SAE DETROIT
An SAE International Section

29th ANNUAL MICRO-ELECTRIC VEHICLE COMPETITION RULES

Wednesday, May 6, 2026
2:00 - 7:00 p.m.

2:00 - 3:00 p.m. Registration
3:00 - 7:00 p.m. Competition

Design Competition papers due Wednesday, April 15

Yazaki North America, Inc.
6801 Haggerty Road
Canton, MI 48187

For information or questions regarding the rules, contact Mike Arnott at mike_l_arnott@hotmail.com.

PLEASE READ CAREFULLY

Introduction

The SAE Detroit Section Micro-Electric Vehicle Competition has been part of the section's science, technology, engineering, and math (STEM) outreach program for almost three decades. When it started, electric vehicles were only just beginning to be part of the technological advancements that now dominate the automotive engineering industry. We hope your school and students take away a sense of pride and accomplishment by participating in the event.

Teams of up to four students will design and build a small vehicle powered by a single AA battery. There are no specific set of components required for construction, it is intentionally wide-open to foster as much creativity as possible. The vehicle must be capable of pulling an attached trailer up an inclined ramp in a head-to-head, multi-round heat race format to advance to the final championship round. There are three categories within this competition: Design, Performance, and Overall Winning School. Each school is permitted to bring up to eight vehicles, four in each (Non-Capacitor and Capacitor) of the vehicle classes.

The Performance Competition is divided into two vehicle classes (Non-Capacitor and Capacitor) based on whether the vehicle uses energy storage devices. Within each class, vehicles will compete in multiple rounds of heat elimination races. Top finishers in each round will automatically advance to the next round, others will get at least one more chance to advance (i.e., double elimination). The goal is to identify the top six vehicles in each class which will then compete in a final race.

The Design Competition encourages students to prepare a one-page paper describing their approach to designing and building their vehicle, along with a five-minute presentation to a panel of engineers. There is only one Design Competition, vehicles are not separated by class. Note that a vehicle does not have to compete in the Design Competition to be eligible for the Performance Competition. Vehicles may also participate in the Design Competition even if they do not participate in the Performance Competition – there is still an opportunity to win an award, even if your vehicle does not perform as intended.

The Overall Winning School Competition will be calculated by adding up the points awarded in the design and performance competitions.

General Rules

- The competition is for high school students only
- A single person/team may not enter more than one vehicle
- Failure to conform to vehicle specifications will result in disqualification from the performance competition
- If you have any questions regarding the rules, contact Mike Arnott at mike_l_arnott@hotmail.com
- Competition host, Yazaki North America, Inc., has provided a beautiful facility so please treat the venue and staff with respect and gratitude

Vehicle Specifications

Schools that have competed in the past will notice the vehicle and trailer specifications for the 2026 competition have changed significantly.

Vehicle Classification

Two separate classifications for the performance competition exist. Vehicles with no form of onboard energy storage will be placed into the "stock" class. Vehicles that use energy storage devices such as capacitors will be placed into the "unlimited" class.

Dimensions

- Vehicle must fit in a box with inside dimensions of 5 inches wide by 8 inches long by 6 inches high
- Vehicle must have a mechanism to secure the trailer at the rear of the vehicle, ideally a hook of some type is best to make sure the trailer stays attached during the competition
    - Trailer eye sits at roughly 0.75 inches from the ground

Drivetrain

- Vehicle must have four wheels arranged like a typical automobile
- Vehicle may have any number of powered wheels, front or back
- Wheel materials and sizes are not regulated. Any are acceptable providing they do not harm the competition surface
    - No spikes or sandpaper
    - No glue or other traction additives
    - Tank-type treads are not allowed

Electronics

- Vehicle must have two functioning forward-facing headlights
    - Any type of light may be used; however, the light must be visible to competition judges in full daylight
- The only source of energy permitted for the competition will be the AA battery provided by the competition organizers
    - No stored energy may be present before arriving at a race
    - Energy storage devices are permitted in the Unlimited Class but must be drained completely before the race begins
        - Must be verified by the competition officials before each race
- Vehicle must have at least one external power switch to completely disconnect power
    - Multiple switches can be used, but one must be available and identified as the "main" switch
- Because the AA battery will be on the trailer, vehicles must have a power cord to attach to the connector on the trailer
    - Cord should extend at least 6 inches past the rear of the vehicle

- Cords must have a 2.1mm x 5.5mm male barrel plug as shown below, with the center post being the positive (+) connection and the outer barrel being the negative (-) connection
- Additional cords will be brought to the competition if competitors need them

Competition Track Specifications

The competition track can accommodate up to six competitors in one race. The track consists of a plywood incline with a starting gate at the bottom and a flat plateau at the top with the finish line. Races will start on the incline and finish on the flat top.

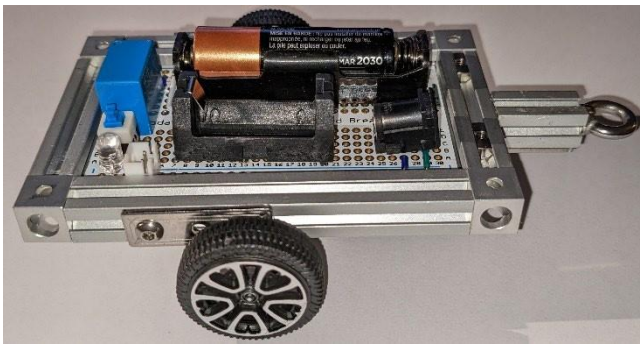
- Track surface is BC sanded on one side, unpainted plywood
- Track lane width is approximately 5.25 inches
- Side walls of track are 3.5 inches high
- Incline is 8 feet long at a slope of 25 degrees
- Level surface is 4 feet in length
- Track is of rough construction with uneven surfaces and small edges, particularly at the top of the incline where the sloped and flat parts meet

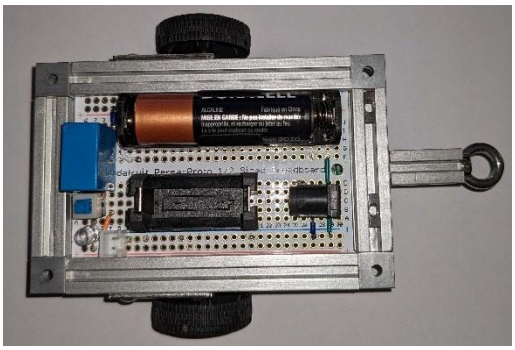
Competition Trailer

The competition trailers are constructed using 10x10mm “MakerBeam” aluminum extrusions. The trailer will house the AA competition battery and the electronics to enable it. Trailers will be provided at the track by the competition judges immediately before each race.

- Exterior dimensions of the trailer platform are 66x102mm
- “Tongue” of the trailer is 35mm long, including the pintle hook
- Trailer hitch is a pintle hook with a 7.5mm ID and a 13.7mm OD
- Bottom of the trailer is roughly 21mm from the ground
- Trailers will be identically prepared and weighted
- Trailer and cargo will weigh approximately 4.5 ounces, weighted 60% / 40% front to back
- Trailer will hold the motive battery for the vehicle as well as a separate battery, relay, and circuitry used to energize the motive battery when turned on

- Trailer will have a 2.1mm female barrel jack socket to connect the motive battery to the vehicle, with the center tip being positive
- Trailer will have a switch and an LED light that shows when the battery is on
- Trailer below is a prototype trailer similar to what will be used in the competition





Design Competition

The Design Competition has two separate components (written report and oral presentation). A month prior to the competition, participants will be required to submit a one-page report discussing their approach to designing and building their vehicle. These reports will be scored and ranked prior to the competition.

Due to time constraints, a limited number of teams will be invited to participate in the oral presentations which take place on day of competition. Teams will be notified prior to competition day if they have been selected to present.

Medals and cash awards will be given to the top three teams based on the combined score of the two components. Points will also be awarded to the Overall Winning School as follows: 1st Place - 8 points, 2nd Place - 4 points, 3rd Place - 2 points.

Written Report

The objective of the written report is to understand the process each team used to achieve their vehicle engineering and development. Teams should discuss their decision-making processes along with the tools, components, and methods used to conceive and construct their vehicle. Up to 50 points will be awarded in the following categories:

- **Design methodology** (20 points) – how and why did the team arrive at the final engineering design for the vehicle? Teams should focus on decisions that could impact their vehicle's success more so than the vehicle aesthetics.
- **Component selection** (20 points) – discuss specific components used in the vehicle, why they were chosen, and what impact those components may have in the success of the vehicle during competition.
- **Unique features** (10 points) – what makes your vehicle unique and how will that help during the competition?

Papers must be submitted electronically as either a Word document (.doc) or as an Acrobat file (.PDF) to Stephanie Alexander at stephanie.alexander@sae-detroit.org no later than **Wednesday, April 15**. The paper must be no more than one page, with one-inch margins

(top, bottom, left, and right), single spaced, using 10-point Arial font. The heading should include title, school's name, and each team member's name, which may appear outside the one-inch text margin (5 points may be deducted for improper formatting). Papers must include one email address for a team representative (teacher's email address is preferred). This email address will be used to notify those teams that will be invited to participate in the Oral Presentation.

Oral Presentation

Teams invited to give an oral presentation will present their vehicle to a panel of professional engineers. Presentations will be limited to five minutes in total, which includes time for answering questions from the panel. Teams are allowed to use physical or digital aids in their presentation. Digital aids will need to be in Microsoft PowerPoint format and must be submitted via email at least 24 hours prior to the competition. Thumb drives and personal computing devices are not allowed for security reasons. Up to 50 points will be awarded in the following categories:

- Ingenuity (10 points)
- Powertrain design (10 points)
- Electrical system design (10 points)
- Aesthetics (10 points)
- Overall vehicle design (5 points)
- Quality of presentation (props, delivery, adherence to time, etc.) (5 points)

Performance Competition

The main attraction for our event is the Performance Competition. Up to six teams in each of the classes will race against each other in multi-vehicle heat races with the goal to place in the top of their race to advance to the next round. Every team gets at least two chances to advance. The number and size of the heats is dependent upon the number of teams in each class which will be announced immediately prior to each round during the competition. The number of competition rounds is also dependent upon the number of entrants. The goal is to determine the six fastest vehicles in each class to compete in the final race for position and points.

We understand that unexpected things can happen during a competition. Our goal is to make sure everyone comes away from the competition with a positive attitude and rewarding experience. We will make every attempt to ensure fairness. Should any issues arise, the team will do their best to rectify situations as fairly as possible, but please be respectful of the organizers and other competitors. Any concerns should be directed to the competition organizers, whose decisions will be final.

Race Rules

- Competitors will use a battery provided by the competition organizers upon registration
    - This single battery must be used in all rounds of competition except for the final race. Competitors will be given a new battery at the starting line
    - Do not use this battery for practice!

- Trailers will be given to each team at the starting line
    - Trailers are not to leave the competition area so that we can begin the next race as soon as one is completed
- Once underway, no outside interference with a vehicle is allowed by any competitor
- Each team should bring two members to the track, one at the starting line and one at the finish line

Race Start

- Competitors in each race will be announced prior to each race
- Once all competitors are present, a pre-race check will begin:
    - Competitors will be given a trailer
    - Competitors must show they are using the provided battery
    - Competitors with energy storage devices will need to prove they have no energy stored
- Once all teams are ready, they will line up their vehicles at the starting gate in one of the six lanes with the trailer attached and power disabled via a switch on the trailer
- Once all teams are in position, the starting official will instruct the teams when it is time to enable power on the trailer
    - There should be a separate switch on the vehicle to turn the vehicle motors on – which should be in the off position at this time
- For Stock Class races, the starting official will announce a countdown when the starting gate will be lifted. Competitors may turn on power on their vehicle at any point during this countdown
- For Unlimited Class races, there will be a 30-second period before the race countdown begins
    - This is the time window during which onboard energy storage can be charged
- Following the countdown, the starting gate will be lifted, and the race will start
- Should a vehicle flip or be in any way inoperable during the start, competitors are allowed to pick up and correct the vehicle, but cannot in any way push or assist the vehicle

The Race

- Headlights must be visible at all times during the race
- Vehicles that flip or get stuck after the start may not be helped
- Trailers must remain attached throughout the race
- Once a vehicle finishes the race, the team member at the finish line must stop the vehicle, and turn off both the vehicle power and the trailer power switches
- Once stopped, leave the vehicle in the competition lane until the finish line official confirms the place order
- Leave the trailer with the finish line official before leaving the competition area
- During a heat race, only the top one or two finishers will automatically advance
- If a vehicle is not going to finish in a qualifying position, competitors may choose to stop the vehicle early to save the battery for the next race

Final Race

For each class, the final race of the event will determine finishing positions. Unlike the heat races, which focus only on the top one or two finishers, this race ranks positions one through six. As a result, the finish line can be quite hectic and often requires video playback to determine placements. The starting process will remain the same, with one exception: each competitor will receive a brand-new battery at the starting line. Medals and cash awards will be awarded to the top three finishers in each competition class. Additionally, points will be awarded towards the Overall Winning School competition from each of the classes as follows: 1st Place - 10 points, 2nd Place - 8 points, 3rd Place - 6 points, 4th Place - 5 points, 5th Place - 4 points, and 6th Place - 3 points.

Supplies

One of the main principles of this competition is that creativity is encouraged. We do not prescribe a set of components or methods that must be used in the vehicle. Teams may choose to use any components, materials, or methods that they have access to. For new schools, it might be good to have a starting point with the following items that have been used successfully by previous competitors.

Component	Site	Description
Breadboard 400	https://kelvin.com	Used for prototyping circuitry
10 Farad Super Capacitor	https://kelvin.com	Capacitor for unlimited class vehicles
Competition 280 Motor	https://kelvin.com	1.5v rated motor
HE Hi-Sped Gearbox	https://hobbylinc.com	Motor, axle, and 2 ratio gearbox
1.5V/25mA Miniature Lamp	https://hobbylinc.com	Low-power lamps for headlights
1 ½ Lite Flite Wheels	https://www.robotmarketplace.com	Foam wheels
4PDT Mini Toggle Switch	https://www.parts-express.com	Two position, multi-contact switch for wiring charging circuits for unlimited class
DPST Toggle Switch	https://www.parts-express.com	Two position switch with two sets of contacts for power and lights
5.5x2.1mm male pigtail connector	https://www.amazon.com	Connector with wire to connect to trailer/battery

Mthree Eye Bolt	https://www.amazon.com	Pintle hook used on the competition trailers
MakerBeam 10x10mm components	https://www.amazon.com	Aluminum extrusions and brackets used to construct the competition trailers
AA Battery Holder	https://www.amazon.com	Secure battery holder with either pins or wires to connect battery from trailer to vehicle
Mthree tap	https://www.amazon.com	Needed to re-thread MakerBeams after cutting
Perma-Prototype Circuit Board, ½ sized	https://www.adafruit.com	Circuit board used on the competition trailer
2.1mm DC barrel jack	https://www.adafruit.com	Female socket used on competition trailer to connect battery cable from vehicle

Tips from Previous Competitions

Many teams have competed in this competition numerous times. See below for their words of wisdom:

- Wide is good
- Traction is king
- Steering can make a difference – see next item
- Track and side walls are not perfect; they may have seams or slivers
- Don’t forget it is double-elimination – be ready to race again even if you lose the first heat
- Securing the trailer is critical, don’t overlook that part
- Bring spare parts and tools, things happen
- Practice, practice, practice
- Have fun!