Electrathon Car Building Tips

So you have decided to take on the Electrathon project. Like any sizable project, it is best broken down into manageable pieces. The first step is to get all the information about Electrathon cars as possible. The Electrathon America rulebook is a great source because it shows schematics, and has many design tips (teams receive this rule-book upon registration) along with Electrathon America Rules. Everyone should read the rulebook and then designate one or more people in to know the rules inside and out. This will be helpful for designing, and building your Electrathon car.

There are other sources of information such as books about go-carts, electric vehicles, local racing teams, etc. Check the Internet and talk with people who have been involved in electric vehicle competitions. All right, let's get started. Here are some guidelines for what your EV (electric vehicle) should look like.

Size and Weight

Let's start by figuring size and weight. You will have a driver ballasted to 180 lbs. and 64 pounds of batteries. That's 244 pounds. The rest of your car will probably weigh somewhere between 100 and 150 pounds. So, the wheels and frame will have to support 350 to 400 pounds. To be competitive, a car should be no more than 130 pounds (without driver and batteries). The Lake Orion, Michigan High School Electrathon car, the National Electrathon record holder, weighs 90 pounds. Remember the K.I.S. theory, KEEP IT SIMPLE.

The size should be as small as you can make it without sacrificing safety and handling. This will keep down the weight as well as air drag. Aerodynamics should be a consideration to achieve minimal wind resistance. Keep in mind that you will want to have a reasonably narrow front end that is not very tall. It's tempting to try to design a body first and then stuff everything inside...but that will cause problems for you later when constructing the frame. You will need access to everything inside your car on race day in case of a pit stop. You don't want a 20-minute pit stop just to tighten a battery cable.

Setting-Up Your Car

Do a mock set-up of your car. Have someone sit on the floor in a driving position on top of a couple of books to get the appropriate height. Hold bicycle wheels (don't use these in your car, just for the mock set-up) in approximate positions. Remember you will have batteries (use a cardboard box to simulate this) and a motor (use a one or two pound coffee can to simulate this). Move this stuff around. It's easy, quick and doesn't cost anything.

Keep a few things in mind:

- Balance the weight. Front to back and left to right. Make each wheel do its share.
- All electrical items should be close to each other to keep the cable lengths short. This will reduce electrical resistances (losses).
- Provide room for the driver to be comfortable for an hour of driving.

Now to capture this, take a picture...take a roll. Shoot from every angle you can think of. Another way of capturing this might be to put a roll of paper behind all of this, shine a bright light against it and trace around everything's shadow.

Constructing the Frame

Now you must plan the frame. Think of it this way; the wheels are in contact with the ground, they hold the frame up, and the frame holds everything else up. From here on, it's like connect the dots. Think of a rough frame that the wheels will hold up. Think of what you have to put on the frame to hold the driver, motor, batteries, controller and everything else up off the ground. Drop in a roll bar (There are rule requirements near the roll bar). Add bracing. Let different frame members do double duty. For example, let the roll bar hold the controller. Always consider aerodynamics when constructing your frame! Many Electrathon participants use aluminum for their frame. Aluminum is strong and light, but can be expensive. Try the local muffler shop for aluminum tubing. Also see the "Parts and Suppliers" section below.

As long as the frame is strong enough, and it follows the rules, THERE ARE NO WRONG ANSWERS! This is your car, be creative and have fun with it. During all of these early planning exercises follow the rules of brainstorming:

- Present all ideas, no matter how strange they sound.
- DO NOT CRITICIZE others' ideas. A strange idea can spur another thought that could be the idea that you go with.
- Write down ALL ideas and sort through them later.

Remember the strength of triangular sections and corner gussets when designing the frame. Leave room for a few additional braces if needed later.

Wheels

How many wheels should my car have? Our suggestion would be to place two in the front and one trailing. The Electrathon America rulebook states that you must have at least three wheels on your EV. What are the advantages and disadvantages of 3 vs. 4 wheels? With four, it's familiar and less likely to tip. That's about all four wheels are good for. With three wheels, you have less drag, (aero and mechanical) and there is less need for a suspension. The need for a suspension comes from frame twisting on a four-wheeled car. Three wheels will always be in contact with the road; with four

wheels, unless the track is perfectly flat, there is always one wheel that just doesn't quite touch or isn't carrying it's share of the load, especially in the turns. This sets you up for frame twisting. The three-wheeled design is more accurately described as a backwards tricycle (cycle-car) layout. During quick turning and hard braking, the proportion of the weight on the front wheels will increase, (imagine the front forks on a motorcycle compressing) changing the handling of the car. If handling changes too much, the car might tip if there is only one wheel in the front. Most, but not all of the Electrathon cars you will see have three wheels.

Wheels can be purchased or salvaged. DO NOT USE STANDARD BICYCLE WHEELS. Moped wheels or BMX wheels are good place to start. You might elect to talk to a local bicycle shop (these have been EXCELLENT sources) about what you are doing and what your requirements are. They might even custom lace special wheels for you (don't forget to tell them that if they help you, that they are considered a sponsor and you will put a sticker on you car advertising for them). Remember to tell them that you will have side loads as well as vertical loads on these wheels. A bicycle will always have a vertical load, even in a corner due to leaning the bike in a corner. Your wheels will get pushed sideways, and a stock bike wheel will fold up right out from under you. This is not safe for you or anyone else out on the track.

Steering

Steering is one area where it is difficult to write exactly what will work best for your car. You want the wheels to turn to steer the car at one end of your steering system, and you want something in the drivers hands to make it happen at the other. We recommend that you look at cars, garden tractors, go-carts, other Electrathon cars if possible, etc. Look at anything that you can to better understand what others do for the steering knuckles and wheel support. It would probably be a good idea to include some adjustment for castor, camber and toe-in. You can't look up the right numbers in Chilton's for this, so the best settings will probably need to be adjusted into place through experimentation. Cedar Rapids Kennedy suggests 4 degrees of caster to keep the car straight. Camber and toe are at 0, but may go negative 1 degree of the right side. Make sure that you have a way of keying or wiring the nuts in place (or other foolproof holding method) for this adjustment.

The steering wheel or levers should be made so that steering happens the way you think it should. A steering wheel is the best and easiest method. Most people are familiar with a wheel. Lever operation is okay, but can be more confusing. If you do this approach, we suggest that it follow the "skid steer" approach...if you pull back on the left lever, you turn left, and the same for the right. In the case of the need for quick response on the track, your action should be carried out without any forethought. You see the need, you immediately respond, the car goes there...no hesitations. We have also seen joystick approaches. You might also want to consider some adjustment on the linkages to set the "speed" of the steering to whatever feels right. With these being fairly short in the wheelbase, the steering tends to be quick.

For what happens in between the wheel or levers and the wheels, we will not make any design suggestions, every car is too unique to make an accurate suggestion here. Make sure that everything is tough and durable. The joints that are bolted should be wired or cotter pinned. Try to keep the slop out of all the joints. This will make your car safer and help you to reduce your frictional losses. If there is slop, the wheel is not in its optimum position at all times. You are essentially plowing that wheel down the track. As a real world example, a universal experience is the grocery cart with one caster that flops all over the place. Is that one easier or more difficult to push than one that travels all wheels straight?