

AIChE Chem-E-Car Competition

2010 National Competition

Updated – April 30, 2010

2010 Chem-E-Car Competition Timeline

Timeline	Date	Item
1		For regional competitions: Plan Chem-E-Car vehicle using approved safety procedures. An Engineering Documentation Package (EDP) including the JSA form must be filled out and appropriate approvals obtained. Instructions will be provided.
2		Design, build & test car following approved safety procedures specified at each university and the national Chem-E-Car competition.
3	various dates	<p style="text-align: center;">Regional Competitions</p> <p style="text-align: center;">Regional qualifiers must submit their entry on the website and send their \$150 entry fee to AIChE National (Attn: Nina Scatton) PRIOR to June 30, 2010, to secure their slot in the National Competition</p> <p>The National Competition application submission website is open <i>exclusively</i> to QUALIFIED REGIONAL WINNERS until May 1, 2010. http://interact.sdsmt.edu/aiche/register.htm</p>
4		Revise and modify cars following approved safety procedures specified at each university and the national Chem-E-Car Competition.
5	May 1, 2010	Website opens for application submission for any open slot , and is open until June 30, 2010. No applications for open slots will be accepted prior to 1 May 2010 (12:00 AM Eastern Time) http://interact.sdsmt.edu/aiche/register.htm
6	June 30, 2010	Eligible team's Student Chapter Annual Report must be completed via web submission http://www.aiche-xtranet.org/aichereport/default.asp?CatID=2
7	June 30, 2010	Closing date for regional qualifier submissions and any applications for open slots for the National Competition. Decision on number of open positions will be made and open-slot teams notified within 30 days.
8	June 30, 2010	\$150 entry fee due from teams selected for any open slots for the National Competition.
9	October 1, 2010	Deadline to submit Engineering Documentation Package (including JSA) to Chem-E-Car SharePoint site.
10	TBD	All chemicals must be received by close of business at designated receiving location.
11	November 7, 2010	National Chem-E-Car Competition Salt Lake City, Utah

Sponsored by Chevron

The objective of this competition is:

- To provide chemical engineering students with the opportunity to participate in a team-oriented hands-on design and construction of a small chemical powered model car.
- To design and construct a car that is powered with a chemical energy source that will carry a specified load over a given distance and stop.
- To encourage students to become actively involved in their professional society.
- To increase awareness of the chemical engineering discipline among the general public, industry leaders, educators and other students.

There are two general competitions. The first is held at spring regional conferences and the second is held at the AIChE Annual Meeting. Each year the annual competition is held in conjunction with the Annual Student Conference at the site of the AIChE Annual Meeting. A host AIChE chapter, along with the national AIChE staff and the competition sub-committee from the Student Chapters Committee, and SACHE, provides support for the annual competition.

There is a poster session and a distance or performance session at each competition, as detailed below. Each year the rules may be modified to address concerns that have developed at the past regional and annual competitions. The rules listed below have been significantly modified, so be sure to read all of them carefully.

Competitions

Regional Conference Competitions

1. In general, a school can have any number of entries at the Regional Conference. However, the Host School has the right to set a limit, should the need arise.
2. The rules listed under the National Conference Competition shall apply for the regional conference competition.
3. Regional conference host school organizers should contact the National Chem-E-Car Rules Committee (see below, at end of item 10) with questions or for clarification on the competition rules.

Regional Conference awards:

Poster Competition:

- Ribbons for 1st, 2nd, and 3rd place
- Ribbon for Most Creative Drive System
- Ribbon for Most Creative Vehicle Design

Performance Competition:

- 1st place: \$200 and Ribbon
- 2nd place: \$100 and Ribbon
- 3rd place: Honorable mention and Ribbon
- Ribbons for 4th and 5th place finishers
- Ribbon for Spirit of Competition

National Conference Competition

There will be a maximum of 31 car entries at the 2010 National Conference. The list of national entries is drawn from regional winners, based on the size of each region. Each Student Chapter Region may send their first and second place winners at the minimum. Mid-America, Northeast, Rocky Mountain and the Western regions may send their 1st, 2nd and 3rd place winners. The Mid-Atlantic, North Central, and the Southern Regions may send their top five winners. **While multiple entries from a single school may be permitted at the regional competitions** only one entry per school, via this qualifying procedure, is allowed at the national competition. Multiple entries per school may be allowed following the open entry procedure outlined in the following paragraph.

Submit your application online: The eligible teams from the Regional Conference Competitions (as described above) *must submit* an application to compete in the national competition at the 2010 AIChE Annual Student Conference in Salt Lake City, Utah.

Applications should be made by [Web application](#) starting immediately after their regional conference concludes and ending on June 30, 2010. If an eligible chapter does not submit their application by the above deadline their competition slot will be opened up to any Chem-E-Car team from any region that wishes to compete according to the following procedure. **Interested teams who do not qualify at a regional competition** should submit their application to the website given above beginning on May 1, 2010, but at least by June 30, 2010. Teams who have failed the safety inspection at regionals will be required to provide documentation (signed by their faculty advisor) to the Chem-E-Car Safety Committee that they have corrected the safety violations. On July 1, 2010, any open entry slots will be allocated on a "first come" basis; however, preference will be given so that there will be only one team entry per student chapter. For this year's national competition a \$150 entrance fee will be charged for each competing team. This entry fee was added to cover the cost of the disposal of chemicals at the competition site. This entry fee must be paid to AIChE as given below:

Web application to Compete in Nationals (submit by June 30, 2010)

Applications should be made by **Web application** to compete in nationals-- <http://interact.sdsmt.edu/aiche/register.htm> -- and should include:

- Student Chapter Name
- Point of contact for the team (name, phone number, email address)
- List of team members
- Title of entry

- General description of chemical reaction(s) / drive system (at least 1 or 2 paragraphs so the judges can understand any potential safety issues involved.)
- Regional Conference (and place) where the team competed
- Place earned in the regional performance competition, or indicate applying for open-slot
- National Competition Fee of \$150. (See web for details)

Web Application: Engineering Documentation Package (Deadline: October 1, 2010)

- Please see Chem-E-Car Safety Checklist for all documents required for this package:
<http://www.aiche.org/Students/Conferences/carsafety.aspx>
- Includes completed 2010 Job Safety Analysis form (JSA)

Questions about the application process should be sent to:

Professor David Dixon
 Dept. Chemical and Biological Engineering
 South Dakota School of Mines and Technology
 501 E. St. Joseph Street
 Rapid City, SD 57701
 Work Phone: (605) 394-1235, FAX (605) 394-1232
 Email: david.dixon@sdsmt.edu

There are two sessions of the National Chem-E-Car Competition: a poster competition and a car performance competition.

Poster Competition

a. A poster board must be displayed with the autonomous vehicle on the day of the competition. This poster should describe how the car is powered using the chemical reaction, the unique features of the car, and environmental and safety features in the design. Appropriate documentation on the design and testing of your vehicle must be available for inspection by the judges at the poster competition. This documentation must include:

- vehicle design description, drawings and testing results
- Complete Engineering Design Documentation package described in the Safety rules.
- Material Safety Data Sheets (MSDS) for each chemical used by the entry
- calculation of relief valve size and evidence of hydraulic pressure testing if required, see below
- procedures for transportation of vehicle and related accessories
- letter from student chapter advisor or department chair stating that to the best of his/her knowledge that the students abided by the rules.

- Entries will also be judged on creativity in the propulsion system and the appearance of the vehicle.
- b.** The poster competition and judging will occur prior to the Chem-E-Car Performance Competition. Team members should be present during judging to answer questions from the judges.
- c.** A team must achieve a minimum score of 70% in the poster competition to be able to advance to the Chem-E-Car Performance Competition. Posters will be judged according to the following criteria:
- Description of the chemical reaction / power source (20%)
 - Design creativity and unique features of the vehicle (20%)
 - Environmental and safety features (40%)
 - Quality of the poster and team member presentations (20%)
- d.** Winners of the poster competition will be announced at the end of the performance competition:
- 1st, 2nd and 3rd place plaques will be awarded.
 - A plaque will be awarded for Most Creative Drive System
 - A Golden Tire plaque will be awarded for the Most Creative Vehicle Design
 - Society of Biological Engineers Award for Best Use of a Biological Reaction to Power a Car
 - SChE Safety Award for the best application of the principles of chemical process safety to the Chem-E-Car competition.

Chem-E-Car Performance Competition:

1. Load and Distance:

Each car will be given two opportunities to traverse a specified distance carrying a certain additional load. The required load and distance will be given to each team one hour prior to the start of the performance competition. The distance will be between 15 and 30 m \pm 0.0127 m (50 - 100 ft \pm 0.5 in.) and the load will be between 0 and 500 ml of water. A judge from the student host chapter will measure out the prescribed water for each team. Teams may not add or remove any "load" (or other inert items) to adjust their vehicle weight once the poster session has concluded. Teams are allowed to adjust "fuel" or reactants used in the car's chemical reaction.

2. Course Layout and Distance Measurement:

The car will start with its front end just touching the designated starting line. There will be a designated finish line. The distance will be measured with respect to the front most point of the car. The goal of the competition is to have your car stop closest to the specified finish line (in bounds) while carrying the specified load. The course should be wedge-shaped with a starting

line and the prescribed distance clearly marked in an arc of constant distance from the starting point. The physical site will dictate the exact course layout. See Figure 1 for an example of the course layout. A vehicle that goes outside the course will have its distance measured to where it went out of bounds, and a penalty of 3.048 m (10 feet) will be added to the measured distance. “Outside the course” is defined as having the entire vehicle outside the side tape boundaries of the course. The tape is considered as part of the course. When measuring the distance from the finish line it does not matter if the car goes longer or shorter than the prescribed distance.

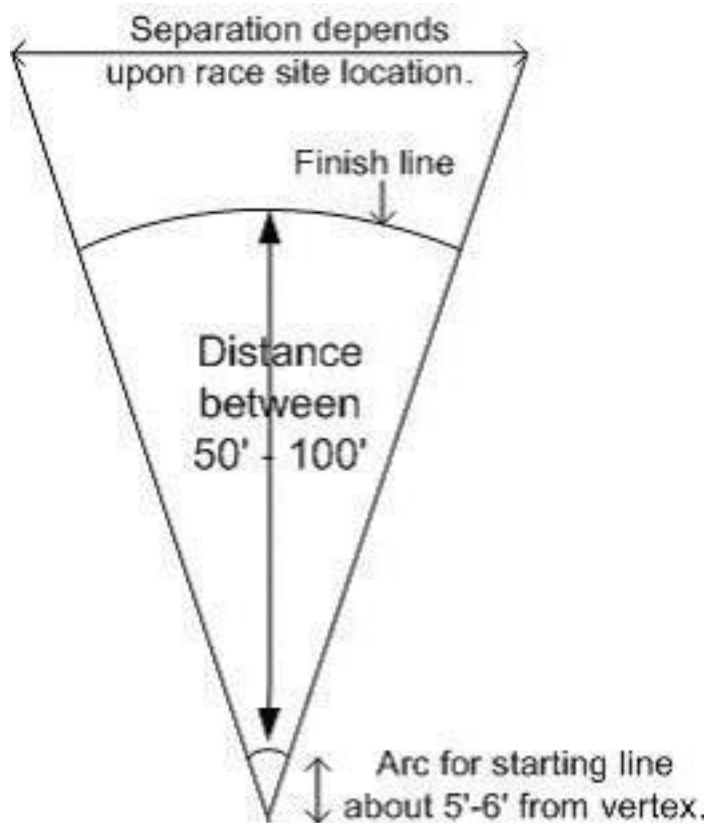


Figure 1. Sketch of typical performance course layout

3. Race Logistics:

A Chem-E-Car Competition judge (or MC) will announce each team just prior to the start of their run. Each team will be asked to introduce its entry to the audience, giving the school name and briefly mentioning the propulsion system. Each car will have two (2) attempts to complete the course, each attempt lasting no more than two (2) minutes. The best score of these two attempts will be used in the judging. In the event a team fails to show up on the starting line, or the vehicle fails to start, the next team in the order of the competition will be announced and requested to proceed to the starting line. The order of the teams in the first round of competition will be determined by random drawing. There will be a short break at the completion of the first round before the second round begins. The competition order in the second round will be

determined by the 1st round standings, beginning with the team that is farthest from the prescribed distance and ending with the team that was closest.

4. Starting Procedure:

Each car is guaranteed a maximum competition time of two (2) minutes. The car must start moving, traverse the distance, and come to a stop within this time interval. If the car goes out of bounds, the next team must be ready to start its run as soon as the MC invites the team to the starting line. Since the run time of cars that go out of bounds or do not start may be less than two minutes, the next car in the order of the competition must always be ready to run at a moment's notice. If a car does not stop within the 2-minute period, then it is disqualified from that round of the competition.

5. Competition Order Logistics:

The purpose of the time restrictions is to allow 31 cars to compete at the national competition within the period allotted for the event.

5.1. Team start order is determined during the poster competition.

5.2. The order for the first round may change because of disqualifications. If a car is disqualified that was scheduled to start before your car, then you will move-up one position in the start order earlier than was originally scheduled.

5.3. The load and distance are announced one hour before the competition starts.

5.4. Five (5) minutes before the start of the competition, the first three (3) teams are called to the start. The first team will be at the start line, the second team at ready, and the third team at the water load check station.

5.5. The first team is given a one-minute warning before the competition starts.

5.6. The competition starts when the MC signals the timing to begin. The first team is given 2 minutes for the car to start moving, traverse the distance and stop. When the car stops, the timer is reset for the next competitor. The timing will also stop if the car travels out of bounds. If the car does not stop within the 2-minute period, then it is disqualified from that round of the competition.

5.7. After the car for team 1 stops, the distance traveled is measured. During the distance measurement, team 4 is called and each team moves up one position. Team 1 should take their car directly to the chemical disposal station to dispose of their spent chemicals. This disposal process is repeated for each car upon completion of its run.

5.8. After the measurement is completed, team 2 is told to start their car, and has 2 minutes to complete the run. When the car stops, the timer is reset for the next competitor. The timing will also stop if the car travels out of bounds. If the car

does not stop within the 2-minute period, then it is disqualified from that round of the competition.

5.9. During the distance measurement of team 2, team 5 is called and each team moves up one position. The process is continued until all qualified cars have competed once in the competition.

Note that if every car took two minutes to complete the course, then the competition for 31 cars would take a minimum of 124 minutes, which is more than the two hours allotted for the competition. To enable the competition to proceed in a timely fashion, it is recommended that the next team to compete should be ready and at the staging area at least five (5) minutes before their anticipated run time. Upon the completion of the run of the previous team, the next car should be ready to start.

6. Vehicle Drive System:

An objective of this contest is a demonstration of the ability to control a chemical reaction. The only energy source for the propulsion of the car is a chemical reaction.

6.1. Vehicles entered into the competition must have a significant and demonstrable student design component, particularly with respect to the vehicle drive system, and the starting and stopping mechanisms. Both the chemical reaction driving the vehicle and the start/stop mechanism (if there is one) must be physically on the vehicle during the competition (i.e., pre-loading of a drive system such as a capacitor assembly is not allowed). The vehicle must be powered and stopped by controlling a chemical reaction.

Any vehicle that is purchased from a vendor without major modifications to its operation will be disqualified. For example a team could not purchase a fuel cell car and race this car without any modifications. (e.g. Thames and Kosmos - Fuel Cell Kit -- <http://www.thamesandkosmos.com/products/fc/fc2.html>).

6.2. Commercial batteries: No commercial batteries (for example, AA batteries) are allowed as the power source. Commercial batteries are allowed for specialized instrumentation (e.g. detectors, sensors)

6.3. Autonomous vehicle: The car must be an autonomous vehicle and cannot be controlled remotely. Pushing to start the vehicle or using a mechanical starting device is not allowed. Check with the Rule Coordinators (see below, after item 12) if you have a specific question concerning your vehicle.

6.4. No brakes: No mechanical force can be applied to the wheel or ground to slow or stop the car (e.g. no brakes).

6.5. Mechanical or electronic timing devices: There can be no mechanical or electronic timing device(s) to stop the chemical reaction or stop the car. In

addition, a timing device cannot utilize what is normally considered as an instantaneous reaction. For example, a constant, or draining, liquid feed to a sensing cell that employs an instantaneous reaction (acid-base or precipitation) would not be allowed. Another example would be a liquid draining out of a vessel to serve as a stop switch would be considered a mechanical timing device, and would not be allowed.

6.6. Internal combustion engines that use an alternative fuel (e.g., biodiesel, ethanol, etc.) are allowed. The fuel **MUST** be completely synthesized by the students (no additive blending is allowed). Succinct safety procedures for the maintenance and operation of this engine must be demonstrated by the team with considerations to indoor operation. If your fuel deviates in anyway from those typically used, then you should submit a description to the committee where its acceptability will be evaluated. Teams need to submit their fuel description to the Chem-E-Car Rules Committee (contact information is listed below).

*(2010 National Competition shipping instructions --
To become available in Fall 2010)*

7. Size of Car:

All components of the car must fit into a shoebox of dimensions no larger than 40 cm x 30 cm x 18 cm. The car may be disassembled to meet this requirement. If the judges are uncertain whether the car will fit inside the box when dissembled, they may request that the team demonstrate that they can do this.

8. Water Load Container:

The car must carry a container that holds up to 500 mL of water without spilling. An example container is a Nalgene Low-Density Polyethylene Narrow-Mouth Bottles (500 mL) Nalge No. 38-430 20039016 or Fisher Cat. No 02-923-11G. At the competition, only the water will be supplied, thus each car must already have its own container.

9. Capital Cost of Vehicle:

The cost of the contents of the "shoe box" and the chemicals must not exceed \$2000. The vehicle cost of the car includes the donated cost of any equipment. The time donated by university machine shops and other personnel will not be included in the total price of the car. It is expected that every university has equal access to these resources. The cost of pressure testing is also not included in the capital cost of the car. The method used to estimate the donated cost of the equipment must be shown. It is expected that standard financial procedures will be used to estimate this cost. **The same car cannot be reused from year to year.** Substantial changes should be made and indicated in the poster presentation.

10. Team Member Status and Conduct:

10.1. All team members attending the National Competition must be National AIChE members.

10.2. The competition will be conducted on the honor system. Faculty and graduate students can only act as sounding boards to the student queries. The faculty cannot be idea generators for the project. There is no restriction on requesting assistance on vehicle safety – teams may request safety assistance from their faculty advisor, other faculty members, other universities, and professional practitioners in industry and elsewhere.

10.3. The students working on the project must sign a statement saying they have read, understand, and abided by the rules. This statement must be included (or be available) at the poster competition.

10.4. The minimum team size is five (5) participants. All team members do not have to be present at the National Chem-E-Car Competition; however, all are encouraged to attend, if possible.

10.5. All team members and the faculty advisor **MUST** have completed the required safety training as outlined in the Chem-E-Car Safety Rules.

10.6. All student chapters that are competing in the national competition must have submitted a Student Chapters Annual Report online to AIChE following the standard timelines given by AIChE.

If there is any uncertainty on an issue of safety or other judging criteria, please contact:

Rules Coordinators: (Contact these folks first if you have questions on the rules.)

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11. Declaration of the Winning Team:

The winning team is the car that stops closest to the finish line. This is defined as the absolute value of the distance between the front most part of the car and the finish line. In case of ties, the team with the best average from the two runs will be declared the winner. Winners of the National Chem-E-Car Performance Competition will be recognized immediately following the performance competition. Chevron sponsors the National Chem-E-Car Competition.

The National awards are:

- 1st place: \$2000 and a trophy
- 2nd place: \$1000 and a trophy

- 3rd place: \$500 and a trophy

In addition to the top three performance awards, other awards will be given as described below:

- **Best Use of a Biological Reaction to Power a Car - \$1,000 Prize:** Sponsored by the Society for Biological Engineering
- **SACHE Safety Award** for the best application of the principles of chemical process safety to the Chem-E-Car competition.
- **Most Consistent Performance** - This award is based on the best average score for the two runs that the vehicle makes. It has been created to recognize the team that has designed and most understands the performance of the reaction that powers the vehicle. Award consists of a plaque.
- **Spirit of the Competition** - This award is given to the team displaying the most team spirit as decided by a panel of judges. Award consists of a plaque.
- **Most Creative Drive System** - Recognition is awarded to the team that has designed and installed the most creative propulsion system. The winner is decided by a panel of judges during the poster competition. Award consists of a plaque.
- **Golden Tire Award** - In 2002, Northeastern University team members created this award to recognize the team with the most creative vehicle design. The national committee has adopted this as an annual award. The winning entry is decided by a ballot cast by each team entered in the competition. Award consists of a plaque.

For more information on this competition, contact AIChE at (646) 495-1331, studentchapters@aiiche.org, or by fax at (646) 495-1503.