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## EVENTS

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## AWARDS

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ADVICE, EXPECTATIONS & POLICIES:

ASK QUESTIONS – If you have a question – ask! If you have any questions about any part of the competition, the schedule, the procedures, the Rules or anything else, ask one of the officials. The first place to bring questions is to the volunteers at the Information Table. Rules questions may be presented to the technical inspectors. If we can’t give you an immediate answer, (confession – we don’t know everything) we know where to find the answer. It all starts with asking and, remember, there are no dumb questions.

ANNOUNCEMENTS - Although we have loudspeakers in the garages, it can be difficult for announcements to be heard with the amount of activity taking place. You can help us make sure everyone knows what’s being announced by passing the announcements along to your team mates and others teams in your area. This is important and we appreciate your help. Also, if you need to make an announcement, go to the Information Table and, please, write down exactly what you’d like the volunteer to announce.

BE ON TIME- The schedule is included in the Event Guide and posted online. It is your responsibility to be on time and aware of event schedule changes announced.

DON’T RUN– Running tells people there’s an emergency. Don’t run unless life or limb is in danger.

LUNCHES
Volunteers will be provided lunches. Vouchers will be given during registration and will be available for pick up in the Information Table.

Teams will be responsible for providing their own lunches on all days. Teams may bring food but may not cook in the paddocks. The Infield Restaurant will be open Mon. – Thurs. from 7:30 a.m. to ~2:00 p.m.

DINNER
Pizza and Platinum Sponsor presentation on Monday evening. Please be respectful and, if you come for food, stay for the presentations.

BBQ on Wednesday night hosted by the Dartmouth Society of Engineers – all welcome, including your vising fans.

SCHOOL DAY
Tuesday 10am – 1pm
Middle and high school students will be touring the Speedway to learn about team vehicles. Each group will be accompanied by a SAE tour guide. Please have at least one assigned person available to speak about your project. Thank you!
ADVICE, EXPECTATIONS & POLICIES:

SOCIAL MEDIA – #FormulaHybrid16

RESTROOMS – Are available for students and visitors inside the restaurant and through the outside doors of the Media Center. Bathrooms inside the Media Center are for officials only. There are also bathrooms with showers (for camping) available on the south side of the infield - see the Overview Map.

MEDIA CENTER – The Media Center is for officials and scheduled team activities, such as presentations. Teams should only enter the media center to ask officials questions, to use the computer stations, and for scheduled presentations. Teams may also use one of the designated rooms for taking proctored final exams. Food and beverages in the Media Center are for officials only!

POSTING OF EVENT SCORES & SCHEDULES - in the Media Center window closest to the Fuel Station

CAR TESTING
No competition vehicles may operate under power prior to passing tech. inspection. Once your vehicle has passed all the safety inspections, you may utilize the vehicle test area.

MANDATORY ELECTRIC SAFETY CLASS
Monday at 5:00 p.m., Center Garage, Bay 25 | All students are required to attend

MANDATORY DRIVERS MEETING
Tuesday at 5:00 p.m. in N. Garage, Bay 8 | Mandatory for all drivers

DRONES | forbidden at NHMS

SAFETY GLASSES | must be worn within 10 feet of a vehicle that is actively being worked on

VEHICLE SHIPPING | is each team’s responsibility - see the Vehicle Shipping page on the FH website

HAZARDOUS WASTE | dispose of it properly! There is a hazardous waste facility in the infield. See the Infield Map in the Event Guide. Stickers are in team packets. Leave your well-marked waste container at the door and phone the number on the sign. No drink containers, please.
RULES OF CONDUCT

Teams are permitted to work in the garages 24 hours/day, however quiet hours must be observed from 9:00 PM - 7:30 AM. Cooking and camping are NOT permitted inside the garages.

*Human-powered transport is permitted. There is a 15 MPH speed limit for all travel in the infield, both motorized and human-powered.*

Keep vehicles clear of the fire lane (the painted line parallel to the garage entrances).

**PADDOCKS** – Each team will be assigned half of a garage space, which is the same paddock space in which NASCAR teams operate. Be courteous to your neighbors by keeping your area clean. Based on availability, organizers may decide to rework the layout on Monday evening. Any updates will be posted in the Media Center window.

**KEEP YOUR PADDOCKS CLEAN**– All of us are responsible for keeping the parts of the NHMS used for FH clean. Trash cans are provided in the paddocks and throughout the site. If you need trash bags we have them available - just ask at the Information Table. Please keep your paddock clean and make sure it is completely clear before your team leaves at the end of each day in addition to the end of event. PLEASE DO NOT leave any furniture, used tires, etc. behind.

**CAMPING** – Thanks to the generosity of the Speedway, camping is permitted onsite during the nights of the Formula Hybrid competition. Please use the designated camping spaces on the Overview Map. Contact officials if you would like to request a longer camping period, outside of the scheduled event. Power and bathrooms with showers are available at the camping sites. Please be respectful and leave your site impeccable when you leave.

CONTACT INFORMATION

The Information Tent is the central contact point for teams and volunteers regarding all issues concerning the event and will be staffed by volunteers with radios and a contact list.

**FORMULA HYBRID OFFICIALS:**
Doug Fraser, Director
Amy Keeler, Associate Director
Dr. Rob Wills, Chief Electrical Tech Inspector
Douglas Van Citters, Chief Mechanical Tech Inspector
Robert Wimmer, Chief Design Judge
Kris MacCartney, Chief Presentation Judge
Michael Royce, Clerk of the Course
DAILY OPERATIONS
Refer to the Infield Map for locations

TECH DAY
Optional Electrical Tech Inspection
SUNDAY, MAY 1 | NHMS PARKING LOT
Registration 8AM – 10AM
Technical Inspection 10AM – 4PM

REGISTRATION
Mon – Thurs 8AM – 2PM

TEST EQUITY EQUIPMENT LOANS
In the Electrical Tech Building Monday - Wednesday

TRAM SERVICE FOR ENDURANCE SPECTATORS
Travels from Info Table to road coarse bleachers
(look for the signs)
Thursday 8:30AM – 3:30PM

ELECTRICAL TECH INSPECTION
Mon 10AM – 5PM
Tues 9AM – 5PM
Wed 9AM – 3PM
Thurs 9AM – noon

MECHANICAL TECH INSPECTION
(INCLUDING: TILT/NOISE/BRAKE TESTS & *SCALES)
*Cars must be weighed prior to design event
Mon 1 – 5PM
Tues 9:30AM – 12PM/1 – 4:30PM
Wed & Thurs by appointment

FUEL STATION
Tues 9:30AM – 12PM/1 – 4:30PM
Wed 9AM – 12PM/1 – 3:30PM
Thurs 8:30AM – 12PM/1 – 3PM

PRACTICE AREA
Mon 12 – 4PM
Tues 10AM – 12PM/1 – 4PM
Wed 10AM – 12PM/1 – 4PM

WELDING | See the Information Table for assistance
RECRUITING PRESENTATIONS

CAREER-ADVANCING OPPORTUNITIES

Monday, May 2
6PM | media center
pizza provided
HOW TO PREPARE FOR ELECTRICAL TECH INSPECTION
You've made sure your car meets all the rules, but you've heard that electrical tech inspection is hard to pass. Believe it or not, the Inspectors fondest wish is for every car to pass electric tech quickly and easily. If you can make it easy for them to see that your car clearly meets the rules, everybody will be pleased.
The Inspectors will be asking many very specific questions. Some examples are given below. If you can answer them, that will expedite the process. If you don't know the answer to something, that's OK. The Inspectors will work with you and your team – this is an educational event.
If there is something deficient on the car or something you are unsure of, bring it to the attention of the Inspectors as soon as possible. Their goal is to help you find the easiest way to resolve the problem to make your car safe and rules-compliant.

WHAT TO EXPECT
Here are some of the things you can expect during the inspection, and ways to help make sure it will go quickly and smoothly. This is not a complete list of points that will be inspected or questions you will be asked. Rather, it focuses on questions that often arise and problems that are easy to overlook.

DOCUMENTATION
Have your documentation ready and up to date.

A clear and up-to-date tractive-system schematic is essential; the inspectors will be referring to it throughout the inspection. If you've changed things, or realized that it's not represented correctly, make corrections by hand before you come to inspection.

Documentation could be on paper or in a computer, but finding files on a computer can slow down the process, and can be harder for several people to look at together. So use a large format printer if possible, and use color to help differentiate between GLV and Tractive circuits.

Inspectors often want to look at spec sheets for insulating materials and fuses—make sure you can access those quickly. Keeping all your spec sheets in three-ring binders with clearly labeled dividers will help move things along more quickly.

ISOLATION
A key inspection area is segregation of tractive system wiring and GLV system wiring (FH Rules - EV4). Here are some of the questions inspectors will ask you. You prepare for this ahead of time by making it a competition. Split into two teams, and take turns asking questions. Whoever is first to ask a question the other team can't answer wins.

Why is segregation between the TS & GLV system important?
An inspector will point to a wire or other conductor and ask whether it's a GLV system wire or a tractive system wire. You should be able to immediately and definitively answer that question for any wire in the system.

There should not be any wires that don't clearly fit into one category or the other. For example, it doesn't matter for the purposes of the rules that a part of the tractive system only carries 12V. If it's electrically connected to the tractive system, it's a tractive system wire and must meet all the rules requirements for tractive system wires. If you have questions about whether a given system is tractive or GLV, ask before you get your car inspected, because the segregation needs to be constructed according to which category the wires are in.

If two wires are near each other, one TS and one GLV, an inspector will ask "how are they segregated". There are only two correct answers to this question: "by spacing", or "with a barrier." Make sure there's a clear answer to that question for any pair of nearby wires (or other conductors). And be prepared for the corresponding follow-ups:

If the segregation is by spacing, the inspector will pull or push on the wire with a non-conductive probe, to make sure the spacing will be maintained as the car bounces around. It should not be possible to pull the wires any closer than the specs given in EV4.1.5 (see also EV4.1.6).

If the segregation is with a barrier, the inspector will want to know what the barrier is made of. You'll want to be ready to pull out a spec sheet showing that it's rated for the necessary voltage and 150 C. Note that this is in addition to the wire insulation.
PREPARE FOR ELECTRICAL TECH

ISOLATION CONTINUED

Any place there is a signal that goes from the tractive system to the GLV system, or vice versa, you need some kind of isolated signal transfer device that transfers the signal by some other means—optically, magnetically, etc. Inspectors will ask you where that isolation happens, and you should be able to pinpoint the location, and provide a datasheet for whatever device provides the isolation. For example, a battery monitoring system has to connect to the tractive system to monitor the batteries, but also connect to the GLV system to interface with the shutdown circuit. So somewhere between those ends of the system there must be isolation. The location of that isolation defines which wires are GLV and which are part of the tractive system.

For a team-built circuit board, you should have a spare empty board ready for the inspectors to look at. If you are relying on the "under coating" spec in Table 14, you'll need to have specifications ready for the coating used.

FUSING

A key fusing inspection point is anywhere a small wire connects to a big wire. The small wire has a lower current rating, and the fuse that protects the big wire is usually rated for too high a current for the small wire. So unless the big wire is protected by a low-current fuse, there needs to be a lower-current fuse right where the smaller wire branches off.

Fuse ratings need to match wire sizes. From a rules and safety inspection point of view, the inspectors are never interested in how much current flows through a wire in normal operation. The wire only needs to be big enough to carry the current corresponding to the continuous fuse rating. How much current you actually run through the wire is not part of the rules or the inspection.

Fuses need to be rated for the system voltage of the system they protect. Most fuses are only rated for AC voltage, and you need a fuse rated for the right DC voltage. Plan to be able to demonstrate that all your fuses have the right DC voltage rating. If a DC voltage rating isn't clearly visible on the fuse, you'll be asked to pull out the spec sheet.

Teams sometimes have the main fuses carefully selected but miss this spec on branch fuses.

In the normal operation of a charger, the charger is the energy source. However, if there is a short in that wiring, the battery can source a much larger current. Thus, the battery end of a charging wire needs to be fused.

CONDUIT PULL TEST

If any of your conduit fittings look questionable, a spring scale will be attached to the conduit or conduit fittings, and pulled until it reads 200 N (45 lbs.). There are two criteria for passing the test:

- Nothing breaks or comes apart.
- The pull doesn't transfer to the wire and pull on the electrical connections. The wire should stay slack while the conduit takes the stain.

You can try this yourself, with a $7.50 scale from Walmart

http://www.walmart.com/ip/Protege-Luggage-Scale-and-Tape-Measure/17472591

BOLTED ELECTRICAL CONNECTIONS

Make sure your bolted connections follow EV4.5.11:

- Are all tight. The purpose of a bolt in the bolted high-current electrical connection is not just to bring the conductors in contact with each other. Serious force is needed to get low resistance in a high-current connection.
- Do not have plastic in the stack-up. Consider a scenario in which the connection gets hot and the plastic softens. The connection then has less pressure on it, and so its resistance goes up. This process continues until the plastic is smoking. In other words, all the parts compressed by the bolt must be metal.
- Do not have steel washers between the Cu (or Al) conductors you are connecting. Steel has an order of magnitude higher resistivity than conductor materials and will overheat.

_We look forward to working with you at the track – the Formula-Hybrid Tech Inspection Team._
All incidents will be covered by EMTs in on-site ambulances.

To expedite matters in case of serious accident or injury after-hours, call 911. This number works from all land lines as well as mobile and coin-operated phones. It is always free of charge.

Defibrillators and Emergency eyewash stations are located inside the paddocks. See the Infield Map.

HOSTPITAL

Onsite EMTs will transport patients to:
Concord Hospital
250 Pleasant Street
Concord, NH 03301
(603) 225-2711

TILT AND FUEL

TILT
LOCATION: See Map in Back of Guide
Tilt testing checks if the vehicle complies with the liquid spillage and rollover stability rules. No vehicle is permitted at this station until it has passed mechanical scrutineering (the stickers that must be applied to the car will serve as proof). Teams should bring the car in ‘ready to race’ condition. That means that all the liquids of the car should be filled properly, all components of the car are mounted.

FUEL
LOCATION: See Map in Back of Guide
The fuel station will provide racing gasoline.

All vehicles must indicate the type of fuel with a sticker, on or near the fill pipe. This sticker can be obtained at Tech Inspection.

NOTE: No vehicle will be provided with fuel until it has passed scrutineering. The first portion of a five-part sticker will be applied in a location near or on the nose cone of the vehicle. Follow the specific safety guidelines while in the fueling area – provided in team registration packets.
DYNAMIC EVENTS

Acceleration
The cars are evaluated on their accelerating abilities from a standing start in a straight line over a distance of 75 meters.

Autocross
The objective is to evaluate the car’s maneuverability and handling qualities on a tight course without the hindrance of competing cars. The course will combine the performance features of acceleration, braking and cornering into one event.

Endurance
Over a distance of 44 kilometers the cars have to prove their durability under long-term conditions. Acceleration, speed, handling, dynamics, fuel economy, and reliability all come into play. The endurance event takes place on the NHMS road course. This one kilometer hill section offers serious elevation changes – two climbs per lap totaling more than seventy-two feet.

The endurance event is the most challenging. All the vehicles begin with fully charged accumulators (batteries or capacitors). These may be charged from the grid, as is the norm for a plug-in hybrid vehicle. Hybrids are then given an additional allocation of liquid fuel so that all hybrid vehicles start with the same amount of energy. Electric-only vehicles must complete endurance with the energy contained in their accumulators.

STATIC EVENTS

Design
The students explain their constructive solutions to a jury of experts from the automotive and motorsport industries in a report and presentation. The concept of the design event is to evaluate the engineering effort that went into the design of the car and how the engineering meets the intent of the competition. The car that illustrates the best use of engineering to meet the design goals and the best understanding of the design by the team members will win the design event.

Project Management Presentation
The objective of the presentation event is for teams to convince a review board that their project has been carefully planned, effectively and dynamically executed. Constrained by scope, time, and budget, students will develop a project management plan which demonstrates their skill and techniques necessary to execute the project. The Project Management component consists of three parts: submission of a written project plan, a written interim report, and a final oral presentation to be delivered before a review board at the competition.
## LOCAL VENUES

### PLACES TO EAT

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<th>Name</th>
<th>Route</th>
<th>Phone Number</th>
<th>Distance</th>
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<tr>
<td>Loudon/Concord</td>
<td>Loudon Country Club – Rt. 106</td>
<td>Rt. 106</td>
<td>(603) 783-3372</td>
<td>2 Miles</td>
</tr>
<tr>
<td></td>
<td>Brookside Pizza – Rt. 106</td>
<td>Rt. 106</td>
<td>(603) 783-4550</td>
<td>3 Miles</td>
</tr>
<tr>
<td></td>
<td>The Egg Shell – Rt. 106</td>
<td>Rt. 106</td>
<td>(603) 783-4060</td>
<td>3 Miles</td>
</tr>
<tr>
<td></td>
<td>Dunkin Donuts – Rt. 106</td>
<td>Rt. 106</td>
<td>(603) 223-0394</td>
<td>5.5 Miles</td>
</tr>
<tr>
<td></td>
<td>Makris Lobster &amp; Steak House – Rt. 106</td>
<td>Rt. 106</td>
<td>(603) 225-7665</td>
<td>9 Miles</td>
</tr>
<tr>
<td></td>
<td>Long Horn Steakhouse- Rt. 106 to Rt. 9</td>
<td>Rt. 106</td>
<td>(603) 228-0655</td>
<td>10.5 Miles</td>
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<tr>
<td></td>
<td>Olive Garden- Rt. 106 to Rt. 9</td>
<td>Rt. 106</td>
<td>(603) 228-6886</td>
<td>10.5 Miles</td>
</tr>
<tr>
<td></td>
<td>Subway- Rt. 106 to Rt. 9</td>
<td>Rt. 106</td>
<td>(603) 228-6828</td>
<td>11 Miles</td>
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### GROCERY STORES

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<tr>
<th>Name</th>
<th>Address</th>
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<tbody>
<tr>
<td>106 Beanstalk Mini-Mart</td>
<td>577 Route 106 N, Loudon, NH 0330</td>
<td>(603) 783-4305</td>
</tr>
<tr>
<td>Sam’s Club</td>
<td>304 Sheep Davis Rd (Route 106)</td>
<td>(603) 226-1255</td>
</tr>
<tr>
<td>Shaw’s Supermarket</td>
<td>246 Loudon Rd, Concord, NH (603)-228-1440</td>
<td></td>
</tr>
<tr>
<td>Wal-Mart</td>
<td>344 Loudon Road (Route 9) Concord, NH (603)</td>
<td>(603) 228-1075</td>
</tr>
</tbody>
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### Auto Supply Stores

<table>
<thead>
<tr>
<th>Store</th>
<th>Address</th>
<th>Phone</th>
<th>Website</th>
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</thead>
<tbody>
<tr>
<td>Advance Auto Parts</td>
<td>136 Loudon Road</td>
<td>(603) 224-4795</td>
<td><a href="http://www.advanceautoparts.com">www.advanceautoparts.com</a></td>
</tr>
<tr>
<td>Autopart International</td>
<td>70 Pembroke Road</td>
<td>(603) 228-5551</td>
<td><a href="http://www.autopartintl.com">www.autopartintl.com</a></td>
</tr>
<tr>
<td>Auto Zone</td>
<td>45 Fort Eddy Road</td>
<td>(603) 225-4243</td>
<td><a href="http://www.autozone.com">www.autozone.com</a></td>
</tr>
<tr>
<td><em>Stratham Tire</em></td>
<td>4 Rocky Rd</td>
<td>(603) 267-7344</td>
<td>or 84 Manchester Street</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Concord, NH</td>
</tr>
</tbody>
</table>

*Can help with tire mounting*

### New Hampshire Motor Speedway | Directions

1122 Route 106 North
Loudon, NH 03307

**From the South**
Take I-93 to Exit 15E to Interstate 393. Take Exit 3 and turn left onto Route 106 North. NHMS is 9 miles north on the right.

**From the North**
Take I-93 to Exit 20 to Route 140 to Route 106 South. Follow Route 106 South to the Speedway for approximately 7 miles and turn left.
Fiat Chrysler Automobiles | Trophy and per $1,000 Award

**FCA Innovation Award** - This award celebrates creativity in design, use of component, or strategy of competition. The unique feature can be traced from conception to deployment throughout the team’s design process. Since innovation involves risk of failure, the team responded appropriately and persevered through challenges and failures. The unique feature has a practical application and demonstrates engineering ingenuity.

**FCA Industrial Design Award** - This award celebrates form and function in an efficiently designed and well-built vehicle. The design is elegant, simple, and practical. The vehicle is built with quality and workmanship. The entire vehicle reflects a system approach that takes into consideration the many different functional systems operating together to achieve the goal. Not just performance but reliability and maintainability are factors too. The entire vehicle is worthy of recognition and not just a single component.

**FCA Gracious Professionalism Award** - The goal of this award is to celebrate gracious professionalism. The team that wins this award demonstrates outstanding sportsmanship, team collaboration, and gracious attitude both on and off the track. While engineering ingenuity is celebrated throughout the competition, we wanted to highlight the importance of a positive and collaborative attitude. In today’s ever diversifying workforce, talent is important and so is the ability to communicate and work with others. The team that wins this award demonstrates professionalism desired by any company in any industry.

**DOUG GORE MEMORIAL CHASSIS DESIGN AWARD** | Trophy

This award is in recognition of Douglas Gore’s enthusiastic support of Formula Hybrid and Formula SAE. For over two decades, Doug shared his NASCAR and open-wheel design, preparation and driving knowledge with hundreds of students as a SAE CDS design judge. He always encouraged and challenged competitors to understand the theory behind their design, and the real-world effects of chassis and suspension tuning.

This award will recognize the team who best demonstrates Doug’s key principals. Although Formula Hybrid does not require a new chassis each year, teams with a new or heavily modified chassis/suspension will receive greater consideration. No separate material or presentation is required. The winning team will be selected by the Design Judges based on their submitted design report, any materials shown during design judging and Q&A with the judges during design judging. Sufficient analysis and/or test data is expected to justify chassis and suspension design decisions. At a minimum, the winning team will demonstrate superior knowledge, analysis and/or test data.
GENERAL MOTORS | Trophy and $2,500 per Award

General Motors Spirit of Formula Hybrid Award
This award recognizes the team which best demonstrates the true spirit of Formula Hybrid: A multidisciplinary educational endeavor mixed with friendly and professional competition. The team that receives this award has not only produced a racecar using sound engineering judgement, but has continuously excelled in teamwork and collaboration. Additionally, General Motors seeks to highlight the importance of project management in the engineering process. We commend the team which demonstrates exceptional preparedness and true completeness. This award highlights defensible designs and decisions while working within constraints of time, budget, and rules. We recognize the Formula Hybrid effort as a holistic challenge, requiring a careful balance of many ingredients.

General Motors Best Engineered Propulsion System Award
This award recognizes the team which best demonstrates professionalism and accomplishment in four categories: engineering design, ingenuity, execution, and vehicle performance. Teams considered for this award will demonstrate a novel approach to one or more aspects of racecar development, ranging from component or system design to validation methods. General Motors wishes to recognize a team that understands that innovation is not without risk, yet has the courage to do something exceptionally difficult or unique. Concurrently, we applaud the team that defends their design concisely, logically, and accurately through the use of appropriate engineering methodology and analysis. Lastly, teams considered for this award must present an exciting product—demonstrated in appearance and performance.

IEEE | Trophies

IEEE Engineering the Future Award
Engineering the Future – This award considers the multidisciplinary makeup of the team and evidence that the vehicle design contained all of the features of a proper racecar. IEEE Engineering the Future also considers whether the vehicle creates a desire to “take it onto the track and see how it performs.”

IEEE Excellence in EV Engineering Award
Excellence in EV Engineering – This award focuses on the entire EV engineering process. Judging begins when the Design and Sustainability reports are submitted. The judging continues at the Speedway with an evaluation of each team’s implementation and performance during the dynamics events. Significant emphasis is placed upon preparation, team dynamics, and attention to details. Also important are the intangibles that lead to good performance, reliability, and establish or continue a legacy.
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<thead>
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<th>CAR</th>
<th>INSTITUTION</th>
<th>COUNTRY</th>
<th>N GARAGE</th>
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</thead>
<tbody>
<tr>
<td>016</td>
<td>Amrita Institute of Technology &amp; Science</td>
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