

Masters Engineering Team #14479

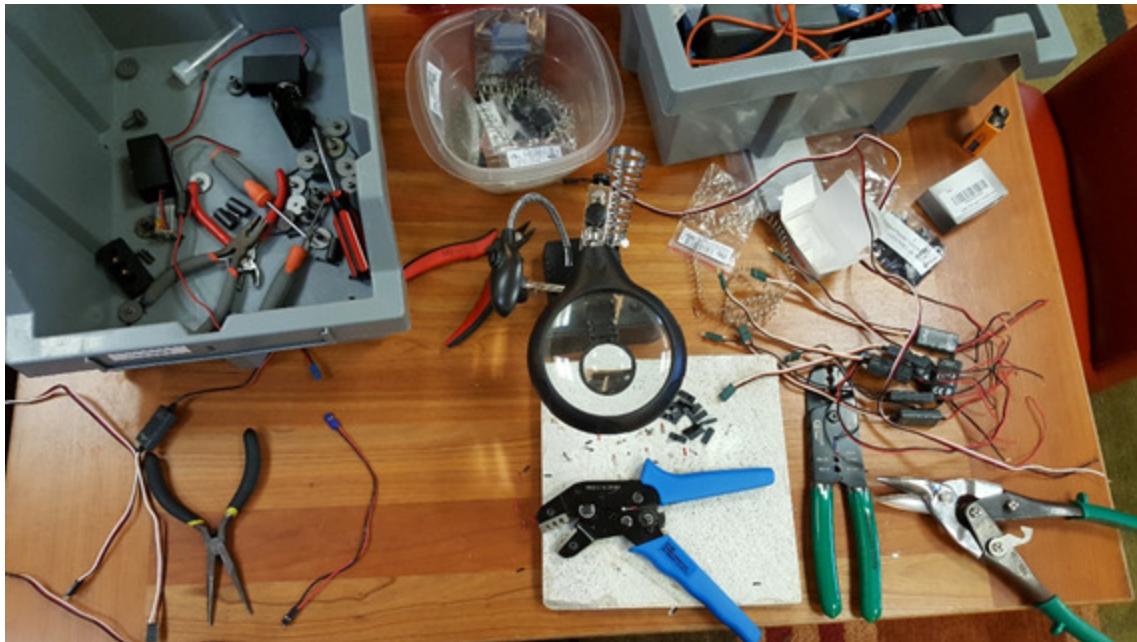
Progress Report on Sustainability Efforts

The Masters School has defined sustainability as the careful management and wide use of the planet and its resources. It is the ability to meet present needs without compromising the survival of future generations. More simply, sustainability is being green. More specific to energy, the school is focused on reducing overall energy usage and shifting Masters' energy portfolio toward more sustainable sources. Our goal is a Masters that is sustainable and low-carbon-emission. In pursuit of this mission, every effort will be made by the Team to repair parts and systems whenever possible, use only rechargeable batteries on robots and robot controllers, minimize waste by making every effort not to cut or modify structural materials unless absolutely necessary, and leverage other strategies to be more sustainable as opportunities present themselves.

Focus 1: Repair Rather Than Replace

While there were a lot of new purchases made subsequent the decision to change from VEX to FTC, we transferred most of our VEX electronics to our engineering program which uses VEX robotics in the Machine Control Unit of Principles of Engineering. The few remaining VEX parts will be held in inventory to replace failed engineering parts.

Over the past twelve months, the Team has worked to repair many robotics parts and accessories. This project significantly reduced the amount of waste going to landfills, and lowered replacement costs. In the process, Team members learned about the anatomy of electric motors, gear ratios, microelectronics, and how to solder. The picture and table below show what had been sitting on our shelves due to breakage that is now back in our active inventory.



Part	Quantity	Unit Price	Savings	Costs
Motor controllers	21	\$9.99	\$209.79	
Battery backup cables	5	9.99	49.95	
2-wire extension cables	17	1.25	21.08	
3-wire cables	8	1.25	10.00	
Servo motors	3	19.99	59.97	
393 motors	12	6.95	83.40	
VEX ARM Cortex	4	249.99	999.96	\$200.00
Repair parts				10.00
Totals			\$1,434.15	\$210.00

Part repair remains an ongoing process that is being led by the Team's Electronics Manager.

Focus 2: Rechargeable Batteries

Because waste batteries can contain various hazardous materials, including heavy metals and acids, batteries can cause serious environmental harm if not discarded properly. Disposal of batteries is determined by the type of batteries. For alkaline batteries the County of Westchester recommends disposing these batteries in regular household waste. Batteries containing lithium are collected and stored until such times as they can be brought to a Household Material REcovery Facility.

Over the summer the Team exhausted its supply of single-use batteries. The only batteries now used by the team are rechargeable.

Focus 3: Minimize Waste By Not Cutting Material

When parts are cut and fragments are no longer usable, they are collected and weighed. Since the beginning of this build season, the Team has focused on minimizing waste metal. As of this writing, the Team has recycled 1.5 ounces of aluminum and 2.4 ounces of steel.

Focus 4: Sustainable Products

Every effort is made to purchase and use products that are sustainable, recyclable and/or compostable. Ideally, we look first to purchase products made of or that we will fabricate with aluminum and steel. When fabricating in metal is not possible, we first look to create parts in wood. Birch plywood (some sheets as thin as 1/16") are fairly durable and compostable. The fabrication method of last resort is 3d printing in PLA because PLA is compostable (3 - 6

months) and emits fewer VOCs than does ABS. Two research studies Steinle (2016) and Azimi et.al.(2016) reported a wide range of VOCs emitting from FDM style printers known as a fused filament fabrication (FFF) printers. Researchers have identified more than 50 organic vapor emissions from FFF printers dependent on the filament material used and printer operating temperatures. VOC's emitted from ABS and PLA printers have been reported to cause headaches, respiratory irritation and eye irritation. MJM printers also emit VOCs during use. In a poorly ventilated room with multiple printers, VOCs could build to potentially hazardous levels. The team is looking to purchase an SLS 3d printer that does not create VOCs.