SCOUT PROP BUILDING INSTRUCTIONS & PHOTOS

Companies should be aware that tolerances in lengths of pipe and length of pipe inserted into joints can change the overall dimensions of product demonstration tasks. Companies should expect tolerances in all product demonstration props, and should build their ROVs and tools accordingly.

Home Depot part numbers are given for certain construction items. However, some Home Depot stores may not carry the listed items. If the local Home Depot does not carry the part in question, MATE recommends checking other local hardware stores or online sources, such as those listed below, for the required component.

http://www.pvcfittingsonline.com/
http://pvcpipesupplies.com/pvc-fittings/schedule-40-pvc-fittings/

TASK 1: COMMERCE: HYPERLOOP CONSTRUCTION

Baseplate

The baseplate is constructed from ½-inch PVC pipe. To construct the baseplate:

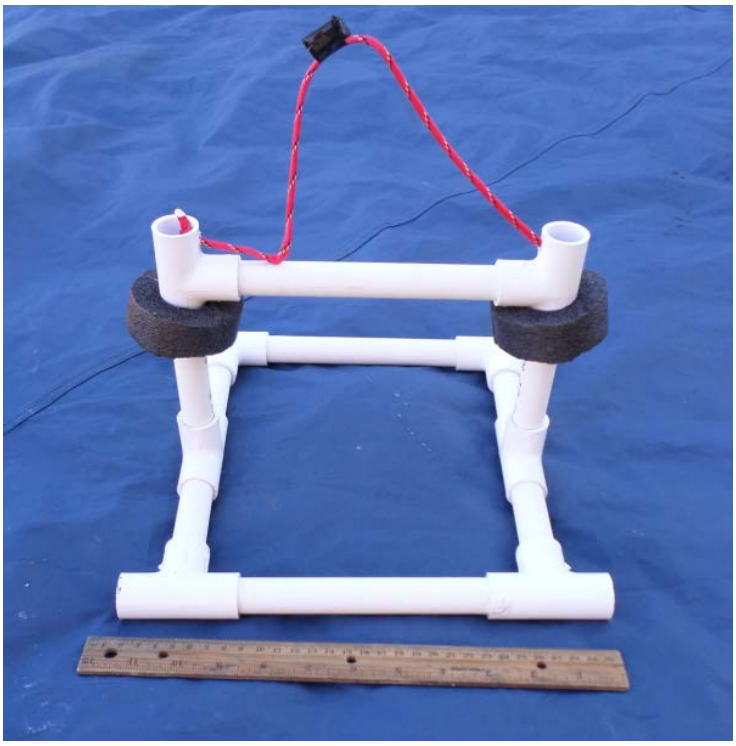
1. Cut four 40 cm lengths of ½-inch PVC pipe. Cut two 40 cm lengths of 3/8-inch rebar. Paint the rebar to reduce corrosion.
2. Insert the two lengths of painted rebar into two of the 40 cm lengths of pipe. Attach the side opening of a ½-inch PVC tee to each end of the two 40 cm lengths with rebar inside of them, four tees total.
3. Insert the other two 40 cm lengths of rebar into the side openings of the tees to form a 40+ cm square of PVC pipe.

SCOUT product demonstration build photo #1: The baseplate.

Frame

The frame is constructed from ½-inch PVC pipe and fittings. A rope with flotation attached will act as a grab point for the frame, but ROVs can also use the PVC pipe to carry the frame. To construct the frame:

1. Cut three 19 cm lengths, two 10 cm lengths, and four 9 cm lengths of ½-inch PVC pipe.
2. Attach the middle openings of two PVC tees to both ends of two of the 19 cm lengths of PVC pipe, 4 tees total. Insert the four 9 cm lengths of pipe into the side openings of two PVC tees. These combined lengths should be approximately 23 cm in length. Insert the other end of each of the 9 cm lengths of pipe into the middle openings of the tees at the ends of the 19 cm lengths of pipe. This should make a square approximately 30 cm per side.
3. Twist the two tees in the middle of the frame so that both of the middle openings face upwards. Insert the two 10 cm lengths of pipe into the two middle openings of the two tees.
4. Attach the middle openings of two tees to the remaining 19 cm lengths of pipe. Attach the side openings of these tees to the top of both 10 cm lengths of pipe.
5. Cut a 45 cm length of 1/8-inch polypropylene rope (Home Depot part #72402, internet #205804755, Store SKU #402816). Drill two ¼-inch holes in the top, inside edge of the two tees at the top of the frame. Insert the ends of the 45 cm length of rope into the holes and tie an overhand knot to secure them inside the tee. Use electrical tape to attach a small bit of flotation to the middle of the rope, 22.5 cm from each end.
6. Add additional flotation to the 10 cm lengths of pipe to reduce the weight of the frame in water.



SCOUT product demonstration build photo #2: The frame.

Hose

The hose for pouring concrete will be constructed from 3 meters 1/8-inch ID airline tubing. A #310 U-bolt attached to a 1-inch PVC cross will provide a grab-point for the end of the hose. To construct the hose for pouring concrete:

1. Cut 3 meters of 1/8-inch airline tubing.
2. Drill two ¼-inch holes 5.8 cm apart in the center of a 1-inch cross. Install a #310 U-bolt into these two holes and use ¼-inch – 20 nuts to secure the U-bolt in place.
3. Drill another ¼-inch hole 1 cm from the end of one of the openings that does not contain the U-bolt. Push one end of the 3 meters of airline tubing into this drill hole and tie an overhand knot in the tubing to secure it inside the cross. Wrap electrical tape around the tubing to hold it in place as well.

SCOUT product demonstration build photo #3: The hose for pouring cement.

Positioning Beacons

The positioning beacons will be constructed from 1 ¼-inch PVC couplings. Two strips of industrial strength Velcro will be attached each coupling. To construct the positioning beacons:

1. Cut two 5 cm by 2 cm rectangles of industrial strength Velcro hooks.
2. Attach the Velcro hook strips to opposite sides of the coupling.

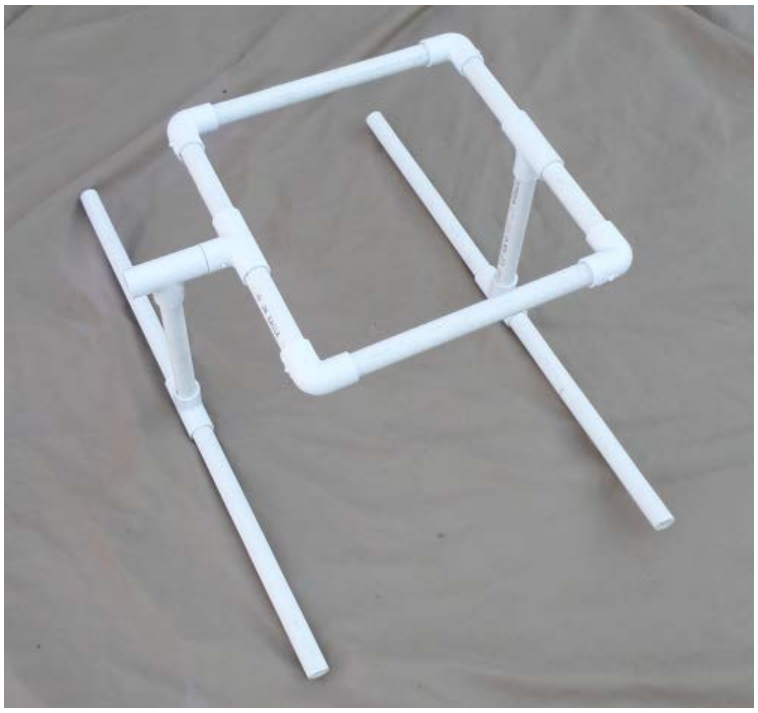
SCOUT product demonstration build photo #4: Positioning beacon.

TASK 2: ENTERTAINMENT: LIGHT AND WATER SHOW MAINTENANCE

Platform

The platform framework will be constructed of ½-inch PVC pipe. A corrugated plastic sheet will cover a small section of the framework. To construct the platform framework:

1. Cut four 30 cm lengths, two 26 cm lengths, two 20 cm lengths, four 12 cm lengths, and one 3.5 cm length of ½-inch PVC pipe.
2. Insert two 12 cm lengths of PVC pipe into the side openings of a PVC tee. Attach a 90° elbow to the other ends of each 12 cm length of pipe. Insert a 26 cm length of pipe into each opening of the two elbows. Attach another two 90° elbows to the other end of each 26 cm length of pipe. Insert the remaining two 12 cm lengths of pipe into the open ends of these two elbows. Bring the ends of the 12 cm pipes together and insert them into the side openings of a PVC tee.
3. At this point you should have a rectangle with two edges of 26 cm pipe, and two edges of 12 cm/tee/12 cm lengths of pipe. The middle openings of both tees should be open.
4. Insert the 3.5 cm length of pipe into the middle opening of one of the tees. Attach the side opening of another PVC tee to the other end of the 3.5 cm length of pipe. Insert two 30 cm lengths of pipe into the two side openings of a tee. Insert a 20 cm length of pipe into the middle opening of this tee. This will create a base for the framework.
5. Repeat step 5 to create a second base stand.
6. Two tees have a middle opening without PVC pipe, one at each end of the framework. Rotate both middle openings so they face down (perpendicular to the rectangle). Insert the 20 cm length of pipe from the two base stands into the two middle openings of these rotated tees.



SCOUT product demonstration build photo #5: Platform framework.

7. Cut a 32 cm by 32 cm square of corrugated plastic sheeting. Use screws to attach it onto the topside of the rectangular portion of the framework.
8. Measuring from the center of the corrugated plastic sheet, draw a 20 cm circle around the center-point. This circle should be visible from the surface, side of the pool.

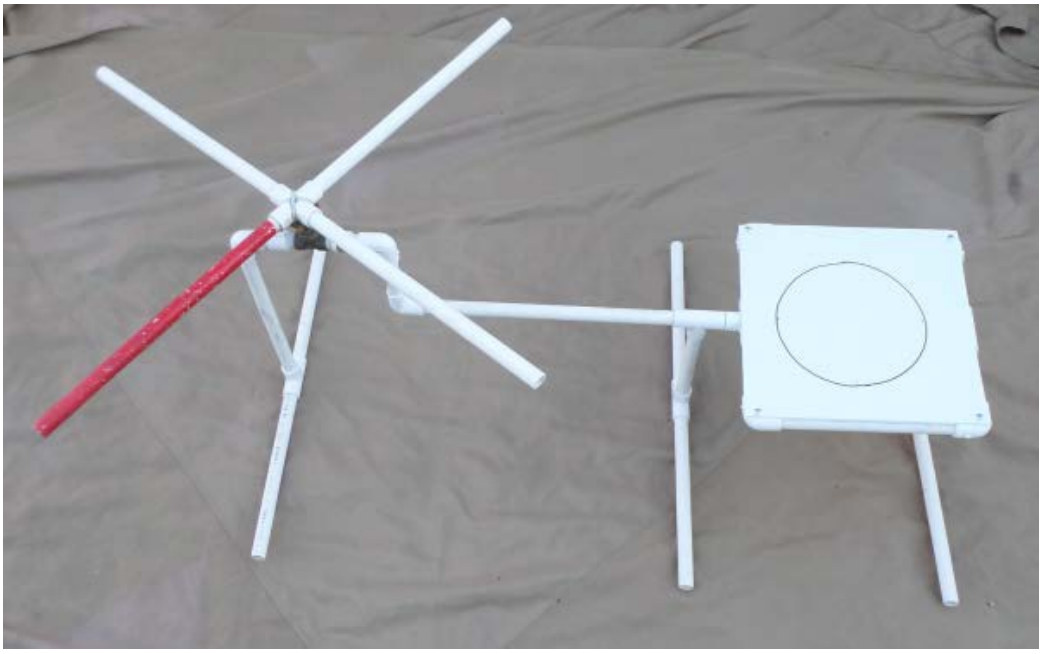
SCOUT product demonstration build photo #6: Corrugated plastic on framework.

Valve

The valve will be constructed from a ½-inch gate valve. A ½-inch cross with 40 cm lengths of pipe serve as a handle to turn the valve. To construct the valve:

1. Cut five 40 cm lengths, one 32 cm length, two 30 cm lengths, one 10 cm length, and two 5 cm lengths of ½-inch PVC pipe.
2. Insert one of the 40 cm lengths of pipe into the side opening of the tee at the end of the platform framework (see above). Attach a 90^{o} elbow to the other end of this 40 cm length of pipe. Rotate the elbow so the opening faces up and insert the 10 cm length of pipe. Attach a 90 elbow to the other end of this 10 cm length of pipe. Insert a 5 cm length of pipe into the other opening of this elbow.
3. Twist a ½-inch male adapter into both ends of a ½-inch brass gate valve (Home Depot Model# 170-2-12-EB, Internet# 205816192, Store SKU# 867855). Use zip ties to secure a ½-inch PVC cross onto the valve handle; use 2 or 3 zip ties to secure the cross tightly.
4. Attach one of the male adapters in the gate valve to the other end of the 5 cm length of PVC pipe. Insert the other 5 cm length of PVC pipe into the other male adapter screwed into the gate valve. Attach a ½-inch 90^{o} elbow to the other end of this 5 cm length of pipe. Rotate the elbow so the open end face downwards.
5. Insert the 32 cm length of pipe into the other end of this 90^{o} elbow. Attach the middle opening of a PVC tee to the other end of this 32 cm length of pipe. Insert the two 30 cm lengths of pipe into the two side openings of this tee.
6. Insert the four remaining 40 cm lengths of PVC pipe into the four openings on the cross attached to the gate valve. Paint one of the 40 cm lengths of pipe red, or other bright color. This will help in determining whether the valve has been turned 360^{o} (1 time around).

SCOUT product demonstration build photo #7: The valve.



SCOUT product demonstration build photo #8: The valve attached to the framework.

Fountain

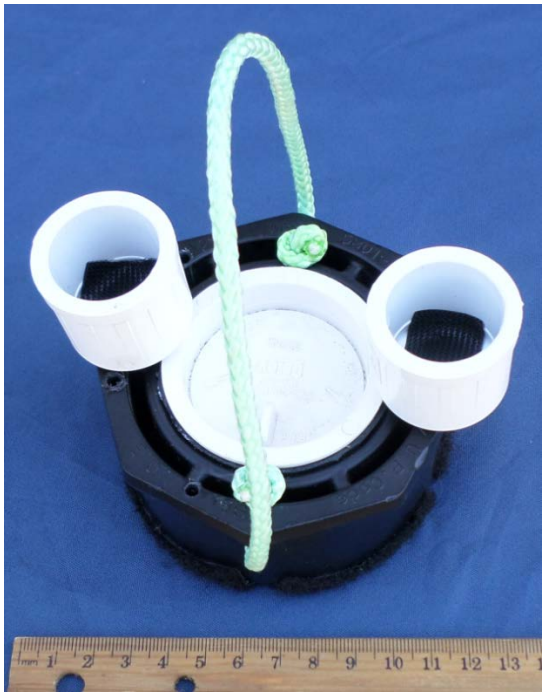
The fountain (old and new) will be constructed from an ABS 3-inch to 2-inch reducer bushing (Home Depot model #C58012FHD32, Internet #100343802, store SKU # 188301). It will have two ½-inch PVC end caps screwed into the top side. To construct the fountain:

1. Cut a 2 cm length of 2-inch PVC pipe. Insert the 2 cm length of pipe into the 2 cm opening on the reducer bushing.
2. Insert a 2-inch knockout cap (Home Depot model #39101, Internet #100137732, Store SKU #508257) into the 2-inch pipe.
3. Use a screw to secure a ½-inch PVC end cap to the outside of the top edge of the 3-inch to 2-inch ABS reducer bushing. The screw should go straight down into the side wall of the bushing. Repeat this one more time (two end caps total) at opposite sides of the bushing.
4. Cut a 50 cm length of 1/8-inch polypropylene rope (Home Depot part #72402, internet #205804755, Store SKU #402816). Drill two 3/16-inch holes through the top side wall of the wellhead cap on opposite sides. Push the 50 cm length of rope through both 3/16-inch holes. Tie an overhand knot on the ends of each rope to secure the rope to the wellhead cap.

Design note: The fountain for the 2017 task is almost identical to the wellhead cap from the 2016 RANGER / NAVIGATOR product demonstration tasks. The 2017 fountains do not require the Velcro add-ons required for the wellhead cap. However, the Velcro does not affect the task in any way and may be included. If you wish to add the Velcro:

1. Cut two 1.8 cm x 1.8 cm squares of Velcro hooks. Adhere the sticky side of the Velcro to the inside bottom surface of the two end caps, over the screw heads holding them in place.

2. Cut four 5 cm x 3 cm lengths of Velcro loops. Attach them around the bottom, angled end of the 3-inch to 2-inch reducer bushing.



SCOUT product demonstration build photo #9: The fountain with Velcro.

A small piece of flotation can be added to the top of the rope to keep it upright in the water.

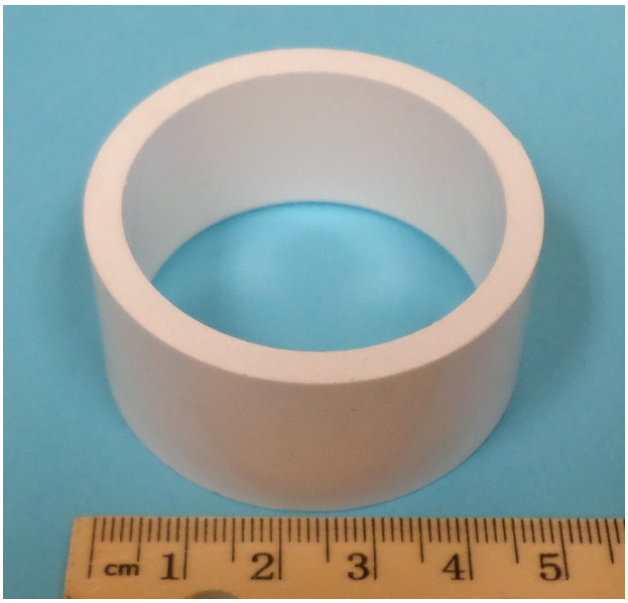
SCOUT product demonstration build photo #10: The fountain on the platform.

TASK 3: HEALTH: ENVIRONMENTAL CLEANUP

Clams

The clams are constructed from 2 to 3 cm lengths of 1 ½-inch pipe or 2 to 3 cm lengths of 1 ¼-inch couplings. To construct the clams:

1. Cut 25 or more 2 to 3 cm lengths of 1 ½-inch pipe or 1 ¼-inch couplings.

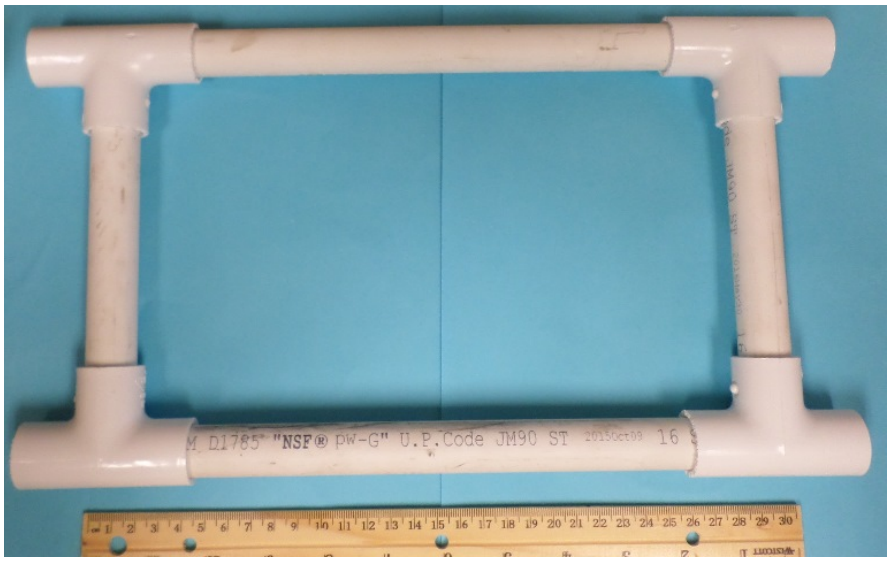


SCOUT product demonstration build photo #11: One clam.

Clam Bed

The 25 (or more) clams will be piled in a small clam bed constructed from ½-inch PVC pipe. The clam bed will be 33 cm by 20 cm. To construct the clam bed:

1. Cut two 24 cm lengths and two 13.5 cm lengths of ½-inch PVC pipe. Attach a side opening of a ½-inch PVC tee to each end of the 24 cm lengths of pipe, four tees total. Insert the two 13.5 cm lengths of pipe into the middle openings of the four tees, creating a rectangle 33 cm in length and 20 cm wide.
2. Pile 25 or more clams randomly into the bed.



SCOUT product demonstration build photo #12: Clam bed.

SCOUT product demonstration build photo #13: Clam bed with 28 clams.

Sediment Sample:

The sediment sample will be simulated by 4-inch PVC end cap. A 40 cm length of rope will be attached to the end cap. To construct the sediment sample:

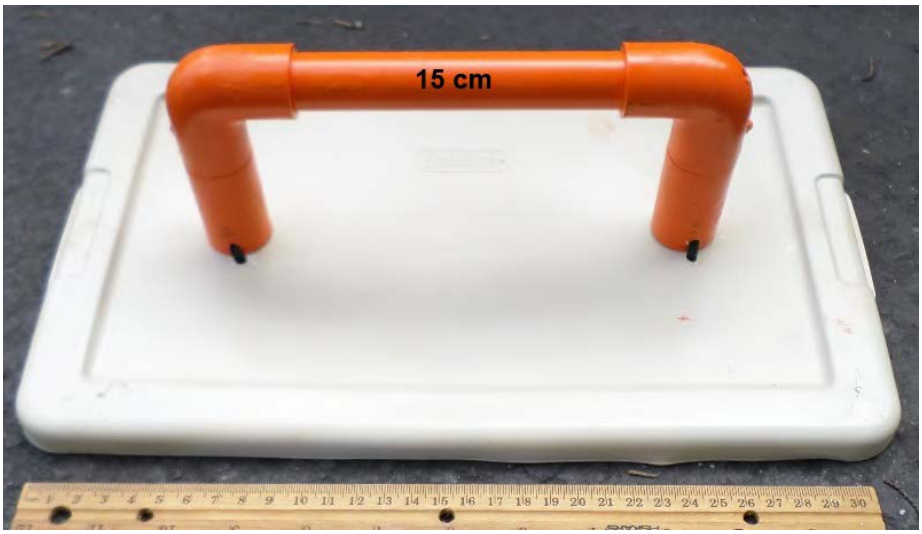
1. Cut a 40 cm length of 1/8-inch polypropylene rope (Home Depot part #72402, internet #205804755, Store SKU #402816). Drill two 3/16-inch holes through the top side wall of a 4-inch PVC end cap on opposite sides. Push the 40 cm length of rope through both 3/16-inch holes. Tie an overhand knot on the ends of each rope to secure the rope to the end cap.
2. Attach a small piece of flotation to the middle of the 40 cm length of rope.

SCOUT product demonstration build photo #14: Sediment sample.

Cap:

The cap is constructed from the lid of a Sterilite 6 Qt. (5.7 L) plastic storage box with a non-latching lid. The lid will be outfitted with a handle constructed from ½-inch PVC pipe. To construct the lid:

1. Cut a 15 cm length of ½-inch PVC pipe. Attach a ½-inch 90° elbow to both ends of the 15 cm length of pipe. Rotate the elbows so both openings face the same direction.
2. Cut two 3 cm lengths of PVC pipe. Insert the 3 cm lengths of pipe into the openings of the 90° elbows. Attach a ½-inch PVC coupling to the other end of each 3 cm length of pipe.
3. Drill two holes at the end of each PVC coupling. The holes should be within 1 cm of the end of the coupling and be drilled straight through both walls of the coupling.



SCOUT build photo #15: Cap with 1-inch PVC handle.

TASK 4: SAFETY: RISK MITIGATION

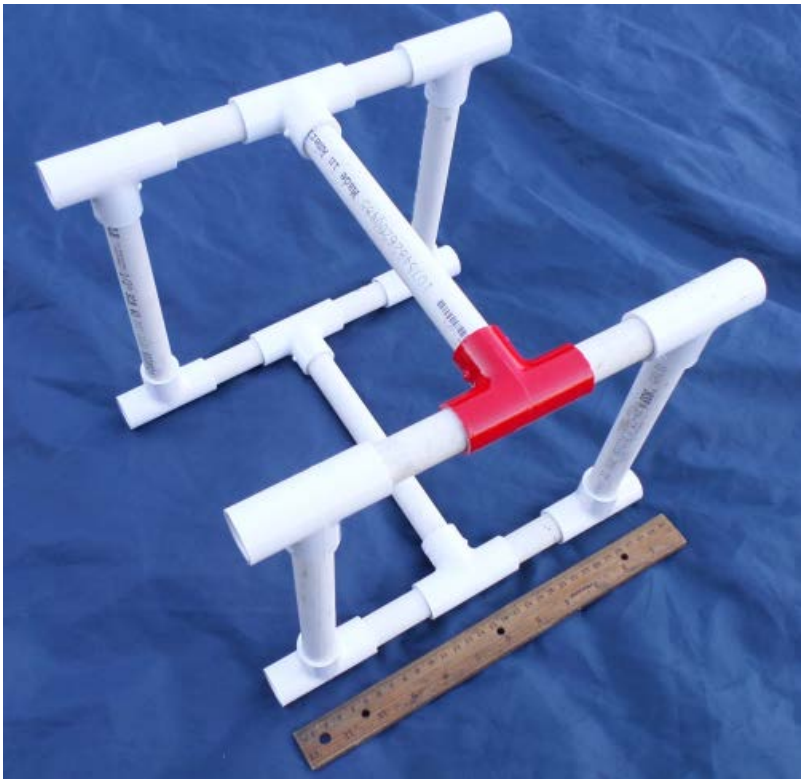
Containers

The four containers will be constructed from ½-inch PVC pipe. To construct the containers:

1. Cut six 20 cm lengths and eight 8 cm lengths of ½-inch PVC pipe. Attach the opening of a ½-inch tee to each end of all six 20 cm lengths of pipe, twelve tees total.
2. Take two of these 20 cm lengths of pipe with tees on each end and insert all eight 8 cm lengths of pipe into the side openings of the four tees. Attach the remaining four 20 cm lengths of pipe with tees on the end to the ends of the 8 cm lengths of pipe.

This should make a cube approximately 30 cm per side.

3. Remove one of the ½-inch tees at the top middle side of the cube. Paint the tee red, orange, yellow or blue. When the paint has dried, return it to the container.



SCOUT build photo #16: One container with a red tee.

Repeat steps 1 through 3 to make four containers total. Each container should have a different colored tee (red, orange, yellow or blue).

Sensor

Companies must build their own magnetic reed switch sensor. A magnetic reed switch (N-O) is a switch that is normally open, but closes (completes the circuit) when a magnet is present. In the absence of a magnet, an N-O (normally open) magnetic reed switch is open, meaning that it does not allow electricity to flow. In the presence of a magnet, the N-O switch closes, completing the circuit and allowing electricity to flow.

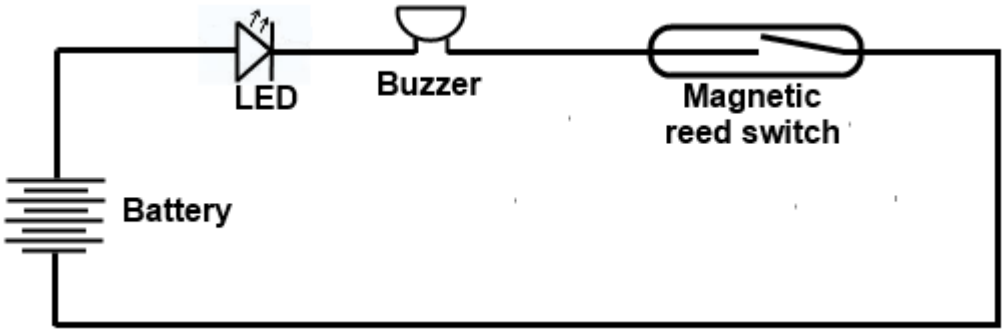
Companies will need to build a circuit with a magnetic reed switch (N-O) that can be transported by their ROV, a wire to reach from the surface to the product demonstration area, a battery (9-volt or other) to power the circuit, and an "indicator." The indicator can be a light, LED, buzzer, or some other device that will turn on, make a noise, or otherwise respond when the switch is closed. The MATE Center is using the following components (see below) for the magnets, magnetic reed switches, and indicators. Companies may choose to order these components through the SeaMATE store (https://seamate.myshopify.com/products/2017-scout-class-sensor-pack?variant=25547315728) or use other sources for components for their sensor.

Magnetic reed switches:
http://www.tanealarm.com/products/surface-mount-contacts/tane-60-qc/
10 pack: https://www.amazon.com/dp/B0011W4YNK?smid=A29PFSLE3D9XFX&th=1
MATE will be using this 10 pack of magnetic reed switches and magnets (10 of each) on the containers for the magnet and the blank (see magnet below).

Buzzer:
Single: http://www.digikey.com/product-detail/en/tdk-corporation/PS1240P02BT/445-2525-1-ND/935930
5 pack: https://www.amazon.com/uxcell-Terminals-Electronic-Continuous-Buzzer/dp/B00B0Q4KKO/ref=sr_1_3?ie=UTF8&qid=1476297215&sr=8-3&keywords=buzzer
If it is a bright, sunny day, visual indicators may be hard to detect. This buzzer will inform your company that the circuit has been closed.

LED:
Multi-pack: https://www.amazon.com/Fulight%C2%AE-Assorted-Colors—Diffused-Yellow/dp/B00SV7U3RO/ref=sr_1_2?ie=UTF8&qid=1475710422&sr=8-2&keywords=colored+leds
LEDs come in a variety of colors. Most of these LEDs should be paired with a resistor, as they can burn out if the voltage is too high. A 1000 ohm resistor in series with the LED is usually sufficient to protect the LED.

Power
The circuit will need power. When in the presence of a magnetic field, the switch will close and this power will be used to light the LED or sound the buzzer. A 9-volt battery or 6-volt battery pack works well for powering this sensor.



Circuit diagram for a SCOUT sensor with an LED and Buzzer as indicators on the surface and a magnetic reed switch on the ROV.

Magnet:
A magnet will be attached to the painted tees on two of the four containers. A blank will be attached to the painted tees on the other two containers. The two containers with the magnet will activate the sensor; the two containers with the blank will not activate the sensor. The MATE Center will be using the magnets found here: https://www.amazon.com/dp/B0011W4YNK?smid=A29PFSLE3D9XFX&th=1

1. Attach the magnet or the blank to the colored tee, parallel to the two side openings. Use hot glue to cover the screws on the reed switch and to help secure the magnet or blank to the tee.

SCOUT build photo #17: Magnet or blank attached to the red tee.