

2do. Concurso de Diseño de Vehículos Eléctricos Rumbo a la Movilidad Eléctrica E-GTO Nivel superior



La Secretaría de Educación, en lo sucesivo "SEG", con fundamento en el artículo 47 fracciones VIII, XVI y XVII del Reglamento Interior de la Secretaría de Educación, en coordinación con la Secretaría de Desarrollo Económico Sustentable en lo sucesivo "SDES" y la Italian German Exhibition Company Mexico convocan a las instituciones públicas y privadas de nivel superior del estado de Guanajuato para participar en el:

2º. Concurso de diseño de vehículos eléctricos Rumbo a la Movilidad Eléctrica E-Gto, Nivel Superior

Objetivo:

Diseñar y elaborar vehículos 100% eléctricos funcionales, con la finalidad de contribuir en la formación de los estudiantes, fomentando la actividad experimental y el desarrollo del talento humano para la creación de vehículos eléctricos a fin de poner en práctica sus conocimientos y habilidades y con esto impulsar la industria 4.0, así como propiciar el trabajo en equipo.

A fin de llevar a cabo esto, se emiten las siguientes:

BASES

I.- DE LOS PARTICIPANTES.

1. Podrán participar las **instituciones de educación superior públicas y privadas del estado de Guanajuato.**
2. Podrán participar los estudiantes que se encuentren inscritos a la emisión de la presente convocatoria en instituciones de educación pública o privadas de nivel superior del estado de Guanajuato, sin importar el semestre o cuatrimestre que cursen.
3. Podrán participar **los docentes adscritos a las instituciones educativas públicas o privadas de nivel superior del estado de Guanajuato, quienes fungirán como asesores de los equipos.**

II.- DE LAS CATEGORÍAS.

Categoría monoplaza: Diseño y construcción de vehículo eléctrico monoplaza.

Categoría motocicleta: Diseño y construcción de motocicleta eléctrica.

III.-DE LA INTEGRACIÓN DE LOS EQUIPOS.

1. Para la categoría monoplaza los equipos estarán integrados por 10 estudiantes y 2 docentes.
2. Para la categoría motocicleta los equipos estarán integrados por 8 estudiantes y 2 docentes.
3. Los equipos deberán estar integrados tanto por hombres como por mujeres.
4. Los equipos deberán estar integrados por estudiantes de por lo menos 2 carreras diferentes de la misma institución educativa.
5. La presente convocatoria se declarará desierta al no contar con más de 3 equipos registrados en cada categoría.

IV.- DEL REGISTRO DE EQUIPOS.

La inscripción de los equipos se realizará conforme a lo siguiente: Las IES deberán enviar oficio en formato libre dirigido al Mtro. José Alberto López García, Director General de Educación Superior, emitido por el titular de la institución educativa en donde manifiesten el interés de participar en la presente convocatoria al correo: **e-gto2024@seggtogob.onmicrosoft.com** indicando:

- Nombre del equipo
- De los estudiantes integrantes del equipo: indicar nombre completo y programa académico que cursan
- Indicar al estudiante líder del equipo y sus datos de contacto: teléfono y correo electrónico
- Nombre completo de los docentes asesores

Las inscripciones para participar podrán realizarse desde la publicación de ésta convocatoria y hasta el **20 de mayo de 2024.**

V.- DE LA POSTULACIÓN.

Los equipos de las instituciones educativas cuyo registro haya sido validado, deberán integrar su carpeta de postulación, la cual deberá contener lo siguiente:

1. Carta-compromiso de la institución donde conste que apoyarán al equipo para que concluya satisfactoriamente su participación.
2. Carpeta técnica que debe contener:

Categoría monoplaza:

- Nombre del equipo
- La postulación de cada equipo deberá ir acompañada de un documento PDF de contenido y organización libre donde se detalle la propuesta del vehículo a construir; el vehículo presentado debe ser una obra original, creada exclusivamente para esta convocatoria. No se aceptarán modificaciones de vehículos existentes. Se deberá incluir planos detallados e imágenes de los diseños por computadora de chasis, carrocería, sistema eléctrico y detalles constructivos del vehículo propuesto alineado al reglamento de Electrathon America (Anexo 1).
- Cronograma de actividades

Categoría motocicleta:

- Nombre del equipo
- La postulación de cada equipo deberá ir acompañada de un documento PDF de contenido y organización libre donde se detalle la propuesta del vehículo a construir. Se deberá incluir planos detallados e imágenes de los diseños por computadora de chasis, carrocería, sistema eléctrico y detalles constructivos del vehículo propuesto.
- Cronograma de actividades

La documentación solicitada para la postulación de los equipos, deberá entregarse como **fecha límite el 3 de junio de 2024**, al correo: **e-gto2024@seggtogob.onmicrosoft.com**

2do. Concurso de Diseño de Vehículos Eléctricos Rumbo a la Movilidad Eléctrica E-GTO Nivel superior



VI. DE LA EVALUACIÓN

Primera Etapa de evaluación:

Durante esta etapa, el Comité de Evaluación se encargará de revisar y evaluar las postulaciones presentadas por los equipos de las instituciones participantes, conforme a la rúbrica de evaluación que establezca dicho comité. De las postulaciones presentadas, se seleccionarán los 10 mejores de cada categoría.

La notificación de los resultados de esta etapa de evaluación se realizará por correo electrónico al titular de las instituciones educativas, así como al correo electrónico del estudiante líder designado por cada equipo, a más tardar **el 7 de junio del 2024**.

Los 20 equipos seleccionados serán acreedores a un apoyo económico de \$20,000.00 (Veinte mil pesos 00/100 M.N.) menos impuestos, el cual deberán utilizar para la adquisición de materiales y construcción del vehículo eléctrico.

La entrega y comprobación de los recursos se realizará conforme a los criterios que establezcan la "SEG" y la "SDES".

Segunda etapa de evaluación:

Esta segunda etapa de evaluación se llevará a cabo en **León, Gto., dentro del marco de Industrial Transformation Mexico 2024, la Hannover Messe de América Latina del 9 al 11 de octubre de 2024**.

En esta etapa el Comité de Evaluación Técnica se encargará de revisar y evaluar técnicamente el diseño, la construcción y el funcionamiento de los vehículos de los equipos finalistas conforme a la rúbrica que establezca dicho comité.

La segunda etapa de evaluación consistirá en:

1º. Presentación del vehículo

En este primer momento de evaluación, cada equipo finalista designará a 3 de los estudiantes integrantes para que hagan una presentación técnica del vehículo al Comité de Evaluación Técnica, para lo cual dispondrán de 5 minutos en donde deberán explicar el diseño, los materiales utilizados y las especificaciones técnicas de su vehículo y el Comité de Evaluación Técnica hará la inspección general de:

- Especificaciones físicas del vehículo
- Verificación de los sistemas eléctrico y electrónico
- Verificación del sistema mecánico
- Diseño de carrocería

2º. Pruebas de funcionamiento

El segundo momento de la evaluación consistirá en realización de las pruebas de funcionamiento de los vehículos, por lo que cada equipo deberá designar a un integrante para que conduzca el vehículo durante las pruebas, se podrán evaluar aspectos como:

- Uso de energía
- Velocidad máxima
- Frenado
- Estabilidad en línea recta
- Maniobrabilidad en curvas
- Autonomía

VII. DE LOS RESULTADOS

Los resultados de los ganadores se darán a conocer dentro del marco de las actividades de la **feria de la Industrial Transformation Mexico 2024, la Hannover Messe de América Latina**.

VIII. DE LOS PREMIOS

1er. lugar en cada categoría: **\$50,000.00 (Cincuenta mil pesos 00/100 M.N.)** menos impuestos para cada equipo.

2do. lugar en cada categoría: **\$25,000.00 (Veinticinco mil pesos 00/100 M.N.)** menos impuestos para cada equipo.

IX. DE LA CONFIDENCIALIDAD

La información proporcionada por los equipos participantes con relación a la presente convocatoria, tendrá el carácter de "estrictamente confidencial" en los términos del artículo 27 fracción III de la Ley de Transparencia y Acceso a la Información Pública para el Estado de Guanajuato, así como el artículo 15 de la Ley de Protección de Datos Personales en Posesión de Sujetos Obligados para el Estado de Guanajuato y al Aviso de Privacidad Simplificado de la Dirección para la Formación Integral en Educación Superior, disponible en:

http://transparencia.seg.guanajuato.gob.mx/AvisosPrivacidad/SEMSyS/DGES/DFIES/APS_DFIES.pdf

X. SITUACIONES NO PREVISTAS

Cualquier situación no prevista en la presente convocatoria, será resuelta por el Comité de Evaluación, resolución que será definitiva e irrevocable.

Guanajuato, Gto., 02 de Mayo de 2024

Para mayores informes, comunicarse con el Comité Evaluador en el correo:
e-gto2024@seggtogob.onmicrosoft.com
O presencialmente en la Coordinación para la Empleabilidad y Pertinencia en Educación Superior ubicada en las oficinas centrales de la Secretaría de Educación, Conjunto Administrativo Pozuelos S/N, Planta Baja, Guanajuato, Gto.
Tel: 473 1020 200 ext. 8036

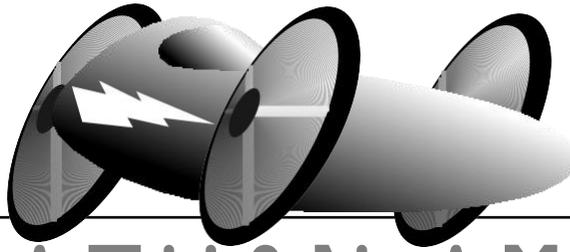
**2do. Concurso de Diseño de Vehículos Eléctricos
Rumbo a la Movilidad Eléctrica E-GTO**

Nivel superior



ANEXO 1

Reglamento de Electrathon America

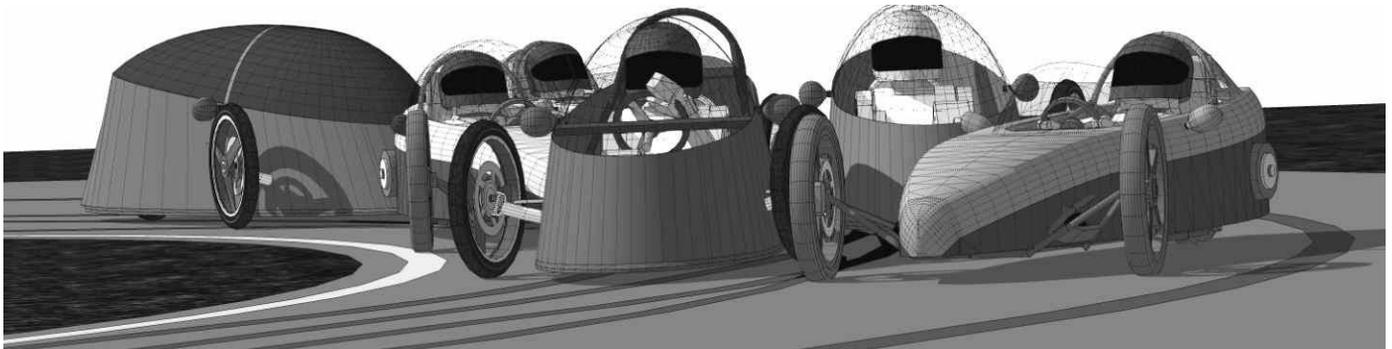


ELECTRATHON AMERICA

Our MISSION: *To inspire an interest in Science, Engineering, and Technology by involving participants in the design, construction, testing and development of competitive electric vehicles.*

COMPETITION OBJECTIVES:

1. To drive electrically powered vehicles as far as possible in one hour on a closed loop course with limited electrical energy.
2. To provide a forum where skill and ingenuity may be displayed, compared and tested.
3. To improve public awareness and understanding of efficient alternative electric vehicles and related technologies.
4. To create an affordable sport defined by established rules in which **Schools, Individuals** and **Corporate Teams** can participate competitively and safely.



VEHICLES

Electrathon vehicles are single person, lightweight, aerodynamic, high efficiency, electric vehicles with three or four pneumatic tires. They must meet specific design and safety rules. They are powered by standard sealed (won't leak if damaged) lead acid battery packs not exceeding the weight limit specified in the vehicle design rules section.

SAFETY

Safety is of key concern at all events. The design of the vehicles is only one variable in the safety of an event. A pre-race inspection of the vehicles is required to ensure they are safe. Event courses must be free from obstructions, and ensure participants and spectators are not in harms way. These are just some of the sanctioning regulations.

For these safety reasons local Event Organizers, Promoters, and Event Stewards may not make ANY changes to the Electrathon America Design and Event Rules other than where specific guidelines for deviation are listed.

To be an Electrathon America Sanctioned Event, the Event Rules must be enforced during the event and all vehicles participating in the event must meet current Vehicle Design rules.

MEMBERSHIP

A Competitor Membership is required for those wishing to compete in sanctioned Electrathon America events. It includes number registration for one vehicle, one Handbook, and one vote on any suggested rule changes that are presented by the Electrathon America Board during the Event Season. The membership voting rights also include the vote to appoint Electrathon America Board Members. The membership application form is available at the back of this handbook.

All memberships are valid for the Event Season during which they are paid. The event season is from January 1st to December 31st. All rule changes approved by member vote will take effect January 1 of each event year. Rule changes will be published in the on-line Handbook as they are approved, at www.ElectrathonAmerica.org

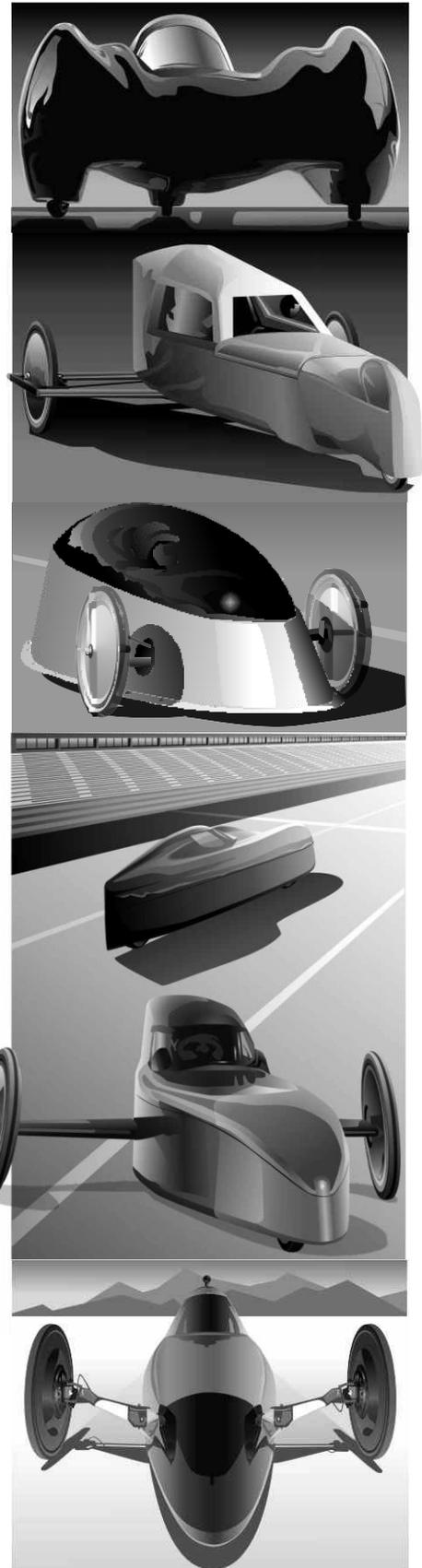
Members are encouraged to communicate with the Electrathon America Director nearest to your location. The Board of Directors list is available at www.ElectrathonAmerica.org

Regional representatives are encouraged to participate as advisors to the Electrathon America board. Member surveys are used as needed to solicit opinion on rules and policy from the membership.

RULE QUESTIONS & CHANGES

Questions & Suggestions for rule changes of either the Design Rules or Event/Host Rules must be emailed to electrathonamerica@gmail.com with "Attention Directors" in the body of the message. If a proposal is consistent with the mission and objectives of Electrathon America competition and will improve the sport, the Board of Directors may present the proposal to the current year membership for an official vote.

However, Rules pertaining to the safety of participants and event spectators are decided by a vote of the Electrathon America Board of Directors. If passed, such rule changes will immediately be published to www.electrathonamerica.org in a revised version of the the on-line edition of the Handbook.

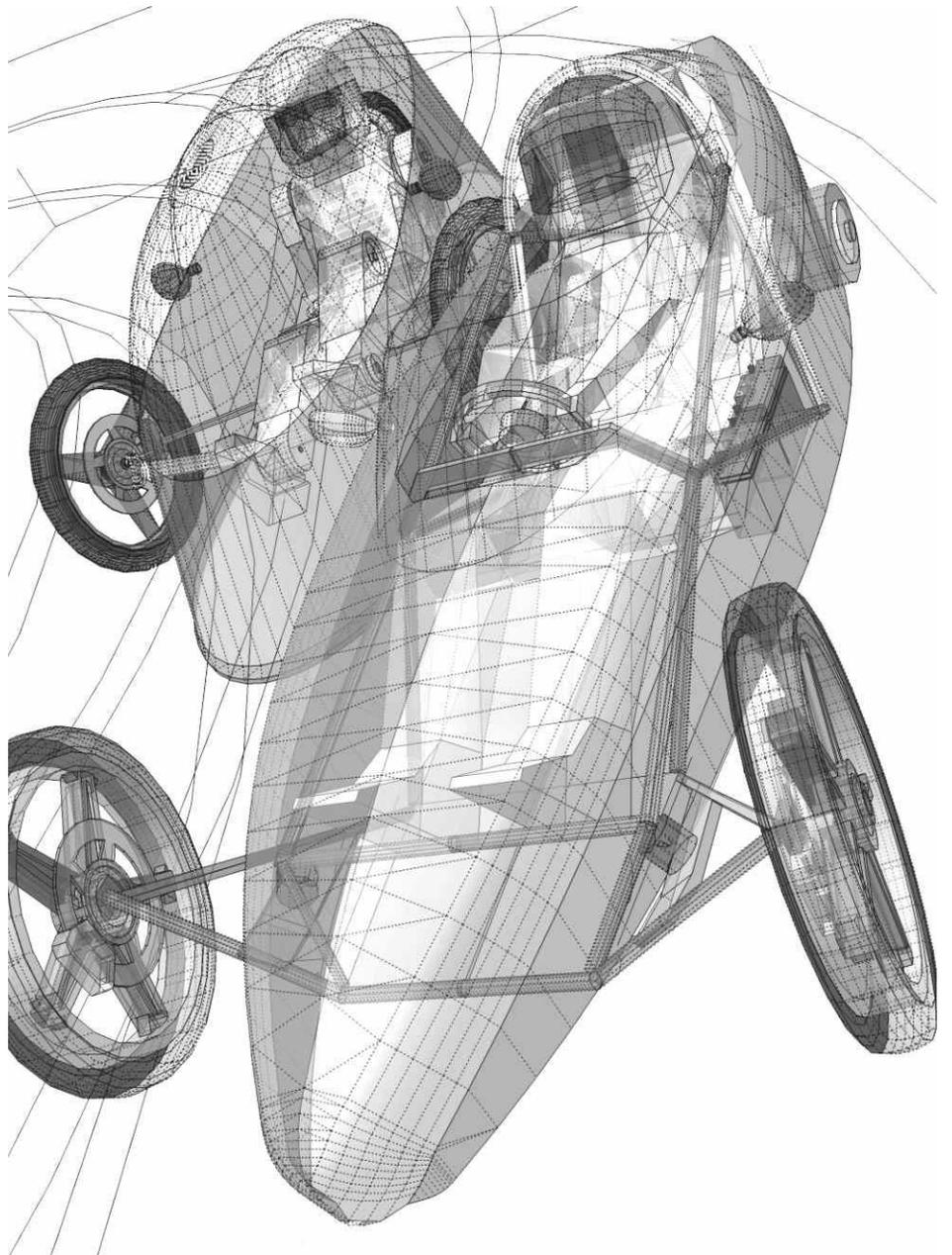


The Vehicle Design Rules are maintained by Electrathon America and enforced at sanctioned events. They are provided to promote safe and fair competition.

Since safety is of key concern these rules should be considered minimum requirements. These rules will be in force and these requirements must be maintained during the entire competition. Any vehicle should be able to pass inspection at any time during a competition.

Experimentation of design and ingenuity are encouraged, but keep in mind the intent of safe competition for the driver and the other participants of an event. If a new concept is being attempted that does not fit the rules exactly it may be wise to contact an event official or an Officer of Electrathon America before proceeding with construction. It would be unfortunate to complete a vehicle and then have it disqualified at a competition. Please remember that safety is a primary goal.

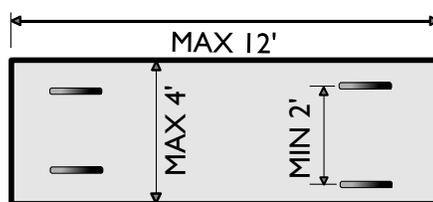
To better understand these rules and how they are enforced, please read the Event section that follows.



VEHICLE DESIGN RULES

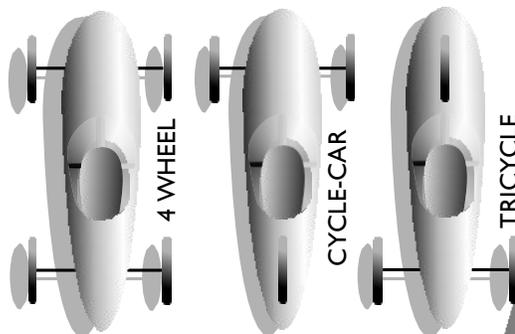
1 DIMENSIONS

1. Minimum track (the distance the tires are apart) on at least one axle, is 2 feet center to center.
2. Maximum vehicle width is 4 feet at its widest point when the steering system is positioned as if driving in a straight line.
3. Maximum vehicle length is 12 feet.



2 CONFIGURATION

1. All vehicles must be three-wheeled (cycle-car or tricycle) or four wheeled. Any configuration is allowed. All wheels must be load bearing, and remain in contact with the ground at all times, even under hard cornering conditions.

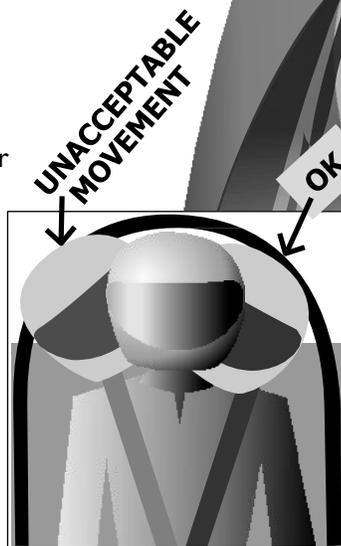


3 FRAME / FRAME MEMBERS

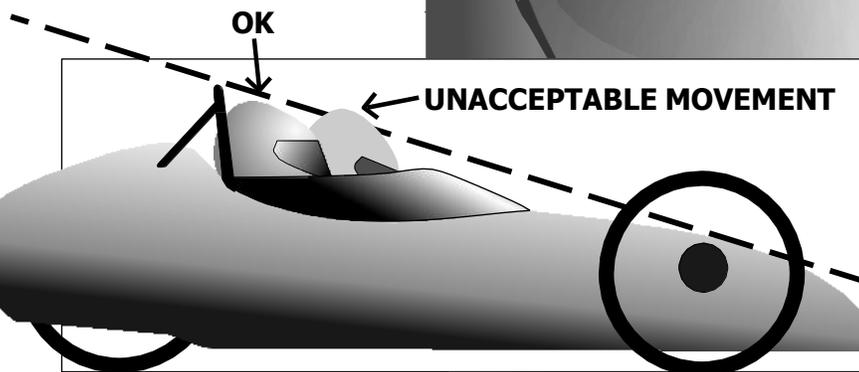
1. All vehicles must have frame members that protect the driver in the event of collisions from any direction.
2. Frames may be constructed of various materials and styles providing that the material(s) or methods provide adequate structural strength for protection/safety. The design will need to be structurally sound in the opinion of inspectors and/or race officials.

4 ROLL BAR

1. The roll bar must protect the driver's head/helmet in the event of a roll-over. It must be tall and wide enough to do this considering the full range of possible movement. (See drawing.)



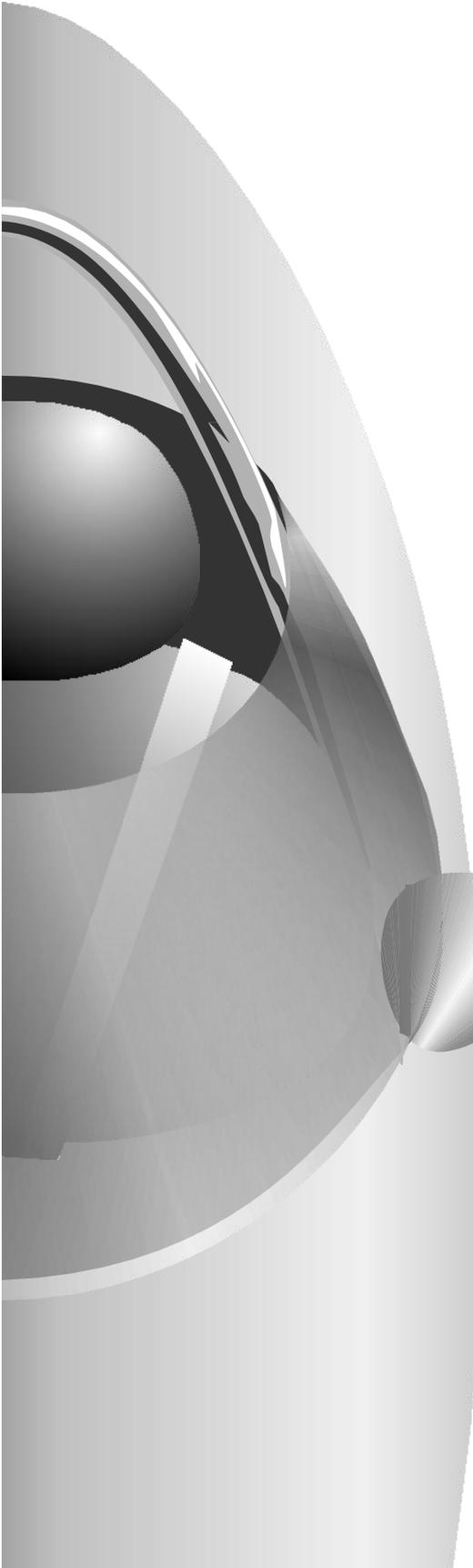
2. The roll bar structure must be triangulated with at least three legs or panel equivalent. Triangulated bracing can be either forward or rearward. With three legs bracing must extend from the top of the roll bar and securely attach to the vehicle structure, with four legs, each of the braces must extend to within 4" of the top. Any roll bar that is constructed from more than one continuous piece must be reinforced and braced triangularly from all junctions/joints in addition to the top.



3. The roll bar structure must appear to be sturdy enough to withstand the vehicle being dropped, upside down, from an altitude of one foot, with the driver inside without failure.

4. The driver's helmet must be below a straight line drawn from the top of the roll bar to the top of the highest structural point when the driver is securely belted in driving position. (see drawing).

5. Composite or monocoque vehicles with integral rollover protection must meet comparable strength and clearance requirements.



5 VEHICLE BODY

1. All vehicles must provide a body/chassis structure sufficient to protect the driver from impact from any side. A suitable structure or shell is required to provide a barrier between the driver and any contact with another vehicle or the ground.
2. This body or structure needs to protect the driver's legs, feet, and side up to shoulder level protecting the rib cage from side impact.
3. The legs and feet must be enclosed to prevent them from leaving the vehicle in an accident and provide protection against a frontal impact.
4. If the chassis contains a structural shell sufficient to protect the driver, then any body provided need not be structural. However, under no circumstances is the body to be made of cardboard, paper or any material that becomes weak when wet. Materials that are brittle or produce sharp edges when broken (e.g. Plexiglas or brittle acrylic panels) are also not allowed.
5. A body is not required if the frame or chassis shell will prevent the driver's arms and legs from leaving the vehicle and prevent another vehicle's parts from entering the vehicle during an accident.
6. The vehicle must not have any sharp edges, corners or protrusions that could cause injury. Any questionable exposed portion of the vehicle should be cut off, rounded off or blunted with durable padding.
7. The nose area must have a minimum radius of 3 inches (6-inch diameter) in at least one direction and not be dangerously pointed in the other direction.
8. The vehicle must have a fixed floor pan of solid-rigid material that prevents any part of the driver's body from contacting the ground.

6 STABILITY

1. All vehicles must demonstrate stability at rest, while cornering, braking and at top speed.
2. Driver contact with the ground cannot be used for stability.
3. Vehicles must be positively balanced and stable at all times while moving and at rest. Stability is critical for safety and must be maintained in off- camber turns, high-banked corners and in windy conditions.

7 LEANING VEHICLES

1. Leaning vehicles are permitted provided the driver is not required to balance the vehicle and stability requirements are met.
2. Leaning vehicles must use a mechanical device for actuation.
3. Vehicles which lean must have the ability to lock out the leaning capability of the vehicle for driver access and exit.

8 STEERING

1. Steering must permit a turning circle diameter of less than 50 feet curb to curb.
2. Any steering system must be well constructed and provide reliable steering action without looseness or binding.

9 BRAKES and AXLES

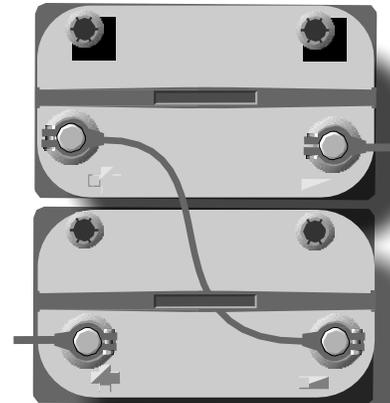
1. At least two wheels must have brakes.
2. Brakes must be fitted to two wheels of the same axle. Either both front wheels or both rear wheels depending on vehicle construction.
3. The two brakes must have separate actuation cables. If both brakes are to be actuated by a single hand or foot lever, then both cables should be attached to the lever.
4. Regenerative braking is permitted in addition to conventional brakes.
5. The vehicle must not roll if pushed while brakes are applied. The vehicle must also be able to demonstrate a straight stop from a speed of 25 MPH in less than 40 feet.
6. Axles supported at both ends must have a diameter of at least 3/8" (10mm).
7. Axles supported only on one end must have a diameter at least 1/2" (12mm)
8. Safety wire or cotter pins must be used to secure cantilevered wheel axle nuts. Nylon lock nuts and double nuts alone are not acceptable.

10 WHEELS and TIRES

1. Tires must be a pneumatic (inflatable) type.
2. Wheels and tires of any diameter or width may be used.
3. The minimum ground clearance is to be judged by the cars ability to roll over a 2x2 that is milled to be 1 1/2" x 1 1/2". This is to prevent the vehicle from sliding on the ground in the event of failure of any or all of the tires.
4. While in driving position the driver's body must not be able to come in contact with tires, wheels or spokes.

11 BATTERIES

1. Batteries must be lead acid only. Only batteries that will not leak if punctured, such as gel cell or AGM (Absorptive Glass Mat) will be allowed to participate at events in practice or in competition.
2. Battery number and voltage is not limited, but must meet specified weight limits, or must be the accepted battery types listed.
3. Batteries must display all original manufacturer's labels.
4. Batteries must be commercially retailed and available to any competitor. Custom built or specialized batteries are not allowed.
5. Batteries must be stock and unmodified in any way, and meet all conditions of the manufacturer's written warranty.
6. Total battery weight can not exceed 73 pounds. Total battery weight includes any batteries used for controls actuation, or functioning of the vehicle. Computers, radios or similar equipment are not included.
7. Batteries cannot be exchanged or recharged from an outside source during a competition. Batteries may be recharged by regenerative braking, or, in the Solar Class, through use of solar panels.
8. Batteries must be securely attached to the vehicle in such a manner to withstand an impact or roll-over.



The following list of batteries are accepted as standard, meaning two of the following batteries will be allowed regardless of actual weight:

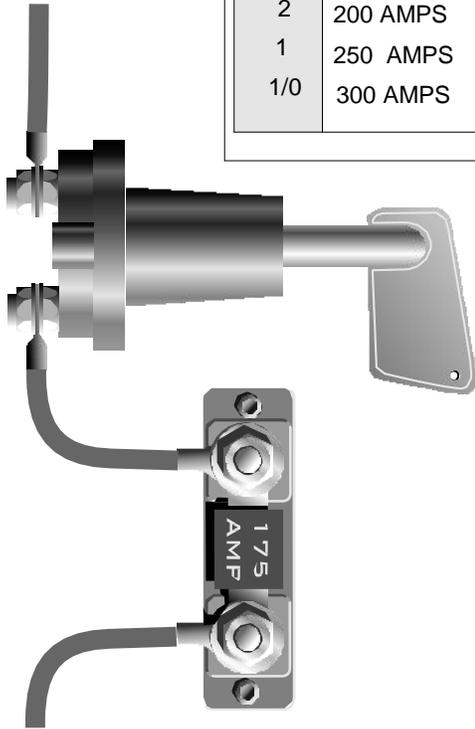
- Optima Yellow Top **D35, D75/25**
- Optima Red Top **SC25A, SC35A, SC75/35**
- Odyssey Genesis **G42 (VP, VPX, EP, EPX)**
- MK **40**
- Exide Orbital Model **75/35**
- Champion Vortex **75/35**

12 ELECTRICAL SYSTEM

Table adapted from National Electric Code (NEC) Handbook for standard automotive type cable, single conductor, not in a raceway or conduit.

FUSE GUIDE	
Wire size AWG	Fuse or Breaker Size
20	5.5 AMPS
18	9 AMPS
16	12 AMPS
14	15 AMPS
12	20 AMPS
10	30 AMPS
8	80 AMPS
6	105 AMPS
4	140 AMPS
2	200 AMPS
1	250 AMPS
1/0	300 AMPS

For other cable types or configuration refer to an applicable NEC (National Electric Code) standard.



1. A fuse or circuit breaker is required in any electrical circuit between the battery and any electrical device.

2. All fuses or circuit breakers should be mounted as close as practically possible to the source of power.

3. All fuses or breakers should be sized to protect the wiring to which they are connected. The current rating of fuses and breakers shall be no more than those listed in the adjacent table for standard automotive cable.

13 ISOLATION SWITCH

1. An isolation switch (kill switch) is required on all vehicles. This switch must have a break current rating that exceeds the maximum current draw of the vehicle.

2. The switch must be located in the main positive power cable between the battery and any motor controller.

3. An actuator may be attached to the switch for remote operation provided that it is durable and reliable.

4. Means must be provided for both the driver and race officials to actuate an isolation switch.

5. The driver must be able to actuate the switch while in driving position and without reaching outside the vehicle.

6. Race officials must be able to actuate the switch from outside the vehicle without reaching in.

7. Two switches may be installed if necessary.

8. A circuit breaker may be used as the isolation switch.

9. The switch or actuator accessible from outside the vehicle must be mounted within a solid red triangle whose sides are at least 4 inches and in contrast to vehicle color or graphics.

10. Wiring must be well insulated and securely attached to the frame or body. All wiring must be kept free from moving parts and protected from chafing.

11. Wiring that passes through a hole with sharp edges or through sheet metal must be protected by an insulating grommet or other suitable device.

12. Terminals must be secured so they will not come loose or short out during a competition.

13. No part of the electrical system may use the vehicle frame as a conductor. The frame must not be grounded.

14 MOTOR and TRANSMISSION

1. Vehicles must only be powered by electric motors.
2. All gears, chains, and sprockets must be covered if they could cause injury to the driver or others in the event of mechanical failure.

15 MOTOR CONTROLLER

1. Any type of power (speed) controller is allowed.
2. Power to the motor must be controlled by the driver and turn off automatically when the driver releases the accelerator ("dead man" cut-off).
3. Remote control of a vehicle is not permitted.
4. Computers on or off the vehicle are legal systems if they present information only. The driver must have complete manual control of the vehicle and make all operational adjustments.

16 NUMBERS

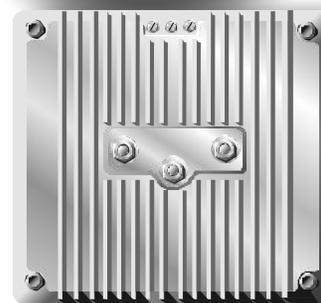
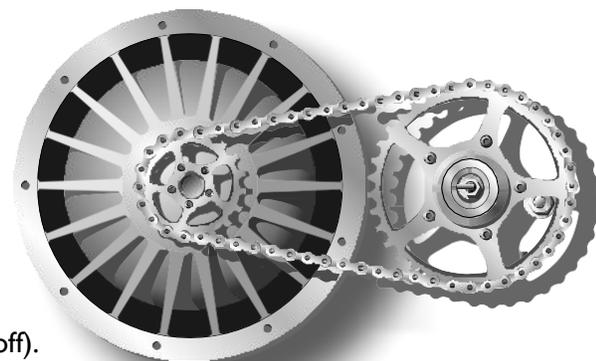
1. All vehicles must display assigned vehicle competition numbers.
2. Vehicle numbers must be least 6 inches in height.
3. Numbers must be clearly visible on both sides of the vehicle.
4. The numbers must be in a contrasting color to the vehicle or number background. Out of state vehicles must also display their state abbreviation following the vehicle number in 3-inch-high letters.
5. Numbers or letters can be purchased when registering on membership form or by contacting the Treasurer of Electrathon America.

17 MIRRORS

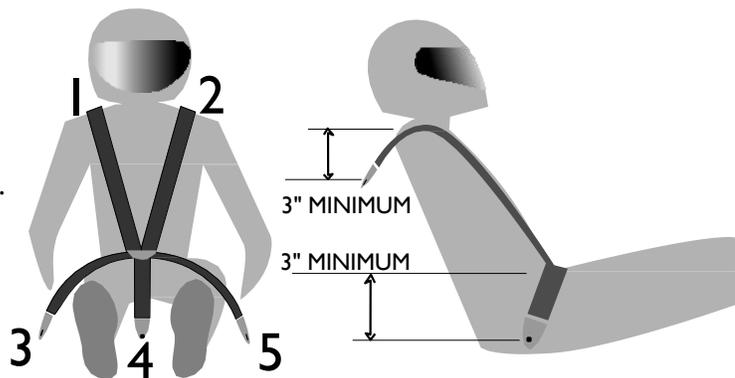
1. Vehicles must be equipped with a minimum of 8 square inches of total usable mirror surface area. This may be one or two mirrors.
2. The mirror(s) must allow the driver to see clearly to the rear on both sides of the vehicle. This will be tested in a manner deemed appropriate by the inspector and race steward.
3. The driver must be able to see clearly to the front and both sides of the vehicle.
4. Electronic sensing devices, such as video cameras and monitors, may not be used as a substitute for rear view mirrors.

18 SAFETY BELTS

1. All vehicles must be equipped with a five-point automotive seat belt system.
2. All five belts must be securely attached to the vehicle frame structure by mechanical fasteners such as nuts, washers and bolts. Questionably small fasteners, zip ties and tape are unacceptable. The harness must be capable of lifting the entire vehicle from the ground with driver and batteries in place.
3. Each waist belts must be mounted to a structural point at least 3 inches below the top of the driver's waist.
4. The shoulder harness must be attached to a structural point at least 3 inches below the driver's shoulder without interference from the seat or other items.
5. The seat belt, shoulder harness and crotch strap must be able to hold the driver in a position that does not allow any excessive movement. The shoulder harness must be installed so that it can't slip off the driver's shoulders while driving. In the event of a sudden stop, it must prevent the driver from sliding forward and maintain the driver's shoulders in the "driving position". The seat belt must be able to hold the driver securely in place if the vehicle rolls over.



** With the available option for purchasing sanctioned numbers this rule will be strongly enforced with possibility of denial to race until standards are met to race host approval.*



19 HELMETS

1. All drivers must wear a DOT approved full faced hard-shell helmet during competition. Bicycle and skateboard helmets are not acceptable.
2. Chin straps on helmets must be properly and securely fastened while operating an Electrathon Vehicle.



20 DRIVE ATTURE

1. Drivers must be fully clothed during competition.
2. Long sleeve shirts, pants and shoes are required (water socks and wrestling shoes are acceptable).
3. Gloves are required for open cockpit vehicles and optional for enclosed canopy vehicles. Fingerless gloves are allowed.
4. All drivers must wear eye protection while operating an Electrathon vehicle. Safety glasses with a Z87 rating, goggles, or a full face-shield helmet are acceptable.
5. Hair must be contained in such a way that all of it is unable to reach the drive train.
6. Necklaces, wrist and ankle bracelets, and large earrings must be removed.

21 CELL PHONE/COMMUNICATION DEVICES

1. Push to talk radios are permitted if the driver is not likely to be distracted by the action of Push To Talk.
2. Cell phones are permitted only when vehicle is at a stop (such as a breakdown) or when in hands free mode on an open line (no dialing).
3. Texting is banned whenever the driver is physically in the car.
4. Penalty for violation of the rules 21.2 or 21.3 is the offending car and driver's immediate removal (disqualification). After 2 violations in same calendar year the driver will be banned from using any electronic form of communication for the rest of the year.

22 DRIVING POSITION

1. Drivers must be in a sitting or recumbent (reclining) position. A kneeling, or prone (head-first) position is not permitted.
2. Arms and legs must remain within the vehicle body structure during competition.

23 EXITING THE VEHICLE

1. Drivers must be able to exit their vehicle as it is driven in competition, unaided in 20 seconds. This includes any external method of securing canopies.
2. Handicapped participants will be allowed up to 2 minutes aided exit.

24 DRIVER AGE & COMPETENCE

1. Event stewards are encouraged to disqualify any driver from competing if believed to be unsafe. Otherwise, drivers over 16 years of age who present a valid driver's license and proof of current Electrathon America registration may compete without prior testing or approval. Drivers over 14 years of age who present proof of current Electrathon America registration may compete if:
 - a) the event steward hasn't limited the event minimum age to 16 years. *Steward must ensure event advertising specifies.*
 - b) driver has obtained written approval (from event steward) to submit at event registration. This mandatory approval serves as proof that the steward (or a delegate of) tested the driver to demonstrate her/his ability to perform on the same or similar track conditions for at least 10 minutes. Requirements may be increased at the discretion of the event steward. It is the responsibility of the driver to contact the steward in advance of the event to plan testing. Approval may not be decided by a steward or delegate who is affiliated by team or familial ties to the driver.

25 COMPETITOR MEMBERSHIP CARD

1. To compete in a sanctioned event, all vehicles must be accompanied by an Electrathon America Competitor Membership Card. This card will be made available by Electrathon America and can be presented as proof of current year paid membership. The Event Organizer may request a computer roster of current competitor members to verify memberships.

26 BALLAST

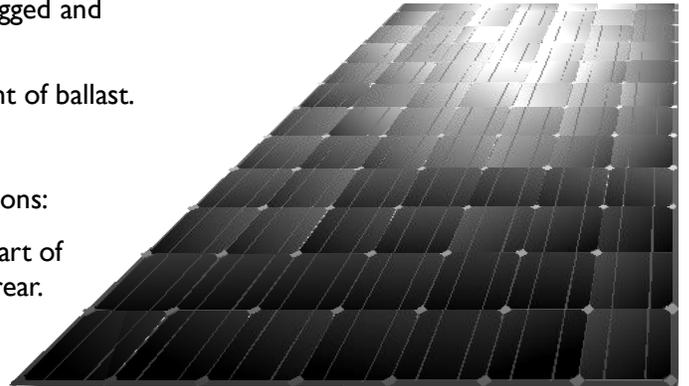
1. Drivers must weigh a minimum of 180 pounds. This includes race clothing and helmet. Drivers under this weight limit must provide non-liquid ballast to increase their weight to the legal limit.
2. Ballast cannot be performance related items such as communication equipment or computers. However, non-performance items such as cameras or music systems may be permitted as ballast, provided they do not present a safety risk to the driver or other competitors.
3. Ballast must be removable for weigh in. Ballast must be securely attached to the vehicle in such a manner to withstand an impact or roll-over. If a vehicle loses its ballast during competition, it will be black flagged and disqualified.
4. Each driver is responsible for providing the correct amount of ballast.

27 SOLAR CLASS

All other Standard Class rules apply with the following additions:

1. Solar panels are permitted provided they are an integral part of the vehicle body and do not protrude to the front, sides or rear.
2. Wings or trailers are not permitted.

The Solar Class allows the use photovoltaic cells to provide additional power during a race. In most cases that additional power will be more than offset by the increased weight and aero drag of the cells, and while the cost of PV cells is usually prohibitively expensive, they are often donated to schools. It was also felt that solar power offers a sustainable alternative to conventional energy sources, and fit the general objectives of Electrathon.



28 ADVANCED BATTERY CLASS

*The Advanced Battery Class is intended to foster experimentation on with newer battery technologies that offer higher energy density than the more traditional lead-acid and reflect the rapidly expanding availability and usage in the transportation industry. The weight limits are meant to keep the available power under **one kW-h**, or about the same as the current Standard Class. This list will be reviewed and updated periodically.*

All other Standard Class rules apply with the following exceptions:

1. Any type of the following sealed production batteries may be used as long as their weight does not exceed:

2. Maximum output of any battery combination used may not exceed a one-hour rating of one kilowatt/hour according to the manufacturer's data.

- Nickel-Metal-Hydride **41 lb.**
- Silver-Zinc **23 lb.**
- Nickel-Zinc **44 lb.**
- Nickel-Iron **58 lb.**
- Lithium-Ion **15 lb.**
- Lithium-Iron-Phosphate **29lb.**



29 COMPLIANCE

1. All vehicles must meet all Vehicle Design Rules to drive at any Electrathon America sanctioned event. This is true for competition, practice or testing and includes driver's clothing, safety equipment, batteries, battery securing systems, seat belts, etc.

ELECTRATHON AMERICA



VEHICLE DESIGN TIPS

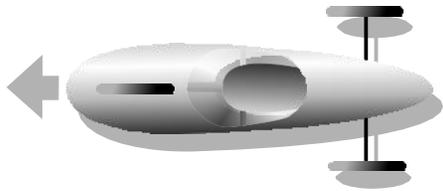
VEHICLE DESIGN TIPS

It is not the intent for this section to tell you how to design and build a car, Electrathons vary widely in style and design. One of the most exciting parts of Electrathon is that the car you design is unique to you and your team! You are the engineers, the builders, the mechanics... It is the intent to guide you in a direction. Some experienced builders could easily write this section, while others look at the whole concept and just go blank, most builders are someplace in between.

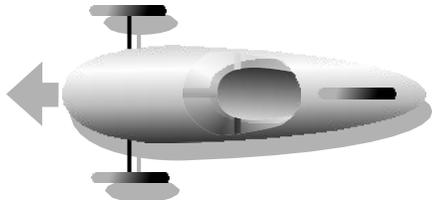
ATTITUDE

Electrathon is fun. You are not going to get rich and famous doing this, but you will have fun. And you will learn something about how things work and about yourself. By establishing and refining simple rules, Electrathon is an elegant balance of design and strategy. No single factor is predominant, and the result is an international racing class known for its creative, competitive and efficient vehicles. Building a vehicle is an attainable challenge, and through friendly competition you gain insight and experience that will improve your chances of winning.

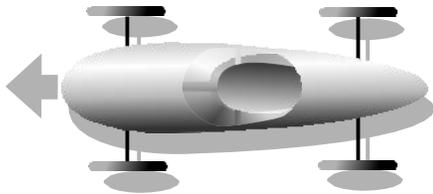




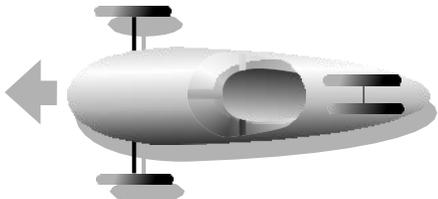
The **tricycle** offers a single wheel steering like a bicycle, and the opportunity to try front wheel drive or rear wheel drive.



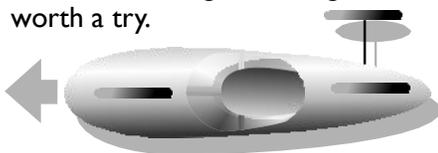
The **cycle car** steers with both front wheels, but requires a complex steering system. It offers a simple power train driving the rear wheel.



The **auto car** layout shares the weight among four wheels, and is less sensitive to placement of weight within the vehicle; but it has the added weight, complexity and rolling resistance of the extra wheel.



A **hybrid** variation. The increase in stability would come with the cost of additional drag, but it might be worth a try.



Side car? Here's an interesting variation that might have some advantages, but achieving the proper balance and stability might be difficult. Not for the beginner!

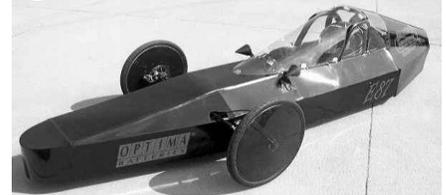
BUILDING YOUR ELECTRATHON

An Electrathon vehicle is much like a full size RC model car, except that you can get in and drive it. Since you are the driver, it is important to make it stable and safe for your protection, as well as the safety of the other drivers and spectators at the track. Building a competitive and safe vehicle is the challenge. The Electrathon rules have evolved over many years to help builders construct a well-designed and safe vehicle. An Electrathon competition combines speed, aerodynamics, handling and lightweight design to create a balanced performance formula. These guidelines offer suggestions to assist you in achieving that goal.

TESTING

This is where races are won or lost. Reliability is the single biggest factor in winning. You don't know what will break until you've tried to break it.

Testing on the bench will give you "benchmarks" and help you choose components. Simple coast down tests can be used to compare and evaluate tires and aerodynamic changes. Testing on a track will allow you to understand how various components work together. It will give you a chance to refine your chassis handling qualities and find your ideal gear ratios. With testing will come the winning edge.



CHASSIS DESIGN

The chassis is the backbone of your vehicle. Unless you are a veteran builder, you should try to keep your first chassis as simple and straight-forward as possible. While weight is a prevalent concern, it is actually only one of several factors that contribute to a successful Electrathon. Reliability is the key to winning. Most Electrathon courses are level, and acceleration is only a small part of the race. Although you will not want to build an overly heavy vehicle, concentrate on building a safe vehicle. Most Electrathons weigh over 350 pounds with driver, ballast and battery, so 10 to 20 extra pounds will be minor. It is more important that the design be strong.



Electrathon vehicles can be configured in a variety of layouts. Each design has disadvantages that you want to minimize, and advantages you want to optimize.

MONOCOQUES

(frameless, or unibody vehicles)

Experiments with a one-piece body/chassis could result in lighter vehicle designs. Like boats and aircraft, they can be very strong. This is an advanced technique using composites (fiberglass, Kevlar or carbon fibers with epoxy or polyester resins). Materials can be expensive, but the drawback is usually the cost and time to engineer a shell properly. Simple but effective designs have been built from wood and fiberglass using small boat construction methods. Some community colleges offer courses in composites.



STABILITY

A well-designed vehicle should be stable under all conditions and situations that might be encountered in a race. Competition places very high loads on a vehicle during tight cornering, even at relatively low speeds. It is therefore very important that the center of gravity of your vehicle be located below the axles. You need only a couple of inches of ground clearance on most race courses. Two to three inches is usually adequate, but make sure that you have clearance even if one, or all, of the tires are flat (this is a rule requirement).

Position the driver, batteries and motor so that the weight is carried low (to prevent flipping over), and near the center of the car (to reduce the tendency to spin). Each wheel should be equally weighted for best handling and control, but a bias toward the front will increase stability. This is easily measured (with driver and batteries on board) with bathroom scales, and can be adjusted by proper placement of the driver's ballast.

Lift an outboard wheel with driver on board. Your vehicle should not tip over at 33 degrees. (This is not necessarily the minimum angle, even steeper banked courses exist) A vehicle that doesn't tip at 33 degrees when static may do so under dynamic conditions typical during racing. Parking lots have potholes, streets have curbs, and when the pavement ends at a racetrack there is usually a little drop-off. All of these can flip a fast moving vehicle.

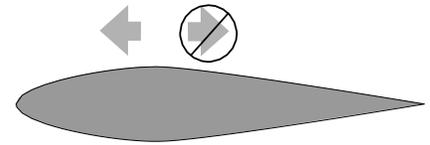
BODIES

AERODYNAMICS

Aerodynamic drag increases rapidly the faster you go, enough to be a deciding factor over the duration of the race. Wind resistance has a noticeable effect above 15 mph, and grows exponentially as the speed increases. Aerodynamic drag is the result of speed, frontal area and length of the vehicle and the shape of the body shell. At Electrathon speeds rounded fish-like teardrop shapes are very functional. Avoid abrupt bends, and flat surfaces. Make sure you can get in and out, and see well from inside the vehicle. Be sure you can get to the chain, tire and other adjustable components. Secure the body panels to the vehicle well, loose panels can create a lot of wind drag.

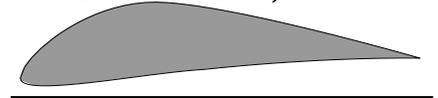


Creating a body shell is a challenge much like building a fiberglass boat or large model airplane. Work in the materials you know and ask around for advice on materials and techniques from plastic suppliers and fiberglass supply shops. Bodies have been made of fiberglass, fabric, steel and aluminum and plastic sheets, even light plywood. A shell is very functional in protecting you from other vehicles and the ground and, is one of the attractive features that make Electrathon distinctive. It can also help attract sponsors for your vehicle.



Up in free air the ideal shape to strive for, looking from the side or from the top, is an airfoil, or teardrop. Note that forward and backward are not the same.

Close to the ground the ideal shape looks like this in side view,



but if it is very close to the ground, this shape works nearly as well.



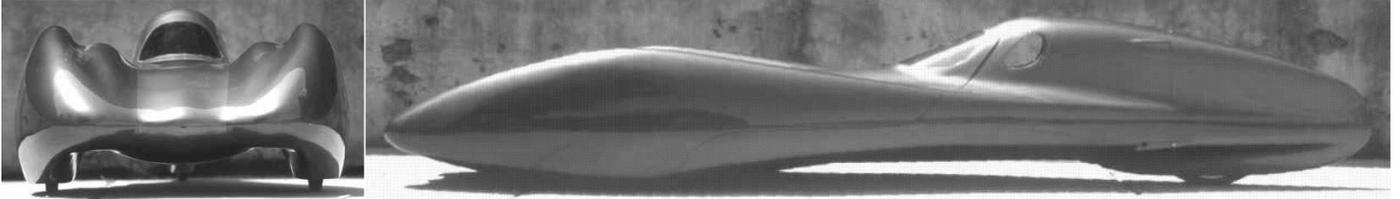
There is a practical limit to ground clearance, though, so it may be better to lift the body high enough to let the air escape.

WIND POWER

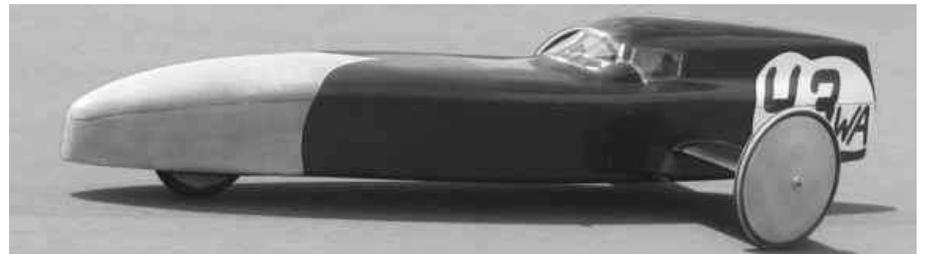
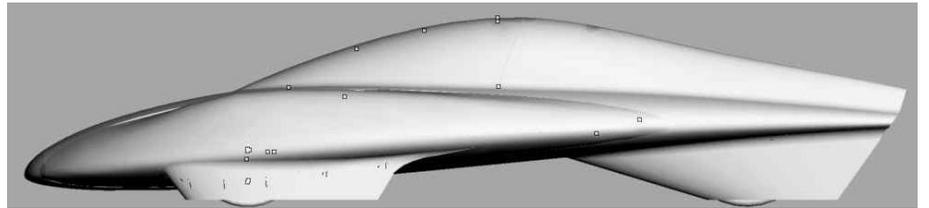
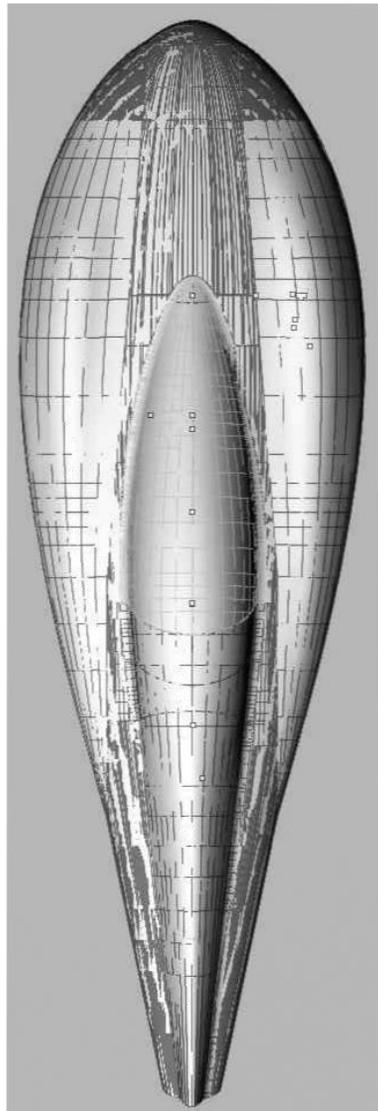
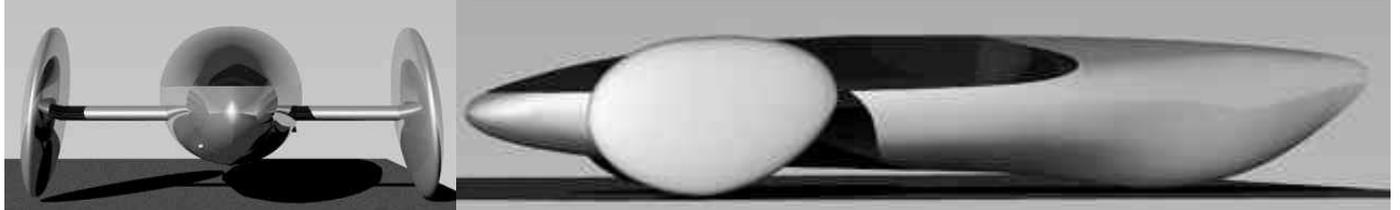
It may be possible to capture extra energy from the wind. In fact, we may already be sailing. Engineers have calculated that the net effect of a light wind from any direction will add noticeably to the speed of an aerodynamic vehicle traveling in a circle (or oval). The head wind is cancelled out by the tail wind, and the rest of the time you are on what sailors call a 'reach'.

While EA has approved the design concept, it has yet to be proven effective in practice.





Frontal area, the size of the hole made in the wind, should be reduced as much as possible. Swept, or Wetted Area, the total amount of body in contact with the wind, should also be minimized. An open wheeled car may have less frontal area than a fully enclosed body, but that advantage could be offset by the increase in swept area.



CANOPIES

A windshield is an important part of your body shell. Depending on your design, you can use clear plastic creatively bent to fit (sheets of acrylic and polycarbonate are readily available in various thicknesses), motorcycle fairings, or buy canopies from a variety of suppliers. Most commercial canopies are molded from these same materials, but this is a difficult process. Acrylic is cheaper, but more brittle and will shatter. It molds at a lower heat, but it doesn't bend as well as polycarbonate, which is also more scratch resistant.



STEERING SYSTEMS

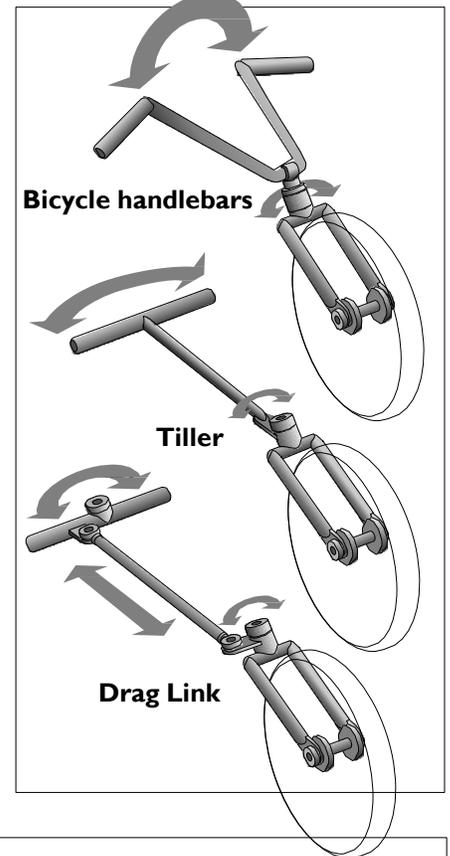
There are a lot of steering systems out there, going into the choices and their variations would be a book in itself. Some vehicles use a steering wheel, some have a joy-stick like a plane, some use a tiller like a boat, and many use some sort of bicycle handlebar. Take a look at other Electrathon vehicles, go-karts, ATV's, and full sized cars. Talk to automotive technicians. Spend time on this aspect, and devise a good reliable system.

If you decide to build a cycle car your design will get a little more complex because you are steering two wheels. Tricycles, with a single steered wheel, can be simpler, unless you opt for front wheel drive, which can make the system even more complicated. Either way you need to design a proper geometry to be stable, maneuverable, and minimize tire wear.

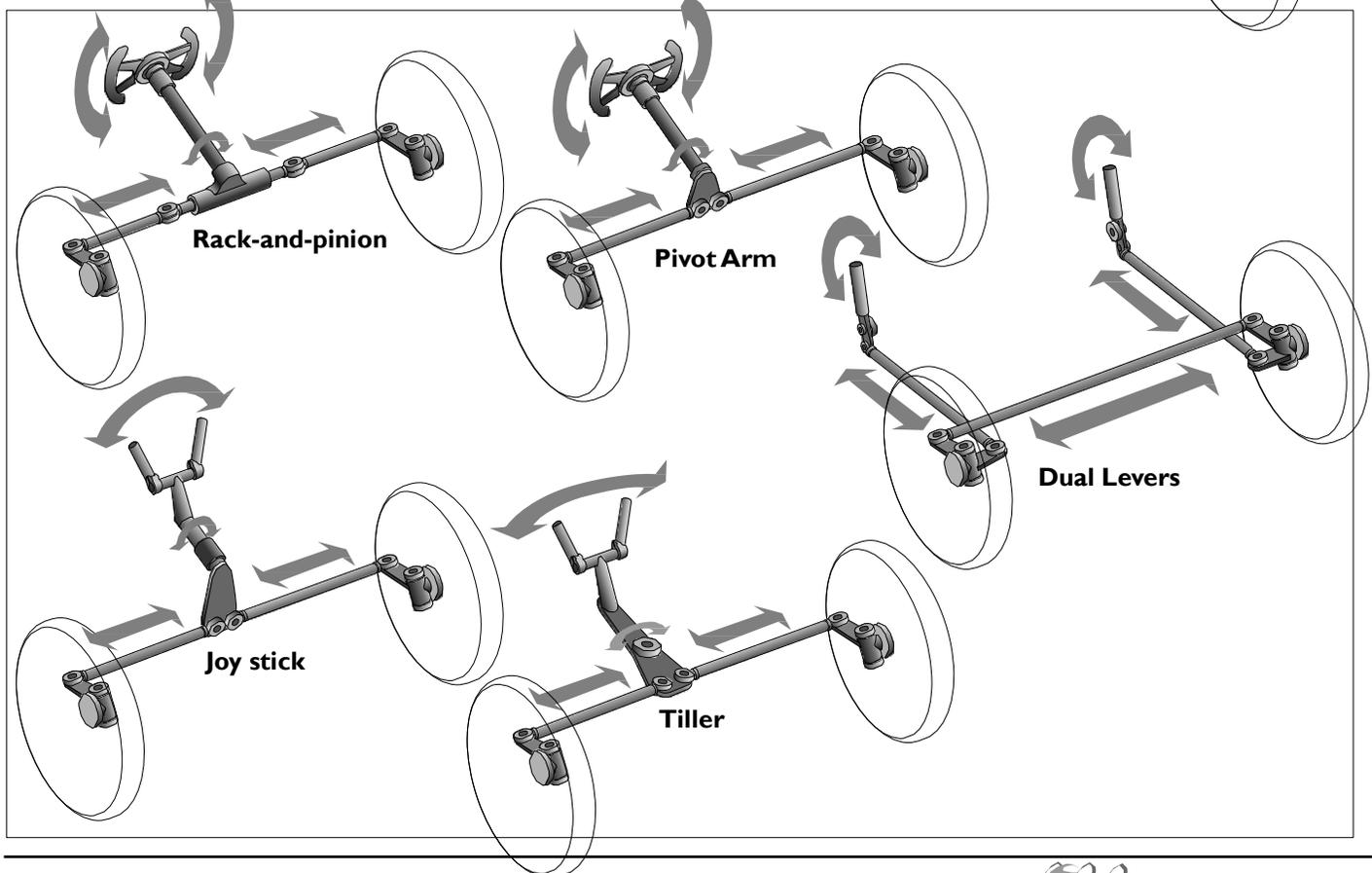
There is no 'best', system, only what works best for the comfort and control of the driver. Determining the length and position of all the elements is probably best determined by trial and error, so build in as many extra mounting holes as you can. Good steering geometry is very important for control at any speed. On tight, short courses you generally want a quick and light response, but on longer, fast courses you want a heavier, more stable feel.

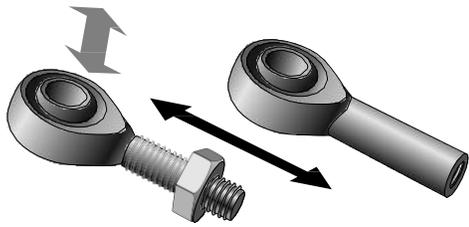
Don't even think about rear wheel steering. It works for fork lifts, but there are good good reasons you don't see it on anything faster than that. It's been tried, and usually ends in disaster.

TRICYCLE



CYCLECAR

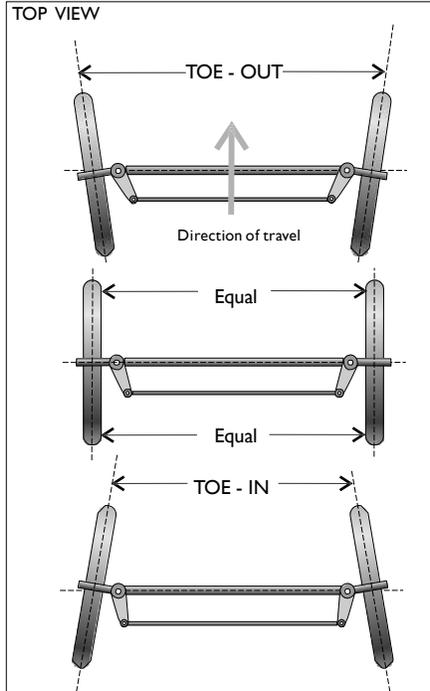




SPHERICAL ROD END BEARINGS

Also called Heim Joints, these are a very common and convenient way to link together all sorts of steering and suspension parts because they swivel and the threads allow you to adjust the length of your part. They come in various sizes, male and female, left or right hand threads. Using a left and right hand thread at either end of a rod means you can turn it to adjust the length without removing it.

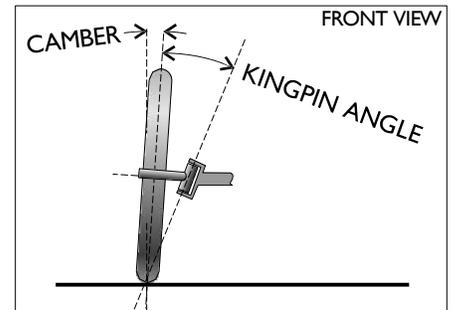
They are meant to be used as links, so they are very strong in the horizontal, push/pull direction. They are not really built to take a lot of force in the vertical direction, but are often used as 'ball joints' anchoring a kingpin, which means they are supporting the weight of a bouncing car. If you use them this way, buy the biggest size and hardest grade you can afford, and check them often...they will get mashed with heavy use!



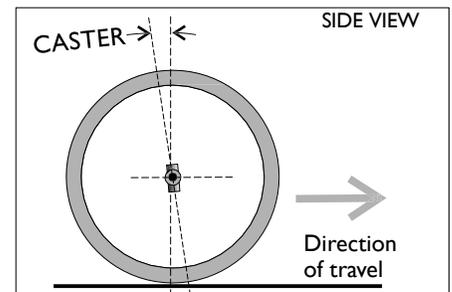
Although some race cars may handle better with a little toe-in or out, keeping it as neutral as possible will minimize rolling resistance.

When measuring the toe-in,, always measure the front and back of the tire at the same distance above the ground because the wheels may be cambered.

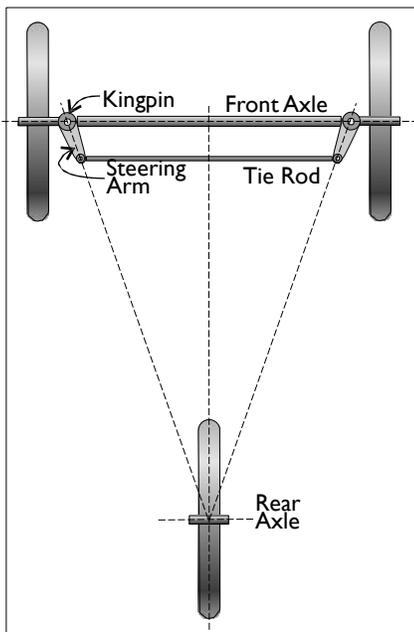
STEERING GEOMETRY



The centerline of the kingpin should intersect the point where the tire contacts the road to minimize tire scrub and insure proper steering action.

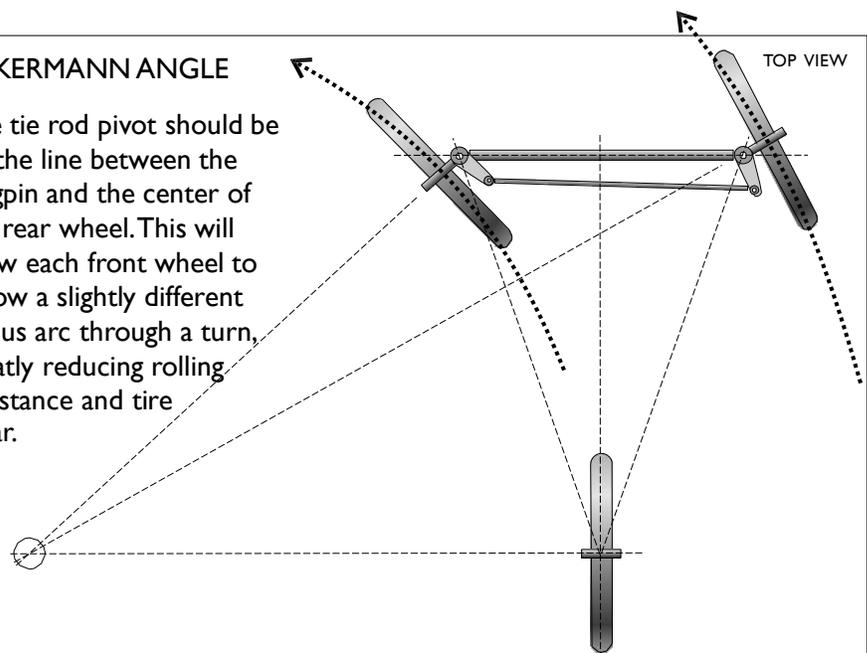


Increasing the caster, or rake angle, will increase straight line stability. Reducing it will improve maneuverability.



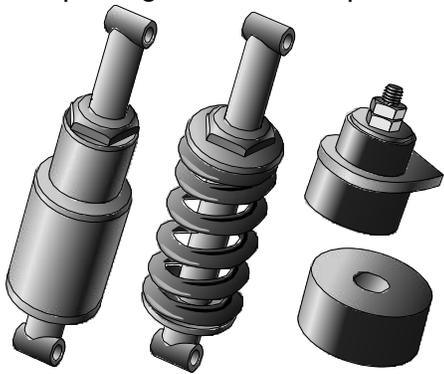
ACKERMANN ANGLE

The tie rod pivot should be on the line between the kingpin and the center of the rear wheel. This will allow each front wheel to follow a slightly different radius arc through a turn, greatly reducing rolling resistance and tire wear.

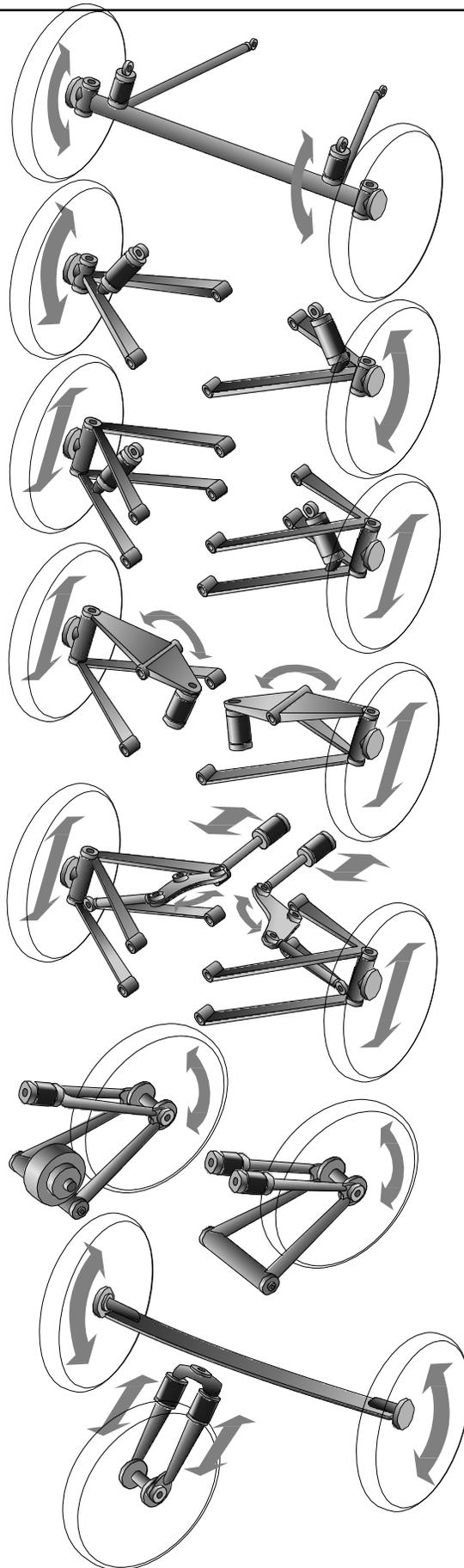


SUSPENSION

If you enjoy devising the linkages of a steering system, you will love getting into suspension. You don't need suspension in Electrathon, but it makes the ride better. Suspension is an advanced project. One of the unique characteristics of three wheeled vehicles is that the wheels will always be on the ground, no matter how uneven the ground may be. A three wheeled vehicle undergoes no twisting or torque in its chassis due to uneven terrain. A four-wheeled vehicle, on the other hand, needs a suspension in order to keep all its wheels on the ground and reduce stress on the chassis. Remember though, simplicity = reliability! You don't need much suspension travel, on a smooth track, the thickness of your tires may be all you need. Even a simple system can reduce vibration and jarring. Just suspending the seat will help.



Springs carry the weight, shocks, or dampers, control the natural tendency of a spring-and-mass system to bounce. Often they are built together. Mountain bikes and ATV's are a good source because they are about the same weight as an Electrathon. You could just drill a bolt hole through a chunk of solid rubber...it doesn't even have to be round! Adding another chunk on the other side of your mount will increase its effectiveness by allowing for rebound.



Solid Axle

Probably the simplest, but another link may need to be added if side loads are severe.

Swing Arm

Pretty simple, and works well with a rubber block. Having a lot of travel will create a lot of camber, so keep it short.

Upper and Lower A-Arm

The conventional set-up in real race cars, it keeps the tire perpendicular to the ground... very important for wide tires, but not an issue for thin, round profile tires. It involves a pretty complex geometry and a lot of time to build it right.

Rocker Arm

This set-up enables the spring and shock to be placed inside the car and out of the airflow, and works well with compact rubber blocks.

Rocker Arm/Pushrod

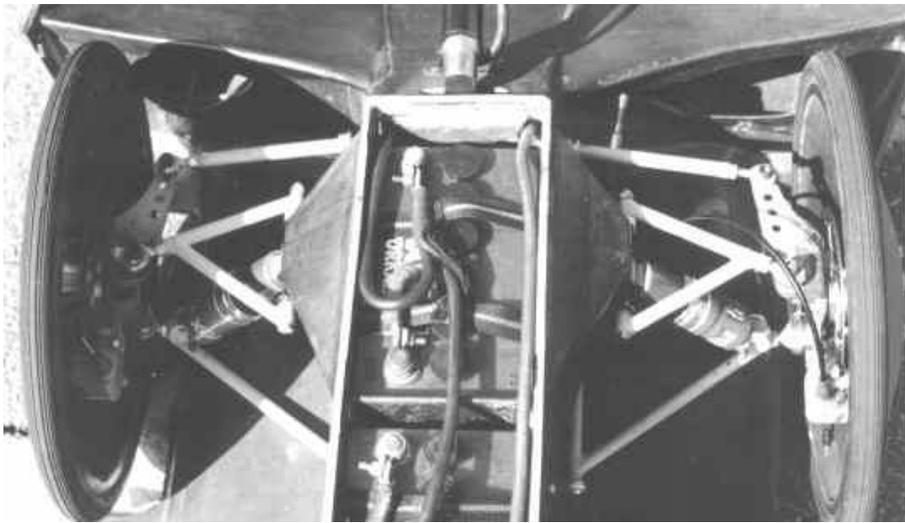
This is the modern Formula 1 arrangement, and allows room for a full coil/shock.

Rear Suspension

With many variations, this is the most common set-up for cyclecars. Using two dampers looks cool, but it allows the wheel to flex more under heavy side loads. Positioning the motor just forward of the hinge point will balance it with the weight of the wheel.

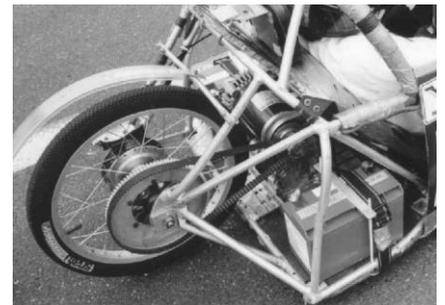
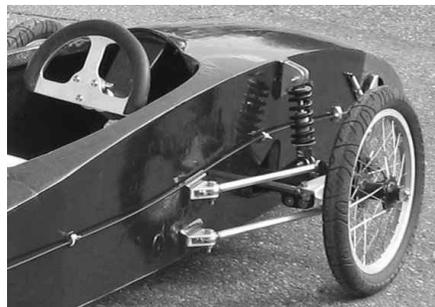
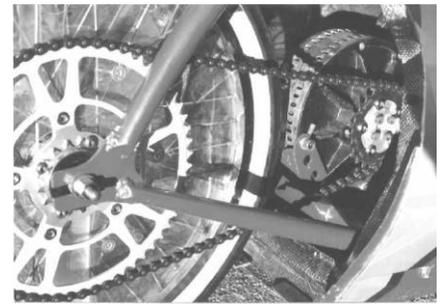
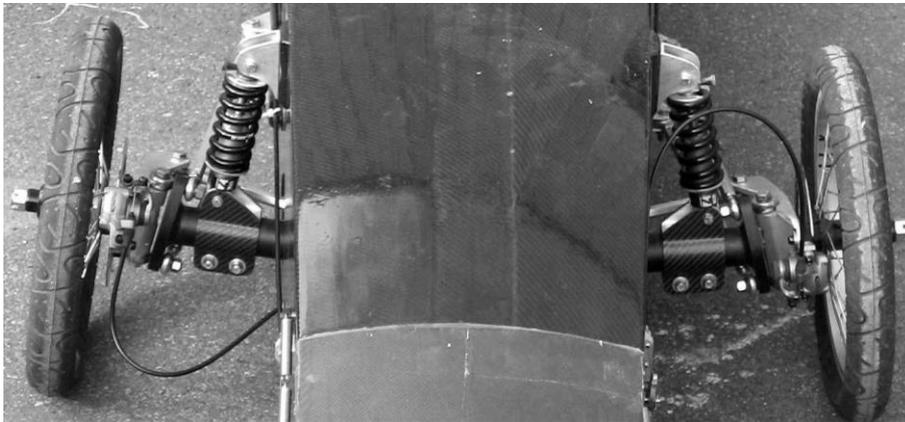
Tricycles

The front is the same as a bike or motorcycle, so either of those systems could be adapted. A solid axle with links would work on the back, or you could try a downhill ski.



DRIVE TRAIN

Most vehicles use a direct drive chain (usually bicycle) or belt drive adapted to fit a bicycle threaded rear wheel hub. Unless you are using regenerative braking, you will want the drive to freewheel when you let off the power. Alignment and tension are critical. Too loose and it will pop off if the drive wheel flexes in turns and bumps; too tight and the friction will cost up to 5% power loss. Gear ratios are critical in tuning your performance and range, well worth the time spent experimenting. Each motor, battery voltage, wheel diameter and course type affects the gearing. A selection of sprockets or pulleys is a necessity. Some vehicles use multiple gear systems, although the added friction may cancel out that advantage.



WHEELS

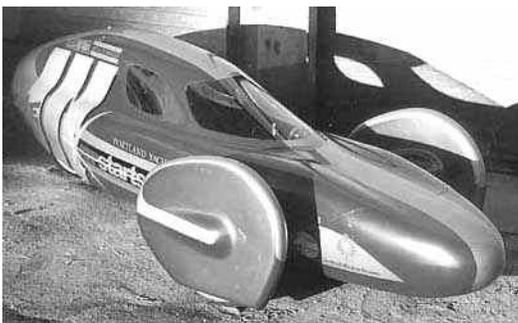
Most competitors use spoked bicycle, BMX or Moped wheels. Keep in mind that these two wheeled vehicles lean into corners, so the force is always straight down the wheel. If those wheels are side loaded, they need to be much stronger.

There is no minimum or maximum allowable tire diameter. If tires are too small, they do not work well on the road surfaces for Electrathon races. Tires of 10", 12", 16", 17", 20", 24", 26" and 27" have all been used with various levels of success. The larger diameter wheels have less rolling resistance, while the smaller diameter wheels have less wind resistance, and are typically stronger under cornering loads.

Spoked wheels should use heavy-duty spokes and lots of them. A good bicycle wheel mechanic can set you up with a very strong and light wheel. Remember to check them often for trueness and loose spokes. Wheel collapse is not uncommon, and a wobbly wheel won't go very fast. BMX type plastic wheels are maintenance free and quite strong (except at low temperatures), but heavier than spoked bicycle wheels and limited to lower tire pressure. Moped wheels are rugged and will take high tire pressure but weigh the most. While tire width and tread pattern are important, tire pressure is the biggest factor in rolling resistance. Obviously, the higher the better, but there are safety limits to consider. Choose the tires according to the track as well. Skinny tires work fine on smooth speedways but may not last the hour on a rough parking lot.

Wheel covers will reduce aerodynamic drag a great deal, as spokes tend to churn the air like egg-beaters. There are commercially available models, but they are not difficult to make in fabric or plastic. It is even possible to heat shrink mylar directly to the rim.

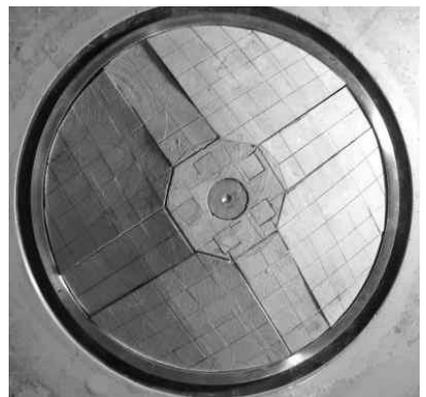
If you are industrious and have some experience with composites, you can mold your own dish wheels on aluminum bicycle rims. End grain balsa and structural foam have been used as core material. Carbon fiber alone is too brittle and should be reinforced with kevlar. It is also a good idea to cut out a simple flower or spoke pattern so some of the fabric layers can pass from one side to the other, forming an internal web. Remember to use some sort of uncompressable filler material where the bolts go through.



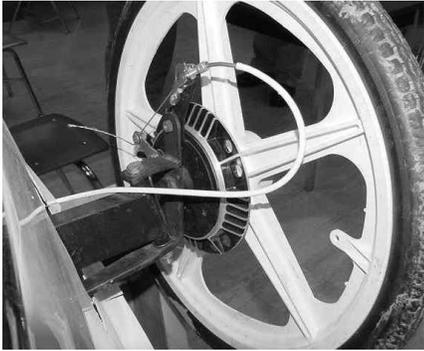
WHEEL PODS

They are called spats on airplanes and help to reduce the drag of an exposed wheel. Ever see the rooster tails flung from a wheel in the rain? The same thing is happening all the time in the air, we just can't see it. This turbulence greatly disrupts the airflow.

Remember, the top of the wheel is actually moving through the air twice as fast as the axle.



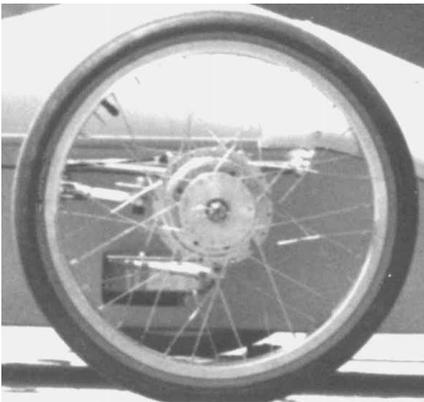
BRAKES



If you can't stop, you can't go. Nowhere are brakes more important than in competition, although most competitors use their brakes as little as possible. From a safety and liability standpoint brakes are vital. In competition, your ability to brake well will help you make that critical pass to win, or avoid a certain collision. In designing your chassis you must resolve how you are going to mount the brakes to your vehicle and what kind of brake assembly will work. Luckily you have a variety of options:

BICYCLE CALIPER RIM BRAKES

The typical bike brake can be mounted out on arms from your axle to grip the wheel rim. Offset arm style calipers can often be modified to reverse the cable so it pulls back along the wheel to the axle and then into the vehicle. Although this is the least expensive way to go, it is also the least effective, requiring ongoing adjustment and pad replacement to keep them working properly.



BICYCLE DRUM BRAKES

These are harder to find, but most bike shops can get them for you. They are used on tandem bikes since the pads don't wear out as fast. They must be custom mounted to your bike rims. Their large hubs and internal (automotive type) brake shoes make them a popular solution for Electrathon use. They do require adjustment though, and you must keep your spokes tight. Another variation is to use moped hub drum brakes. If you can, try a used set from an old moped. They are made from an aluminum alloy and can be adapted to fit bicycle wheels, or the entire moped wheel can be used.



DISC BRAKES

There are many disc brakes available now for mountain bikes and tandems, both cable and hydraulically operated. They are very light and strong but can be expensive. Go-kart discs are another option, however they are quite large, heavy and difficult to adapt. Small motorcycle disc brakes are also a possibility although large and heavy.

Whatever you use, make sure you can actuate them both evenly. If one side or the other locks up you will spin out or swerve.

AXLES



One important note: **DO NOT USE BICYCLE OR MOPED AXLES UNLESS SUPPORTED AT BOTH ENDS.** If your axles are cantilevered (attached on one side only like a wheelchair) you **MUST** replace the stock axle with a 1/2" or 12mm diameter bolt. Axle diameters less than 12mm are illegal. A bicycle or moped axle **WILL** break. It is easy to pull out the stock axle and replace it with a larger one. You must replace the wheel bearings with cartridge bearing assemblies. These can be found at bearing supply stores. Use an axle bolt and nut that accepts a cotter pin so your wheel doesn't come off. This is a rule requirement.

MOTORS

Most Electrathon vehicles use 12 or 24 volt motors although any voltage (36 volts and up) is allowable provided the total battery weight does not exceed 73 pounds of non-leaking batteries. Most motors are over 2 horsepower permanent magnet types. Series wound motors are lighter, but are not as efficient. Unloaded they can spin up and destroy themselves. Never let them rev free. Choose a continuous duty rated motor if you can, although small or intermittent duty motors can work but may require a cooling fan to prevent overheating. Not only does the fan use power, heat itself is energy - if your motor is hot, you are wasting it. Small motors running near their maximum current tend to get hot. Your batteries will give you about one horsepower averaged over the hour, but you can easily find yourself drawing 3 or more horsepower coming out of a tight turn. Pump, starter, forklift, surplus military aircraft motors and even generators can be found at low prices occasionally. Evaluate your motor carefully, talk to the manufacturer and other vehicle owners. Remember, your power comes from the battery, not the motor. Motors are only another place to lose energy on the way to the wheels.

MOTOR CONTROLLER

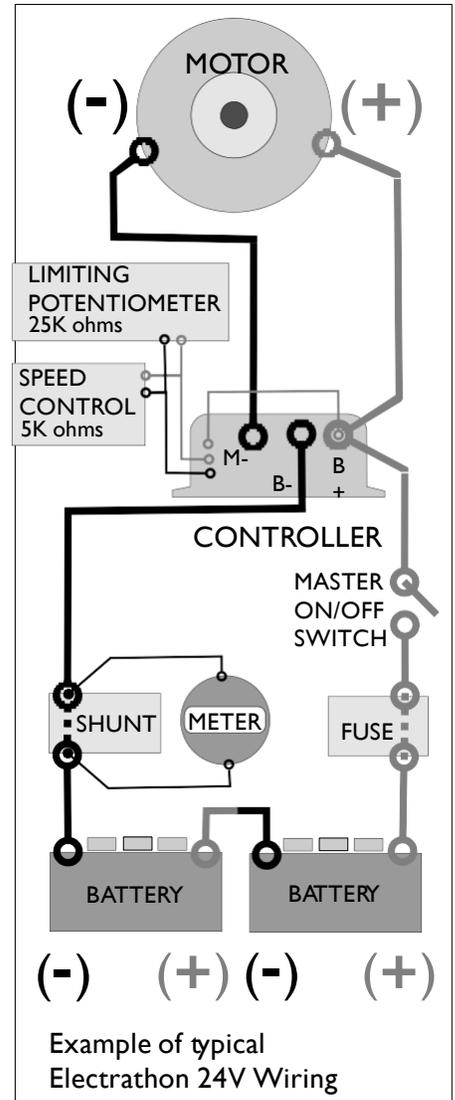
A P.W.M. (Pulse Width Modulated) type electronic speed controller is the best way to go. Although they are expensive, on tight tracks or where you must modulate power in traffic, they are beneficial and very efficient because they very rapidly cut power off and on to the motor. The controller is 'controlled' by a speed control, or potentiometer at the foot pedal, which operates at very low voltage to tell the controller how much power to send to the motor. This is often combined with another limiting potentiometer which sets a top limit on that power. This way you can drive with your foot to the floor and adjust the limit to the desired amperage, rather than trying to hold your foot at a precise point part way down for an hour.

Resistance type Rheostats absorb power from the motor creating heat. They are cheap but not as efficient. The simplest way is an on/off button, and can be fine on a fast track. You must be able to control power manually so that the power shuts off automatically when you release the throttle.

INSTRUMENTS

The goal of Electrathon is to see how far you can go in an hour. To do that effectively, you will need to know what your vehicle is doing, so instrumentation is essential.

Amperage and voltage are the most important things to know. Simple analog gauges will work, but it's hard to see the needle and small numbers when you are bouncing around in a race. Digital units (E-Meters) are more expensive, but they are much more precise, easier to read, and will record the data over time, so at the end of a race you can tell the total number of amp or watt hours you've used. Either way, your meter needs to be connected to a shunt, which is a chunk of metal of known resistance that current flows through.



It is also helpful to know how fast you are going. Bicycle speedometers are inexpensive and offer a reasonably accurate measure of speed and distance, but remember, Electrathon distances are measured at the minimum possible for the course, not how fast or far **you** might have gone. Bike speedometers usually have another very helpful feature...a clock! If you do your calculations right, you can also use it as a motor tachometer, unless of course you are spinning your wheel (a definite no-no).

Electrathon America has tested these batteries to establish a reference point. Your actual results may vary

Optima SC25A AGM (SC35A
are the same with "reversed posts")
41.8 Amp/hours, 480 Watt/hours

Optima 75/35 AGM (Double Post)
38.9 Amp/hours, 447 Watt/hours

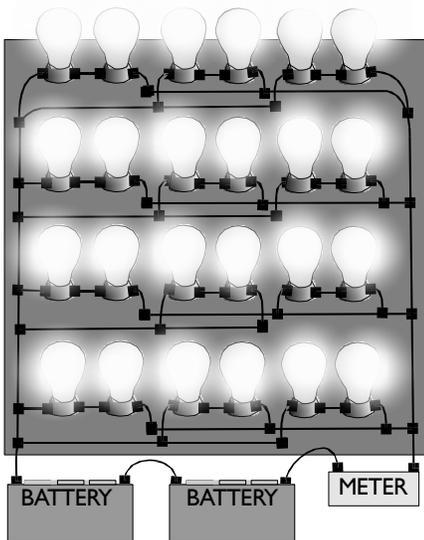
Exide Orbital 75/35 AGM
(Double Posts & built in Handles)
37.4 Amp/hours, 445 Watt/hours

Champion Vortex 75/35 AGM
(Double Posts & built in Handles)
35.8 Amp/hours, 415 Watt/hours

MK 40 amp/hr Gel Cell
21.5 Amp/hours, 233 Watt/hours

CHARGING

Battery chargers come in many sizes over a broad price range. 10 amp chargers are fine, they just take 6-8 hours to charge, where a 50amp charger can do it in 2-3 hours. 20 amps is a good compromise, and if it has a 24volt option, you can charge pairs together. Its better to charge them individually, though, as a weaker one will get weaker as you cycle them, and a strong one will get stronger.



Typical 24V system test board

BATTERIES

Electrathon allows only non-leaking lead-acid batteries, with no more than 73 lbs. total weight. Batteries generally offer higher performance when they are warmer, so if you are racing on a cold day, it might make sense to heat them, at least to a level they were designed for, say a hot day in Arizona. Remember, batteries heat naturally when they are being charged or discharged, so keeping them in an insulated box retains more of their energy. Heating can be done with warming blankets, hair dryers, or immersion heaters. Hot tap water is often enough, as there may be diminishing return and permanent damage after 120 degrees (oven thermometers are a handy tool).

Batteries may be labeled as starter or deep cycle, although the distinction has become blurred in recent years and the cost is about the same.

Generally, starter batteries have more and thinner plates inside, so they will charge or discharge more quickly, but their useful life is shorter. The heating and deep discharging of racing is hard on any battery, but if you are kind to them (don't go below 21 volts and don't leave them drained for more than a day or two, even starter batteries should last a couple racing seasons.

Most lead acid batteries are 12 volt, and most Electrathon vehicles use two of them in series for 24 volts. It's the common compromise. Motors run more efficiently at higher voltages, but fewer batteries usually means more of the battery weight is "capacity holding material", not plastic cases and terminals. But Electrathon is all about creativity and experimentation, so anything is worth a try. Besides...technology evolves. While the basic idea hasn't changed much in a hundred years, manufacturers are trying harder than ever to improve them.

TESTING

The most important thing to know about your batteries is how much power they have. There is no way to know how fast you can go in an hour until you know how much power you have available. This is the Art (or Science) of Electrathon. To make an intelligent guess you need to draw them down over the course of an hour at a rate you think you can sustain. You can, of course, do that in the car on a track. Since this is not always convenient, or even possible, you can recreate those conditions in the shop. The simplest and most accurate method is to connect a test load directly to your car (and its meter). You will need something that uses power: 12 volt light bulbs (25 or 50 watt) work great, but you should wire them in pairs and test pairs of batteries together if you have a 24 volt system. Screw or unscrew bulbs until you draw the amperage you want. 36 amps is a good number. More than that and you've got a sure winner! To be more precise, you can keep screwing and unscrewing bulbs to maintain a constant draw (or just figure an average draw). Notice that the amps will drop as the voltage drops. This process also gives you a chance to plot the voltage curve. Record the voltage at even increments, say every 10 minutes. Having this data in the car can help you keep track of how much power you are using. A good set of fully charged batteries will show over 26 volts with no load. Under load that will drop to about 24 volts, and continue a slow drop to 21 volts. At that point they will drop rapidly, and continuing to drain them will cause lasting damage. While it shows admirable determination to keep a car going at walking speed, it can be expensive if it ruins the batteries.

RESOURCES

This is just a quick survey, and is not intended to be a promotion or endorsement of products or services. For more listings, go to www.electrathonamerica.org. Please contact us about suggestions for future editions.

LOCAL

These are the people you need to establish a relationship with. They have the expertise and the parts you need. They may even sponsor you by donating time and materials.

Bike Shop- wheels, tires, chain, sprockets, brakes, cables, bar ends, grips, speedometers, shocks, old frames, and forks

Hardware Store- nuts, bolts, and other fasteners, tools, metals, plastics, paint, tape, and especially duct tape

Battery Distributor- He sells batteries to all the local stores. Since what you are doing is promoting the wider use of batteries, it is in his interest to at least give you a good discount. Buy batteries locally; this is one item you *do not* want to pay shipping costs on.

Marine Supply Store- composite materials, batteries, switches, fuses and miscellaneous hardware

Motorcycle/Moped/Go Kart Store- Wheels, tires, brakes, helmets, seat belts

Machine Shop- there are critical parts, like motor and sprocket adapters that you can't buy... they have to be made

Body Shop, Welding/Fabrication Shop- If you don't have the expertise or space to work, they do.

Schools- Even if yours is not a school project, tech high school and colleges often have fabulous shop space, like machine, welding and body shops. If you can involve and inspire students, you may be welcome there.

BOOKS

Bicycling Science - Frank Rowland Whitt and David Gordon Wilson (MIT Press)

The Leading Edge - Aerodynamic Design of Ultra-Streamlined Land Vehicles Goro Tamai (Robert Bentley, Inc.)

Race Car Vehicle Dynamics - William F. Milliken and Douglas L. Milliken (SAE International)

Successful Composite Techniques - Kieth Noakes (Osprey Automotive)

The World's Most Fuel-Efficient Vehicle - Design and Development of PACcarII- Santin, Onder, Bernard, Isler et al Swiss Federal Institute of Technology/VDF

The New Electric Vehicles - A clean and quiet revolution Michael Hackleman (Home Power Publications)

The Winning Solar Car - A Design Guide for Solar Race Car Teams by Douglas R. Carroll (SAE International)

Electric Dreams - (story of high school kids building and racing an electric car) Caroline Kettlewell (Carroll & Graf Publishers)

ELECTRATHON KITS and PARTS

Blue Sky Design Rolling Chassis Kit
www.blueskydsn.com (541)895-5421 49

Cloud Electric Vehicles Components
www.cloudelectric.com (800)648-7716

SHIFT Electric Vehicles Kits & Parts
www.SHIFTEv.com (541)760-1895, accepts PO's

Electric Vehicles of America Inc Components
www.ev-america.com (603)569-2100

BS Designs Meter
www.brucesherrydesigns.com (206)909-3409

Enigma Industries Simulator
www.enigmaindustries.com

Lynch www.lemcoltd.com Motors

ALLTrax, Inc. Controllers
www.alltraxinc.com (541)-476-3565

Curtis Instruments Controllers
(914) 666-2791 www.curtisinst.com

Composites One Composites
www.compositesone.com

FiberGlass Supply, Inc. Composites
(509) 493-3464 www.fiberglasssupply.com

Aircraft Spruce & Specialty Composites
1-877-4-SPRUCE www.aircraftspruce.com
