SAE DETROIT
An SAE International Section

29th Annual MICRO-ELECTRIC VEHICLE COMPETITION RULES

Design Competition papers due Monday, April 6

Wednesday, May 6, 2026
2:00 p.m. – Registration opens

(competition starts promptly at 3:00 p.m.)

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

1 Introduction

Thank you for your interest in the SAE Detroit Section Micro-Electric Vehicle Competition. This event has been part of our science, technology, engineering, and math (STEM) outreach program for three decades and we are proud that it continues today. When it was 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 can take away a sense of pride and accomplishment by participating in our event.

For this competition, 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 to be used in the 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: individual design, individual performance and overall school team score. Each school is eligible to bring up to eight vehicles, four in each of the vehicle classes.

The performance competition is broken into two vehicle classes 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 will be to identify the top six vehicles in each class who will then run in a for-position final race.

The design competition has students 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 complete 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 school competition will be calculated by adding up the points awarded in design and performance competitions.

2 General Rules

- The competition is for high school students only
- A single person/team may not enter more than (1) vehicle
- Failure to conform to vehicle specifications will result in disqualification from the performance competition
- If you have any questions regarding the rules, please contact Mike Arnott at mike_l_arnott@hotmail.com

- Our host (Yazaki North America) has provided us with a beautiful facility to host this event, treat it and them with respect and gratitude

3 Vehicle Specifications

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

3.1 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.

3.2 Dimensions

- The vehicle must fit in a box with inside dimensions of 5 inches wide by 8 inches long by 6 inches high
- The 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. The trailer eye sits at roughly 0.75 inches from the ground.

3.3 Drivetrain

- The vehicle must have 4 wheels arranged like a typical automobile
- The vehicle may have any number of powered wheels, front or back
- The wheel materials and sizes are not regulated, any are acceptable providing they do not harm the competition surface (no spikes, sandpaper) and do not leave any residue on the track surface (no glue or other traction additives)
- No tank type treads are allowed

3.4 Electronics

- The vehicle must have two functioning, forward facing headlights. Any type of light may be used but 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. This must be verifiable by the competition officials before each race.
- Each 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 (new for 2025) vehicles must have a power cord to attach to the connector on the trailer. The cord should extend at least 6 inches past the rear of the vehicle. The 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.

4 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.

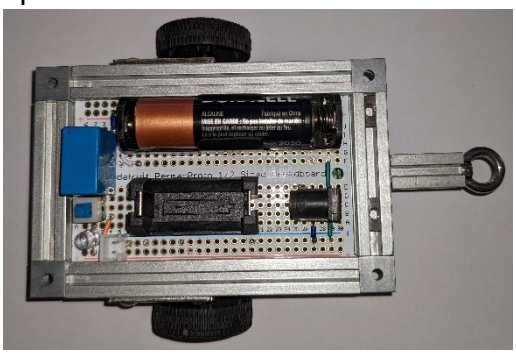
- Track surface will be BC sanded on one side, unpainted plywood
- Track lane width will be approximately 5.25 inches
- Side walls of track will be 3.5 inches high
- The incline will be 8 feet long at a slope of 25 degrees
- The level surface will be 4 feet in length
- Track is of rough construction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

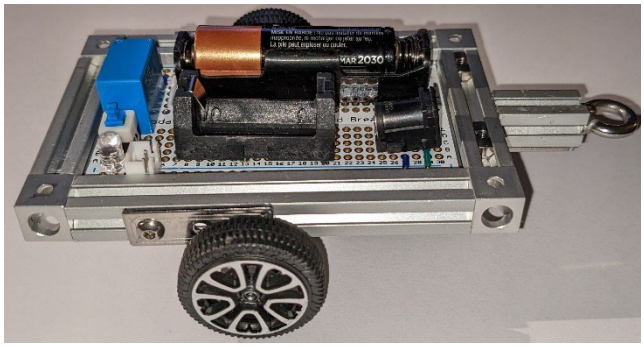
5 Competition Trailer

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.

- The exterior dimensions of the trailer platform are 66x102mm. The "tongue" of the trailer is 35mm long, including the pintle hook.
- The trailer hitch is a pintle hook with a 7.5mm ID and a 13.7mm OD
- The bottom of the trailer is roughly 21mm from the ground

- The trailers will be identically prepared and weighted
- Trailer and cargo will weigh approximately 4.5 ounces, weighted 60% / 40% front to back
- The 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
- The trailer will have a 2.1mm female barrel jack socket to be used to connect the motive battery to the vehicle, with the center tip being positive
- The trailer will have a switch and a LED to enable and indicate when the battery is “live”
- The trailer seen below is a prototype trailer similar to what will be used in the competition





6 Design Competition

The design competition has two separate components. Prior to the competition date, 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 date. A limited number of teams will be invited to participate in the oral presentations on the competition day due to time constraints. 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 towards the overall school competition as follows: first place – 8 points, second place – 4 points, third place – 2 points.

6.1 Written Reports

The goal of the reports is to understand the process each team used to achieve their vehicle engineering and development. Teams should discuss their decisionmaking 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? This is a competition, as such 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 5. The paper must be single page, with one-inch margins (top, left, and right), using 10-point or larger 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. This email address will be used to notify those teams that will be invited to participate in the Oral Presentation. We suggest you use your teacher's email address.

6.2 Oral Presentation

Teams invited to oral presentations will be presenting their vehicle to a panel of esteemed engineers. Presentations will be limited to five minutes 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 24 hours prior to the competition. Thumb drives and personal computing devices not allowed for security reasons by our host. 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)

7 Performance Competition

The main attraction for our event is the performance competition. Here, 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 into 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 and 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 our event with a positive attitude and a rewarding experience. As such we will make every attempt to ensure fairness. Should any issues arise, our 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 only be brought to the competition organizers and their decisions will be final.

7.1 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, where 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

7.2 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 6 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 OK to enable power on the trailer. There should be a separate switch on the vehicle to turn the vehicle motors on – that should be in the off position at this time.
- For stock class races, the starting official will announce a countdown to 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 period of approximately 30 seconds before the race start countdown will begin. 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 underway
- 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

7.3 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, turn off both the vehicle power and the trailer power switches
- Once stopped, leave the vehicles in their competition lane until the finish line official confirms the order of finishing
- Leave the trailer with the finish line official before leaving the competition area
- During a heat race, only the one or two top finishers will automatically advance. If you are not going to finish in a qualifying position competitors may choose to stop their vehicle early to save their battery for their next attempt

7.4 Final Race

For each class, the final race of the event will be for position. Unlike the heat races where we only care about the top one or two finishers, this race is for positions one through six so the finish line is a bit hectic, often required video playback to determine the positions. The same starting process will be used for this race, with the exception that each competitor will be given a brand new battery at the starting line. Medals and cash awards will be given to the top three finishers in each of the competition classes. Additionally, points will be awarded towards the overall school competition from each of the classes as follows: first place – 10 points, second place - 8 points, third place – 6 points, fourth place – 5 points, fifth place – 4 points and sixth place – three points.

8 Supplies

One of the main principles of this competition is that creativity is encouraged. As such, 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 for which they have access to. But we understand particularly for new schools, it might be good to have a starting point with some things that have been used successfully by previous competitors. The following components may be a good place to start.

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	The pintle hook used on the competition trailers
MakerBeam 10x10mm components	https://www.amazon.com	The 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

9 Hints from Previous Competitions

We have had many teams that have competed in this event dozens of times over the years. Here are some words of wisdom from them!

- Wide is good
- Traction is king
- Steering can make a difference – see next item
- The track and side walls are not perfect, they may be seams or slivers
- Practice, practice, practice
- 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
- Have fun