

**WATERLOO | ENGINEERING**

**Waterloo High School  
EV Challenge**

**2024 EVENT RULES**

**Updated November 7, 2023**

## 1. Electric Vehicle Challenge

High School and College students, with the assistance of their technology teachers or other mentors, design and build battery powered vehicles capable of carrying a driver the maximum distance on a single charge. The Electric Vehicle (EV) Challenge consists of two endurance races: a 12 V race and a 24 V race.

### 1.1. Mission Statement

The Waterloo Electric Vehicle Challenge mission statement is to:

1. **Provide an accessible enrichment program.** The event organizers seek to reduce barriers to entry and keep a level playing field for all teams, regardless of their financial resources
2. **Provide a safe event for teams to celebrate their success.** The EV Challenge makes every effort to ensure its events are as safe as possible for teams.
3. **Support the growth of the EV Challenge community in Ontario.** The formation of new teams is actively encouraged, with the responsibility for mentoring and promoting new teams shared between the event organizers and established teams. The EV Challenge will actively seek financial support for new teams.

### 1.2. Eligible Vehicles to Enter Competition

The goal of the EV Challenge is to provide students with an opportunity to design and build an electric vehicle according to specifications presented in the competition rules. This goal cannot be achieved when schools purchase and use pre-manufactured vehicle kits or bring the same vehicle back to the competition every year.

Because of cancellation of the event in 2020 and 2021 and reduced participation in 2022, these years will not be included when determining the number of competition seasons.

In order to encourage teams to provide design and fabrication experiences for their student members, the following rules will be enforced for all entries. **These rules do not apply to College teams, which are expected to build a new frame and vehicle every year.**

1. **The use of pre-designed vehicle plans and/or pre-fabricated vehicle kits is prohibited.** The necessary engineering knowledge and technical information will be gained through research and experience and utilizing the fabrication knowledge and skills of the team members and their mentors.
  - The use of a pre-designed, purchased kit for an EV Challenge vehicle, including copying its dimensions or modifying it to meet competition specifications, is prohibited
  - Teams are allowed to use a frame designed and built by their own school as a starting point for a new design. This may include copying its dimensions and reusing key components such as steering, brakes, powertrain and controls.

- New teams may reuse existing parts including frames donated by other teams. If a donated frame (any age) is used by a new team, it will be considered an eligible car for 2 competition seasons, starting with the 2023 season. **College teams may not use a donated frame to construct their vehicle.**
  - Inspection / verification will be part of the Safety Inspection at the EV Challenge race. Ineligible cars will not be allowed to participate and the judge's decision is final.
2. **A vehicle built by a team can be raced for a maximum of 4 competition seasons;** after this it will be considered a classic car and will not qualify for future competitions. **For 2024, a car first raced in 2018 is eligible, a car first raced in or before 2017 is not.** The 4-year limit will be monitored and enforced by the race organizers as follows:
- A "new car" is considered to be one where the chassis has been designed and fabricated from basic materials. Steering, brakes, wheels, and drive system components from previous vehicles can be reused when constructing a new car.
  - Modifications to an existing car, such as a new steering or drive system, or remanufacturing a portion of the chassis, is not considered building a new car. Modifying a car does not change its 4-competition season limit.
  - All cars must have the year of completion permanently affixed (welded, embossed) on the frame in at least 3 different locations. Teams are expected to provide an honest, accurate disclosure of the age of the car. The car will retain these same year labels for all times that it is entered in the competition.
  - Inspection / verification of car year labels will be part of the Safety Inspection at the EV Challenge race. Cars that do not have year labels or are not eligible will not be allowed to participate and the judge's decision is final.
3. **Teams may continue to race 1 classic car at all EV Challenge events.** In order to allow participation by all schools and to take into account situations where a school is unable to design, construct or complete a new vehicle, teams will be permitted to compete at the EV Challenge as follows:
- A classic car is defined as a car that is more than 4 years old, counted from the first EV challenge event it has competed in. **For 2024, a car first raced in or before 2017 is considered a classic car.**
  - **A team may enter a classic car in one race only, either the 12 V or the 24 V race.**
  - If a team races an eligible car in the 12 V or 24 V race, a classic car may be entered as a second car for the competition by the team, to be raced as either 12 V or 24 V.
  - All entries, whether an eligible car or a classic car, must follow the registration limit

(Section 2.2). Each team is allowed a maximum of one car in the 12 V race and one car in the 24 V race.

- Inspection / verification of cars (eligible and classic) will be part of the Safety Inspection at the EV Challenge race and the judge's decision as to a car competing or not competing is final.

## 1.3. EV Challenge Website

The EV Challenge website is available at [uwaterloo.ca/evchallenge](http://uwaterloo.ca/evchallenge). It is kept up-to-date through the year and contains race results, registration instructions, and other important information for teams. In particular, attempts are made to provide advice to teams on anticipated changes to the rules prior to the release of these official rules.

## 2. Registration

### 2.1. Online registration

Teams must complete an online registration to compete at the Waterloo EV Challenge. This is done on the EV Challenge website and must be completed at least two weeks prior to the competition date. A registration fee of \$50 per team will be charged as part of the online registration process.

### 2.2. Registration limit

For 2024 there will be one 12 V race and one 24 V race, and teams are allowed one entry into each race. If a team brings two cars to the competition, they will enter one car in the 12 V race and one car in the 24 V race (two entries). If a team brings one eligible car to the competition, they will enter it into both the 12 V race (one entry) and the 24 V race (one entry). If a team brings one classic car to the competition, they will enter it into one race only, either 12 or 24 V.

### 2.3. Restriction of race entries

The race organizers reserve the right to restrict or refuse entry into any of the races based on safety requirements as follows.

- If during inspection a design flaw or fabrication problem is identified by the safety inspector that would cause the car to be unsafe in operation, the race organizers may decide to restrict that car to participate in the 12-volt race only.
- If during the 12-volt race the marshals or scoring team identify a problem with the operation of the car that would cause it to be unsafe in the 24-volt race, the race organizers may decide to restrict that car to participate in the 12-volt race only.

All teams must ensure they are designing and fabricating their cars according to the design rules, and all cars should be tested prior to the race to ensure the car is stable and the critical safety components, including the steering and brakes, are working well.

## 2.4. On-site registration

In addition to the online registration, teams must complete an on-site registration between 8 and 9 am on the day of the race. Teams are expected to provide the following documents during this time:

1. Completed **Team Registration Form** including the names of all students and teacher/advisors that are attending the event and the names of all drivers
2. Completed **Participant Information Sheet** form for all students and teacher/advisors that are attending the event.
3. A completed **Safety Inspection Checklist** for each car.
4. A signed **Construction Responsibility Waiver** for each team.
5. Drivers for the 24 V race need to show a valid driver's license.

See the appendix for copies of these forms.

A **Certificate of Insurance** will be required for any team that is not affiliated with a Ontario Secondary School or an Ontario Catholic Secondary School, **such as College teams** or community teams.

## 2.5. Early Load-in & Registration

Teams are permitted to load in on Friday afternoon prior to the race. During this time, teams may also complete their safety inspections. On-site registration and award judging will wait until Saturday morning. Secure storage for vehicles and trailers will be provided for all teams.

## 3. Competition Classes

There are two different classes within the competition: one for high school students and one for college students. Each class builds their vehicle and competes according to a different set of rules, as follows.

### 3.1. High School Team

A high school team is defined as a group of students that are currently enrolled in high school working together to design, build and race a vehicle. A team does not have to be associated with a particular school, but must have a teacher, parent or mentor acting as a supervisor for the team. All vehicles must be designed and built according to the Vehicle Design Rules.

### 3.2. College Team

A college team is defined as a group of students that are currently enrolled in a post-secondary college working together to design, build and race a vehicle. A college team must be associated

with a particular college and must have at least one teacher or mentor from that college acting as a supervisor for the team. All vehicles must be designed and built according to the Vehicle Design Rules. The following rules are additional requirements for all college teams.

- 3.2.1 A college team must fabricate a new vehicle frame each year. The frame can be similar to the previous year, but it is expected that some improvements will be made to the design. Components of the car other than the frame can be reused from the previous year.
- 3.2.2 The total cost of building the car must not exceed \$6000. Full MSRP of all materials and parts must be used, including donated and discounted parts from sponsors and parts reused from a previous vehicle. Batteries, travel costs and driver safety equipment i.e., helmets, are not included.
- 3.2.3 College teams are expected to provide documentation that includes mechanical drawings, electrical schematics, and a spreadsheet with detailed cost information. This information will be used by judges for the College Engineering Award.

## 4. Vehicle Design Rules

**All vehicles competing in the EV Challenge must conform to the following design guidelines.** (These have been taken primarily from the *Electrathon America* design guidelines and adapted for use in the EV Challenge)

### 4.1. Dimensions

- 4.1.1 The distance between the tires must be at least 0.60 m, center to center.
- 4.1.2 The vehicle may be no wider than 1.2 m at its widest part.
- 4.1.3 The maximum vehicle length is 3.5 m.

### 4.2. Configuration

- 4.2.1 Vehicles must be three- or four-wheeled. All wheels must be load-bearing and must remain in contact with the ground at all times.

### 4.3. Driver position

- 4.3.1 The driver must be in a sitting position. A kneeling or head-first position is not permitted.
- 4.3.2 Arms and legs must remain within the vehicle body structure during normal operation of the vehicle.
- 4.3.3 The driver must be able to exit the car independently in less than 1 minute.

### 4.4. Frame

- 4.4.1 All vehicles must have frame members that protect the driver in the event of a collision from any direction. This includes having the frame extend beyond the driver's feet and having adequate side protection for the driver.

- 4.4.2 Frames must be constructed using steel or aluminum. Members may be joined by welding or with bolts. Non-structural frame members may be constructed using other materials, including wood, plastic, composites, etc.
- 4.4.3 The first year when the chassis was raced must be permanently marked on the vehicle frame in 3 locations; at the front, the rear and on the roll bar. Valid marks include etching, welding or machining.

## 4.5. Roll bar

- 4.5.1 There must be a roll bar that extends 50 mm over the top of the helmet of the tallest driver, and protect them throughout their full range of motion. It must be constructed so that, in the event of a roll-over, the driver's head is fully protected.
- 4.5.2 The roll bar must be made from steel or aluminum, welded or bolted construction.
- 4.5.3 The roll bar must be triangulated with at least three legs or panel equivalent.

## 4.6. Vehicle body

- 4.6.1 The vehicle body is only required to be structurally strong if the frame does not provide adequate protection from an impact. If the frame is not sufficient, then the body must be constructed to protect the driver in the event of an impact.
- 4.6.2 The body must have a floor to prevent the driver from contacting the ground.
- 4.6.3 The driver's legs and feet must be enclosed to prevent them from leaving the vehicle in the event of an accident.
- 4.6.4 Self-tapping screws are prohibited on vehicles as they can loosen, fall on the race track and cause tire failure. Machine screws or rivets are both suitable fasteners.

## 4.7. Stability

- 4.7.1 The vehicle must be stable at rest, while cornering, braking, and at top speed.
- 4.7.2 Leaning vehicles are not permitted.

## 4.8. Steering

- 4.8.1 The vehicle's steering must allow for a minimum turning radius of 5 m.

## 4.9. Brakes and axles

- 4.9.1 The braking system must be designed to provide stability (equal braking on both sides of the vehicle) and redundancy (vehicle can still be stopped in event of brake component failure). This is normally achieved using brakes fitted to two wheels of the same axle – either two on the front or two on the back, depending on vehicle configuration. The competition organizers should be consulted prior to construction in case of other configurations (differentials, front wheel drive, etc.)
- 4.9.2 The two braking systems must have separate actuation systems (cables or master cylinders). If both brakes are actuated by a single hand or foot lever, then both actuation systems should be attached to the lever.

- 4.9.3 The vehicle must not roll if the brakes are applied.
- 4.9.4 Axles supported at both ends must have a diameter of at least 10 mm.
- 4.9.5 Axles supported only on one end must have a diameter of at least 12 mm.
- 4.9.6 Safety wire or cotter pins must be used to secure all wheel axle nuts. Nylon lock nuts and double nuts alone are not acceptable.

## 4.10. Tires

- 4.10.1 Tires must be inflatable.
- 4.10.2 Vehicles should be designed with at least 40 mm ground clearance.
- 4.10.3 The driver must not be in a position to come in contact with the tires, wheels, or spokes.

## 4.11. Batteries

- 4.11.1 The required battery for the 12 V race is the Interstate MTX-35 battery. No other type of battery may be used in the 12 V race.
- 4.11.2 The required batteries for the 24 V race are two Optima Yellow Top SC35DA batteries. No other type of battery may be used in the 24 V race.
- 4.11.3 Batteries must not be modified or heated.
- 4.11.4 Batteries must be securely attached to the vehicle in such a manner that they are protected from a roll-over or impact, and, in the event of an accident, will not leave the vehicle. Examples include a metal bracket or a ratchet strap.

## 4.12. Electrical system

- 4.12.1 A fuse or circuit breaker is required in any electrical circuit between the battery and any electrical device.
- 4.12.2 All fuses or circuit breakers should be mounted as close as practically possible to the source of power.
- 4.12.3 All fuses or breakers should be sized to protect the wiring to which they are connected.

## 4.13. Isolation switch

- 4.13.1 An isolation (kill switch) is required on all vehicles. This switch must have a break current rating that exceeds the maximum current draw of the vehicle.
- 4.13.2 The switch must be located in the main positive power cable, between the battery and any motor controller.
- 4.13.3 The driver must be able to actuate the switch while in driving position, without reaching outside the vehicle. Race officials must be able to actuate the switch from outside the vehicle without reaching in. Two separate switches may be used.
- 4.13.4 The switch must be in a colour contrasting the rest of the vehicle, preferably red.
- 4.13.5 A circuit breaker may be used as the isolation switch.



## 4.14. Wiring

- 4.14.1 Wiring must be well-insulated and securely attached to the frame or body. All wiring must be visible for inspection for the entire length of the wiring runs. All wiring must be kept free from moving parts and protected from chafing.
- 4.14.2 Wiring that passes through a hole with sharp edges or through sheet metal must be protected by an insulating grommet or other suitable device.
- 4.14.3 Terminals must be secured so they will not come loose or short out during a competition.
- 4.14.4 No part of the system may use the vehicle frame as a conductor. The frame must not be grounded.

## 4.15. Motor and transmission

- 4.15.1 All vehicles must only be powered by electric motors.
- 4.15.2 All gears, chains, and sprockets must be covered. Strong material, i.e., steel, aluminum, or Lexan must be used in constructing the guards. The guards should cover all moving parts in such a way that a finger or hand cannot reach them.

## 4.16. Motor controller

- 4.16.1 Any type of power controller is allowed.
- 4.16.2 Power to the motor must be controlled by the driver and turn off automatically when the driver releases the accelerator ('dead man' cut-off).
- 4.16.3 Remote control of a vehicle is not permitted.
- 4.16.4 Computers are permitted on the vehicle if they present information only or collect data only. The driver must have complete manual control of the vehicle.

## 4.17. Mirrors

- 4.17.1 Vehicles must be equipped with at least 8 square inches of usable mirror surface area. Mirrors are required on both sides of the vehicle
- 4.17.2 The mirrors must allow the driver to see clearly to the rear on both sides of the vehicle.
- 4.17.3 Electronic sensing devices, such as video cameras and monitors, may not be used as a substitute for rear-view mirrors.

## 4.18. Safety belts

- 4.18.1 All vehicles must be equipped with a five-point racing style seat belt system.
- 4.18.2 Seat belts must be mounted to a structural point at least 3 inches below the top of the driver's waist.
- 4.18.3 The shoulder harness must be attached to a structural point at least 3 inches below the driver's shoulder.

## 4.19. Helmets

- 4.19.1 The driver must wear a helmet that is DOT approved for motorcycles. Eye protection – shield, goggles or safety glasses – is required at all times.

## 4.20. Driving attire

- 4.20.1 Drivers must wear long sleeve shirts, pants, closed toe shoes and gloves.  
4.20.2 Hair must be contained so that it is unable to reach the drive train.

## 4.21. Numbers

- 4.21.1 Vehicles must display numbers at least six inches in height using contrasting colours to the vehicle.

## 5. Safety

Pursuant to the mission of the EV Challenge, safety is of utmost importance during the event. Any cars or drivers deemed to be unsafe will not be allowed to participate in the race. These decisions will be made by the race organizers, the Head Marshal and the Lead Safety Inspector.

### 5.1. Safety inspection

The safety inspection will verify that the car has been constructed according to the Vehicle Design Rules and that the driver has the required safety equipment. If a car fails the safety inspection, that car will not be allowed to compete. All rulings by the judges are final. If a car is repaired, a second safety inspection will be conducted. The race will not be delayed for this process.

Prior to the competition, the team's teacher / advisor will complete the **Safety Inspection Checklist** form (found in the Appendix) by initialing each line to confirm the team has met the requirements. The team will present the completed form at the on-site event registration and the safety inspector will refer to the form during inspection of the vehicle. The requirements to pass the inspection are as follows.

1. The vehicle must have a minimum of three road wheels. All wheels must be in contact with the ground at all times. Vehicle must be inherently stable at rest and in operation.
2. The frame must be fabricated in such a way to protect the driver in a collision. The design and fabrication must be structurally sound.
3. The first year when the chassis was raced must be permanently marked on the vehicle frame in 3 locations; at the front, the rear and on the roll bar
4. Mirrors are required on both sides of the vehicle to permit the driver a clear view behind.

5. A five-point safety harness is properly mounted.
6. All wiring must be visible for inspection for the entire length of the wiring runs. All wiring must be insulated and neatly secured and terminated. Wiring must be sized to have sufficient capacity.
7. Batteries must be firmly secured to the chassis with a metal bracket, a ratchet strap, or are otherwise strongly secured. In the event of a collision, the battery must not move.
8. There must be an Emergency Power Off switch on the vehicle, accessible to the driver and emergency workers outside the car.
9. The braking system must be designed to provide stability (equal braking on both sides of the vehicle) and redundancy (vehicle can still be stopped in event of brake component failure). This is normally achieved using brakes fitted to two wheels of the same axle – either two on the front or two on the back, depending on vehicle configuration. The two braking systems must have separate actuation systems (cables or master cylinders). The vehicle must not roll if the brakes are applied.
10. Cotter pins or safety wire must be used to secure all wheel axle nuts.
11. All chains, sprockets, belts or pulleys in the vehicle drivetrain must be safeguarded to prevent injury to the driver or any member of the team. Strong material i.e. steel, aluminum, or Lexan must be used in constructing the guards. The guards should cover all moving parts in such a way that a finger or hand cannot reach them.
12. The vehicle must have a steel or aluminum roll bar mounted to the frame in such a manner as to prevent collapsing or breaking. The bar must be at least 50 mm above the top of the tallest driver's helmet when seated in race position. The roll bar must be braced either forward or rearward to the frame of the vehicle. It must provide protection for the driver's head throughout the full range of possible movement.
13. The driver must wear a helmet that is DOT approved for motorcycles. Eye protection – shield, goggles or safety glasses – is required at all times
14. The driver must be able to exit the car independently in less than 1 minute

Please note that this not a complete set of rules to be followed and additional inspection items may be applied as necessary. These rules represent the most significant hazards teams will face. For a full set of rules, see Section 4 Vehicle Design Guidelines.

## 5.2. Event safety

During the event, extensive arrangements are made to promote the safety of all participants. These include

- 5.2.1 Dedicated first-aid trained personnel will be on-site throughout the event.
- 5.2.2 A fire extinguisher will be on-site with a trained operator.
- 5.2.3 No less than eight (8) marshals will be present to monitor the race and respond to emergencies. Race organizers and marshals will be in continual radio communication regarding overall event progress and safety. Marshals will use horns and other visuals aids to stop the race when conditions merit.
- 5.2.4 Race marshals and other track workers will wear high-visibility vests.
- 5.2.5 The race area will be secured with various levels of crowd control/barricades. For any area where there is the potential for a vehicle to leave the race course and cause an injury, a metal barricade will be used. A combination of wood barricades and barricade tape will be used to secure other areas. Volunteers will be stationed around the course to provide a secure perimeter at all times.

## 6. Race Rules

### 6.1. Race schedule

The 12 V race will be 60 minutes in duration and the 24 V race will be 70 minutes in duration. Each race will end when the time is complete or when none of the cars are able to continue. Time is kept by the race organizers and will be broadcast to teams via a web-based application.

Time	Item
8:00 – 9:15am	Teams arrive, registration opens
9:15 – 10:15am	Safety inspections, award judging Transponder set-up and inspection
10:15am	Driver’s meeting in pits – mandatory attendance by all drivers, 12 and 24V
10:30am	Opening ceremonies, 12 V cars on track
10:45am – 12:00pm	12 V race (60 minutes duration)
12:00 – 1:30pm	Lunch break and prep for 24 V race
1:30 - 2:45 pm	24 V race (70 minute duration)
3:00 pm	Awards ceremony

### 6.2. Track rules

Track rules must be adhered to at all times, as follows.

- 6.2.1 **Pit access.** The pit area will be accessible only to a maximum of six students and two teachers/mentors per car during the race. No spectators will be allowed in the pit area during the race.

- 6.2.2 **Pit safety.** The pit is a no power zone. All cars must stop completely at the pit entrance gate and be pushed by the pit crew. When the car is moving in the no power zone, at least one person (other than the driver) **must** have a hand touching the car at all times.
- 6.2.3 **General vehicle safety.** Drivers must operate their vehicle safely. Their speed and control of the vehicle must be appropriate for the track conditions, including weather conditions, the number of vehicles on that part of the track, and their position in the course.
- 6.2.4 **Flag controls.** Drivers must obey all flag instructions of the marshals as follows:
  - Green - GO!
  - Red – STOP! Wait for Marshal to wave Green Flag.
  - Black - Report to pits on the current lap for penalty or repairs.
- 6.2.5 **Yielding to a faster vehicle.** Slower cars must hold their line. Weaving across the track to block a passing vehicle is not permitted
- 6.2.6 **Passing a slower vehicle.** It is the responsibility of the faster cars to pass in a safe manner. Never pass in a no passing area.
- 6.2.7 **When vehicle runs out of power.** Remain in the vehicle if it breaks down until the race has been stopped. The marshal and race organizers will decide whether your car will be returned to the pits for repairs or whether it will be removed from the race. No team member is to go onto the track to retrieve a broken down car. If required, the track workers will push the car to the pits if when it is safe to do so.
- 6.2.8 **Mechanical issues.** Cars that have mechanical issues will be allowed to make repairs and continue racing; however, they must drive with care, not exceeding a reasonable safe speed, and they must yield to passing cars at all times.

## 6.3. Race procedures

Races will be conducted and scored according to the following procedures

- 6.3.1 **Starting position.** Starting position for the race will be determined by lottery, with one member of each team drawing a number that will be their starting position
- 6.3.2 **Cars in starting position.** Once starting position is determined, cars will be arranged in starting order on the track near the start-finish line
- 6.3.3 **Test lap.** Once the cars are arranged in their starting order they will proceed around the track, or a portion of the track. As they pass the start-finish line scoring system operation can be verified for each car. Any malfunctioning transponders will be identified and replaced during or after the test lap, prior to the start of the race. The test lap may be repeated if necessary to ensure all transponders are functioning properly.
- 6.3.4 **Scoring system.** Once the test lap is complete the scoring system will be reset so that the number of laps and elapsed time for each car is set to zero.
- 6.3.5 **Standing start.** Once the test lap has been successfully completed (see 5.3.3) all cars will stop in their starting order in a location near the start-finish line. When the green flag waves all cars will move forward at race speed past the start-finish line and around the track

- 6.3.6 Race timer.** When the green flag waves to start the race the race timer will be started. The timer will run continually throughout the race and will only be stopped during a red flag.
- 6.3.7 Transponder failure.** If a transponder fails during the race, the number of laps will be counted manually from that point forward. Note that this may affect the race results as the exact elapsed time between the first and last time the car crosses the start-finish line cannot be determined.
- 6.3.8 Last lap in the event of power failure.** If a car runs out of electrical power and it pulls off the track into a safe area, it will only be scored based on the number of laps it has completed and not the lap that it is on.
- 6.3.9 End of elapsed time.** The checkered flag will be shown to all cars when the timer indicates the total race time has elapsed, 60 minutes for 12 V race and 70 minutes for 24 V race.
- 6.3.10 Completion of the race.** When the checkered flag is shown indicating that the total race time has elapsed, all cars will continue to race until they cross the start-finish line to complete their last lap. Once all cars have completed their last lap, operation of the scoring system will be stopped.
- 6.3.11 Race results.** The data from the scoring system will be used to determine the results for the race as follows.
- (1) Finishing order is determined based on the number of laps completed by each car as recorded by the scoring system
  - (2) If two (or more) cars complete the same number of laps, they will be ranked based on the total elapsed time between the first and last time they cross the start-finish line, as recorded by the scoring system
- 6.3.12 Review of race results.** Schools/organizations may request a review of the race results, either immediately following the race or afterwards.

## 6.4. Driver requirements and mandatory pit stops

Each team must make two pit stops during the race (both 12 V and 24 V classes) to change the driver of the car, as follows.

- 6.4.1** 12 V drivers must be team members. They must be of high school age.
- 6.4.2** 24 V drivers must be team members and have a valid G1 license, or equivalent.
- 6.4.3** Teams competing in multiple races (12 V and 24 V) must register and use a minimum number of qualified drivers as follows
- (1) A team with one race entry (12 V or 24 V) must register and use at least 2 qualified drivers
  - (2) A team with two race entries (12 V and 24 V) must register and use at least 4 qualified drivers
  - (3) A driver cannot drive more than one event. (i.e. A driver that races in the 12 V event cannot drive in the 24 V race)

- 6.4.4 At least two different drivers must be used by each team during each race (12 and 24 V). The intent of this rule is to give as many students as possible an opportunity to race, rather than having one highly skilled student drive all but a few laps of the race.
- 6.4.5 If a team chooses to have only two drivers, they must still perform two driver changes during the race. The driver who is re-entering the race must completely exit the car and place both feet on the ground before re-entering the car.
- 6.4.6 Each driver must complete one full lap before performing another driver change.
- 6.4.7 Teams are allowed to change the driver if they have stopped in the pit area to repair a mechanical problem.
- 6.4.8 Teachers/advisors must disclose hearing or uncorrected vision impairments, including colour-blindness (particularly red/green), of their drivers to the organizers at least one week prior to the race. Race controls (i.e., flags) are colour-coded and this can present a safety hazard if unaddressed. Every effort will be made to allow the driver to participate if participation can be done safely.

## 6.5. Cell phones & communication devices

Compliance with the following sections may require additional design changes to the vehicle. Communication devices must not distract the driver.

- 6.5.1 Push to talk radios are permitted as long as the driver is not distracted by them.
- 6.5.2 Cell phones are permitted, so long as the line is kept open through the duration of the competition (i.e., no dialing).
- 6.5.3 Texting is prohibited.

## 6.6. Contravention of Rules

The race organizers, in cooperation with the Head Marshal and the Lead Safety Inspector, has the right and authority to remove from the competition any driver, vehicle or team that has demonstrated a lack of respect for the rules of the competition or poses a safety risk for themselves or others.

## 6.7. Scoring System

Scoring for all races will be done using an electronic scoring system.

- 6.7.1 **Assignment of transponder.** Each car will have an assigned transponder that will be used to track its progress during the race. Every time the car crosses the finish line, the scoring system will increment the completed laps for that car.
- 6.7.2 **Transponder mounting and operation.** The transponder will be provided prior to the start of the race and should be attached to the outside of the body shell in an area near the front of the vehicle where it can point upwards. All teams are required to prepare their vehicle for the transponder, as follows:
  - (1) **Location.** Identify the location where the transponder will be located. This should be a flat area near the front of the vehicle where the transponder can “see” the scoring loop above it without obstruction. The transponder must be attached using the Velcro tabs provided.

(2) **Power.** The transponder must be wired to **one** of the vehicles 12 V batteries directly and not wired into any vehicle system, including the main power switch or E-stop. It may not be powered using a separate battery pack. It is the team's responsibility to provide wiring from the battery to the transponder and attach to the connector provided to the team prior to the competition. Proper transponder wiring will be checked by inspection and must be approved before a car will be allowed to compete.

(3) **Operation.** Once connected to a 12 V battery, transponder function can be verified by a brief flash of a red or white LED light, visible at the top of the transponder. Once a transponder is connected and functioning prior to the race, it should be left plugged in – a transponder only draws a few milliamps to operate so it will not affect the number of laps that a car will complete during the race.

(4) **Checking.** Transponder function will be checked during the Test Lap when the cars move slowly under the scoring loop, located at the start/finish line. Any non-functioning transponders will be repaired or replaced prior to the start of the race if possible.

**6.7.3 Transponder failure.** The race will not be stopped in the case of a transponder failure. It is the responsibility of the team to ensure that the transponder is correctly wired and functioning properly before the start of the race. In the case of a transponder failure, the number of laps the car has completed will be manually scored for the remainder of the race.

## 7. Awards

The EV Challenge provides awards as follows

### 7.1. Race Awards

Awards for 1st, 2nd and 3rd place for both the 12 V and 24 V races are presented to teams as follows:

(1) Awards are presented to the teams that completed the most laps during the race, as recorded by the scoring system

(2) If two (or more) cars complete the same number of laps, the award will be given to the team with the lower total elapsed time between the first and last time they cross the start-finish line, as recorded by the scoring system

(3) Separate race awards will be presented to college teams if 3 or more teams attend the competition. The number of awards will be based on the number of teams participating.



## 7.2. Interstate Batteries Rookie Team Award

The Interstate Batteries Rookie Team Award is given to the team competing for the first time at the EV Challenge whose vehicle scored the highest number of laps in the 12 V race. If two (or more) cars complete the same number of laps, the award will be given to the team with the lower total elapsed time between the first and last time they cross the start-finish line, as recorded by the scoring system

## 7.3. Dennis Weishar Engineering Design Award

The Engineering Design Award will be presented to the school that demonstrates the best overall design innovation, use of engineering calculations, and/or design for ease of assembly, maintenance, ergonomics and safety in their competition vehicles.

The Engineering Design Award is judged in two parts: an engineering report submitted one week prior to the competition, and an interview with qualified teams during the time between registration and the first race, approximately 8:00 – 9:45am. Only teams that submit an engineering report will qualify for the award, and interviews will only be conducted with these teams.

Teams should indicate during online registration if they intend to qualify for the Engineering Design Award. Details of the Engineering Design Award, including the requirements for the report, may change slightly from year-to-year. These will be provided to teams approximately 1 month prior to the competition date.

## 7.4. Toyota Fabrication & Manufacturing Award

The Toyota Fabrication & Manufacturing Award will be presented to the school that demonstrates the best examples of manufacturing and fabrication in the vehicles that their team brings to the competition.

To qualify for this award, teams must be able to provide examples of manufacturing and fabrication that have been completed in the current year. These examples can include new vehicles or new systems (powertrain, steering, etc.) adapted to existing vehicles.

Teams should indicate during online registration if they intend to qualify for the Toyota Fabrication and Manufacturing Award.

During the time between registration and the first race, approximately 8:00 – 9:45am, Judges will visit each qualified team and will conduct a 5-minute interview, focusing on the different manufacturing and fabrication techniques that were used in building your vehicle or vehicle system.

## 7.5. College Engineering Award

The College Engineering Award will be presented to the school that demonstrates the best overall design innovation, use of engineering calculations, design documentation and fabrication quality.

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The award will be judged in two parts: detailed design documentation will be submitted one week prior to the competition, and an interview with qualified teams will be held during the time between registration and the first race, approximately 8:00 – 9:45am.

The College Engineering Award will only be awarded if three or more college teams attend the competition.

## 8. Team Registration Form

School \_\_\_\_\_

Teacher/Advisor \_\_\_\_\_

Race	Car #
12 V Race	
24 V Race	

### 12 V Race Drivers

Driver #	Name
1	
2	
3	
4	

### 24 V Race Drivers

Driver #	Name
1	
2	
3	
4	

Please note that all drivers for the 24 V race will need to show a valid G1 driver's license at check-in.

## Participant Information Sheet

Name: \_\_\_\_\_ Age: \_\_\_\_\_

School: \_\_\_\_\_

Role on team:

12 V Driver     24V Driver     Pit Crew

**Media release:** I consent to the use of my image, voice, and/or likeness by the University of Waterloo as long as there is no intent to use it in a disparaging manner. The University shall have the right to photograph, distribute, reproduce, publish, edit, display, or otherwise use my image, voice, and/or likeness in connection with any products or services in all markets, media, or technology developed in the University.     Yes     No

OFFICE USE ONLY  
 Driver ID Check

\_\_\_\_\_  
Parent signature (if under 18)

\_\_\_\_\_  
Print name

\_\_\_\_\_  
Date

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## Participant Information Sheet

Name: \_\_\_\_\_ Age: \_\_\_\_\_

School: \_\_\_\_\_

Role on team:

12 V Driver     24V Driver     Pit Crew

**Media release:** I consent to the use of my image, voice, and/or likeness by the University of Waterloo as long as there is no intent to use it in a disparaging manner. The University shall have the right to photograph, distribute, reproduce, publish, edit, display, or otherwise use my image, voice, and/or likeness in connection with any products or services in all markets, media, or technology developed in the University.     Yes     No

OFFICE USE ONLY  
 Driver ID Check

\_\_\_\_\_  
Parent signature (if under 18)

\_\_\_\_\_  
Print name

\_\_\_\_\_  
Date

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## Participant Information Sheet

Name: \_\_\_\_\_ Age: \_\_\_\_\_

School: \_\_\_\_\_

Role on team:

12 V Driver     24V Driver     Pit Crew

**Media release:** I consent to the use of my image, voice, and/or likeness by the University of Waterloo as long as there is no intent to use it in a disparaging manner. The University shall have the right to photograph, distribute, reproduce, publish, edit, display, or otherwise use my image, voice, and/or likeness in connection with any products or services in all markets, media, or technology developed in the University.     Yes     No

OFFICE USE ONLY  
 Driver ID Check

\_\_\_\_\_  
Parent signature (if under 18)

\_\_\_\_\_  
Print name

\_\_\_\_\_  
Date

**10. Construction Responsibility Waiver**

I \_\_\_\_\_ take all responsibility for the supervising and inspecting the construction of the Electric Vehicle(s) that my students are entering into this competition. I understand that safety inspections will be done but am aware that such things as the strength of a weld are nearly impossible to verify with a visual check.

I have ensured that all safety requirements have been met as listed in the design rules.

\_\_\_\_\_  
**Teacher / Advisor Signature**

\_\_\_\_\_  
**Date**

## 11. Safety Inspection Checklist

CAR #
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Requirement	Initial
<input type="checkbox"/> The vehicle must have a minimum of three road wheels. All wheels must be in contact with the ground at all times. Vehicle must be inherently stable at rest and in operation.	
<input type="checkbox"/> Frame must be fabricated in such a way to protect the driver in a collision. The design and fabrication must be structurally sound.	
<input type="checkbox"/> The first year when the chassis was raced must be permanently marked on the vehicle frame in 3 locations; at the front, the rear and on the roll bar	
<input type="checkbox"/> Mirrors are required on both sides of the vehicle to permit the driver a clear view behind.	
<input type="checkbox"/> A five-point safety harness is properly mounted.	
<input type="checkbox"/> All wiring must be visible for inspection for the entire length of the wiring runs. All wiring must be insulated and neatly secured and terminated. Wiring must be sized to have sufficient capacity.	
<input type="checkbox"/> Batteries are of the correct type: Interstate MTX-35 for the 12 V race and Optima Yellow Top SC35DA for the 24 V race only. No modifications have been made to the batteries	
<input type="checkbox"/> Batteries must be firmly secured to the chassis with a metal bracket, a ratchet strap, or are otherwise strongly secured. In the event of a collision, the battery must not move.	
<input type="checkbox"/> There must be an Emergency Power Off switch on the vehicle, accessible to the driver and emergency workers outside the car.	
<input type="checkbox"/> The braking system must be designed to provide stability (equal braking on both sides of the vehicle) and redundancy (vehicle can still be stopped in event of brake component failure). This is normally achieved using brakes fitted to two wheels of the same axle – either two on the front or two on the back, depending on vehicle configuration. The two braking systems must have separate actuation systems (cables or master cylinders). The vehicle must not roll if the brakes are applied.	
<input type="checkbox"/> Cotter pins or safety wire must be used to secure the wheel axle nut.	
<input type="checkbox"/> All chains, sprockets, belts or pulleys in the vehicle drive train must be safeguarded to prevent injury to the driver or any member of the team. Strong material i.e. steel, aluminum, or Lexan must be used in constructing the guards. The guards should cover all moving parts in such a way that a finger or hand cannot reach them.	
<input type="checkbox"/> The vehicle must have a steel or aluminum roll bar mounted to the frame in such a manner as to prevent collapsing or breakage. The bar must be at least 50 mm above the top of the tallest driver's helmet when seated in race position. The roll bar must be braced either forward or rearward to the frame of the vehicle. It must provide protection for the driver head throughout the full range of possible movement.	
<input type="checkbox"/> The driver must wear a helmet that is DOT approved for motorcycles. Eye protection – shield, goggles or safety glasses – is required.	
<input type="checkbox"/> The driver must be able to exit the car independently in less than 1 minute	