



# Competition Rules & Scoring

February 18, 2017 rev.1

## TABLE OF CONTENTS

<b>INTRODUCTION.....</b>	<b>2</b>
<b>PRIUS CHALLENGE COMPETITION RULES &amp; SCORING SUMMARY .....</b>	<b>2</b>
<b>COURSE DESCRIPTION.....</b>	<b>3</b>
COURSE CONFIGURATION .....	3
TRACK ENTRY .....	3
COOL PITS.....	4
PIT ROW .....	4
COURSE ENTRY .....	5
COURSE EXIT .....	5
FLAGS .....	5
<b>IN-CAR REGULATIONS.....</b>	<b>7</b>
TEAM MEMBER ROLES.....	7
UMPIRES .....	7
<b>DRIVING PROCEDURES AND RULES .....</b>	<b>8</b>
GENERAL.....	8
STAGING .....	8
COURSE ENTRY .....	9
WARM UP.....	9
GRID (STARTING) POSITIONS.....	9
START.....	9
LAPPING .....	9
DRIVER CHANGES .....	10
FINISH .....	11
<b>SCORING .....</b>	<b>12</b>
OVERALL WINNER.....	12
PENALTIES .....	12
VIOLATIONS .....	12

## Introduction

The Prius Challenge is an invitational event for leaders and practitioners inspired by big data analysis, machine learning, strategic formulation, and transportation. The event is presented by Toyota Research Institute as part of their Onramp event series.

The event challenges individuals and teams to drive a hybrid Toyota Prius around the famed Sonoma Raceway to achieve the highest miles per gallon efficiency possible. Teams in Toyota supplied cars will lap the race course for a predetermined distance within an allotted time. The overall winner will be the team with the highest cumulative MPG rating.

Teams may compete without any pre-event preparation or they may choose to use the TRI provided cloud-driven application and vehicle performance database to create simulations and event-day strategies. Additional tools provided by Toyota Research Institute will allow the teams to access, evaluate, and modify these strategies during the competition to refine their strategies, maximize efficiencies, and adjust for real-world parameters.

Toyota Research Institute hopes this challenge will showcase, broaden, and enlighten the intersection of technology application & transportation in a fun, competitive, and real-world atmosphere.

Additional information can be found at <http://priuschallenge.toyotaonramp.com>

Toyota Research Institute is lead by CEO, Dr. Gill Pratt.

## Prius Challenge Competition Rules & Scoring Summary

The Competition Rules & Scoring defines Toyota Research Institute's Prius Challenge on-track competition rules and scoring for the March 2 & 3, 2017 events only.

This document augments the event organizer's event procedures and serves two goals:

1. Increasing safety standards for competitors, staff, organizers, and all attendees on the race track, and
2. Providing a fair and competitive on-track experience for all competitors.

If any conflicts are found in this document, the more stringent or higher impact interpretation shall prevail.

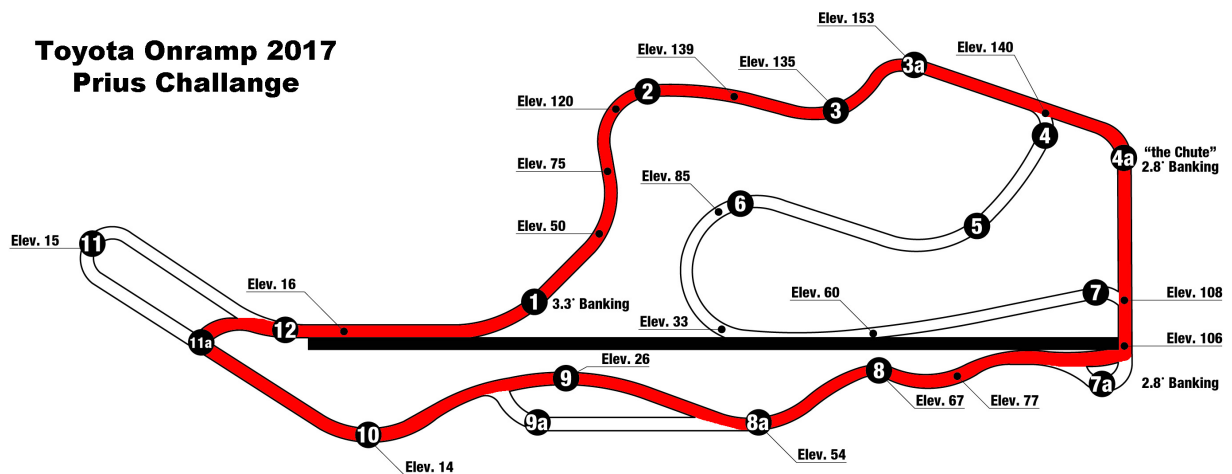
All participants shall sign all required waivers prior to participating.

## Course Description

The Onramp 2017 Prius Challenge event will be held at Sonoma Raceway (29355 Arnold Drive, Sonoma, California). The overall event will utilize the amenities of the raceway including the race course, hospitality, meeting rooms, grandstands, vehicular garages for Prius Challenge cars, the paddock, and the paved visitor parking areas. This document relates only to the competition event held on the race course.

### Course Configuration

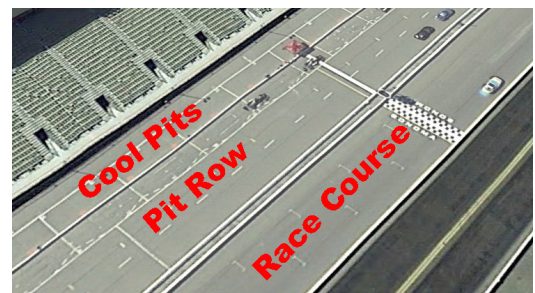
The on-track Prius Challenge will be run on the Race Course in the standard clockwise direction. The complete track is shown below and the Prius Challenge course configuration is shown in red.



Way-finding cones blocking unused routes and access will be placed to guide drivers to the official Prius Challenge course.

Only Prius Challenge cars, safety vehicles, and steward vehicle(s) will be allowed on-track immediately prior and during the challenge events. On-track includes the Race Course, Pit Row, and the Cool Pits.

The image at the right defines the Cool Pits and Pit Row for the Prius Challenge. This definition will equally apply to the area behind the garage buildings. Sonoma Raceway provides a narrow concrete barrier between the Cool Pits and Pit Row to define limits for both. The Raceway also provides two concrete barriers to define the limits of the Pit Row and the Race Course. No person shall stand on any concrete barrier.



### Track Entry

All persons crossing the main track entry gate (located adjacent to the podium and media center) must wear a visible non-reusable wristband on the right wrist, where possible. Wristbands will be provided by the event organizer at the time of the Onramp Prius Challenge waiver acceptance.

At all times during the event, the main vehicular entry gate to the race track shall remain open for safety and emergency vehicles only—no other vehicles will be allowed entry immediately prior and during the competition. The event organizer shall provide an attendant to control vehicular access at all times.

All other vehicular track entry gates shall be closed for the duration of the event. Gates that are not securely closed with locks will require an attendant provided by the event organizer.

#### Cool Pits

Only safety vehicles and steward vehicle(s) will be allowed to park at the north end of the Cool Pits in front of the media building and in front of track entry only. These vehicles shall be positioned to allow direct and immediate access to Pit Row. No other cars will be allowed in the Cool Pits.

All participants must remain in the cool pits except to immediately enter or exit the Prius Challenge competition cars. The only other permissible people allowed in pit row will be safety team members, umpires, staff, and pre-approved press and photographers.

#### Pit Row

Pit row will begin after Turn-11a (at the traditional course exit) and end after passing the pit-entry steward prior to the Course Entry.

Only Prius Challenge cars, safety vehicles, and steward vehicle(s) will be allowed on Pit Row. Vehicles provided by Toyota for demonstration purposes will not be allowed in Pit Row immediately prior or during the challenge events. At no times, will participants, spectators, attendees, or any car besides vehicles cleared by the Track Steward be allowed on Pit Row.

Two speed limits will exist for Pit Row. No competitor car shall exceed 30 MPH in the initial section (highlighted in orange), and no competitor car shall exceed 15 MPH in the secondary section (highlighted in red).



Passing in Pit Row is allowed when safe and only on straight sections. All Passing in Pit Row shall be performed on the right (faster car on right, slower car on left). No car shall pass another moving car attempting to pass another moving car. It is the faster car's responsibility to initiate and complete a safe pass. In-car umpires have the discretion to deny or direct passes to promote safety.

Pit Row will be used to stage Challenge cars immediately prior and after the challenge events. Challenge cars will be staged in the pre-designated pit boxes by the event staff. One pit box space will be provided for each car.

Only the safety crew, stewards, staff, and umpires are allowed to be outside the Pit Boxes in Pit Row.

### Course Entry

Track entry will be the standard configuration, beginning at the end of pit row and entering the track between Turn-1 & Turn-2. A pit-exit steward will be posted as a courtesy to the drivers however, in the spirit of providing a fair competitive atmosphere, the steward will not be limiting access however cars may not enter the course if there is no pit-exit steward present at the pit-exit steward station.

A row of cones shall be placed between T1 and the T1a and will delineate a formal separation between lapping cars and cars entering the track. This separation will provide a visible path for safety and a blending line allowing entering cars to reach a common and safe merge speed. This blending line also provides two clear driving lines merging together in a safer zone.

It is the ultimate responsibility of both teams to blend safely.

### Course Exit

The standard pit-entry on drivers-left between Turn-11a & Turn-11 will be utilized. Drivers will be required to provide a Hand-Signal prior to entering the Course Exit. The Hand-Signal shall be the left arm out the driver's side window with the upper arm parallel to the ground, the forearm extended straight up, and the hand in an open palm configuration.

### Flags

Selected corner worker stations will be staffed by professional corner workers. Corner workers will use flags to visually communicate safety related information to the driver and in-car team members. All in-car team members shall know the meaning and course-of-actions for all flags. It is the responsibility of the driver and in-car team members to see the flags and respond appropriately.

The following flags may be utilized:

Green Flag:	Signals the beginning of the competition or the restart in the event the competition is temporarily stopped. Except for immediate safety reasons, cars must begin or maintain movement upon the waiving of the green flag. This is a command flag signaling that action must be taken.
Yellow Flag:	Signals an unplanned and potentially dangerous incident has occurred on-track. No overtaking will be allowed until passing the next corner worker without a yellow flag. Cars should be prepared to stop safely. This is a command flag signaling that action must be taken.
Waiving Yellow Flag:	Similar to a Yellow flag but signals increased urgency and immediacy. Waiving Yellow Flags will be displayed immediately before an incident. A Waiving Yellow Flag may be converted to a (non-waving) Yellow Flag if the incident remains for one lap without a safety escalation.
Red Flag:	Signals that an unplanned and potentially dangerous, urgent incident has occurred on-track. Cars must cautiously come to a safe, non-abrupt stop unless immediate safety concerns dictate otherwise. This is a command flag signaling that action must be taken.
Black Flag, Furled:	Signals a warning that the driver or car has performed in a manner that is undesirable. Continued performance may lead to a Black Flag or Penalty.
Black Flag:	Signals that the driver or car has performed in a manner that does not meet a safety, sportsmanship, or other rule or standard practice. The car must safely enter the

	Course Exit and speak to an Umpire in Pit Row. This is a command flag signaling that action must be taken. Black flags may result in penalties.
Passing Flag:	A blue flag with a yellow diagonal line. A faster car may be approaching and may intend to pass. This flag is displayed as a courtesy and may not be utilized in every occurrence. This is an advisory flag.
White Flag:	A non-competing car may be on the race track and may be travelling at a pace faster or slower than competing cars. This is an advisory flag.
Checkered Flag:	Communicates that the maximum allotted time period has or will soon expire, and that all remaining cars on-track shall proceed to the Course Exit at the next available opportunity. Unlike traditional races, this checkered flag might not indicate the end of the competition.

While it is the responsibility of the driver and team to see, understand, and react to all flags, in-car umpires may offer assistance to in-car team members.

## In-car Regulations

### Team Member Roles

Each car will carry a maximum of three team members. Every member in a Prius Challenge vehicle must correctly wear a helmet, closed toe & flat bottom shoes, and a seatbelt. Team members may assume more than one role but may only assume one role at a time while in a car.

All team members must attend a safety briefing prior to being on-track. Team members are encouraged to ask questions and umpires will be available to clarify rules at this meeting.

There shall be no eating, drinking, or smoking in the car. There shall be no alcohol or drug use at the event.

### Driver

The driver must be an individual licensed to operate a motor vehicle in the United States or by prior arrangement with the event organizers. Only the driver may operate the Prius Challenge vehicle; no other person may operate any switchgear that controls the Prius Challenge vehicle including the steering wheel, the gas pedal, the transmission, the “EV” switch, or any controls that have a direct impact on fuel efficiency, safety, or performance.

All drivers must successfully complete a classroom and in-car familiarization course to be held the morning of the event; drivers successfully completing the familiarization course will be awarded a non-reusable wristband that shall be worn on the left wrist throughout the event.

The driver is not allowed to operate or use any personal or non-factory installed electronic devices including heads-up displays (HUD) during the event. All personal electronic devices in or near the possession of the driver shall be powered off.

### Strategist

The strategist shall be seated in the front passenger seat and will be the only team member allowed to directly communicate with the driver for non-safety related issues. The role of the strategist is to provide verbal instructions, competition strategy, and feedback to the driver. The strategist may use any number of personal electronic devices but may only communicate with others through direct verbal dialogue. The strategist is not allowed to use any electronic device to communicate with anyone else. The strategist is allowed to use electronic devices to access Onramp provided strategy tools and information.

### Communicator

The communicator shall be seated in the driver’s side rear passenger seat and shall not communicate with the driver except for safety related issues. The communicator is the only team member allowed to operate a cellular phone or other electronic device to wirelessly communicate with any non-in-car team member.

### Umpires

An event umpire shall be seated in the passenger-side rear seat. The role of the umpire is to witness the team’s performance, adherence to competition rules, and levy penalties for infractions. The umpire may, but is not obligated to, remind team members of rules and provide assistance in avoiding penalties. The umpire may also make demands on the driver with regard to safety—disregarded demands may result in penalties determined by the umpires or competition steward and may be as severe as immediate elimination from participation or competition. All demands of the umpire must be followed.



## Driving Procedures and Rules

Rules and protocols for each section or phase of driving.

### General

Team members may not disable any stability, traction, ABS, Toyota Safety Sense™ systems, or other safety enhancing systems. Team members may change all other consumer operable setting, as described in the owner's operation manual, while inside the cabin of the car. Team members shall not alter, touch, or influence any electronics installed by Toyota Research Institute or any third party provider.

All operable side windows shall be open at all times. In the event of rain, the track steward may approve closed windows.

Headlights shall be in the on position at all times. The in-car umpire may approve the use of hazard lights to indicate a problem with the car. High-beam lamps shall not be used at anytime. Turn indicator/signal lamps shall not be used at anytime. Horns shall not be used at anytime.

Umpires will adjust tire pressures to 45 PSI; teams shall not alter tire pressures. Fuel will be top-offed to full by umpires; teams shall not remove or alter fuel. No physical changes shall be allowed to the car—this includes any modifications to alter fuel consumption, weight, aerodynamics, mechanical grip, output power or any other changes whether performance enhancing or not performance enhancing.

Forceful Charging is defined as applying both the brakes and the throttle at the same time. Forceful Charging is not allowed when the car is moving or during driver changes.

Drivers shall follow the process to signal entry to Course Exit. In all other circumstances, all in-car team members must keep all body parts inside the car at all times.

### Staging

Prior to the competitor's access, all Prius Challenge Cars will be staged on Pit Row in an assigned team Pit Box. The state-of-charge (SOC) for each car will be recharged by the umpires prior to leaving the pits.

Sonoma Raceway's Pit Row provides 22 painted pit boxes in front of the main grandstand. For the Prius Challenge, each car/team will be provided two adjacent pit spaces to form one large Pit Box to stage and complete driver changes. The two spaces will provide a larger area and increased safety for cars entering and exiting the combined larger pit boxes.

Prior to starting their vehicle, all team members will be properly seated and all other people, with the exception of safety crews and umpires, will be out of Pit Row. Cars may be started but drive mode shall not be engaged.

All cars will remain in their Pit Box and shall not move until a confirmation by an umpire that all cars have started. Cars will leave their Pit Boxes and proceed through pit row in the same order as their Pit Box. There will be no overtaking of any cars, whether stationary or moving—an exception may be granted or directed by the in-car umpire. Cars will travel down Pit Row at a speed no greater than the pit row speed limit until passing the pit-exit steward. Cars will proceed to Course Entry and follow Course Entry procedures.

This phase will not be used in the fuel efficiency calculation for the competition.

### Course Entry

Course Entry procedures begin after the pit-exit steward. Cars will stay to the left of the blend cones and reach a speed to safely blend with any potential lapping traffic. All in-car members of the team will assist the driver to enter the course safely.

The initial course entry (prior to Grid) will not be used in the fuel efficiency calculation for the competition.

### Warm up

Cars will continue for almost one lap. All cars shall remain moving in the forward direction unless immediately required for safety, or approved or directed by an umpire. Car will not pass other cars unless verbally approved or directed by the in-car umpire. The warm up lap may be used to prepare the car for the competition including safe driving techniques to replenish the car's SOC. After completing Turn-10, no car shall exceed 10 MPH and every car shall be prepared to stop before the start/finish line. The safety crew or umpire may assist cars to stop at their pre-designated Grid (Starting) position.

This phase will not be used in the fuel efficiency calculation for the competition.

### Grid (Starting) Positions

The Sonoma Raceway painted Grid indicators will be utilized. This grid pattern is a staggered arrangement and provides useful visibility down the race course.

The car's ignition shall remain in the "running" mode. The strategist shall reset the Prius onboard MPG indicator immediately prior to the start of the competition; the onboard MPG indicator shall not be reset, manipulated, or altered after the beginning of the competition. The official MPG data will be reset and managed by the Prius Challenge technical team. The driver may continue to use this time to replenish the car's SOC. Cars will remain in the Grid for a minimum of one minute after the last car has stopped in their Grid position.

This phase will not be used in the fuel efficiency calculation for the competition.

### Start

A flag person, located at the start/finish tower will vigorously wave a green flag to start the Prius Challenge competition. Immediately after the green flag, all cars must begin moving. No car shall start with an abrupt acceleration. Drivers shall be responsible for a safe start and to maintain a minimum ten-foot open distance in every direction, from any other car.

Fuel efficiency calculations for the competition will begin when the green flag is displayed.

### Lapping

All cars shall remain moving in the forward direction unless immediately required for safety, or approved or directed by an umpire. No car may stop, move counter to the course direction, or move in reverse.

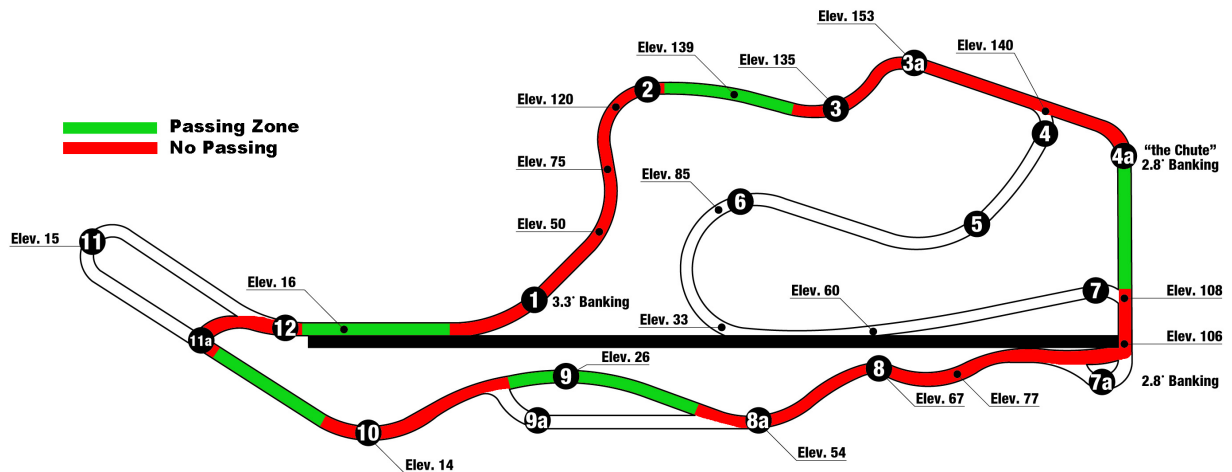
All cars must stay on the pavement. No car or portion of the car shall leave the pavement. All cars shall obey wayfinding cones and shall not encroach areas designated as off-limits.

No car may exceed the maximum Top Speed of 65 MPH.

All drivers shall provide a minimum distance from any other car. It is the faster car's responsibility to initiate the minimum distance but every car has the responsibility to maintain minimum distance. The minimum distances shall be: 20-feet clear in front, 20-feet clear in back, 10-feet clear on both sides.

All lapping cars traveling through Turn-1 to Turn-2 must stay to the right of the Course Entry blend cones and allow course entry cars to blend onto the race course safely.

Passes shall only be performed at designed straightaway and in accordance with the passing zones shown below. In-car umpires have the discretion to approve or direct additional passes for safety reasons.



All drivers leaving the course via the course exit must signal with the left arm out the driver's side window, the upper arm parallel to the ground, the forearm extended straight up, and the hand in an open palm configuration.

### Driver Changes

A minimum of two Driver Changes is required. All drivers must drive a minimum of one lap per change. A minimum of three unique drivers must be utilized. No driver shall drive for more than one continuous session. Driver Changes must occur in the team's assigned Pit Box on Pit Row. All car doors must remain closed and all team members in the car must remain seated and belted until the car has come to a full stop, the transmission is in Park, and the emergency brake is engaged. Incoming team members may only enter the Pit Box after the driver's car door is opened. Strategist and Communication members may change during the Driver Change but are not required to do so. Only incoming and outgoing team members may enter the pit row and all must remain within the team's assigned Pit Box. Outgoing team members may assist incoming team members with seat belts, transfer of helmets, and other equipment. The transmission may only leave Park and the emergency brake may only be released after all team members have left pit row.

To reduce the stress of Driver Changes, the transmission must be in Park and the emergency brake must be engaged for a minimum of 30 seconds.

Cars and in-car team members leaving the Pit Box are responsible for the safe blending into Pit Row and oncoming traffic.

Driver changes in Pit Row shall follow all Pit Row rules including maximum speed and passing.

#### Finish

The target time for completion (from green flag start to parked in the pit box finish) is 40 minutes to 42 minutes.

For the purposes of maintaining the event schedule, on the ninth lap or after 45 minutes from the start, each car shall enter the Course Exit and proceed to their respective Pit Box. It is the team's responsibility to safely travel through the Course Exit and Pit Row.

For the purposes of maintaining the event schedule, all cars must end the competition and be stopped in their own team's Pit Box within the Maximum Allotted Time of 50 minutes of the start of the competition.

Cars will travel down Pit Row and must observe all Pit Row rules including passing and speed limits.

Each team's effort is completed when their car comes to a complete stop, their transmission is in Park mode, and the ignition is in the off mode. Competition timing for will stop at this time.

All team members in the car must remain seated and belted until the car has come to a full stop and the car's ignition is turned off. The Umpire will signal the team members to safely leave their car. Team members must exit the car by staying in the boundaries of their Pit Box, and return directly to the cool pits without stopping.

## Scoring

### Overall Winner

The overall winner will be the team that finishes with the highest Overall Miles-Per-Gallon rating for a complete session. The Base MPG efficiency will be calculated by the Hyperdrive Scoring System and penalties will be assessed to the Base MPG efficiency to calculate the Overall MPG rating.

The following Penalties and Violations

### Penalties

*Stop-&-Go Penalty:* A Stop-&-Go penalty will be communicated to individual cars by the in-car Umpire. This penalty is non-negotiable. Cars levied with a Stop-&-Go shall proceed to the Course Exit at the next available opportunity. Cars will drive through Pit Row, observing all Pit Row rules, and stop at the Track Steward station. The Track Steward may speak with the Driver and may release the car—the car shall proceed to the Course Entry. If a Stop-&-Go penalty is levied during the last lap, an Efficiency Penalty of up to 15 MPG will be assessed in lieu of the Stop-&-Go penalty. No additional activity, including Driver Changes, may be performed during a Stop-&-Go penalty.

*Efficiency Penalty:* An efficiency penalty will be expressed in MPG and be subtracted from the Base MPG rating.

*Disqualification & Expulsion Penalties:* A team or team member may be removed from competition for serious infractions or infractions breaking the spirit of competition or fairness. A team or team member may be removed from the event for severe infractions or infractions breaking the spirit of safety. Disqualification & Expulsion Penalties are non-negotiable and final.

### Violations

Efficiency Penalties for the following Violations are estimates. Actual Efficiency Penalties will be published at a later date.

*Pit Row Lane Speed:* Cars that exceed the Pit Row lane speed (30 MPH & 15 MPH per Course Description, Pit Row) will be levied an Efficiency Penalty of 1 MPG for every second of infraction. Umpires may remind teams of speed limits at any time.

Cars that exceed the Pit Row lane speed by 20% will be levied an Efficiency Penalty of 0.5 MPG for every second of infraction, up to 5 seconds per lap. Speeds in excess of 20% or beyond 5 seconds per lap will be assessed an Efficiency Penalty of 5 MPG for every second. Umpires may remind teams of speed limits at any time.

*Unpermitted course entry:* Any car entering the course during the practice or competition when no pit-exit steward is present will be assessed an Efficiency Penalty of 20 MPG. Any car entering the course at any other time will be assessed a Disqualification Penalty.

*False start:* At the start of the competition, any car starting before the Green Flag will be assessed an Efficiency Penalty of 2 MPG.

*Blend line violations, track entry:* Any car entering the course and crossing the blend line will be assessed a Stop-&-Go penalty for the first two infraction. The third infraction will result in a Disqualification Penalty.

*Blend line violations, lapping:* Any lapping car crossing the blend line will be assessed an Efficiency Penalty of 1 MPG per incident.

*Top speed:* Any car traveling in excess of the Top Speed (65 MPH per Driving Procedures and Rules, Lapping) will be assessed an Efficiency Penalty of 2 MPG per second of infraction.

*Proximity:* Any car approaching another car and encroaching within the minimum open distance (distance between two car) will be assessed an Efficiency Penalty of 5 MPG per infraction.

*Course exit signal:* Any car entering the Course Exit without providing a Hand-Signal will be assessed an Efficiency Penalty of 2 MPG per infraction.

*Encroachment of competitor's Pit Box:* Any car entering another competitor's Pit Box on Pit Row shall be assessed one Stop-&-Go penalty per occurrence.

*Driver Change:* Every infraction of the Driver Changes rules will be assessed an Efficiency Penalty of 5 MPG per infraction.

*Minimum and Maximum Allotted Time:* Any car completing the challenge outside of the target window of 40:01 to 42:00 minutes will be assessed an Efficiency Penalty in accordance to the schedule below. Any car completing the challenge outside of the target window of 35:01 to 50:00 minutes will be disqualified.

Time	Under 35:01	35:01 - 36:00	36:01 - 37:00	37:01 - 38:00	38:01 - 39:00	39:01 - 40:00
Penalty	Disqualification	25 MPG	20 MPG	15 MPG	10 MPG	5 MPG

Time	40:01 - 42:00
-	Target Window

Time	42:01 - 42:30	42:31 - 43:00	43:01 - 43:30	43:31 - 44:00	44:01 - 44:30	44:31 - 45:00
Penalty	2 MPG	4 MPG	6 MPG	8 MPG	10 MPG	12 MPG

Time	45:01 - 46:00	46:01 - 47:00	47:01 - 48:00	48:01 - 49:00	49:01 - 50:00	Over 50:00
Penalty	15 MPG	20 MPG	25 MPG	30 MPG	35 MPG	Disqualification

*Personal Electronic Devices:* Any personal electronic device directly providing information to the driver or operated by the driver will be assessed a Disqualification Penalty.