step by step instructions shown on Slides 2-20.

The cost of parts for this project is estimated at \$155-\$165. Also, you may need some special tools and supplies, with an estimated cost of \$30-\$40. The cost of shipping and sales tax is not included in these estimates.



# Emergency Shutoff Valve

## Step 1 - Review The Design









### Operation






- Valve is open if Valve Switch = ON and Overflow Switch = NORMAL
- Valve is closed if Valve Switch = OFF or Overflow Switch = OVERFLOW
- Valve is closed if ESV or Water Pump power is lost and Overflow Switch = OVERFLOW
- Status indicator is ON when valve is open and OFF when valve is closed

# Emergency Shutoff Valve

## Step 2 - Buy The Parts







ESV Parts List				
Item	Project Part Name	Description	Buy QTY	Suggested Product (Link)
1	Valve	- motorized ball valve - 1/4" NPT threading - 2 wire, auto return	1 unit	
2	ESV Box	- gray DIY project box - water and dust proof 4.7 x 4.7 x 2.4 in 120 x 120 x 60 mm	1 unit	
3	Brass Elbow	- 90° pipe fitting - 1/4" M to 1/4" F NPT - 2 pieces/bag (2 used)	1 bag	
4	Brass Nozzle	- pipe/hose adapter - 1/4" M to 1/4" M - 5 pieces/bag (2 used)	1 bag	
5	Valve Switch	- toggle Switch - 2 position, SPST - 2 pieces/bag (1 used)	1 bag	
6	Status Indicator	- 12 vdc LEDs - Red, Grn, Yel, Blue, Wht - 5 pieces/bag (1 used)	1 bag	

ESV Parts List				
Item	Project Part Name	Description	Buy QTY	Suggested Product (Link)
7	Power Adapter	- power adapter, 2 amps - 100-240 Vac to 12 Vdc - 8' cord, 5.5/2.1 mm plug	1 unit	
8	Socket (P1, P2)	- female panel connector - accepts 5.5/2.1mm plug - 5 pieces/bag (2 used)	1 bag	
9	Plug (J1, J2)	- 5.5/2.1 mm plug - 20 inch pigtail cord - 10 pieces (2 used)	1 bag	
10	Washer	- nylon flat washer - ID=1/2" OD=3/4" - 10 pieces/bag (2 used)	1 bag	
11	Diode	- rectifier diode, - - eliminates feedback from water pump	1 unit	

# Emergency Shutoff Valve

## Step 3 - Buy Special Tools & Supplies

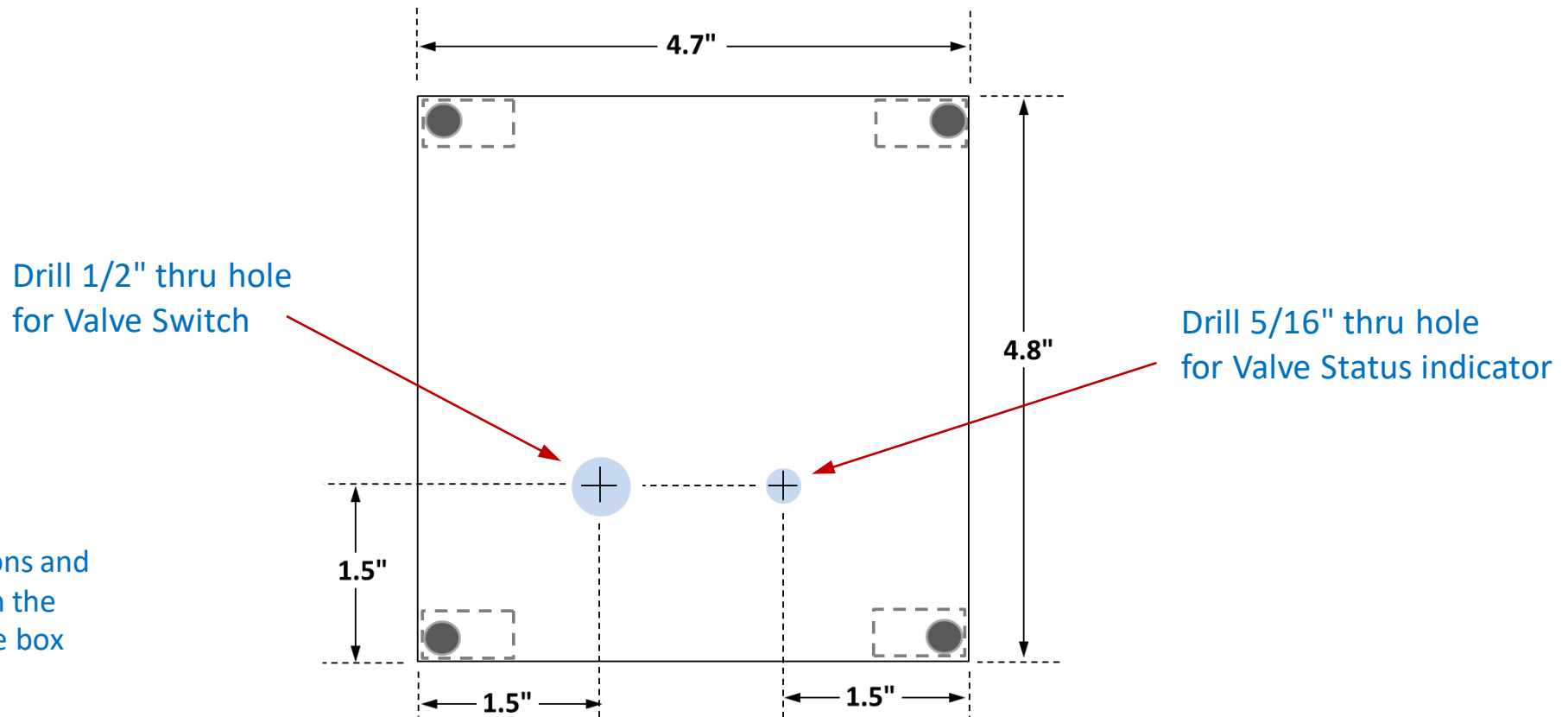
ESV Special Tools & Supplies				
Item	Project Part Name	Description	Buy QTY	Suggested Product (Link)
1	Heat Gun	- 750 & 1000 deg - for heat shrink terminals & sleeving	1 unit	
2	Heat Shrink Terminals	- use to connect wires - self solder/insulate - 50 pieces/bag (3 used)	1 bag	
3	Double Sided Mounting Tape	- use to keep parts and units from slipping	1 roll	
4	Sealant Tape	- use to wrap around NPT pipe fittings	1 roll	

# Emergency Shutoff Valve

## Step 4 - Drill Holes



ESV LID (TOP VIEW)



# Emergency Shutoff Valve

## Step 4 - Drill Holes

### SIDE PANELS

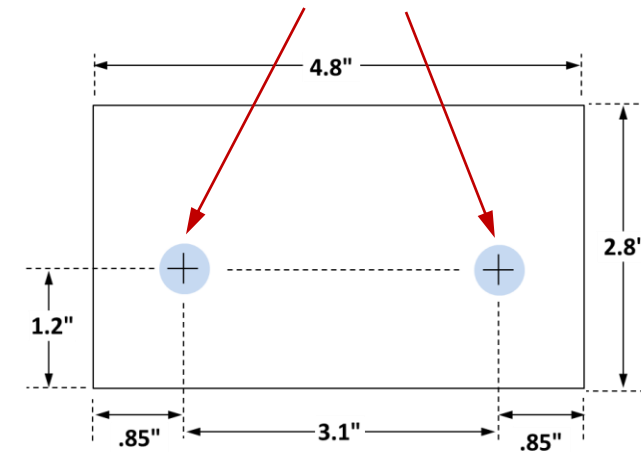
Side A has a larger internal opening than Side B. Make sure Side A is used for the Nozzle holes, otherwise the motor/valve assy will not fit.



Side A



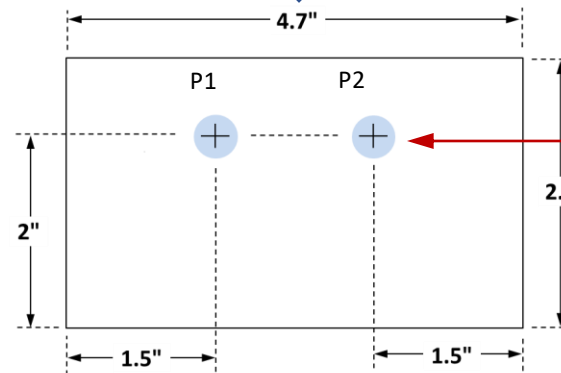
Drill 9/16" holes for Brass Nozzles



Side B



Note: All dimensions and views are based on the external side of the box.



Drill 7/16" holes for Sockets P1, P2

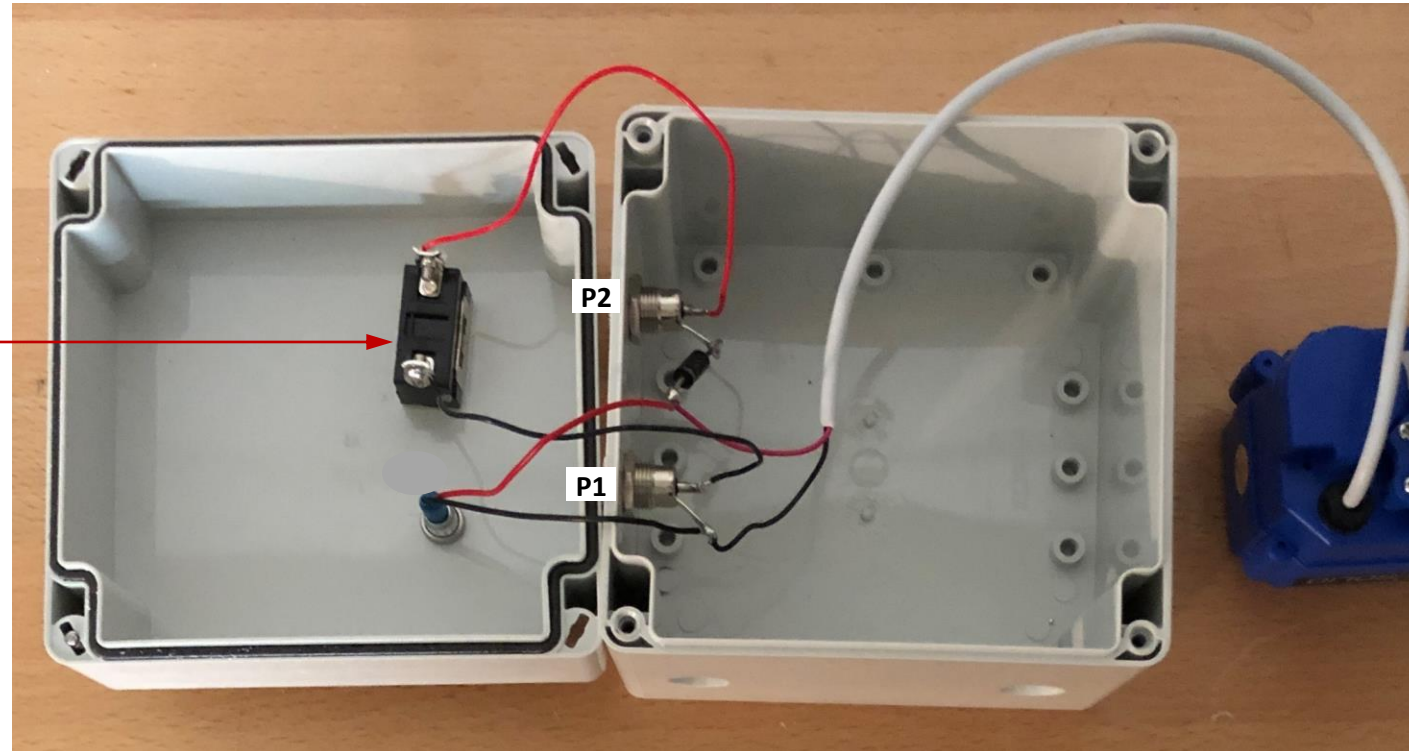
# Emergency Shutoff Valve

## Step 5 - Connect Electrical Components



Install and wire components using the photo shown below and the schematic on Slide 2 for reference.

Put a small strip of Double Sided Mounting Tape between the Valve Switch and ESV Lid to keep the switch from rotating.



# Emergency Shutoff Valve

## Step 6 - Label Cable 1



Cable 1 is part of the Power Adapter and used to supply power (+12vdc) to the ESV.

Add a cable label (Cable 1) and a connector label (J1) to the cable as shown.



The same connectors are used for J1 and J2, so it is possible to accidentally plug the J1 cable into the P2 socket (and visa-versa).

If this happens, the ESV system will not work.

Adding labels at each connection point will help to avoid this problem.



# Emergency Shutoff Valve

## Step 7 - Build Cable 2

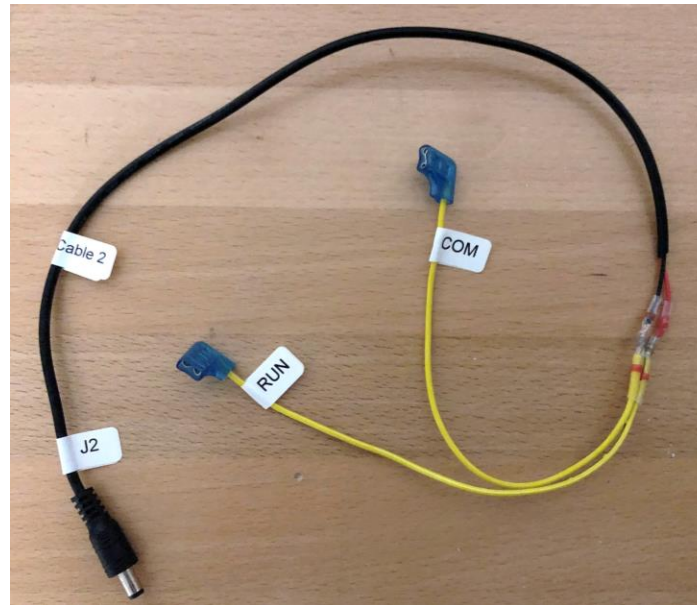


Cable 2 is used to connect the Valve control lines to the RUN/COM terminals located on the Water Pump. The Cable can be constructed using the following procedure to connect the red and black wires on Plug/Cable J2 to the yellow wires (with attached terminal lugs) provided with the Water Pump.

A) Cut 6 inches off the lug end of the two yellow wires provided with the Water Pump.

B) Strip about 3/4" of insulation off the open end of the two yellow wires and the red & black wires connected to J2.

C) Slip a Heat Shrink Terminal over the open end of both yellow wires. Connect one yellow wire to Cable 2 black and the second to Cable 2 red. Slip the Heat Shrink Terminals down over the junction so the solder section covers the connected wires.



D) Use a Heat Gun \* to blow hot air on the solder area. The solder will turn to liquid and the sleeving will shrink, which will secure and insulate the connection.

Heat Shrink Terminal



Solder section

E) Add labels (Cable2, J2, RUN, COM) to identify the cable and connection points.

\*A hair dryer or lighter will not work as a heat gun, they don't provide the correct temperature and an even flow of heat which is needed to create a reliable connection.

# Emergency Shutoff Valve

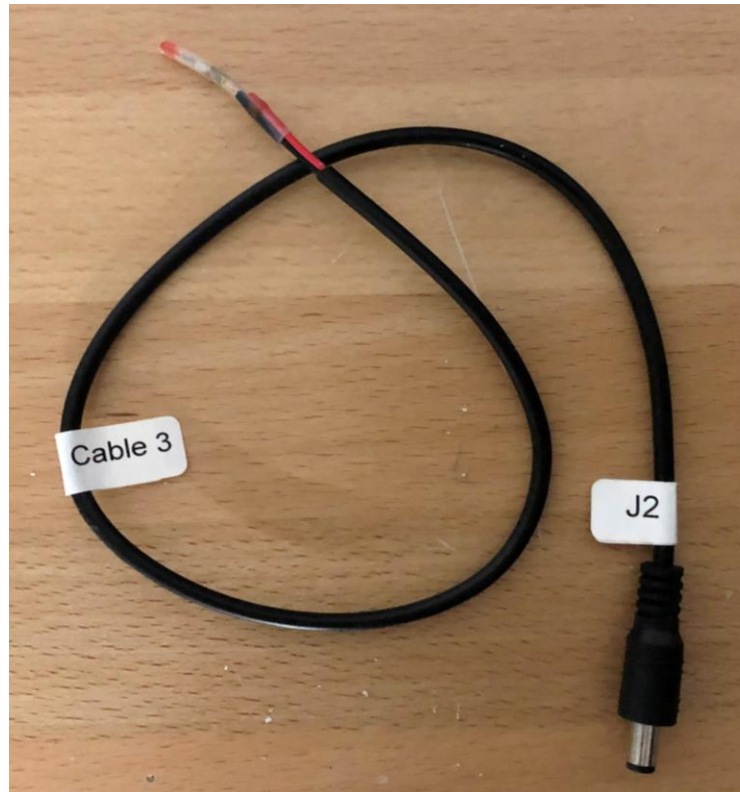
## Step 8 - Build Cable 3



Cable 3 is used as a test cable to simulate the Water Pump in normal run condition. The Cable can be constructed using a spare J2 plug/cable and the following procedure to connect the red and black wires together.

A) Strip about 3/4" of insulation off the red and black wires on a spare J2 cable. Twist the wires together.

B) Slip a red Solder Terminal over the twisted wire. Position the center section (solder area) of the Solder Terminal over the center of the bare wires.



C) Use a heat gun to apply heat to the center section of the Solder Terminal. Continue applying heat until the solder turns from solid to liquid and binds the wires together.

D) Add labels (Cable3, J2) to identify the cable and connection points, as shown in the photo.

# Emergency Shutoff Valve

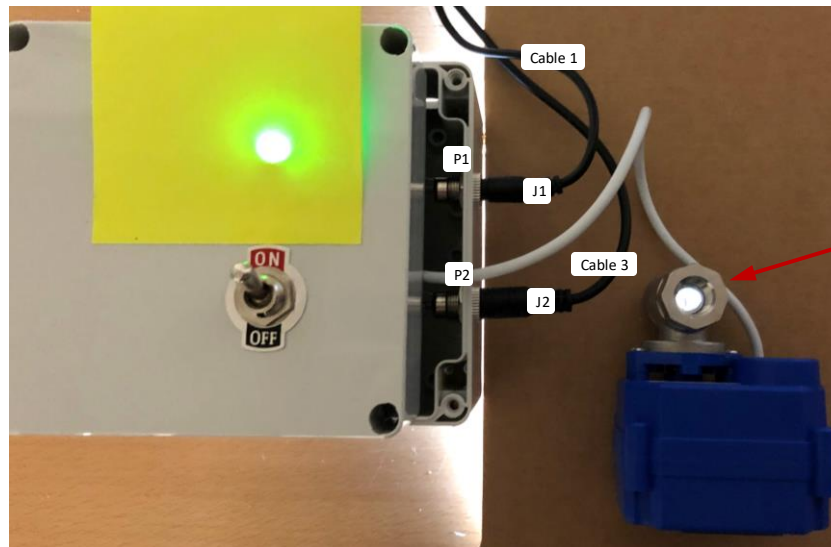
## Step 9 - Perform Standalone Test A

- A) Set the Valve on the outside of the ESV box in order to run a standalone functional test.
- B) Move the Valve Switch to OFF.
- C) Plug Cable 1-J1 into P1, plug Cable 3-J2 into P2.

D) Plug the Power Adapter into a 120 Vac outlet.

E) Move the Valve Switch to the ON position. The Valve Status LED should light up and the Valve should move to an open position. You can hear the Valve motor running when it changes state, it may take a few seconds for the valve to fully open.

F) Once open, verify that you can see through the Valve ports.



Valve shown in  
Open position

We placed the Valve opening on top of a light table to clearly show how the Valve looks in the Open state. We used paper filters to cover the light table and Status Indicator in order to defuse the bright light when taking the photos.

# Emergency Shutoff Valve

## Step 10 - Perform Standalone Test B

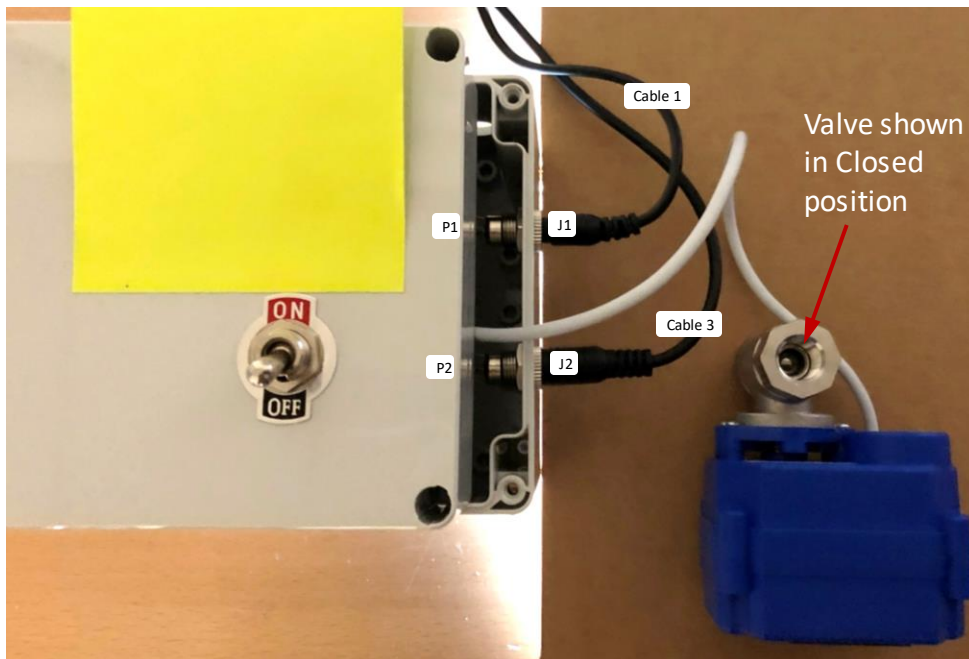
G) Move the Valve Switch to the OFF position. Verify that the Status Indicator goes off and the Valve moves to the closed position.

H) Move the Valve Switch to the ON position. Verify that the Status Indicator goes on and the Valve returns to the open position.

I) Unplug Cable 3 to simulate the Water Pump detecting an Overflow condition. Verify that the Status Indicator goes off and the Valve returns to the closed position.

J) Plug Cable 3-J2 into P2. Verify that the Status Indicator goes on and the Valve returns to the open position. Unplug the Power Adapter to simulate a power outage. Verify that the Status Indicator goes off and the Valve returns to the closed position.

K) If you passed tests A-J, then proceed to the next slide to finish assembly. If not, double check all wiring to make sure it matches the wiring diagram provided on Slide 2. If necessary, make corrections and redo tests A-J or contact Project Launchpad for assistance.



# Emergency Shutoff Valve

## Step 11 - Mount Brass Elbows



A) Add a white Washer to each Brass Nozzle. Wrap Sealant Tape around the threaded section of the Brass Elbows and Brass Nozzles. Be sure to wrap the tape in a clockwise direction (as viewed from the open side of the threaded area). This will help the tape stay in place as the elbow/nozzle is screwed into the female fitting.

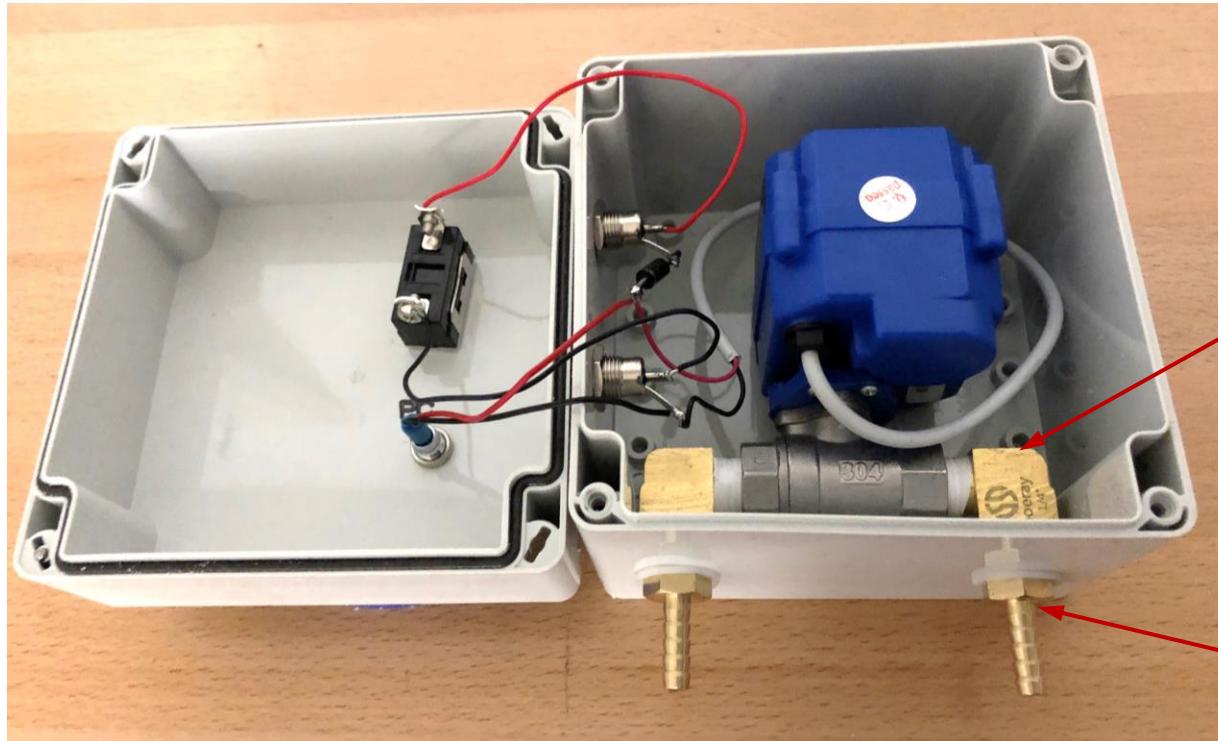


B) Screw the Brass Elbows into the Valve's input and output ports. Hand tighten as much as possible. Then use wrenches to continue tightening until the female section of the Brass Elbows are facing away from the blue box at an angle of 90 degrees.



# Emergency Shutoff Valve

## Step 12 - Mount Valve



A) Put the Valve in the ESV Box. Place the edge of the Brass Elbows up against the box side panel (side A).

B) Screw the Nozzles into the Elbow ports. Tighten enough to make a slight deflection in the white Washer.

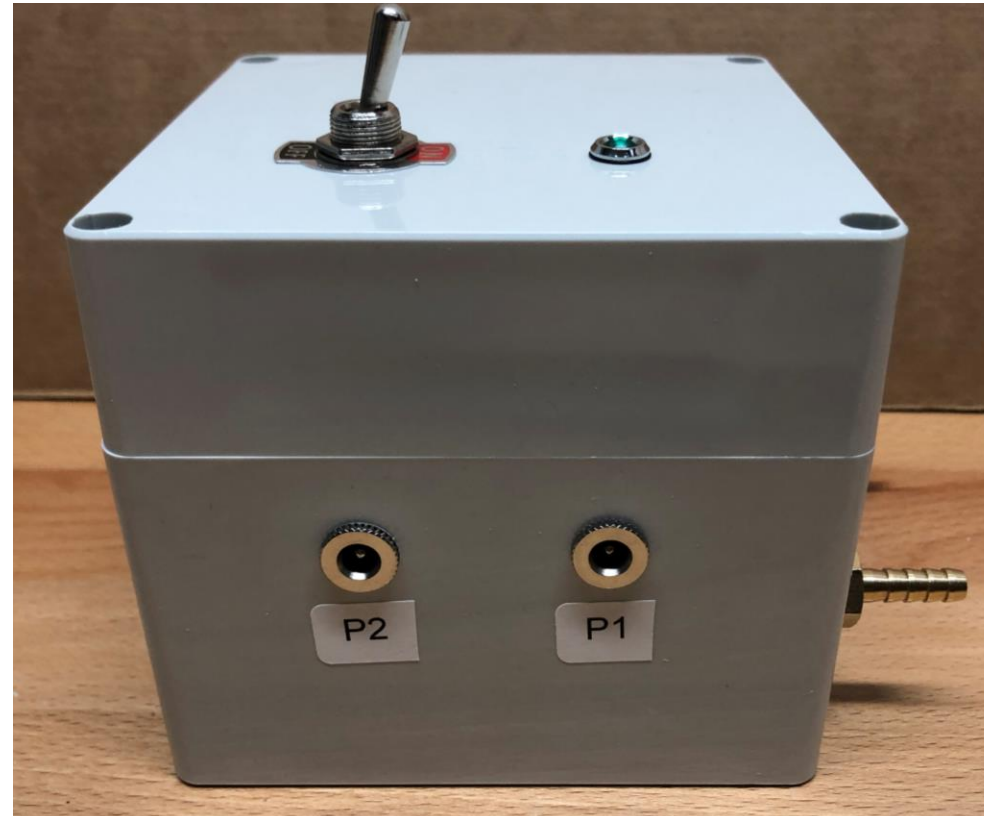
# Emergency Shutoff Valve

## Step 13 - Finish Assembly



A) Use the screws provided with the ESV Box to attach the lid to the bottom section of the box.

B) Add labels P1 & P2 under the associated Sockets, as shown in the photo.



# Emergency Shutoff Valve

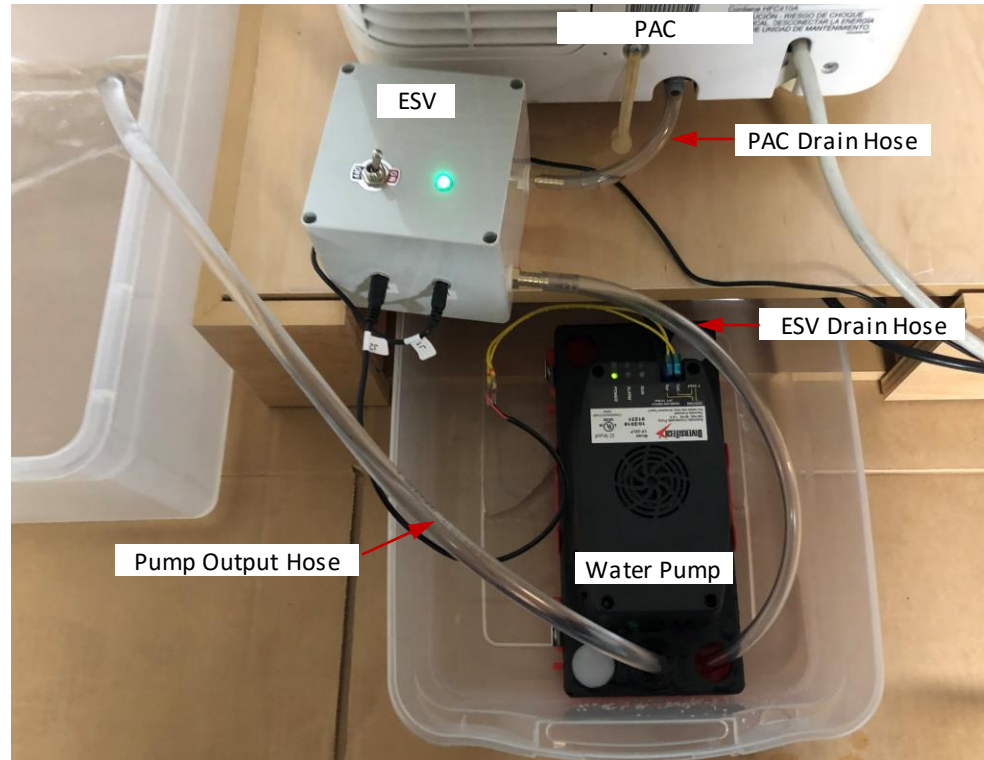
## Step 14 - Install The ESV



A) Cut 4" off the PAC Drain Hose and use it to connect your PAC Drain Nozzle to an ESV nozzle (it doesn't matter which one).

B) Use the remaining piece of hose as the ESV Drain Hose to connect the other ESV nozzle to an open input port on the Water Pump.

C) Verify that the open end of the Pump Output Hose is placed in a tub or near a drain that will accept a flow of water.



D) Plug Cable 1-J1 into P1.  
Plug Cable 2-J2 into P2

E). Insert the Cable 2 terminal lugs onto the Water Pump terminals (RUN and COM). The wire names should match the terminal names.

F) Plug the Power Adapter and Water Pump into AC outlets.



# Emergency Shutoff Valve

## Step 15 - Perform Functional Test



A) Turn the Valve Switch ON. Verify that the Status Indicator goes on.

B) Verify that the Water Pump is on and ready for operation (i.e. the green Power light is on). Make sure the Water Pump is on a level surface.

C) Pour 2 cups of water into an open port on the top of the Water pump. Verify that the Water Pump pumps out some of the water, then turns OFF when nearly empty.



# Emergency Shutoff Valve

## Step 16 - Perform Overflow Test



A) Put a "kink" in the pump hose and pour 4 cups of water into an open port of the Water Pump to intentionally create an overflow condition. Verify that the Water Pump Alarm light goes ON and the ESV Status Indicator goes OFF.

B) Remove the kink from the pump hose, allowing the Water Pump to pump out the excess water. Verify that the Water Pump Alarm light goes out and the ESV Status Indicator goes ON when the overflow condition has been cleared.



# Emergency Shutoff Valve

## Step 17 - Complete The Installation



A) Make sure all hoses are securely connected to the nozzles. If needed, use a small hose clamp to hold any hose that is not held tight by the nozzle ribs.

hose  
clamp



B) Push the Container/Water Pump into the platform.

C) Use Double Sided Mounting Tape to secure the bottom of the ESV to the PAC Platform.



# Emergency Shutoff Valve

## Step 18 - Additional Testing



There are two additional tests that can be done while the PAC is running:

**Test 1** - Unplug the Water Pump and let the PAC continue to operate. This will cause the Water Pump tank to fill up, trigger the overflow switch and cause the ESV to shut off the PAC drain water.

**Test 2** - Turn the ESV Valve Switch OFF. This will close the Valve and block water from leaving the PAC.



Each of these tests will cause the water tank within the PAC to fill up and eventually shut down PAC operation to demonstrate that all system components are working together.

The PAC can be easily restarted by re-storing normal operation (e.g. flipping the Valve Switch ON) and allowing the PAC's internal tank to drain.

If you've succeed in completing STEPS 1-18, you now have an operational air conditioning system that uses a PAC to produce cold air, a Water Pump to dispose of PAC water and an Emergency Shutoff Valve that will close off the PAC water drain if something goes wrong. Be sure to monitor operation during the first few days to ensure that all components are operating properly.