Best Frame Materials TIP

**What:** The best frame material for new teams is ½ inch PVC pipe and fittings, for intermediate teams is HDPE cut into strips, for advance teams it is custom cut HDPE, Aluminum, or 3D printing plastics.

**Who:** MATE Staff

**ROV System:** Frame

**Competition Class:** Scout, Navigator, Ranger, Explorer

**When:** Various Competition

**Plus:** See MATE Insights

**Minus:** See MATE Insights

**MATE Insights:** The best frame material depends on the construction skills of the team and the tools and funds available as well as the physical properties of the materials.

For teams new to building ROV’s frames PVC pipe and fittings is the place to start. The materials are readily available, inexpensive, and easy to cut. The same PVC pieces can be reused for many years though PVC can become brittle if left in the sun for long periods of time. PVC does not paint well and colored PVC is available, though it is costly. As teams advance they discover a challenge of PVC frames is their weight since they are filled with water.

For intermediate teams HDPE (high density polyethylene-think your kitchen cutting board) plastics is recommended. Two of the cool properties of HDPE are that it is naturally buoyant and can be bent if heated with a simple heat gun. HDPE can be easily be cut or drilled by hand and requires mechanical fasteners (pan head machine screws and lock nuts or rivets). Glues, Epoxy, and paint will not adhere to HDPE. The “stick built” HDPE frames is an easy way for teams to starting building HDPE frames and only require a hand drill. In the “stick” built method ¼ inch thick HDPE is precut into ½ wide strips of...
various lengths (18, 14, 12, and 8 inches). The teams can then bolt together the sticks to make their frame design. Typically HDPE can be purchased at local plastic stores and this is much more economical than purchasing off the web and paying shipping cost. Often local plastic stores have scrap pieces that they will sell you by the pound.

More advanced teams typically have advanced building skills and tools. Most of these teams use HDPE sheets that have been either hand cut or cut into the desired shapes by a CNC machine. A common error is for teams to use HDPE that is too thick (over ½ inches) resulting in a heavy frame. Some frames are made out of a single piece of HDPE and bent with heat thus reducing the number of fasteners and weight of the frame.

Aluminum is a very good frame material. Aluminum is light, strong, inexpensive, and readily available. Typically U channel or angels are used, though one clever team used aluminum tent poles with 3D printer connectors. Aluminum frames can be more difficult to manufacture and modify. Often Aluminum frames are limited to rectangular shapes. Aluminum frames typically weigh less than HDPE frames.

Many teams are beginning to 3D print their entire frames out of PLA. Some of the most innovative 3D printed frames incorporate their waterproof housing as a structural component. These ROV tend to be compact and nimble.

We do not recommend teams use acrylic. Acrylic can shatter if dropped or roughly handled during travel and unfortunately we have seen this several times.

References: 2018 International Competition Ranger Technical Reports:

Ozaukee High School, Ozaukee Robotics, page 3

Aptos High, Seal Team 1272, page 15

Drexel University, D.A.R.T, page 5
Search Words:  Three common brands of HDPE are Seaboard™, Starboard®, and Marine Board™.

Fun Facts:  Want to build a frame for a mini ROV, use ¼ inch plastic irrigation drip line.

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