

## Milestone #8 – Finish Mechanical Work & Begin Electrical Work

**DUE:** 09 April along with Milestone #7 Deliverables

### DESCRIPTION:

This week will serve as a ‘buffer week’ for finishing your vehicle if it did not pass the Milestone 7 inspection, as well as redressing deficiencies that were addressed during the checkoff. Additionally, you will start planning out your vehicle’s electrical systems and optionally begin fabricating it.

**Complete vehicle Solidworks Model:** You should have been updating your vehicle’s Solidworks model if you made any changes during fabrication. The **finished** SW model of your vehicle is due for this milestone. **Finished** means assemblies are fully constrained, there are no “blank rectangular prism” parts, all holes have mating features (e.g. a corresponding hole). The amount of detail you put into it is up to you, but here are some guidelines:

- All major vehicle parts have to be present. No scooters without handlebars, go-karts without steering wheels, etc. They may be geometric approximations (see below).
- All parts must at least have basic mounting dimensions. For instance, your motor can be a cylinder with another cylinder as the shaft, but it should at least have mounting holes at the correct spacing.
- All moving parts - wheels, steering columns, linkages, etc. should move as they do in real life (Modeling brake movement is not necessary). For instance, gear/rotation mates between pulleys and correctly mated steering links.
- Include a motor controller model, battery placement and mounting structure models, and power switch/access port holes and features if applicable. No other electrical parts are required.
- There is no need to add fasteners, teeth to your pulleys and belts, individual balls in the bearings, etc. More detail does not necessarily imply better grade.

**Vehicle Electrical System Plan:** You should create a drafted plan for the electrical system of your vehicle. For now, you have enough information to fully create a power-side wiring diagram, and you will learn the signal-side wiring information this week. When completed, this diagram should include:

- Motor(s), controller(s), switches and relays, charging connections, and the correct number of batteries your vehicle will be using. Each ALM12V7 battery is treated separately *i.e.* a 24v electrical system has two separate batteries in the plan.
- Which wire sizes (in AWG) you plan on using. All wiring should have this indication.
- Which connectors will be used on which wires. (4mm Bullets? XT60 (the yellow ones)? Deans? ¼” Quick Disconnect terminals? Etc.)
- Indicate solder joints (no connectors) where necessary.
- Any other relevant power-side circuitry such as precharge switches/circuits or removable links (indicate how you will make them if you are planning on using removable links).

Computer-generate graphics are encouraged, but *clean* hand-drawn diagrams will be allowed.

**Motor Sensor Mounting:** If your vehicle is using **sensored** commutation (i.e. all Kelly controllers), download the **Hall Effect Sensor Mounting Boards** file from STELLAR and understand how it must be mounted. Your vehicle **must** have mounting facilities for this sensor board – it cannot operate without them. This should not come as a surprise – you were warned about these well before Spring Break.

**FORMAT OF DELIVERABLE:**

- Milestone 7 deliverables
- Your complete vehicle Solidworks model (collapsed into one compressed folder! Use “Pack and Go” in Solidworks)
- Your vehicle’s **power** electrical system plan as 1-2 pages in your notebook.

**OTHER ACTIVITY:** Mini-lathe and Mini-mill training will occur this week, as needed. Vehicle Signals and Systems mini-lecture will be on Friday 6 April – this will be a brief overview of the signal-side wiring of a typical EV.

Office hours on Wednesday will focus on EV electrical system design as well as sensor board mounting.

**RESOURCES: To be posted – 2.007 Vehicle Electrical System Guide**

For students using Kelly controllers, refer to the Kelly Controller user manual for an example hookup diagram: <http://kellycontroller.com/mot/downloads/KellyKBSUserManual.pdf>

Note that the example is not directly applicable to our vehicles – it will be clear if you just copied the example diagrams without understanding which parts are required.

The “Wiring” section of the Instructable document may be handy in providing you links to power switch, etc. resources: <http://www.instructables.com/id/The-New-and-Improved-Brushless-Electric-Scooter-Po/step13/Electrical-System-Loose-Wires/>