



# EVENT GUIDE

*April 30 – May 3, 2018*

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# 2018 Formula Hybrid Schedule Rev. 1

	Sunday April 29	Monday April 30	Tuesday May 1	Wednesday May 2	Thursday May 3
8:00 AM			Officials/Tech Inspectors Meeting <i>Jack Ratta Media Center</i>		Workers Meeting <i>Jack Ratta Media Center</i>
8:30 AM					
9:00 AM		Electrical Tech. Inspectors Meeting <i>Electrical Tech. Building</i>		Workers Meeting & Electrical Safety lect. <i>Media Center</i>	
9:30 AM			Registration	Tech. Inspection Mechanical - N. Garage, Bay 1 Electrical - Electrical Tech. Building	Tech. Inspection Mechanical - N. Garage, Bay 1 Electrical - Electrical Tech. Building
10:00 AM					
10:30 AM		Registration	Tech. Inspection Mechanical - N. Garage, Bay 1 Electrical - Electrical Tech. Building	Tech. Inspection Mechanical - N. Garage, Bay 1 Electrical - Electrical Tech. Building	Presentation Event <i>Jack Ratta Media Center</i>
11:00 AM					
11:30 AM		Tech. Inspection (Electrical only) <i>Electrical Tech. Building</i>			Endurance Event*  <i>NHMS Road Course</i>
12:00 PM					
12:30 PM	OPTIONAL  Electrical Tech Inspection  NHMS Parking Lot*	Mechanical Tech. Inspectors Meeting <i>North Garage, Bay 1</i>	Lunch Break		
1:00 PM		Lunch Break			
1:30 PM					
2:00 PM					
2:30 PM					
3:00 PM		Tech. Inspection  Mechanical <i>North Garage, Bay 1</i>  Electrical <i>Electrical Tech. Building</i>			
3:30 PM					
4:00 PM					
4:30 PM					
5:00 PM	* No access to garages until Monday morning				
5:30 PM					
6:00 PM					
6:30 PM		Mandatory Elect. Safety Class <i>Followed by The Test Equity Hit The Ground Running Prize Center Garages</i>			
7:00 PM		Special presentation and discussion for Faculty Advisors and Sponsors			
7:30 PM		New Dartmouth Course: "Practical Electrified Vehicle Engineering"  Prof. Charles Sullivan <i>Media Center</i>			
8:00 PM					
8:30 PM		Note: Garages closed from 12:00 Midnight until 6:00 AM the following Morning	Note: Garages closed from 12:00 Midnight until 6:00 AM the following Morning	Note: Garages closed from 12:00 Midnight until 6:00 AM the following Morning	4/20/18 (Subject to change)

\*Lunch breaks will be scheduled based on event activity

## EVENT SITE REVIEW

### **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 volunteer 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 is being announced by passing the announcements along to your TEAM MEMBERS and other 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 would 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 not run unless life or limb is in danger.

**LUNCHES** - VOLUNTEERS will be provided lunches. Vouchers will be distributed 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. STUDENTS will have the opportunity to earn \$6 towards the Infield Restaurant by completing their "Connect with Platinum Sponsors" forms and submitting the forms to the Information Table.

**RECEPTION DINNER** – There will be a reception for all Faculty Advisors, Sponsors, VIPs, Officials, and Volunteers on Tuesday, May 1, 2018, beginning at 6:00pm. Location for this reception is Bruton's Suite overlooking the Speedway.

**DSE BARBECUE/COOKOUT** – There will be a cook out on Wednesday at 6:00pm hosted by the Dartmouth Society of Engineers – all welcome, including your visting fans.

### **SOCIAL MEDIA – #FormulaHybrid2018**



@Formula\_Hybrid



FormulaHybridCompetition



formula-hybrid.org/blog



Formula Hybrid

## EVENT SITE REVIEW

### **ADVICE, EXPECTATIONS & POLICIES:**

**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 exams. The times and locations must be set up ahead of time with the organizers. Food and beverages in the Media Center are for officials only!

**EVENT SCORES & SCHEDULES** – Scores and Schedules will be posted 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 5:00PM, Center Garage, Bay 25

All students are required to attend

**MANDATORY DRIVERS MEETINGS** - located in Ratta Media Center

**Autocross:** Tuesday at 5:00PM

**Endurance:** Wednesday at 7:00PM

All Drivers are required to attend

**DRONES** – FORBIDDEN AT NHMS

**SAFETY GLASSES** - **must be worn at all times when 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. TEAMS must remove all equipment (vehicle, tools, etc.) from NHMS by 5:00PM Thursday.

**HAZARDOUS WASTE** - Dispose of it properly! There is a hazardous waste facility in the infield. See the Infield Map in the Event Guide. Hazardous Waste stickers are in TEAM packets. Leave your well-marked waste container at the door and phone the number on the sign. Do not use drink containers.

## RULES OF CONDUCT

**GARAGES** – The garages will be closed and locked at 12 midnight daily. They will reopen at 6 AM. Vehicles and accumulator systems must remain in the garages. All charging systems must be shut down. TEAMS may remove small items to work on elsewhere, but all large energy storage systems must remain with the vehicles. NHMS security will be checking the garages. Cooking and camping are NOT permitted inside the garages.

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

**PARKING** – 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 space in which NASCAR teams operate. Be courteous to your neighbors by keeping your area clean.

### 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. DO NOT leave any furniture, used tires, etc. behind.

**UNSAFE WORKING AREAS** – If a team's garage space is deemed to be unsafe due to clutter or is blocking safe movement through the garages, the TEAM RSO will be notified by the garage steward. If the problem is not rectified within 20 minutes of the notification, the TEAM will be required to stop all work on the vehicle until the problem is taken care of.

**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.

**WELDING** – Welding is not permitted in the garages. TEAMS may weld outside of the garages provided they are at least 10 feet from any building and a TEAM MEMBER (in addition to the person doing the welding) is standing by with a fire extinguisher at the ready.

**DYNAMIC AREA PASSES (DAP)** – Each TEAM will be issued four (4) dynamic area passes (“hot passes”) which must be displayed at all times whenever a TEAM MEMBER, or FACULTY ADVISOR, is inside any dynamic event area. The dynamic area pass is separate and distinct from the ID badge itself. TEAM MEMBERS or FACULTY ADVISORS without a dynamic area pass may not enter any dynamic event area – No exceptions. FACULTY ADVISORS are not issued separate dynamic area passes.

## FORMULA HYBRID OFFICIALS

**INFORMATION** - The Information Table 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 (Main Points of Contact)**

Doug Fraser, Director

Sydney Garcia, Coordinating Manager

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

Wiley Cox, Dynamic Events

### **MEETINGS:**

ELECTRICAL TECH. INSPECTORS MEETING – Monday, 9:00AM-9:30AM

MECHANICAL TECH. INSPECTORS MEETING – Monday, 12:00PM – 12:30PM

WORKERS MEETING & ELECTRICAL SAFETY LECTURE – Wednesday, 9:00AM – 9:30AM

WORKERS MEETING – Thursday, 8:00AM – 8:30AM

## DAILY OPERATIONS | TECH DAY AND INSPECTION SCHEDULES

### DAILY OPERATIONS

Refer to the Infield Map for locations

### OPTIONAL ELECTRICAL TECH DAY

Sunday, April 30 | NHMS PARKING LOT S2

Technical Inspection 10AM – 4PM

### REGISTRATION

Monday: 8:00AM – 2:00PM

Tuesday: 8:00AM – 12:00PM

Wednesday: 9:00AM – 12:00PM

Tuesday: 9:00AM – 12:00PM

### TEST EQUITY EQUIPMENT LOANS

Test Equity will be bringing over \$50,000 worth of Electrical/Electronic test equipment for loan to teams.

Monday – Wednesday -- Garage 12a

### TRAM SERVICE FOR ENDURANCE SPECTATORS

Travels from Info Table to road course bleachers (look for the signs)

Thursday 8:30AM – 3:30PM

### ELECTRICAL TECH INSPECTION

Sunday: 10:00AM – 4:00PM

Monday: 10:00M – 4:00PM

Tuesday: 9:30AM – 4:30PM

Wednesday: 9:00AM – 12:30PM

### MECHANICAL TECH INSPECTION: TILT/NOISE/BRAKE TESTS & SCALES\*

\*Cars must be weighed prior to design event

Monday: 1:00PM – 5:00PM

Tuesday: 9:30AM – 12:00PM/1:00PM – 4:30PM

Wednesday: 9:00AM – 12:30PM

### FUEL STATION

Monday: 10:00AM – 4:00PM (Lunch Break 12:00PM – 12:30PM)

Tuesday: 9:30AM – 4:30PM (Lunch Break 12:00PM – 1:00PM)

Wednesday: 9:00AM - 3:30PM (Lunch Break 12:30PM – 1:00PM)

Thursday: 8:30AM – 3:00PM (Lunch Break 30 minutes, unscheduled)

### TEST/PRACTICE AREA

Monday: 12:00PM – 4:00PM

Tuesday: 10:00AM – 12:00PM / 1:00PM – 4:00PM

Wednesday: 10:00AM – 12:00PM/1:00PM – 4:00PM



# PRACTICAL ELECTRIFIED VEHICLE ENGINEERING

**Monday, April 30, 2018**

**6:30 PM**

**Jack Ratta Media Center**

Dartmouth engineering professor Charlie Sullivan will describe a new course, Practical Electrified Vehicle Engineering, which he developed to help mechanical and electrical engineers work together on projects such as Formula Hybrid.

A fellow of the IEEE, Charlie is one of the founders of the Formula Hybrid competition and has conducted electrical tech inspections since the very first event -- 12 years ago.



## **COURSE DESCRIPTION:**

Implementation of electric vehicles, including hybrid-electric vehicles (HEVs), battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs) requires a wide range of engineering skills. This course focuses on practical aspects of this challenge that are rarely addressed in standard engineering curricula, including high-power wiring, circuit protection, electrical safety, and battery system safety. The course is designed to be accessible to both electrical and mechanical engineers. It draws on principles from both fields and fills in some of the gaps between the usual fields of expertise of each group, enabling them to work together more effectively.

Coffee and light snacks will be served. See you there!

## HOW TO PREPARE FOR ELECTRICAL TECH

### 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.

### 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 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.

## HOW TO PREPARE FOR ELECTRICAL TECH

### 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 strain.
- You can try this yourself, with a \$7.50 scale from Walmart  
<http://www.walmart.com/ip/Protege-Luggage-Scale-and-Tape-Measure/17472591>

### 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.

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 must 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.

*We look forward to working with you at the track – the Formula-Hybrid Tech Inspection Team.*

## 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, including fuel, 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.

## FIRST AID & HOSPITAL

### FIRST AID

**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.

### HOSPITAL

Onsite EMTs will transport patients to:

Concord Hospital  
250 Pleasant Street  
Concord, NH 03301  
(603) 225-2711

## STATIC AND DYNAMIC EVENTS

### PRESENTATION AND DESIGN SCHEDULE

TUESDAY, MAY 1, 2018

PRESENTATION SCHEDULE				
GROUP A			GROUP B	
9:00 AM	3	SRM Engineering College	202	Princeton University
9:30 AM	1	Milwaukee School of Engineering	212	Lafayette College
10:00 AM	2	RV College of Engineering	207	Boston University
10:30 AM	4	Dartmouth College		
11:00 AM	20	Rochester Institute of Technology	203	University of Vermont
11:30 AM	9	University of Victoria	222	Georgia Institute of Technology
12:00 PM		LUNCH		
1:00 PM	7	Binghamton University	205	Tufts University
1:30 PM	8	Rensselaer Polytechnic Institute	214	Atilim University
2:00 PM	13	Vellore Institute of Technology	220	Amrita Inst of Tech & Science
2:30 PM	6	Lawrence Technological University	204	Illinois Institute of Technology
3:00 PM	5	University of Michigan - Ann Arbor		
3:30 PM	24	University of Houston		
DESIGN SCHEDULE				
GROUP A			GROUP B	
9:30 AM	222	Georgia Institute of Technology	203	University of Vermont
10:10 AM	214	Atilim University	220	Amrita Inst of Tech & Science
10:50 AM	204	Illinois Institute of Technology	205	Tufts University
11:30 AM	202	Princeton University	212	Lafayette College
12:10 PM		LUNCH		
1:30 PM	20	Rochester Institute of Technology	24	University of Houston
2:10 PM	3	SRM Engineering College	1	Milwaukee School of Engineering
2:50 PM	2	RV College of Engineering	7	Binghamton University
3:30 PM	9	University of Victoria	4	Dartmouth College
4:10 PM	6	Lawrence Technological University	8	Rensselaer Polytechnic Institute
4:50 PM	13	Vellore Institute of Technology	5	University of Michigan - Ann Arbor
5:30 PM			207	Boston University

Schedules are subject to change. Be alert!

Be prepared to start sooner or later than your scheduled time.

## STATIC AND DYNAMIC EVENTS

### 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.

### 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

This is the most challenging event at Formula Hybrid. The cars must demonstrate their durability and efficiency over a distance of 44 kilometers. Acceleration, speed, handling, dynamics, fuel economy, and reliability all come into play. The endurance event takes place on the one kilometer "hill section" of the NHMS road course and includes two climbs totaling more than seventy-two feet per lap.

All the vehicles begin with fully charged accumulators (batteries or capacitors). These will have been charged from the grid, as is the norm for a plug-in hybrid vehicle. Hybrids are then given an additional allocation of liquid fuel such that the total energy they have available to complete the endurance event equals 35.5 megajoules\*. Electric-only vehicles must complete endurance with the energy contained in their accumulators.

\*The energy allocation of 35.5 MJ is approximately equal to 1.11 Gal. of gasoline and is reviewed by the Formula Hybrid rules committee every year.

## LOCAL VENUES

### PLACES TO EAT

Loudon/Concord		
Loudon Country Club – Rt. 106	(603) 783-3372	2 Miles
Brookside Pizza – Rt. 106	(603) 783-4550	3 Miles
The Egg Shell – Rt. 106	(603) 783-4060	3 Miles
Dunkin Donuts – Rt. 106	(603) 223-0394	5.5 Miles
Makris Lobster & Steak House – Rt. 106	(603) 225-7665	9 Miles
Long Horn Steakhouse- Rt. 106 to Rt. 9	(603) 228-0655	10.5 Miles
Olive Garden- Rt. 106 to Rt. 9	(603) 228-6886	10.5 Miles
Subway- Rt. 106 to Rt. 9	(603) 228-6828	11 Miles

### GROCERY STORES

106 Beanstalk Mini-Mart	577 Route 106 N, Loudon, NH 0330 (603) 783-4305
Sam's Club	304 Sheep Davis Rd (Route 106) Concord, NH 03301 (603) 226-1255
Shaw's Supermarket	246 Loudon Rd, Concord, NH (603)-228-1440
Wal-Mart	344 Loudon Road (Route 9) Concord, NH (603) 228-1075

## AUTO SUPPLY STORES

Advance Auto Parts	136 Loudon Road Concord, NH (603) 224-4795 <a href="http://www.advanceautoparts.com">www.advanceautoparts.com</a>
Autopart International	70 Pembroke Road Concord, NH (603) 228-5551 <a href="http://www.autopartintl.com">www.autopartintl.com</a>
Auto Zone	45 Fort Eddy Road Concord, NH (603) 225-4243 <a href="http://www.autozone.com">www.autozone.com</a>
*Stratham Tire	4 Rocky Rd Gilmanton, NH (603) 267-7344 or 84 Manchester Street Concord, NH (603) 225-8473  *Can help with tire mounting

## DIRECTIONS TO SPEEDWAY

### NEW HAMPSHIRE MOTOR SPEEDWAY

1122 Route 106 North  
Loudon, NH 03307

603.783.4931

[www.NHMS.com](http://www.NHMS.com)

**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.

**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.



## AWARDS

### FORMULA HYBRID AWARDS

HYBRID AWARDS: 1ST – 6TH PLACE TROPHIES

ELECTRIC AWARDS: 1ST – 6TH PLACE TROPHIES

### SPONSORS AWARD



### TEST EQUITY HIT THE GROUND RUNNING AWARD

This prize will be awarded to the two teams that arrive at the competition with vehicles that are deemed to be the most ready to “hit the ground running”.

(Note: Teams must notify the organizers before or during registration if they wish to be considered for the HTGR Award)

Formula Hybrid judges will meet the teams and view the vehicles as they are being unloaded.

#### Judging criteria are:

- Vehicle completeness
- Documentation organization
- Organization of equipment and spares
- Preplanning and setup of garage workspace

The winners will be announced and prizes awarded on Monday evening after the Safety Class.

#### FIRST PRIZE:

DSOX1102G Digital Storage Oscilloscope with the 100 MHz Bandwidth Upgrade. (\$1,377.00 Value)

This includes the 2 serial decode options:

- EMBD & AUTO I2C
- SPI, UART/RS232 (DSOX1EMBD) CAN, LIN (automotive) (DSOX1AUTO)

#### SECOND PRIZE:

U1282A Series Handheld Digital Multimeter (\$499.00 Value)

## AWARDS



FIAT CHRYSLER AUTOMOBILES

### FCA INNOVATION AWARD

(\$1,000.00)

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.

#### **Guidelines:**

- The team can competently describe the feature
- The team took a risk and created this device/strategy rather than discovered it after the vehicle was built
- It is highly original in concept or execution
- Its uniqueness has practical application even if the vehicle did not perform the best on the track

### FCA INDUSTRIAL DESIGN AWARD

(\$1,000.00)

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.

#### **Guidelines:**

- Vehicle design is simple and executable
- The vehicle can withstand the rigors of competition and maintain functionality
- The team values workmanship in both the vehicle design and supporting equipment, e.g. clean welds, joints, wiring, paint, organized pit area, tools,
- The vehicle is designed with maintainability in mind, i.e. can be diagnosed and serviced easily during the competition

### FCA GRACIOUS PROFESSIONALISM AWARD

(\$1,000.00)

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 it's the ability to communicate and work with others. The team that wins this award demonstrates professionalism desired by any company in any industry.

#### **Guidelines:**

- The team consistently demonstrates good sportsmanship and positive spirit – on and off the track
- The team is humble and cooperative toward everyone in the competition, e.g. judges, inspectors, other teams,
- The team demonstrates collaboration and teamwork within its own organization. They may describe the following:
  - How collaboration was conducted during the build season
  - How the teams divided up tasks fairly and equitably
  - How teammates resolved differences in design concepts
  - How working together as a group was beneficial over working independently

## AWARDS

# GENERAL MOTORS

### GENERAL MOTORS SPIRIT OF FORMULA HYBRID AWARD

*(Trophy & \$1,000.00)*

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

*(Trophy & \$1,000.00)*

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 rigorous attention to a purposeful engineering process. The award recipient 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 ENGINEERING THE FUTURE AWARD

*(Trophy)*

Engineering the Future – This award considers the multidisciplinary makeup of the team and evidence that the vehicle design contained all 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

*(Trophy)*

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.

## GARAGE ASSIGNMENTS

### BY TEAM NUMBER

#### HYBRID

Car No.	Institution	Team Name	Bay #
001	Milwaukee School of Engineering	Mozeer Motorsports	16
002	RV College of Engineering	Ashwa Racing	17
003	SRM Engineering College	Hybrutos Racing	15
004	Dartmouth College	Dartmouth Formula Racing	20
005	University of Michigan - Ann Arbor	Michigan Hybrid Racing	25
006	Lawrence Technological University	Blue Devil Motorsports	26
007	Binghamton University	Bearcat Motorsports	18
008	Rensselaer Polytechnic Institute	Rensselaer Formula Hybrid	21
009	University of Victoria - Hybrid in Progress	UVic Hybrid	17
013	Vellore Institute of Technology	Team Uttejti	19
020	Rochester Institute of Technology	Hot Wheelz Formula Hybrid	21
024	University of Houston - College of Technology	Harvey Hybrid	23

#### ELECTRIC ONLY

Car No.	Institution	Team Name	Bay #
202	Princeton University	Princeton Racing Electric	26
203	University of Vermont	Alternative Energy Racing	16
204	Illinois Institute of Technology	Illinois Tech	23
205	Tufts University	Tufts Electric Racing	22
207	Boston University	BU Racing	18
208	Yale University	Bulldogs Racing	24
212	Lafayette College	Lafayette Motorsports	24
214	Atilim University	Atilgan	19
218	Indiana University Purdue University Indianapolis	Jaguars	22
220	Amrita Inst of Tech & Science	Formula Agraganya	20
221	Wayne State University	Wayne State Motorsports	25
222	Georgia Institute of Technology	HyTech Racing	15

Fuel & Scales

Media Center



Restaurant

North Garages

1	<b>Mechanical Tech</b>	14	
2	<b>GM</b>	SRM GA Tech	15
3		U. Vermont Milwaukee	16
4	<b>LG Chem</b>	RV College U. Victoria	17
5		Boston U Binghamton	18
6	<b>FCA</b>	Atilim Vellore Tech	19
7		Dartmouth Amrita	20
8	<b>Ford</b>	RIT RPI	21
9	<b>IEEE SAE FH Info</b>	Tufts IUPUI	22
10	<b>BAE Intralinks</b>	IIT U. Houston	23
11		Lafayette Yale	24
12		U. Michigan WSU	25
12a	<b>Test Equity</b>	Lawrence Princeton	26

FIRE LANE

FIRE LANE

**FORMULA HYBRID**  
Garage Assignments

**Electrical Tech**

Laconia Grandstand

TURN 4

TURN 3

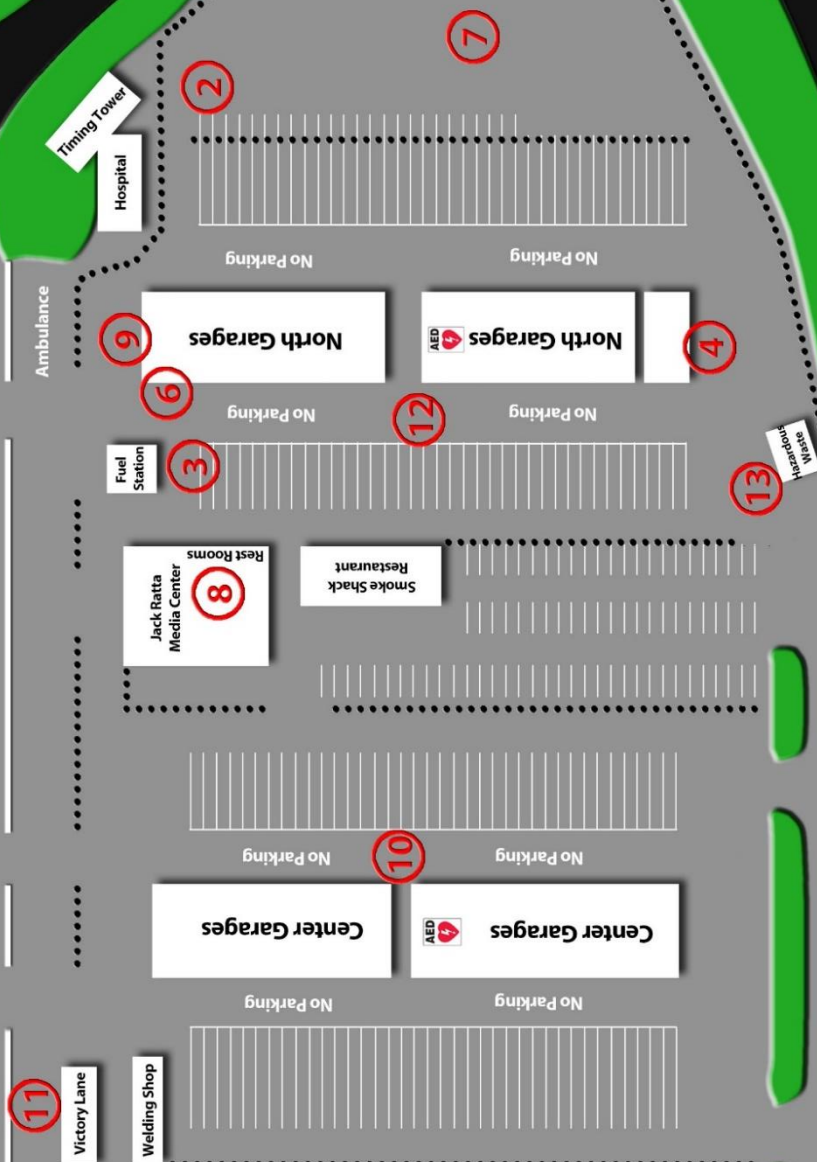
Main Grandstand

PIT LANE

PIT LANE

Footpath to Stands

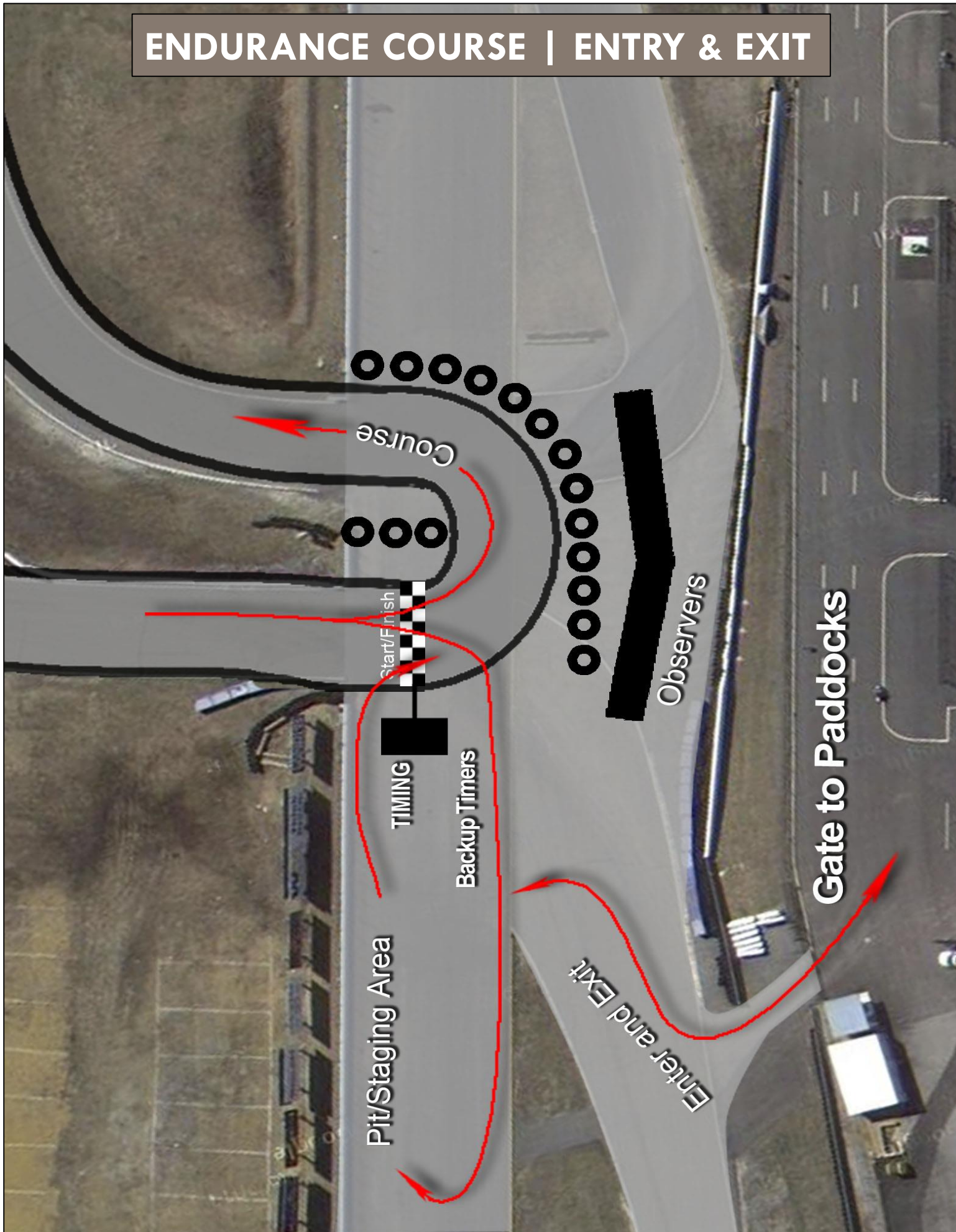
Infield Rest Rooms & Camping



- 1. Acceleration Runs
- 2. Brake Test
- 3. Weigh Scale, Fuel, Design Finals
- 4. Electrical Tech
- 5. Autocross, Endurance
- 6. Mechanical Tech
- 7. Test Area
- 8. Presentation Event
- 9. Tilt Test, Noise
- 10. Design Event
- 11. Awards Ceremony
- 12. Spectator Shuttle
- 13. Hazardous Waste Bldg.



# ENDURANCE COURSE | ENTRY & EXIT





Route 106

Entrance

Registration

Entrance to Bruton's Suite

Bruton's Suite

Tech Day Lot

Media Center

Restaurant

North Garages

Center Garages

Camping

Endurance Course

To Infield Parking

Endurance Bleachers

Restrooms

