Electrathon

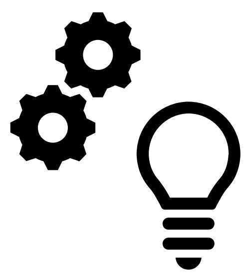
COUGAR

Electric Co.

2018-2019

985

Information



Cougar Electric Car Company

Car 985, Class 2

Advisor: Barry Wilson

Contact Information:

School:	Kennedy High School
	c/o Barry Wilson (Advisor)
	4545 Wenig Rd. NE
	Cedar Rapids, IA 52402
Phone:	Barry Wilson (Advisor)
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Facebook:	Kennedy Electric Car Company

Electric Car at Kennedy

John F. Kennedy High School's electric car program is called Cougar Electric Car Company. Our school and program is located in Cedar Rapids, which is in east-central Iowa. Cougar Electric built its first car in 1998 to take part in the 1998-1999 race season. In 2001, Iowa governor, Tom Vilsack, awarded the FINE (First In Nation in Education) award. We were one of five k12 programs in Iowa to receive this award, as well as the first electric car program in the nation to win a prestigious award in education.

When the program was originally held as an after school class, but starting in 2016, it was added to the normal school day. All of the planning, designing, and assembly are done in the shop by students. The cars are made from aluminum tubing which gets covered in foam padding. The entire car is then covered with painted plastic that has been cut to the necessary shapes and sizes to enclose the car. Finally, each car is decorated with the necessary graphics and a few fun ones. This year, we have added telemetry, which is going smoothly, and will be fully functional by the first race.

Skills

Cougar Electric Company provides an opportunity to learn a variety of soft and Iowa Core skills. Soft skills include problem-solving, communication, and time management. These soft skills as well as the Iowa Core skills below that learned in the program help students in their everyday life and their future.

Iowa Core Skills

- Manage money efficiently by developing spending plans and selecting the appropriate financial instruments to maintain positive cash flow
- Demonstrate critical thinking skills using the appropriate tools and resources to plan and conduct research, manage projects, solve problems, and make informed decisions
- Communicate and work productively with others to increase innovation and work quality
- Adapt to various roles and responsibilities
- Changing priorities
- Demonstrate leadership skills, integrity, ethical behavior, and social responsibility while collaborating to achieve common goals
- Demonstrate initiative and self-direction while exploring the ways individual talents and skills can be used for productive outcome in personal and professional life
- Demonstrate productivity and accountability by meeting high expectations
- Listening to establish, maintain, and enhance relationships
- Gain knowledge through problem solving
- Apply and adapt a variety of appropriate strategies to solve problems
- Understand, analyze, represent, and apply problem (problem solving skills)
- Understand and interpret descriptive statistics

Race Schedule

April 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

April 6th, 2019 **West Point** **West Point, Nebraska**
April 12th & 13, 2019 **University of Wisconsin Platteville** **Platteville, Wisconsin**
April 26th & 27th, 2019 **Stout** **Menomonie, Wisconsin**
April 28th & 29th, 2019 **Autobahn** **Joliet, Illinois**

May 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

May 4th, 2019 **Wayne** **Wayne, Nebraska**
May 10th, 2019 **Berlin** **Marne, Michigan**
May 13th & 14th, 2019 **Road America** **Elkhart, Wisconsin**
May 18th, 2019 **Hawkeye Downs** **Cedar Rapids, Iowa**
May 19th, 2019 **Prairie** **Cedar Rapids, Iowa**

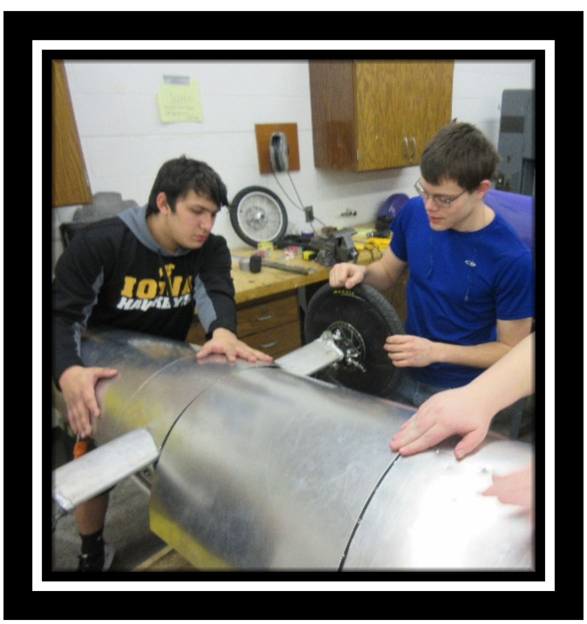
Team

Departments

Mechanical engineering

There are several small teams that fall under the overhead title of Mechanical Engineer. They are; Crew Chief, Machinist, and Aerodynamics/Design.

Aerodynamics and Design- The job of our aerodynamics and design team is to make 1/10 scale models of our cars, then advise the crew chiefs either where to make their car more aerodynamic, or if the crew chief is making a new car, tell him which parts of other cars to copy and what parts to do differently. They also help the crew chief that is making a new car with his design. The only current member is Lucas Corrigan.

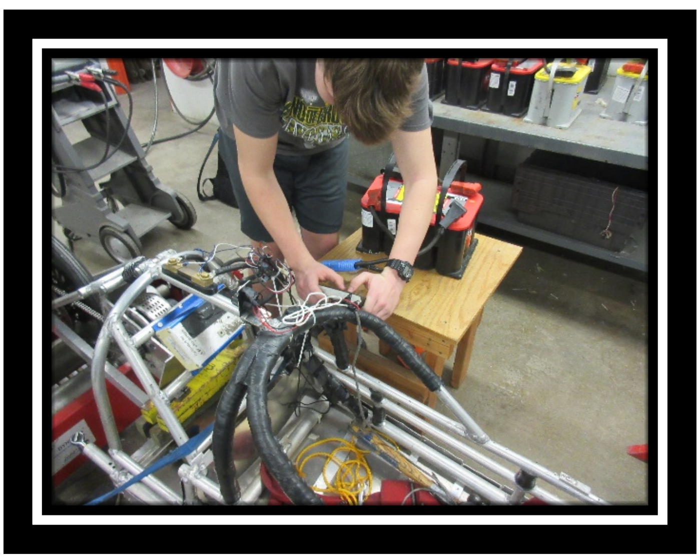


Crew Chief- Our crew chiefs are responsible for designing and building their car, or any changes made to it throughout the year. They also work with their drivers at the races to ensure the best possible performance by their car. They also have the unofficial responsibility as class leaders. Our current crew chief for the 983 is John Tedesco, who is mentoring Colin Flannagan; for the 984 is Derek Severson, who is mentoring Jesse Hempstead; and for the 985 Bryan Becker, who is mentoring Isaac Hofferber.

Machinist- Our machinists have the duty to work with the crew chiefs to make the parts they need to either improve their cars or the make parts for the new car we build that year. They use a lathe, mill, and various other shop tools. Our current machinist is Jakob Davis.

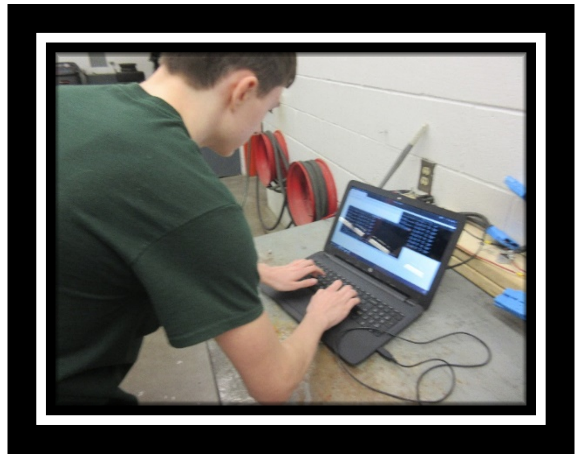
Electrical Engineering

There are two teams that fall under the overhead title of Electrical Engineer. They are Telemetry and Batteries/Trailer Maintenance.



Batteries and Trailer Maintenance- Our battery technicians have several jobs including battery care, testing, and general trailer maintenance. The team takes care of the batteries by fully charging them after every race and freezing the batteries to preserve them. To test they set up our dyno tester and ensure it is at full performance, then test the old batteries to find out how useable they are for the upcoming season. They are also in charge of keeping the trailer clean, neat, and organized at all times. Our current battery technician is Noah Wilson, who is mentoring Dennis Davis.

Telemetry- Our telemetry team has had the burden this year of creating a car-to-pit communications system so the crew chiefs can look at the laptop and know exactly how many volts we have left, how many amps and amp hours we are running, and how fast we are going. They were originally following a documentation provided by Lakeview, WI, but after numerous problems, decided to start from scratch. The team includes Trever Schoulte and Tyler Barz.



Promotions and Documentation

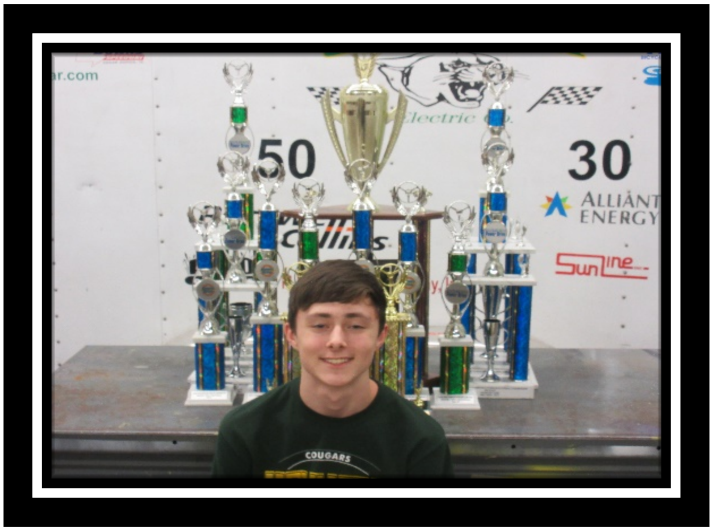
Within Promotions and Documentation, we have three main teams; Promotions, Documentation, and Graphic Design.

Promotions- Seeing as how Cougar Electric Car receives no funding directly from Kennedy High School, we have to raise 100% of the funds we need every year to operate, which is in the range of twelve to fourteen thousand dollars. We raise every penny through a number of fundraisers and outreaches, all managed by our promotions department. Our current promotions department consists of Dylan Davis, with spellcheck by Brian Stubblefield.

Documentation- A good documentation book can make the difference between pulling off a win and taking the big L in Electric Car. The job of our documentation writers is to provide that extra push that gave our team the state championship in Nebraska and Wisconsin last year. This year, with a bumper crop of new writers and no old ones, our Documentation team has their work cut out for them. Our team includes Kaleigh Martin, Brian Stubblefield, and Dylan Davis.

Graphic Design- Our cars look great on their own, but our graphics department makes them look even better. The graphics department has numerous jobs, including; T-shirt design and production, number board production, trailer graphics, and car graphics. Our only current graphics specialist is Rodrigo Sagastume.

Team Members



Like most of the group Tyler Barz is brand new to the team. He is a freshman and is one of the most useful members in our new telemetry team. When Tyler grows up, he doesn't know what he wants to do, but "hopefully something in computer science"

"Work smarter not harder."

Bryan Becker is one of our older team members considering most of our team is in their first year. But Bryan has been with the program for 2 years and both of those years he has been a crew chief for the 985 car. Bryan has been working non-stop to make his car and driver better. When Bryan grows up, he hopes to use what he's learned here in the real world, as a mechanical engineer.

"Shut up and make it work."

Lucas Corrigan is a first timer in the program and has already found something he loves to do. Lucas has joined our aerodynamics and design team. After what he learns this year, he hopes to one day grow up and become an aerospace engineer. He is designing our new 984 car, which will help him greatly at this aspect of his future life.

"I don't hate it, I just don't like it at all and its terrible."

Dennis Davis is yet another first timer. Originally Dennis signed up for graphics but with nothing to do his adviser had placed him on documentation, which he has managed to have changed to batteries. Dennis has not yet figured out what he wants to do when he gets out of school. All Dennis figured out is that he wanted to go into the military, preferably the navy.

"I didn't sign up for this."

Dylan Davis is a first timer just like his older brother Dennis Davis. Dylan had initially decided to do promotions and now helps with documentation. He is doing well in promotions as his first Facebook post got 1,800 hits and is still growing. When Dylan grows up, he hopes to go into professional baseball.

"What are you doing?"

Jakob Davis is a first-year member and works for the team as a Mechanical Engineer. He is a hard worker and is the machinist of Electric car. When Jacob grows up, he wants to be a soldier in the Army and fight for our country. When he is sitting around at home, he likes to trap shoot and hunt.

"I'm done with this."

Colin Flannagan is another first timer in electric car. Colin had little difficulty finding what to do. Colin has been training to be a crew chief for the 983. When Colin grows up, he wants to be an aerospace engineer. Colin's quote has been chosen from the multiple times he has tried to help his driver.

"John, the first one was fine"

Jesse Hempstead is a first semester kid in the class, and he is already doing great. Jesse hunts deer and he enjoys racing. When Jesse grows up, he wants to be a U.S. soldier. Jesse loves to help other people when it counts.

"If I die driving too fast, don't cry because I was smiling the whole time."

Isaac Hofferber has been in the Electric Car for 1 year and has loved it the whole time. His job in Electric car is assistant crew chief for Bryan Becker and is being a great help. He loves to play basketball and hangout in the park with his friends. When he grows up, he would love to be a computer scientist or play NBA. Isaac is another one of our highly academically qualified students in the Electric car program.

"Just stop, ok. Just stop."

Kaleigh Martin is a new addition to the Documentation team. She loves it in this class room and is easily the best worker in Documentation. She lives at home with her parents, brother and sister. When Kaleigh grows up, she wants to be a teacher. She loves reading, history, and playing with her dog. Kaleigh will also be the driver of the 984 car.

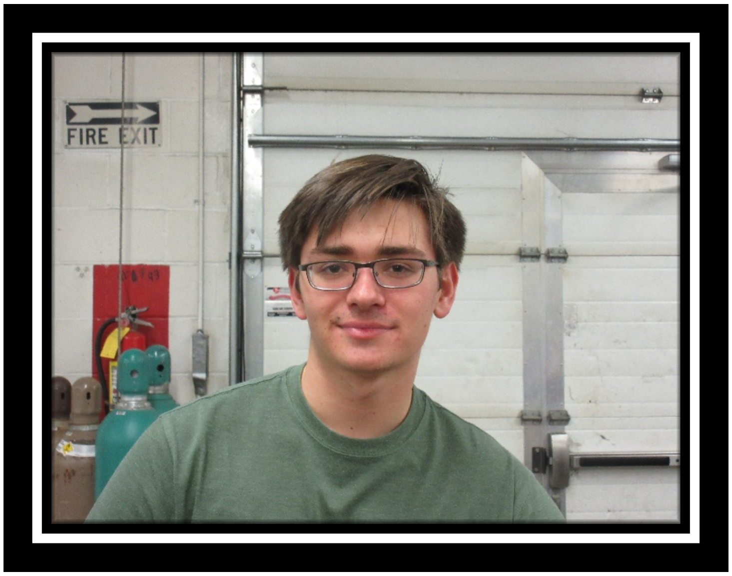
"Life is too important to be taken seriously."

Rodrigo has been with the program for three years. Rodrigo has been a graphics apprentice, and/or teacher for all three years. He has also taken up driving the 985 car. When Rodrigo graduates, he wants to become a lawyer or border control. So far in his 2018 year of driving he has competed in four races and is looking forward to getting more experience this year.

"If you're not first your last."

Trevor Schoulte is another first timer to the program. He is the telemetry team's electrical engineer. He is a senior, and caught senioritis on day 1, but is fighting through it. He plans to become an electrical engineer after college. He enjoys playing with wires in his free time.

"Why was the programmer happy?
He got arrays (pronounced a raise)"



Derek Severson is the longest standing student member of our program. He is a senior and has been a crew chief with the 984 car all 4 years and is the only crew chief in the program who has built a car from the ground up. He wants to be a mechanical engineer after he gets out of school. He plays guitar in his free time. Over his high school career, he has taken 9 AP classes.

“Don’t panic.”

Elizabeth Severson is Derek Severson’s younger sister. Elizabeth is a sophomore, and a driver for the 985. She is not a part of the Electric Car class because of her tight schedule but helps after school in every way she can. She enjoys welding and might start doing it as a part of the class next year.

“What? There’s another one? Little little Severson!”

Brian Stubblefield is one of our new documentation people. Brian is a freshman and started out the year in telemetry but moved to documentation in January. In the future Brian wants to be a part of the Cedar Rapids Fire Department and enjoys helping people.

“Knowledge is knowing a tomato is a fruit. Wisdom is not putting it in a fruit salad”

He is a three-year member of the program. He has been a crew chief of the 983 car all three years and started driving this year. John is a picky person but a hard worker when you get to know him. John does not like people touching anything on his car. He gets especially ticked off when other classes touch his car When John graduates, he wants to be a welder.

"Stop touching that."

Noah Wilson is the leader of our battery team and is probably the most committed freshman. Noah is another one of our amazing students and loves to work hard. In the future Noah would love to be an Air Force electrical engineer. Noah is currently not in a sport but used to play football, baseball, and wrestled.

"You can only play with the hand you're dealt."

Barry Wilson is our instructor in the electric car class. This is Barry's 21st year with electric car and he has no plan on stopping. Barry also teaches three other classes not counting electric car (welding, woodworking and auto mechanics). Barry loves to work with kids and joke around a little bit. In his words, he is nothing but our money handler and glorified bus driver.

Phone number is 319-558-1595

"If it isn't done, then why are you standing around here? Get back to work!"

Community Events

Community Events

Cougar Electric Car Company takes advantage of every opportunity we get to show off our cars. We have three primary reasons for wanting to present our cars and work to the public as much as possible. The first reason is we believe in showing our love and appreciation to the companies and individuals that have helped our program by providing funding. The second reason is to promote the use of alternative energy. We do this by running our electric cars in parades and explaining how they run and were built. Finally, we use events with the public to recruit potential members, both now and for the future. By allowing little kids to sit in our cars and seeing them run, we are encouraging their interests in the program and hands-on learning. The events include:

- Hiawatha Fun Fest Parade
- Kennedy Club Fair
- Kennedy Homecoming Parade
- Alliant Energy's Rise Event
- Kennedy Incoming Freshmen Event

The Kennedy Cougar Electric Car Team was showing off their electric cars for the upcoming season at the Hiawatha parade. We use parades like this to show off our cars and all the hard work we put into them throughout the year.

Electric Car spreads the word about us at the club fair that takes place at the beginning of every Kennedy school year. The fair is to help students find new passions and join new clubs and organizations. Our main goal is to find kids that are interested in joining Cougar Electric Car and enjoy racing.

Every year, Electric Car participates in the annual homecoming parade. It allows us to spread the word and celebrate our school. The parade is highly attended and is great setting for us to show the cars in action.

We participate in the Rise Event in downtown Cedar Rapids, at Green Square Park put on by Alliant Energy. We use this event to show our sponsor Alliant Energy we appreciate their support of our program. We also attend this event because we would like to spread the news about Cougar Electric Car and get more sponsors, or even new participants.

Every February, Kennedy has a freshman orientation for all the incoming ninth graders to understand what they are signing up for when they commit to classes. We take advantage of this and set up a table in the middle of the Main Foyer. We think it went very well this year and that we might have gotten some new recruits.

Sponsors

Sponsors

We are very thankful to all of the companies that allow us to go racing each year! Our sponsors support our team in donations ranging from $500-$2,000. Without the, we could not go do what we love to do. Many of our sponsors come from students in the program, but we also apply for community grants with major corporations.

ALLIANT ENERGY®

IN TOLERANCE
CONTRACT MANUFACTURING

Sunline inc.

Collins Aerospace

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS
ORGANIZED NOV. 28, 1891
AFFILIATED WITH AMERICAN FEDERATION OF LABOR & CONGRESS OF INDUSTRIAL ORGANIZATIONS & CANADIAN LABOUR CONGRESS
REG. U. S. PAT. OFF.

Mark Flannagan

Cougar Electric Company
Budget Estimate
2018-2019

A.	**Cars**		**$1,350.00**
	1. One new car		
	a. Chassis	$400.00	
	b. Plastic Body		$250.00
	c. Painting Car	$100.00	
	2. Update two cars		
	a. Chassis modifications	$300.00	
	b. Body modifications		$300.00
B.	**Batteries**		**$1254.00**
	1. 6 New Optima ($209)	$1,254.00	
C.	**Telemetry**		**$500.00**
	1. Parts for Telemetry research		$500.00
D.	**Racing**		**$6,290.00**
	1. Tires		$540.00
	2. Tubes	$50.00	
	3. Fuel for Vans	$3500.00	
	4. Misc. Supplies for Hauler & Cars	$700.00	
	5. Motels	$1500.00	
	a. Stout, Autobahn, Road Am (3 nights)		
E.	**Speed Trials**		**$1400.00**
	1. Trophies	$300.00	
	2. Track Rental, Tickets, Power	$500.00	
	3. Ambulance	$600.00	
F.	**Graphics**		**$750.00**
G.	**Promotion**		**$1837.00**
	1. Sponsor Appreciation	$382.00	
	2. Memberships		
	a. Michigan	$180.00	
	b. Wisconsin	$1050.00	
	c. Electrathon America		$75.00
	3. Miscellaneous	$150.00	
H.	**Misc. Shop Supplies**		**$1,200.00**
Total			**$14,581.00**

Fundraising Events

Our annual Cougar Electric Car dinner is a way for us to interact with the students' parents and is a big fundraising event. During the week leading up to the dinner, the students spend every class period cleaning the shop and turning it into a makeshift restaurant. We open the dinner to anyone who wishes to come. To make a profit from this, we charge a small fee, usually around six dollars a person, and ask students to bring in as much food as they can. All we make in profits from this event goes toward the program.

While hosting the Midwest Speed Trials, we offer a concession stand to racers and spectators. A long day of racing and watching little cars drive around and around in circles works up an appetite. Hamburgers, hot dogs, sides, and drinks are all offered. Like the annual dinner, all profits go towards the program.

Sample Communications

John F. Kennedy High School

4545 Wenig Road N.E.

January 28th, 2019

Dear Sir or Madam,

Cougar Electric Car is a STEM based program that focuses on the areas of mechanical engineering, electric engineering, and graphic design. Through these programs students get hands on experience in these areas.

The dedicated high school students in this program every year work towards the goals of designing, building, and racing three electrically powered one person cars. These cars are raced in the spring every year. Our electric cars are scored in five areas; design, endurance, braking, handling, and documentation.

The Kennedy High School team has several accomplishments for the 2017-2019 school year. The team competed in Nebraska, Iowa, Wisconsin, and Michigan. The team brought home first, second, and third place in Nebraska. We also took first and second place overall in Wisconsin. Cougar Electric Car attended several community events over the summer such as the Freedom Festival, Hiawatha Fun Fest and Fly-In Breakfast at the Marion airport. Attending community events is a huge part of our history and students love sharing aspects of the program with the public.

Our goals for the 2018-2019 include designing and building a new electric car for the new season as well as modifying the other two cars. Also we plan on updating our technology on calculating aerodynamics and bring more awareness to alternative energy transportation.

We are not funded by Kennedy High School or The Cedar Rapids Community School District. We are supported through sponsorships from community business and we would be honored to include your company in reaching our goals for the 2017-2018 year.

Sincerely,

Pamela Severson
Promotional Leader
Cell Phone: (319)-440-7317
e-mail: pjsevers@msn.com

Prospectus

Our prospectus is an informational packet we give to potential sponsors to give them an idea of what we are all about. The following is the prospectus from this year we used to promote our program to the individuals and organizations that became our main sponsors.

Prospectus For Cougar Electric Company 2018-19

- What We're About
- Accomplishments in the 2018-19 Year
- Goals for 2018-19 Year
- Budget Plans for the 2018-19 Year
- Our 2018-19 Partners and Sponsors
- 2018-19 Budget Estimate

- What You Will Receive for your Support
- How to Contact Us

What We Are All About

Cougar Electric Company is not like most classes offered at the high school level. We have made it our mission to simulate a real-world company.

Students face high-level challenges every day they walk into the classroom. They deal with different types of learning expectations in the field they choose to explore. Our engineers – electrical, chemical, and mechanical - deal with challenges that are so unique sometimes professionals can not offer advice and they have to find their own answers. In their commitment to electric car, all students do their best to further their education by facing challenges that no other high school course can offer.

The company is divided into different teams: promotion, publicity, graphics, mechanical engineering, telemetry, aerodynamic engineering, and electrical engineering. Our teams work with area business professionals and staff who give their time, advice, and most importantly, teach students how to deal with real-world problems.

We hope that after reading about our class you will become as excited as we are to offer this alternative to traditional education. We need your help in order to continue this high level of learning.

Accomplishments in the 2018-19 Year

This year marked Cougar Electric Car's twenty-first year**.**

Cougar Electric Company continues to participate in many events. This year we attended events in Wisconsin, Michigan, Iowa, and Nebraska. Below is the list of 2019 competition events that we had the opportunity, the ones bolded are the ones we plan to attend.

DATE	EVENT	LOCATION
April 6th	**West Point**	**West Point, Nebraska**
April, 12th & 13th	**University of Wisconsin Platteville**	**Platteville, Wisconsin**
April, 13th	Lincoln	Lincoln, Nebraska
April 26th & 27th	**Stout**/Hastings	**Stout, Wisconsin**/ Hasting Nebraska
April 28th &29th	**Autobahn**	**Joliet, Illinois**
May 4th	**Wayne**	**Wayne, Nebraska**
May 10th	**Berlin**	**Marne, Michigan**
May 13th & 14th	**Road America**	**Elkhart, Wisconsin**
May 18th	**Hawkeye Downs**	**Cedar Rapids, Iowa**
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Events that attended in Cedar Rapids Festival Parade, Breakfast, Fest Parade, Open Doors well as Homecoming Kennedy Open

Promotional Cougar Electric 2018 included: Freedom Marion Fly-in Hiawatha Fun Open Mind Exposition, as Kennedy's Parade, and the House.

Goals for 2018-19 Year

In order to be successful in competition, a team must not only create a car which can go the greatest distance in an hour, but it must also do well at the other components of the competition – maneuverability, braking, design, and documentation.

- Promote alternative energy use
- Create three new cars, using new designs to become more efficient
- Make 1 major modifications our old car
- Race in Iowa, Michigan, Wisconsin and Nebraska competitions

- Sponsor the Iowa competitions
- Participate in local community events

Partners and Sponsors

Cougar Electric Co. relies on sponsors and partners to realize its goals.

Partners offer money and advice for all facets of the company or competition events. Sponsors offer the money to build, compete, and promote the program.

Our 2019 partners and sponsors are listed below

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Mark Flannagan

Cougar Electric Company
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2018-2019

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Budget Plans for the 2018-19 Year

As of now we are still looking to find a new towing van. The van we have now is becoming less reliable. We are looking to put $5,000 more than our annual budget away to go towards a replacement.

Kennedy continues to be the sponsoring organization for electric car competition in Iowa. Since then we have been solely sponsoring the challenge, and we are looking for an outside sponsor to take over.

There seems to be a somewhat stronger focus on technical education in surrounding states. Cougar Electric continues to look at additional traveling to surrounding states, especially Nebraska, Michigan, and Illinois.

We Need Your Interest

Work has already begun for 2018. We are in the midst of ….

Attending several fall shows and educational activities
Designing a new 2019 car
Planning changes on two existing cars
Planning the Iowa program
Planning to use both the wind tunnel and chassis dyno in design

These are lofty goals and they will cost money. We enjoy seeing you become part of this learning process. We hope you consider becoming a sponsor or partner when contacted by our promotion team. A financial plan for the year is included with this prospectus. We accept any size donation. Sponsor dollars are the only way that the goals that we have can be reached. **It is also tax deductible!**

What You Will Receive for Your Support

Sponsors receive logo recognition on primary areas of race cars. Partners are also recognized on each car on the sides of the nose (the middle of each side is reserved for the number of the car). Your company's logo will be prominently displayed on both sides of the trailer as the sponsor of the chosen car. A strong effort is made to have the car and trailer out in public regularly; our goal is to have more than 50,000 people see the program each year. We accomplish this by attending six or more races throughout the Midwest. We attend competitions from April to October. We also attend all possible public festivals and parades in the Cedar Rapids area, including all public educational events in and related to Kennedy High School. We actively solicit opportunities to have the program highlighted in school and area media. We have been on TV and in the newspaper in the past and look to increase that exposure.

By supporting our company, you are making a difference in how students develop their knowledge of the world. It is hard to replicate a business-type atmosphere for students before they graduate. By participating in real-world education early, students are challenged in several personal development areas including teamwork (with students and adults), goal setting, problem solving, and skill development. They may even be introduced to their future career. Several graduates have gone on to careers similar to their involvement in Cougar Electric Company. Thank you for your interest. Please give us a call or e-mail us if you have any questions or if you need any other information.

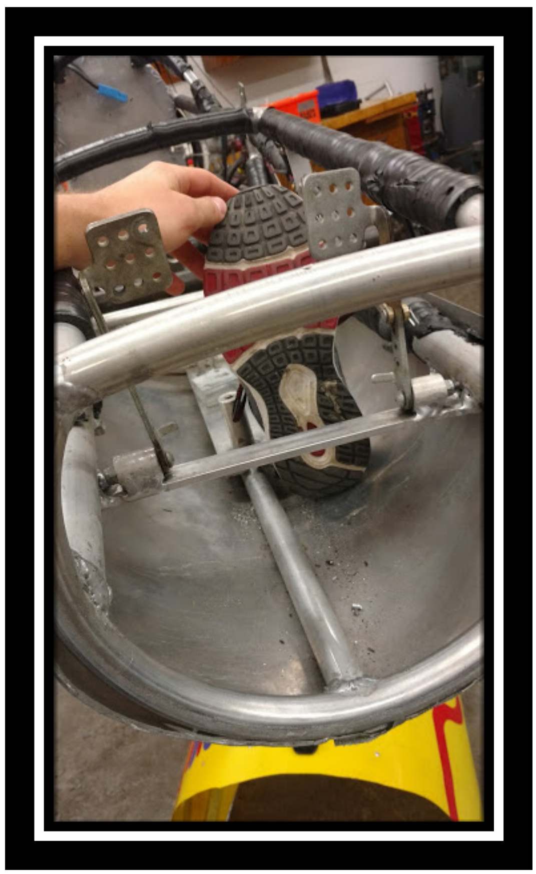
How to Contact Us

School: Kennedy High School
c/o Barry Wilson (Advisor)
4545 Wenig Rd. NE
Cedar Rapids, IA 52402
Phone: Barry Wilson (Advisor)
(319) 558-1595 (school number)
E-mail: bwilson@cr.k12.ia.us
Website: www.cougarelectriccar.com
Facebook: Kennedy Electric Car Company

Design

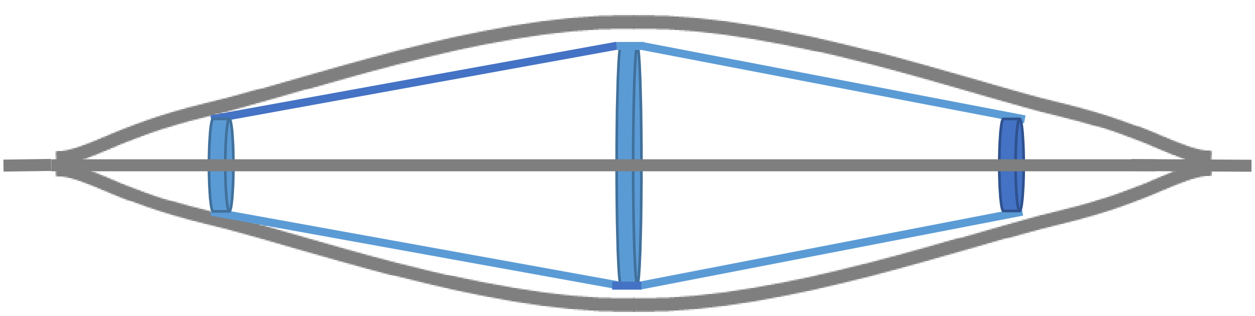
Design

We take a lot into consideration when designing a car. Numerous measurements are taken from the driver, such as their weight, height, and how wide their hips and shoulders are. These numbers, along with the weight of various car parts, are used to calculate the center of balance, the center of gravity, and static stability of the car. This all helps the crew chief to properly design a car that will meet the goals and visions they set.



The goal for the design of the 985 car was to have a car with zero air distortion; similar to a needle cutting through the air where instead of morphing the air around the shape, the air is only slightly displaced. A common problem we run into with our cars is that the air sticks to the straight sides and will not go underneath the cars. This creates a vacuum underneath the car and slows the car down. Keeping this in mind the car uses the shape of the British-French Concorde airplane or of a cigar.

We achieved this with a circle with a small diameter near the front of the car, gradually to a larger circle and gradually back down to a small circle near the rear [see diagram below]. Instead of pooling the air in unwanted areas, the curved walls allow the car to cut through the air. Our overall goals were to have zero drag, downforce, and lift.



Center of balance

The center of balance tells us how well a car will take a corner. It is calculated by measuring the weight of various components of the car and how far they are from the back axle. The numbers are then averaged to get the center of balance. If the center of balance is too close to the front or back of the car, then the car will not handle very well and is at risk of flipping when taking a corner.

Center of gravity

The center of gravity is another number calculated from various measurements throughout the car that determines how a car will handle a turn. It is calculated by measuring the weight of different components of the car, such as the batteries, and the vertical distance from the ground to the center of those parts. The weights and heights are then averaged to give the center of gravity. Ideally, this will be lower than the center of the front wheels so that the car doesn't tip. If it is above the center of the front wheels, the car is at risk to flip when taking a corner.

Static stability

Static stability is where the center of balance and center of gravity meet. This number determines the car's overall likelihood of flipping and/or rolling during a race. Center of balance can be compared to a horizontal line running along the car and center of gravity would be a vertical line. Static stability is where these two lines intersect. The point of intersection moves when the car accelerates or brakes, or turns left or right. If that point goes beyond the front wheel while turning, the car will flip. The higher the number is, the less likely the car is to flip. A number of at least 1 or higher means the car is almost guaranteed to not flip.

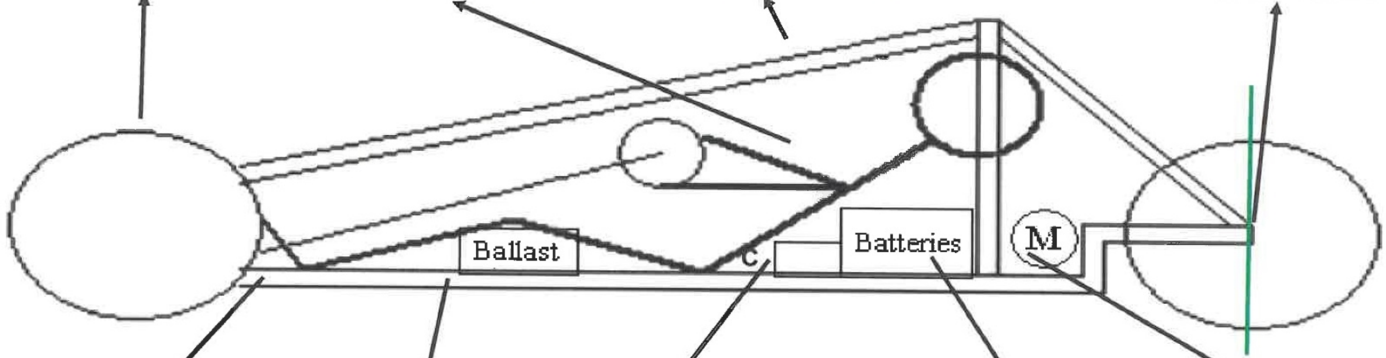
Center of Balance

Car # S50
Date: 3/31/2019
666

1. Record the weight of each component in corresponding box. (See the chart to the right)

2. Measure from the back axle to the center of the component then record in the box.

Component	Weight	Distance
Front Axle	25.1	82.5
Driver	175	58.5
Frame / Electrical	61.8	60
Rear Wheel	7.6	0
Master Cylinder	3	89.7
Ballast	0	0
Controller	5.6	35.25
Batteries	73	30
Motor	22.1	16.18



Weight values will automatically transfer to Center of Gravity sheet.

Center of Balance	19030 in/lbs	=	Center of Balance: 50.99 Inches From Rear Axle
Total Weight	373.2 lbs		

Front %	Rear %
61.81%	38.19%

Notes: Overall frame is 110 inches

Conversion Chart	
1/16"	0.0625
1/8"	0.125
3/16"	0.1875
1/4"	0.25
5/16"	0.3125
3/8"	0.375
7/16"	0.4375
1/2"	0.50
9/16"	0.5625
5/8"	0.625
11/16"	0.6875
3/4"	0.75
13/16"	0.8125
7/8"	0.875
15/16"	0.9375

Component Weight Averages

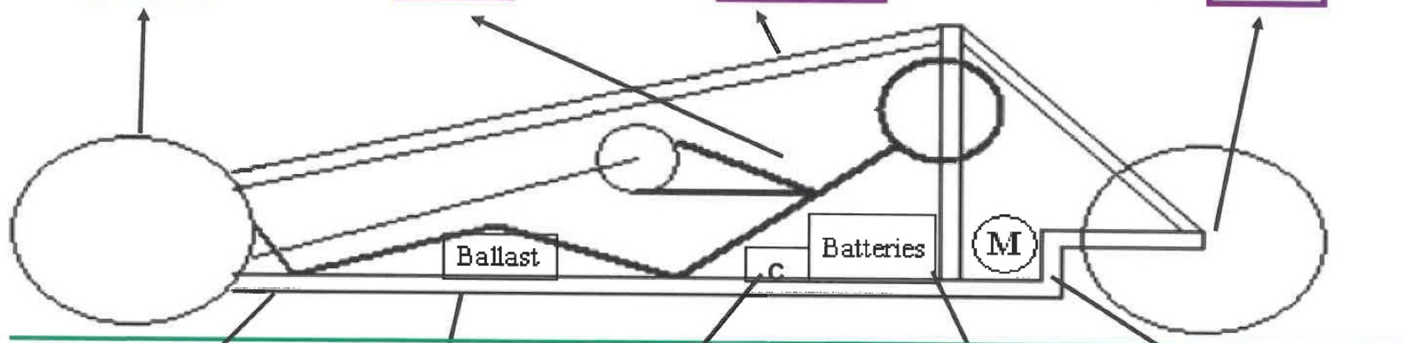
1	Etek Motor with Sprocket	22.1 lbs
1	7080 Modified Motor / Etek-R with sprocket	28.4 lbs
1	Alltrax Controller	5.6 lbs
1	Curtis Controller	4.2 lbs
1	20" Spoked Rear Wheel, Sprocket, & Chain	8.1 lbs
2	20" Front Wheels, Brakes, Axle, & Steering	29.3 lbs
2	20" Tomos Front Wheels, Brakes, Axle & Steering	32.3 lbs
2	16" Front Wheels, Brakes Axle & Steering	25.1 lbs
2	Optima Batteries	67.3 lbs
1	Master Cylinder and Fluid	3 lbs
1	Driver	180 lbs
1	Ballast	As Needed
1	Frame and Body balance out naturally	NA

This is a template worksheet so copies of this sheet will be created when saving, to protect the original. It is also automatically be date stamped and protected to prevent altering of the formulas.

Center of Gravity

Car # S50
Date: 1/9/2018
Student: ____________

3. Measure the distance in inches from center of gravity of the part to ground. Record in the box.



	Weight	Distance
Front Axle	25.1	7.75
Driver	175	11.87
Frame / Electrical	61.8	10
Rear Wheel	7.6	9.8
Master Cylinder	3	10.25
Ballast	0	0
Controller	5.6	19.75
Batteries	73	10.25
Motor	22.1	13.5

Center of Gravity

$$\frac{\text{Center of Gravity} \quad 4152 \text{ in/lbs}}{\text{Total Weight} \quad 373.2 \text{ lbs}} = 11.13$$

Inches off the Ground

Install all components as low as possible.
Center of Gravity maximum 10" (lower the better)

Notes:

Conversion Chart	
1/16"	0.0625
1/8"	0.125
3/16"	0.1875
1/4"	0.25
5/16"	0.3125
3/8"	0.375
7/16"	0.4375
1/2"	0.50
9/16"	0.5625
5/8"	0.625
11/16"	0.6875
3/4"	0.75
13/16"	0.8125
7/8"	0.875
15/16"	0.9375

Component Weight Averages		
1	Etek Motor with Sprocket	22.1 lbs
1	7080 Modified Motor / Etek-R with sprocket	28.4 lbs
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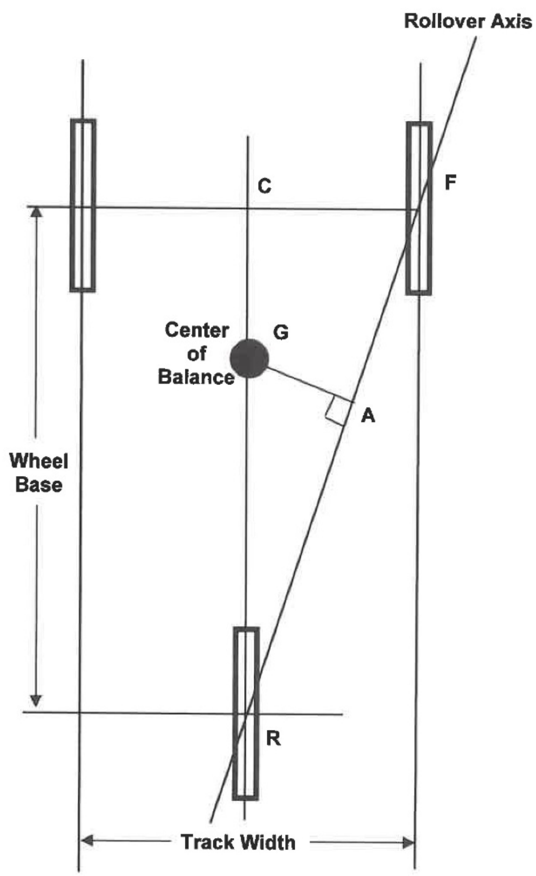
2	20" Tomos Front Wheels, Brakes, Axle & Steering	32.3 lbs
2	16" Front Wheels, Brakes Axle & Steering	25.1 lbs
2	Optima Batteries	67.3 lbs
1	Master Cylinder and Fluid	3 lbs
1	Driver	180 lbs
1	Ballast	As Needed
1	Frame and Body balance out naturally	NA

Static Stability

Car # S50
Date: 1/9/2018
Student: ____________



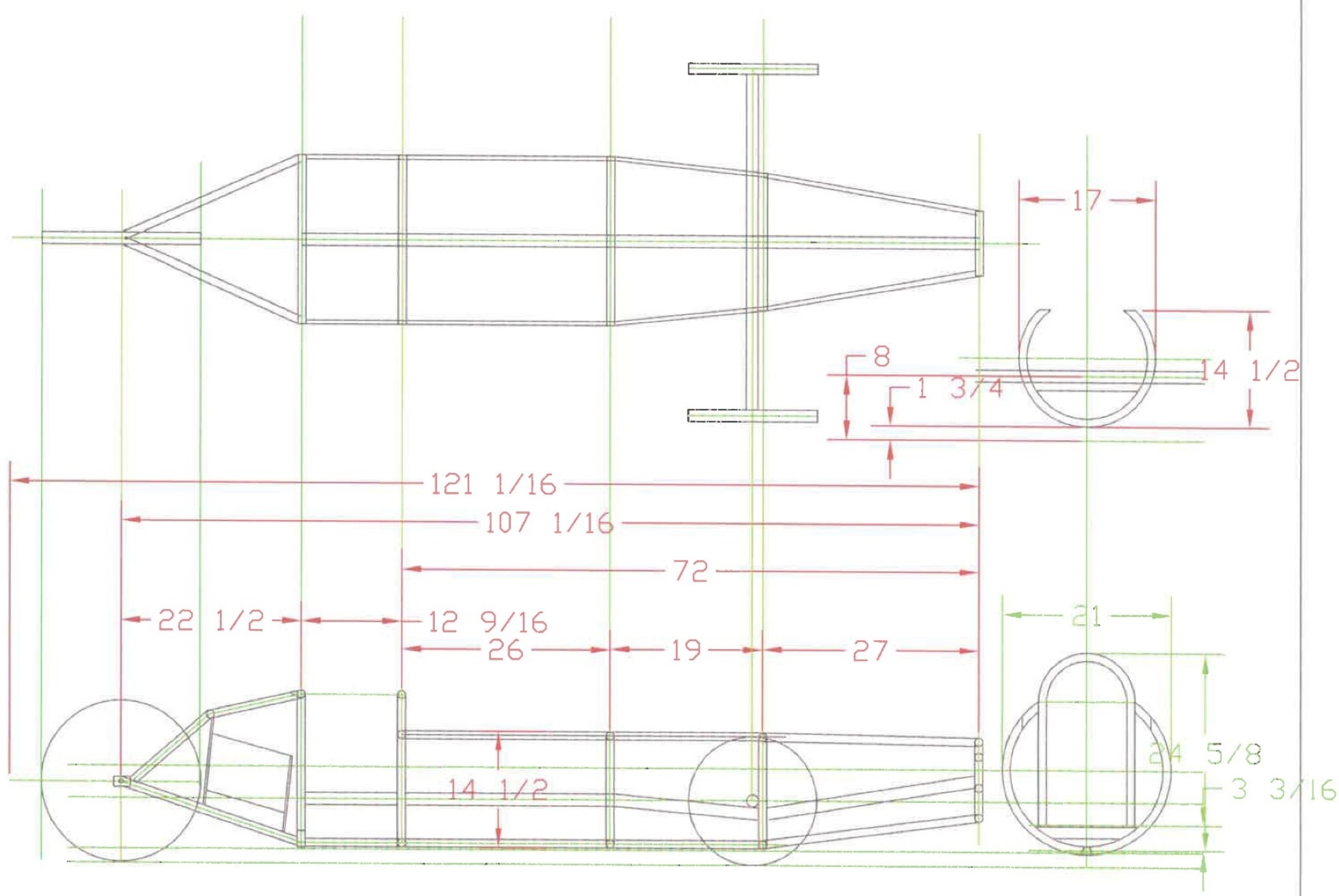
4. Record the Track Width in the box.

41.625	Track Width
82.5	Wheel Base
50.99	Center of Balance Distance from Rear Wheel
11.13	Center of Gravity
20.813	CF
82.5	RC
50.99	GR
85.085	RF
12.473	GA

1.12	**Static Stability Factor**

Short track cars should be close to 1.5 SSF.
Long track cars should be at or greater than 1.0 SSF.
Use steering blocks to improve driver Safety.

Notes:


17
14 1/2
8
1 3/4
121 1/16
107 1/16
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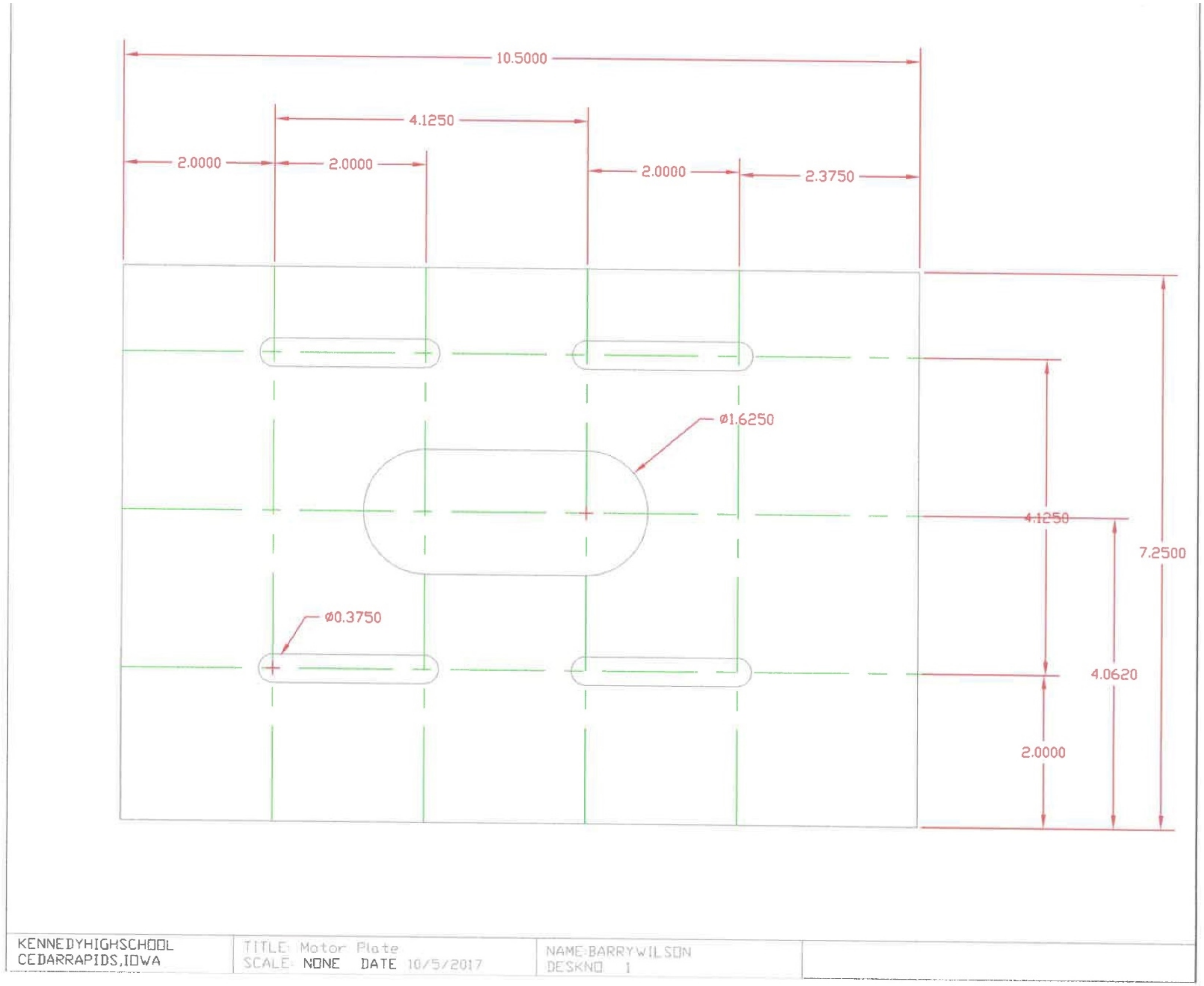
24 5/8
3 3/16

2018 50 Car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KENNEDYHIGHSCHOOL
CEDARRAPIDS,IOWA
TITLE: Motor Plate
SCALE: NONE DATE 10/5/2017
NAME:BARRYWILSON
DESKNO 1

Parts List

Team - Cougar Electric Company - Kennedy High School

Car Number: A50 **Time period: Sept 2018 - May 2019**

Part	Vender	Price
Frame	Storm Steel	$219.23
Floor Pan	Storm Steel	$45.00
Seat	Fabric	$5.00
Padding	Ace Hardware	$5.00
Circuit Breaker	Del City	$25.14
Key Switches	EV Parts	$27.68
Mirrors	O'Reilly Auto Parts	$5.50
Motor	Etech	$310.00
Controller	EV Parts	$399.00
Pot box	EV Parts	$26.50
Analyst	Grin Technologies	$299.95
Sprockets	Rieken's Racing	$32.28
Cog	Hall Bicycle	$6.95
Rear Gear Adapter	Rieken's Racing	$30.00
Chain	Rieken's Racing	$6.00
Batteries	Advance Auto	$635.00
Peddles	Rieken's Racing	$11.00
Shell	Home Built	$100.00
Paint	Ace Hardware	$25.00
Rims & Hubs	Hall Bicycle	$375.00
Disc brakes	Hall Bicycle	$205.50
Tires & Tubes	Hall Bicycle	$36.75
Tie Rods & Ends	Rieken's Racing	$35.00
Steering Assembly	EV Parts	$97.00
Wires	Brenneman & Associates	$20.00
Misc Parts	Ace Hardware	$25.00
Graphics	Cougar Graphics	$20.00
	Total Cost of Parts	$3,028.48

Chassis

Chassis

The 985, being in its second year of racing, modifications had to be made. The first major change to the chassis was the introduction of a new axle. The previous axle was a solid steel bar stretching nearly three feet in length. Due to the weight of steel, the team has elected to use a lighter, aircraft grade, aluminum airplane strut. This six-foot strut was cut in half to be used on the car. Plates were added to the strut on the middle for mounting to the car and on the ends for mounting knuckles. This design simplifies the mounting system and is around seven pounds lighter than the previous design.

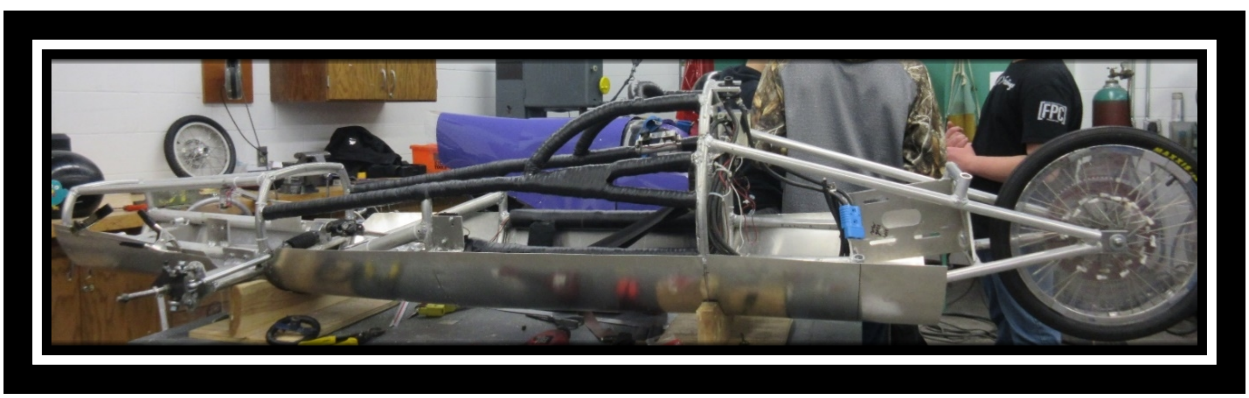
The second of the two changes made was the complete remodel of the rear of the car. The back end of the car was cut clean off to start with a fresh slate. The problem with the old swing arm that held the rear wheel was that it was heavy and the shock absorber that it featured was ineffective at best. The new rear features 4 straight bars connecting the wheel to the rest of the car making a much simpler and lighter design. Due to the new shape, a new tail also needed to be constructed. Old designs included two separate pieces that allowed access to the batteries and gearing. For better aerodynamics, weight and overall simplicity, a one-piece cover was constructed. This tail end of the car was finished after a day of work in the shop in late February.

Suspension

The new tail's design was made due to the removal of the 985's suspension. Last year the angle at which the old swing arm was mounted led to little room for the wheel to move and the shock absorber was ineffective, rendering the suspension useless. Instead of trying to make a better suspension system the suspension was abandoned altogether as it was only used at one of our races and deemed unnecessary.

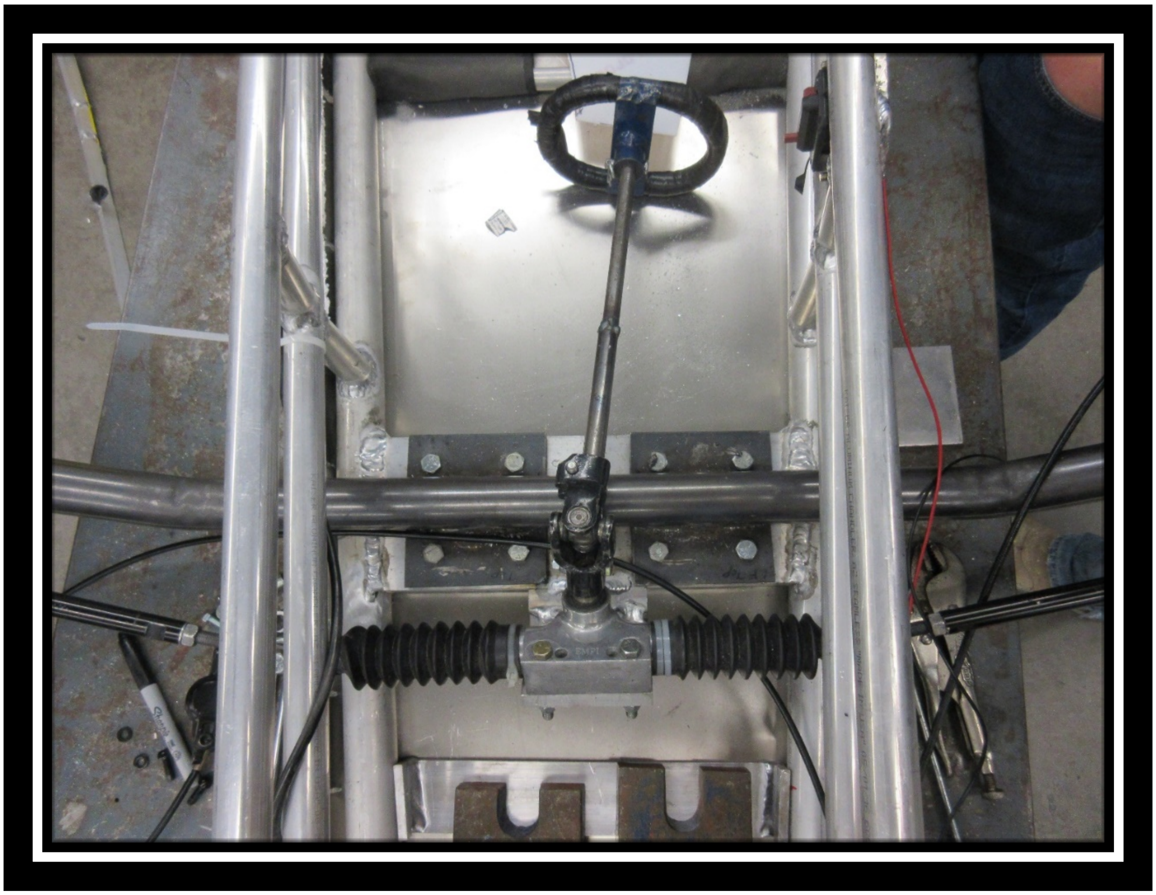
Frame

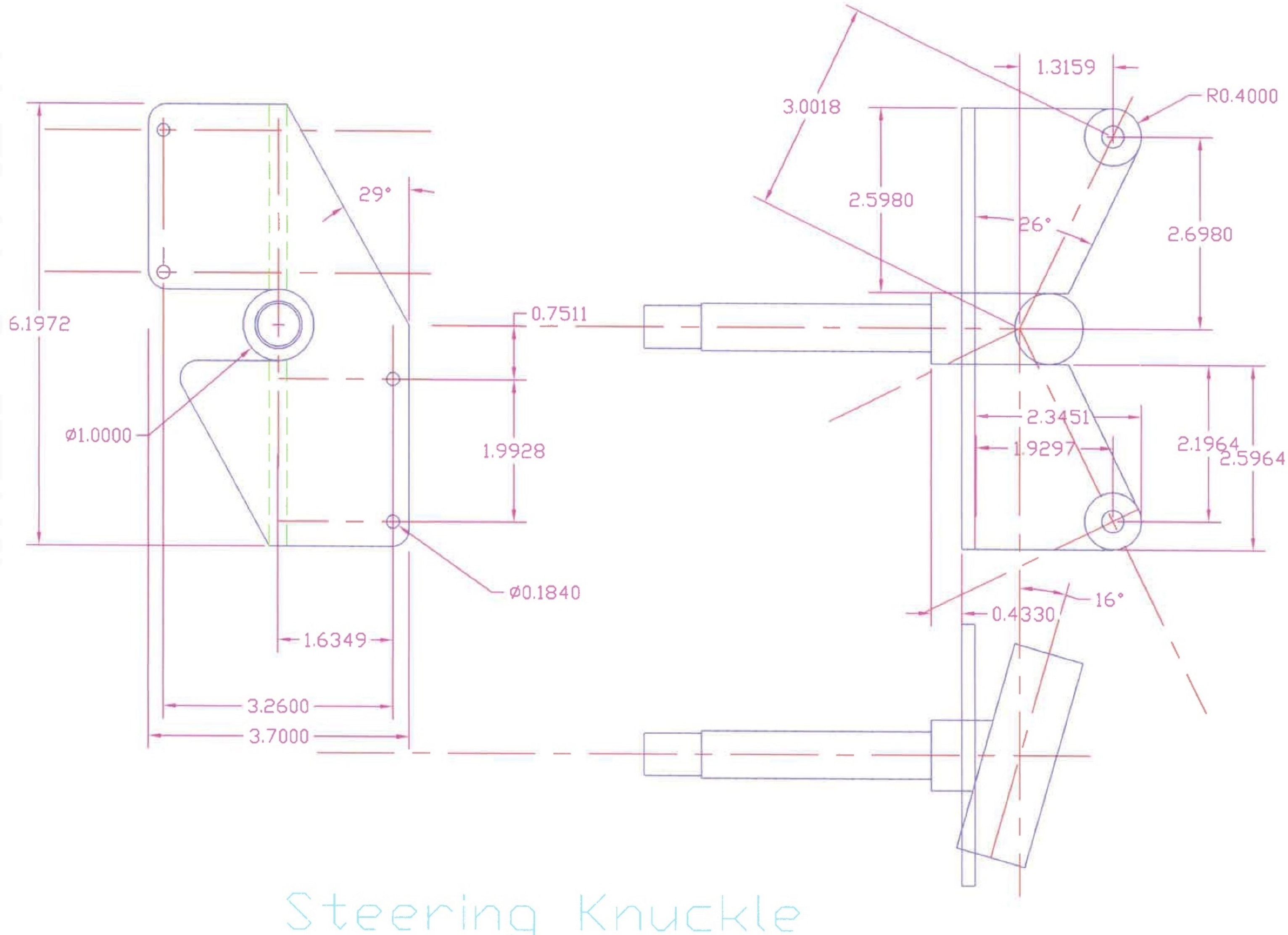
The 985 car has frame that consists of one inch and one-and-a-half-inch aluminum tubing. One and a half inch tubing is used for the bottom rail to create a sturdy base. Attached at the bottom's midpoint are one-inch circular aluminum rails. Along with a large, curved belly pan of 0.06-inch aluminum sheeting, which covers approximately half of the car's side walls, the frame gives the car a unique cigar-like shape making the 985 car stand out.



Steering

We use a rack and pinion steering system in all of our cars. Turning the wheel causes the pinion gear- located at the end of the steering column to turn. This then causes the rack gear to move which then turns the wheels.

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2.5980
26°
2.6980
2.3451
1.9297
2.1964
2.5964
0.4330
16°
Steering Knuckle

Wheels

We use two different sized wheels to on our cars to get better performance. Sixteen-inch wheels are used on for the front because their increased durability allows them to withstand more force when taking corners. A twenty-inch wheel is used on the back because it is larger and allows for gears to be changed easily. We get all our wheels and chains from our partner, Hall Bicycle.

Rear twenty-inch wheel

Front sixteen-inch wheel

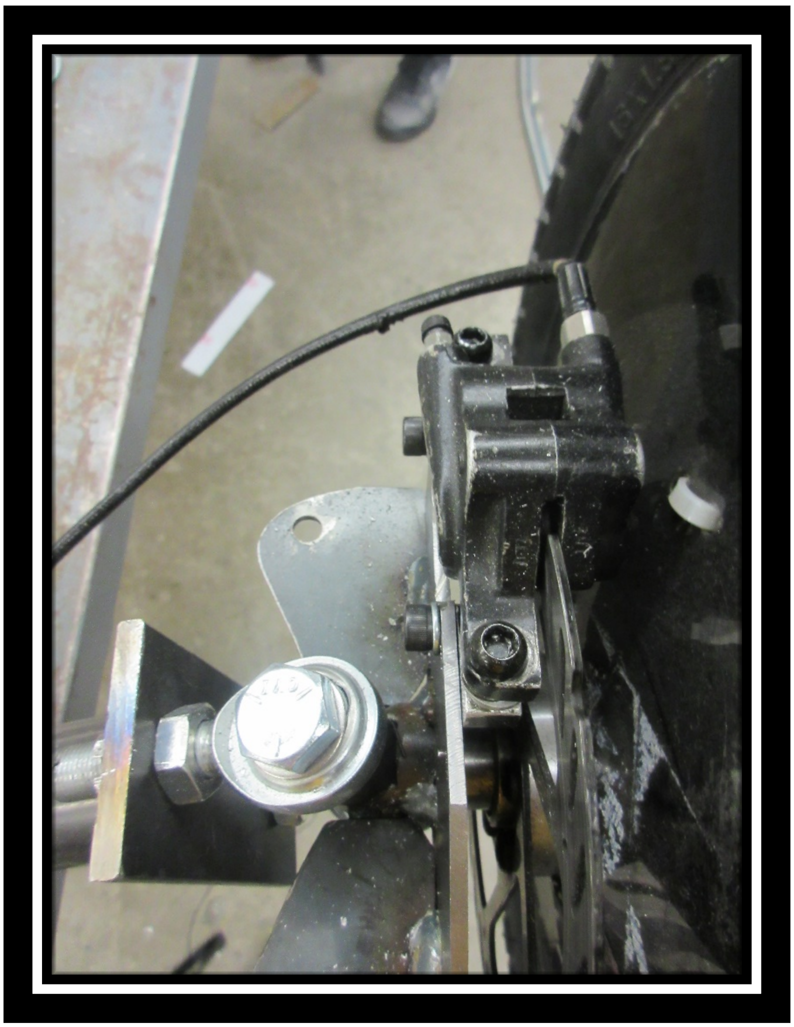
Tire Pressure

The crew chief adjusts the tire pressure for each race based on the weather and track type. In hot weather a lower pressure is preferred as to balance out the extra pressure that will build as the tire heats up. The opposite is done in cold weather, the crew chiefs adding more air into the tires to compensate the lack of pressure from heat. On speedways we aim to have the rolling resistance as low as possible. The accomplish the we run a higher psi, generally 90-95 psi in hot weather and 105 psi in cold. On road courses our goal is to have good traction. To achieve this we run a lower psi. For these courses the suggested running psi is 85-90.

Brakes

We use a disc brake system in all of our cars because they provide the best braking quality available to us. Due to their higher quality, they are among the more expensive brake systems, but thanks to our partnership with Hall Bicycle, we can buy them at a discounted price.

We use hydraulic disk brakes on the car for many reasons. They are more effective in rainy conditions because they have holes in them, which stops water from collecting on them. They also don't lock up as easily as other brakes do, allowing for the driver to stop in a timelier fashion.



Electrical Systems

There is a rather complex electrical system in our cars, but everything is of course attached to the battery. One of the many systems in the car is the motor. The motor has two wires, one connecting to the B+ terminal. This provides power to the motor and a ground so that current flow has a complete path.

Another system is the skill switch. The interior kill switch acts as a circuit breaker for the car, preventing more than 150 amps being drawn from the battery. The interior switch has two wires running to it; one that goes to the battery providing power, and the other to the external kill switch so that they can communicate. The exterior switch as two wires as well; the one to the interior switch and one to the B+ on the mother board. How this works as a whole, is power flows from the battery to the internal kill switch. When more than 150 amps flows through it or the driver turns it off, it sends a signal to the external kill switch which lets the mother board know to turn off the car.

Another system is the throttle. The throttle has a total of four wires; one to the pot toggle switch, one to the pot, and two to the motherboard. Power is received through the motherboard based on the conditions of the throttle pedal. When the pot is turned on, current flows through the pot series, controlling how much power is given to the throttle and therefore how much power is sent back through the motherboard to the motor. If the pot is turned off, the throttle position controls how much current is sent through the system. Both of these options control how fast the motor rotates and fast the car is going.

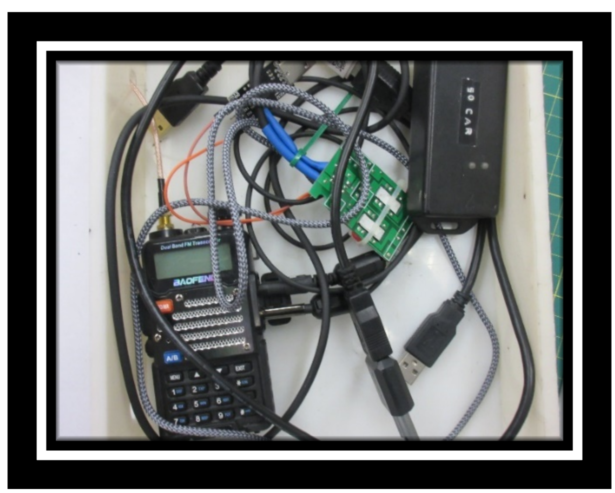
The cycle analyst has a system in the car as well. It has two wires to the logger, one to a wheel speed senor, and two chunte wires. The cycle analyst is what tells the drivers how fast they’re going, how many amps they’re drawing, and what their battery state is. The telemetry system is hooked up to the cycle analyst in place of the cycle analogger to record and transmit the data from the car to the pit PC for the crew chiefs to use.

A big part of all the systems is the motherboard. It receives electrical signals from pretty much every electrical component in the car. A final system in the car is the brake light system. This system is pretty simple; the driver hits the brake pedal which closes a circuit and turns the brake lights on. When the driver lets off, the lights turn off.

Telemetry

Telemetry has been brought back as a separate team this year, after Barry came across a promising telemetry documentation to use. On telemetry, we have software engineer Tyler Barz and electrical engineer Trevor Shoulte.

The team has been hard at work to get the system up and running. It's a basic program that just uses two python scripts, one on the Raspberry Pi and the other is the VPS which is viewed on our computer. The client.py is hosted on our VPS and just binds the IP and the port which the server.py connects to that same IP and port, then replays the data over a raw socket. The server.py gets the data off the cycle analyst and then encodes it and sends it to the client.py which then decodes the data turning it into plain text. They had this basic idea after their first attempt not working out at, they had thought it was going to work, they originally used a lot of equipment, things such as GPSD, Ham Radios, etc. They thought that was too much of a hassle after it didn't work and took up too much space. This new idea just uses the Raspberry Pi and a serial to USB converter. It runs on the Internet, using PuTTY to set everything up, then the car is connected to a mobile hotspot, and it transmits to the PC.



Batteries

Batteries are tested and maintained by our trailer and battery maintenance crew of Noah Wilson and Dennis Davis, headed by freshman Noah Wilson. The batteries team oversees putting together sets, or pairings of batteries that will produce and maintain the most amperage. Last year we had some difficulties with batteries not holding a charge very long, so we purchased three sets of three red, three yellow brand-new Optima Red Top batteries. These batteries preformed wonderfully at the end of last season, so to conserve them they were put in a freezer over the summer and into the fall. The hope was to keep the batteries in a new-like state for longer. Batteries were pulled from the freezer in February to thaw and then hooked to a battery maintainer.

Noah and Dennis are responsible for making three sets for each car. The first set is our oldest, worst-performing batteries, these we run as our "setups" as they typically will only last for the events prior to the endurance race such as inspections, braking, handling, and test laps (if allowed at the course). After these batteries are spent, we place our "heat one" batteries in the car. It is up to the crew chief whether they run their "A" set or "B" set. The "A" sets are the best batteries we own and should produce the best outcome for that car in a race. "B" sets are still good enough to get you around the track for the 60-90 minutes, however the "A" sets will typically yield the best results.

Our trailer is equipped with battery maintainers and chargers. Sets of batteries are placed in their respective plastic tote and can be slid in and out of the shelves with the help of a large screwdriver. In the trailer we also use battery heaters, if allowed by the organization’s rules. We heat the batteries because cold batteries don’t perform well.

Battery Certifiction Sheet

Battery Information			
Battery Number	Type of Battery	Date Purchased	Weight (lbs)
18-01	Optima Red Top SC35	2018	33
18-02	Optima RedTop SC35	2018	33
18-03	Optima Red Top SC35	2018	33
18-04	Optima Red Top SC35	2018	33
18-05	Optima Red Top SC35	2018	33
18-06	Optima Red Top SC35	2018	33
16-02	Optima Yellow Top D35	2016	33
17-01	Optima Red Top 75/25	2017	33
17-03	Optima Red Top 75/25	2017	33
16-12	Optima Red Top SC35	2015	33
16-09	Optima Red Top SC35	2015	33
16-10	Optima Red Top SC35	2015	33
19-01	Optima Red Top SC35	2019	33
19-02	Optima Yellow Top D35	2019	37
19-03	Optima Red Top SC35	2019	33
19-04	Optima Yellow Top D35	2019	37
19-05	Optima Red Top SC35	2019	33
19-06	Optima YellowTop D35	2019	37

Kennedy High School

Team Name

Barry Wilson

Advisor Name

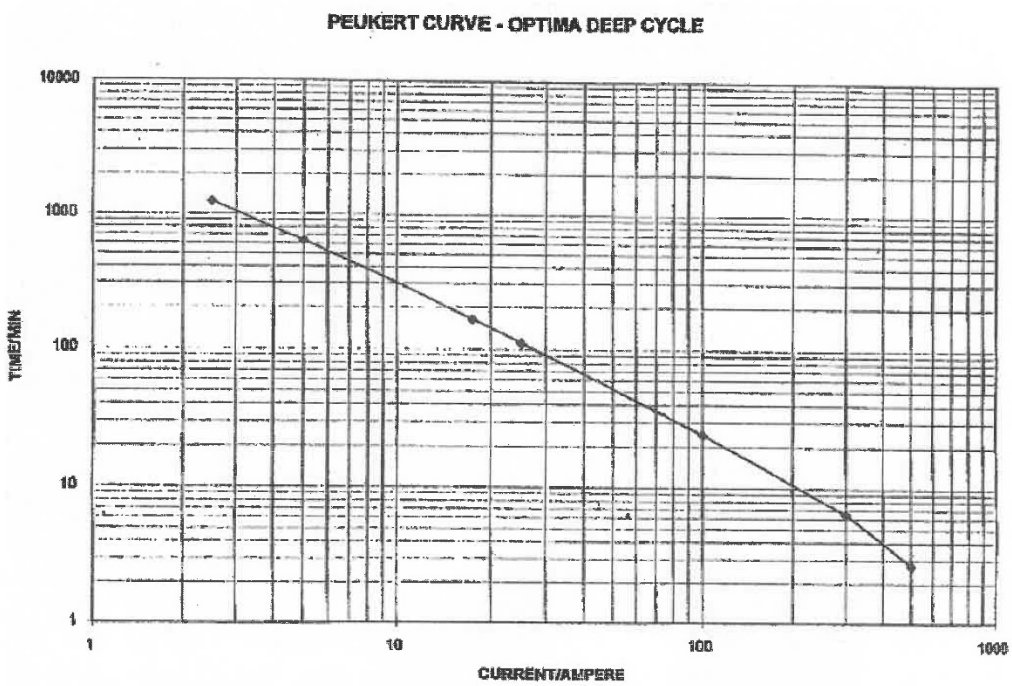
Barry Wilson 4/1/19

Advisor's signature & date

A Sets	(green)
B Sets	(yellow)
Setups	(red)

Optima Batteries Graph 2

Optima Reserve Capacity Peukert Graph



Gearing

Why gear?

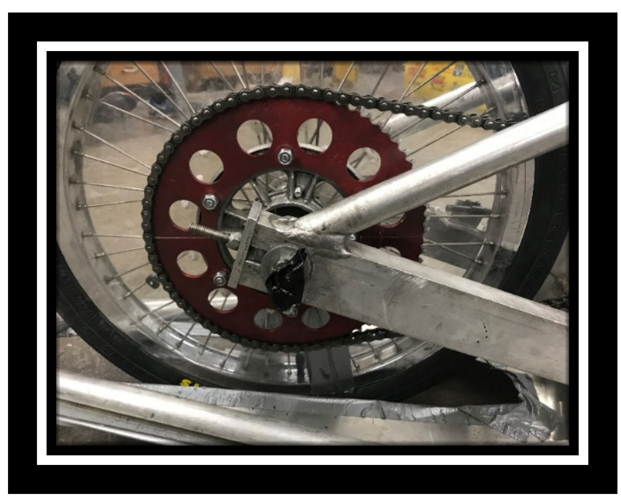
Gearing is one of the most important specifications on the car when competing. Gearing sets the top speed of the car, as well as determining how many amps must be drawn to reach and maintain that speed. It also allows us to adjust the car to various tracks.

What is gearing?

Gearing is the process of changing the ratio between the drive shaft on the motor and the wheel. This process changes not only how fast the car can go, but how much wear and tear is put on the batteries. The difference in gears affects how many amps are drawn to reach the top speed. This is important because as more amps are drawn, the batteries losses voltage.

How do I gear a car?

To gear a car, you first need to determine the correct gear ratio. Once you have done that, you gather the correct gear sizes for that ratio. If gears are already on the car, they first get removed. Once the car is free of gears, the new gears can be put on the motor and rear wheel. The wheel gears are much larger than the motor gear, and they are connected by a chain.



How do I know what to gear the car at?

The first piece of information needed to gear a car is the average number of amps drawn from the batteries. This lets you know how hard you can push the car during a race. On a flat track, such as Hawkeye Downs Speedway, top speed in maintainable, meaning you can go faster. On a road course, one with hills or tight corners, top speed is harder to maintain so a gear that requires pulling fewer amps to reach to speed will work better.

What is “getting on top of the gear”?

Getting on top of the gear refers to overcoming or going faster than the top speed for the gear. When this happens, the number of amps needed to maintain top speed decreases. In some cases, it can drop as much as five amps.

What happens if you gear too high?

Gearing too high causes the motor to overheat and your speed to drop up to 50%. In most cases, speed increases again once the motor has cooled off. However, top speed may not be reached again, as the speed is now reliant on how many amps are left in the batteries.

Motors

We currently run two different motors in our 985 car: the Briggs E-Tech and Lynch 170.

We primarily run the Briggs E-Tech motor on road course due to its minimal amperage draw upon acceleration. The Briggs motor is a 'baby motor', compared to the very powerful, high-speed Lynch 170 motor, which is ideal for speedways. A draw back of the Lynch motor is the very high amperage it pulls in acceleration. To minimize the draw we use a potentiometer (pot) to accelerate slowly and limit the large draw. Once the motor is running on top or cruising it draws little to no amperage. The Lynch motor is no longer in production so we are currently exploring the possibilities of the Saietta motor as a replacement for when the Lynch motors die.

Motor	Briggs E-Tech	Lynch 170	Saietta
Quantity	3	2	1
Pull (amperage)	Low	High	High
Ideal Course	Road	Speedway	Speedway

2014 Briggs Gear Ratios
20 Inch Wheel
1668 RPM

Wheel Gear	Motor Gear	Actual Ratio	Speed
114	17	6.705	14.79
	22	5.18	49.15
	24	4.75	20.88
	26	4.385	22.62
	27	4.222	23.49
	28	4.071	24.36
	30	3.800	26.10
	32	3.562	27.84
	35	3.257	30.45
	38	3.00	33.06
100	17	5.88	16.86
	22	4.54	21.85
	24	4.16	23.84
	26	3.846	25.79
	27	3.703	26.78
	28	3.571	27.77
	30	3.333	29.76
	32	3.125	31.79
	35	2.857	34.72
	38	2.632	37.68
95	17	5.588	17.75
	22	4.318	22.97
	24	3.958	25.06
	26	3.654	27.14
	27	3.518	28.19
	28	3.393	29.23
	30	3.167	31.32
	32	2.968	33.92
	35	2.714	36.54
	38	2.500	39.67
93	17	5.470	18.13
	22	4.227	23.46
	24	3.875	25.59
	26	3.577	27.73
	27	3.444	28.80
	28	3.321	29.86
	30	3.100	31.99
	32	2.906	33.92
	35	2.657	36.54
	38	2.447	39.67

85	17	5.000	19.83
	22	3.86	25.69
	24	3.541	28.01
	23	3.69	26.88
	25	3.400	29.17
	26	3.269	30.34
	27	3.148	31.57
	28	3.036	32.67
	30	2.833	35.01
	32	2.656	37.34
	35	2.429	40.83
	38	2.237	44.34
83	17	4.882	20.31
	22	3.773	26.29
	23	3.608	27.49
	24	3.458	28.68
	25	3.32	29.87
	26	3.192	31.07
	27	3.074	32.26
	28	2.964	33.47
	30	2.767	35.85
	32	2.594	38.24
	35	2.371	41.83
	38	2.184	45.41
79	17	4.647	21.34
	22	3.591	27.62
	24	3.292	30.13
	26	3.038	32.65
	27	2.925	33.91
	28	2.821	35.16
	30	2.633	37.67
	32	2.468	40.19
	35	2.257	43.95
	38	2.079	47.71
73	17	4.294	23.10
	22	3.318	29.89
	24	3.042	32.60
	26	2.808	35.32
	27	2.703	36.69
	28	2.536	39.11
	30	2.433	40.77
	32	2.281	44.88
	35	2.086	47.55
	38	1.921	51.63

72	**17**	**4.235**	**23.42**
	22	**3.273**	**30.30**
	24	**3.000**	**33.06**
	26	**2.769**	**35.82**
	27	**2.666**	**37.20**
	28	**2.571**	**38.58**
	30	**2.400**	**41.33**
	32	**2.250**	**44.08**
	35	**2.057**	**48.22**
71	**17**	**4.176**	**23.75**
	22	**3.227**	**30.74**
	24	**2.958**	**33.53**
	26	**2.730**	**36.33**
	27	**2.629**	**37.73**
	28	**2.536**	**39.11**
	30	**2.367**	**41.90**
	32	**2.218**	**44.72**
	35	**2.029**	**48.88**
	38	**1.868**	**53.10**
69	**17**	**4.058**	**24.44**
	22	**3.136**	**31.63**
	24	**2.875**	**34.50**
	26	**2.654**	**37.37**
	27	**2.555**	**38.82**
	28	**2.464**	**40.25**
	30	**2.300**	**43.12**
	32	**2.156**	**46.00**
	35	**1.971**	**50.32**
	38	**1.816**	**54.62**
67	**17**	**3.941**	**25.17**
	22	**3.045**	**32.57**
	24	**2.791**	**35.54**
	26	**2.577**	**38.49**
	27	**2.481**	**39.98**
	28	**2.393**	**41.45**
	30	**2.233**	**44.42**
	32	**2.093**	**47.39**
	35	**1.914**	**51.82**
	38	**1.763**	**56.26**

65	17	3.823	25.94
	22	2.954	33.58
	24	2.708	36.63
	26	2.500	39.67
	27	2.407	41.21
	28	2.321	42.74
	30	2.167	45.77
	32	2.031	48.84
	35	1.857	53.42
	38	1.711	57.97
63	17	3.705	26.77
	22	2.863	34.64
	24	2.625	37.78
	26	2.423	40.93
	27	2.333	42.52
	28	2.250	44.08
	30	2.100	47.23
	32	1.968	50.40
	35	1.800	55.12
	38	1.658	59.82
61	17	3.588	27.64
	22	2.772	35.78
	24	2.541	39.03
	26	2.346	42.28
	27	2.259	43.91
	28	2.179	45.52
	30	2.033	48.79
	32	1.906	52.04
	35	1.743	56.91
	38	1.605	61.80
59	17	3.470	28.58
	22	2.681	36.99
	24	2.458	40.35
	26	2.269	43.71
	27	2.185	45.39
	28	2.107	47.07
	30	1.967	50.43
	32	1.781	55.69
	35	1.686	58.83
	38	1.553	63.87
57	17	3.352	29.59
	22	2.590	38.29
	24	2.375	41.77
	26	2.192	45.25
	27	2.111	46.98

	28	2.036	48.72
	30	1.900	52.21
	32	1.781	55.69
	35	1.629	60.89
	38	1.500	66.13
55	17	3.235	30.66
	22	2.500	39.67
	24	2.292	43.27
	26	2.115	46.90
	27	2.037	48.69
	28	1.964	50.50
	30	1.833	54.11
	32	1.718	57.74
	35	1.571	63.14
	38	1.447	68.55
53	17	3.117	31.82
	22	2.409	41.18
	24	2.208	44.92
	26	2.038	48.67
	27	1.962	50.55
	28	1.892	52.42
	30	1.766	56.17
	32	1.656	59.90
	35	1.514	65.51

RPM / Ratio x RollOut / 12 / 5280 x 60 = Speed

Roll Out for 20 Inch Wheel = 62.8

Constant / Ratio = Speed

Constant = 99.1954

RPM for Briggs =1668

Lynch LM170
Gear Sheet
2019

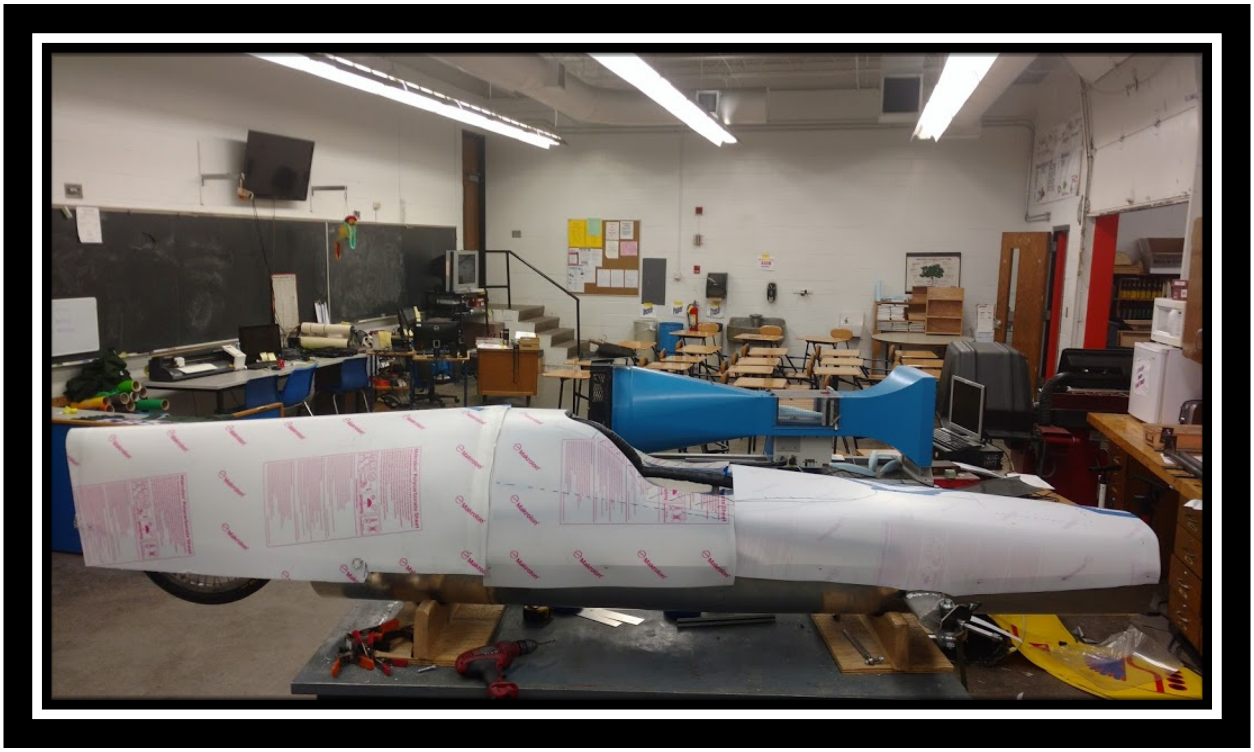
Wheel Gear	Motor Gear	Gear Ratio	Speed
81	21	3.86	19.63
	23	3.52	21.54
	25	3.24	23.39
	27	3	25.66
	30	2.7	28.08
	32	2.5	30.32
	35	2.3	32.96
	40	2.025	37.44
79	21	3.76	20.16
	23	3.43	22.09
	25	3.16	23.99
	27	2.93	25.8
	30	2.63	28.82
	32	2.47	30.69
	35	2.25	33.69
	40	1.97	38.48
73	21	3.477	21.8
	23	3.17	23.91
	25	2.92	25.96
	27	2.7	28.08
	30	2.43	31.19
	31	2.35	32.25
	32	2.28	33.24
	35	1.92	39.48
	40	1.82	41.65
71	21	3.381	22.42
	23	3.09	24.53
	25	2.84	26.69
	27	2.63	29.3
	30	2.37	31.99
	31	2.29	33.1
	32	2.22	34.15
	35	1.868	40.58
	40	1.77	42.8
69	21	3.286	23.07
	23	3	25.26

	25	2.76	27.47
	27	2.56	29.61
	30	2.3	32.96
	32	2.16	35.09
	35	1.97	38.48
	40	1.72	44.08
67	21	3.19	23.76
	23	2.91	26.05
	25	2.68	28.29
	27	2.48	30.56
	30	2.23	34
	32	2.09	36.27
	35	1.91	39.69
	40	1.67	45.4
65	21	3.096	24.48
	23	2.826	26.82
	25	2.68	28.28
	27	2.41	31.46
	30	2.17	34.93
	32	2.03	37.34
	35	1.86	40.76
	40	1.62	46.79

Body

Shell

The 985 car's frame is enclosed by 0.03-inch polycarbonate (plastic) and 0.03-inch aluminum sheets. We cover the chassis with a plastic body to increase the aerodynamics of our cars. We use 0.03-inch polycarbonate as it is a thin, lightweight cover that is easily replaceable, weather resistant, and greatly improves aerodynamics. The plastic is applied in panels, so if one area experiences damage just that area would need to be replace. This plastic does not absorb water and can be treated with Rain X to repel precipitation. A smooth glossy finish allows the air to glide down the sides of the car, not pocketing the air. A sheet of plastic is also cut and used as our canopy.



How is it applied?

Plastic panels are riveted on with one-eighth-inch diameter rivets. Wheel covers are plastic circles attached to the spokes of the wheels in a cone-like shape, nine zip-ties securely fasten the covers to the inside and outside of the wheel.

Foam Padding

Thin, grey, foam, pool noodle-like tubes are applied to the car's frame from the firewall forward. The foam is a safety feature. In the case of an accident, the foam is supposed to absorb some of the force as opposed to the driver's body hitting the aluminum tubes directly. The foam tubes are secured with electrical tape and help hide electrical wires.

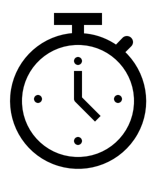
Graphics

Required graphics include car numbers, a three-inch red triangle pointing towards the exterior on/off switch, and a ‘push here’ graphic directing inspections personnel where to apply pressure. Everything else is up to the team’s imagination and creativity. This year the 985’s crew chief Bryan, and one of the drivers and graphics lead Rodrigo chose a dark grey background, with forest and lime green stripes in a geometric pattern, that is sure to make the car stick out.

Aerodynamics

In aerodynamics our lead Lucas Corrigan creates foam models of our cars and then tests them in a wind tunnel, to find what the drag coefficient, and lift/downforce is on all the cars to then figure out what features and design aspects can be used to design a more aerodynamically efficient shape. The process then repeats with the creation of a new foam model, testing, and improving, until he can find the best design.

Testing



Testing

Throughout the year, we do a lot of testing on the cars and the parts that make up the car. Because the battery testing is such a long process, it runs from when school starts in the fall until the start of the race season. As a part of this testing, all three cars are taken to a test track to get actual running data from the batteries. Frequent testing also done throughout the year by the aerodynamics team during the design process of the car. We also do our best to get cars out to a parking lot or test track at least once before racing to get an idea of how they will run and look for any last-minute improvements. This also provides an opportunity to see how well the cars perform in breaking and handling, as well as giving the drivers some practice laps. Testing is important for keeping our drivers from getting rusty, as well as allowing new drivers to get used to their car prior to the first race.

We also do exit and vision testing with drivers. For safety purposes, drivers must be able to exit the car unaided in less than 20 seconds. If a driver fails this, they are not permitted to race because in the event of an emergency, the driver will need to be able to exit the car swiftly. Vision is also important because the driver needs to be able to see the cars around them so that no one gets hurt during a race. We test this by holding a clipboard up to see if it is visible in the driver's mirrors.

Windtunnel Testing 2018-19

Car #	Wind Speed	Lift + Down -	Drag	Comments
2018 (50) A	24.4	-0.08	0.38	Air falls to side at about half way up the canopy. Air starting under the car stays under
2018 (30)	31.3	-0.08	0.4	Air falls to side at about 1/3 of the canopy. Air under the car stays under
Show Car	30.9	-0.3	0.55	Air slowly drifts to the side of the car and then falls to the side where the wheel covers end. Air under stays under with very low turblence
2019 (40) B	30.8	-0.05	0.28	Air started at the top of the Car. Starts to fall to the sides at about halfway up the canopy Air started under the car will stay there all the wayback 30.3% improve over 50 Car
Derek Car				
40 Dream C 2019	31.8	-0.25	0.17	The car is narrower but taller. 49% improvement over 50 car

Test Before Treatment

Battery Test Sheet

Car/Set

Battery No.	16-13		Date	15-Nov
Temp	Room		Open Circuit Voltage	13.02

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
3	11.83	37.2	440.08	1320.228
6	11.81	36.5	431.07	1293.195
9	11.76	36.4	428.06	1284.192
12	11.71	36.1	422.73	1268.193
15	11.65	35.6	414.74	1244.22
18	11.57	35.4	409.58	1228.734
21	11.52	35.2	405.50	1216.512
24	11.44	34.8	398.11	1194.336
27	11.22	34.5	387.09	1161.27
30	11.11	34	377.74	1133.22
33	11.08	33.2	367.86	1103.568
36	10.82	32.3	349.49	1048.458
39	10.48	30.1	315.45	946.344
42			0.00	0
45			0.00	0
48			0.00	0
51			0.00	0
54			0.00	0
57			0.00	0
60			0.00	0
		Total Power		15442.47
		Avg Volts		11.38462
		Total Power/Avg V		1356
		Avg P / 60		

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
5			0	0
10			0	0
15			0	0
20			0	0
25			0	0
30			0	0
35			0	0
40			0	0
45			0	0
50			0	0
55			0	0
60			0	0
		Total Power		0
		Avg Volts		#DIV/0!
		Total Power/Avg V		#DIV/0!
Avg Amps		Avg P / 60		

When voltage reaches 10.5 turn off switch and stop test.

Calculate the power produced for every interval by multiplying the current draw (amps) times the voltage (volts) and record thin in the cower collum of the table. Sum the entries in the power collum and multiply this number by the time interval, either three or five minutes. Determine the average or middle battery voltage. Divide the total power output by the average voltage to obtain the average battery output in amps.

First Test before treatment

Battery Test Sheet

Car/Set

Battery No.	16-14			
Temp	Room			

Date	16-Nov		
Open Circuit Voltage	13.69		

Time in	Voltage	Amperage	Power	Work
Minutes	in Volts	in Amps	in Watts	Done
T	V	A	V x A = P	P x T
3	11.94	38.8	463.27	1389.816
6	11.84	38.4	454.66	1363.968
9	11.69	37.6	439.54	1318.632
12	11.54	37.2	429.29	1287.864
15	11.32	36.4	412.05	1236.144
18	11.01	35.5	390.86	1172.565
21	10.69	34.5	368.81	1106.415
24			0.00	0
27			0.00	0
30			0.00	0
33			0.00	0
36			0.00	0
39			0.00	0
42			0.00	0
45			0.00	0
48			0.00	0
51			0.00	0
54			0.00	0
57			0.00	0
60			0.00	0
		Total Power		8875.404
		Avg Volts		11.43286
		Total Power/Avg V		776
		Avg P / 60		

Time in	Voltage	Amperage	Power	Work
Minutes	in Volts	in Amps	in Watts	Done
T	V	A	V x A = P	P x T
5			0	0
10			0	0
15			0	0
20			0	0
25			0	0
30			0	0
35			0	0
40			0	0
45			0	0
50			0	0
55			0	0
60			0	0
		Total Power		0
		Avg Volts		#DIV/0!
		Total Power/Avg V		#DIV/0!
Avg Amps		Avg P / 60		

When voltage reaches 10.5 turn off switch and stop test.

Calculate the power produced for every interval by multiplying the current draw (amps) times the voltage (volts) and record thin in the cower collum of the table. Sum the entries in the power collum and multiply this number by the time interval, either three or five minutes. Determine the average or middle battery voltage. Divide the total power output by the average voltage to obtain the average battery output in amps.

1st Test

Battery Test Sheet

Car/Set

Battery No.	18-05		Date	5-Dec
Temp	Room		Open Circuit Voltage	13.44

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
3	12.12	38	460.56	1381.68
6	12.1	37.6	454.96	1364.88
9	12.07	37.6	453.83	1361.496
12	12.05	37.3	449.47	1348.395
15	11.44	36.4	416.42	1249.248
18	11.42	36.5	416.83	1250.49
21	11.88	36.1	428.87	1286.604
24	11.83	36	425.88	1277.64
27	11.77	35.7	420.19	1260.567
30	11.68	35.2	411.14	1233.408
33	11.6	34.8	403.68	1211.04
36	11.52	34.5	397.44	1192.32
39	11.43	34.8	397.76	1193.292
42	11.32	34	384.88	1154.64
45	11.28	33.9	382.39	1147.176
48	11.15	33.7	375.76	1127.265
51	11.08	33.5	371.18	1113.54
54	10.92	33.3	363.64	1090.908
57	10.85	33	358.05	1074.15
60	10.77	32.5	350.03	1050.075
		Total Power		24368.81
		Avg Volts		11.514
		Total Power/Avg V		2116
		Avg P / 60		

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
5			0	0
10			0	0
15			0	0
20			0	0
25			0	0
30			0	0
35			0	0
40			0	0
45			0	0
50			0	0
55			0	0
60			0	0
		Total Power		0
		Avg Volts		#DIV/0!
		Total Power/Avg V		#DIV/0!
Avg Amps		Avg P / 60		

When voltage reaches 10.5 turn off switch and stop test.

Calculate the power produced for every interval by multiplying the current draw (amps) times the voltage (volts) and record thin in the cower collum of the table. Sum the entries in the power collum and multiply this number by the time interval, either three or five minutes. Determine the average or middle battery voltage. Divide the total power output by the average voltage to obtain the average battery output in amps.

Battery Test Sheet

Car/Set

Battery No.	18-03			Date	6-Dec		
Temp	Room			Open Circuit Voltage	13.88		

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
3	12.1	38.4	464.64	1393.92
6	12.07	38	458.66	1375.98
9	12.08	38	459.04	1377.12
12	12.03	37.8	454.73	1364.202
15	11.95	37.2	444.54	1333.62
18	11.92	37.2	443.42	1330.272
21	11.88	36.8	437.18	1311.552
24	11.82	36.6	432.61	1297.836
27	11.76	36.4	428.06	1284.192
30	11.67	36	420.12	1260.36
33	11.61	35.7	414.48	1243.431
36	11.55	35.4	408.87	1226.61
39	11.52	35.1	404.35	1213.056
42	11.42	34.7	396.27	1188.822
45	11.21	34.5	386.75	1160.235
48	11	34.2	376.20	1128.6
51	10.91	33.7	367.67	1103.001
54	10.87	33.1	359.80	1079.391
57	10.65	32.8	349.32	1047.96
60	10.6	32.4	343.44	1030.32
		Total Power		24750.48
		Avg Volts		11.531
		Total Power/Avg V		2146
		Avg P / 60		

Time in Minutes	Voltage in Volts	Amperage in Amps	Power in Watts	Work Done
T	V	A	V x A = P	P x T
5			0	0
10			0	0
15			0	0
20			0	0
25			0	0
30			0	0
35			0	0
40			0	0
45			0	0
50			0	0
55			0	0
60			0	0
		Total Power		0
		Avg Volts		#DIV/0!
		Total Power/Avg V		#DIV/0!
Avg Amps		Avg P / 60		

When voltage reaches 10.5 turn off switch and stop test.

Calculate the power produced for every interval by multiplying the current draw (amps) times the voltage (volts) and record thin in the cower collum of the table. Sum the entries in the power collum and multiply this number by the time interval, either three or five minutes. Determine the average or middle battery voltage. Divide the total power output by the average voltage to obtain the average battery output in amps.

2019 Batteries
Apr-19

	Group	Type	Delivered	Charged
			Voltage	Voltage
19-01	A1	35	12.68	
19-02	A1	D35	12.9	
19-03	A2	35	12.6	
19-04	A2	D35	12.86	
19-05	A3	35	12.66	
19-06	A3	D35	12.89	

Safety

Safety

To insure the safety of our drivers, we apply the rules put in place by the four different organizations we race under (EVERON, Iowa, NECA, and Challenge USA). New rules are instated frequently, and we must adjust to the changes.

Driver

Drivers must wear either a DOT approved full-faced helmet or an open-faced helmet with safety glasses when driving the car. This ensures the protection of the head and eyes in the event of an accident. Gloves are also required to be worn by the driver. Gloves protect the driver's hands in the event of a rollover accident or any situation where their hands could come in contact with the ground causing injury. Similarly, long pants and sleeves are needed to protect the driver's body in the event of contact with the ground or debris that may enter the car. Closed-toe, leather shoes are required at races within Nebraska and we chose to follow this rule at all our races. The protection they provide is essential to the driver's feet, which reside at the very front of the car.

Car

A five-point safety harness is used to secure the driver in the car- one point at each shoulder, one point at each side of the hip, and one point between the legs that all connect at the waist. The metal tubing used for the frontal impact and roll bars, in place to protect the driver in the case of a collision or rollover, are padded with foam tubing to protect the driver from sharp metal edges. The firewall is in place between the motor and the driver and the car's motor. Firewalls must be capable of withstanding one hundred pounds of force so that in the case of an accident the driver's head does not move. The barrier also protects the driver from the chain and motor.

Course Maps

Where we race:

Cougar Electric Car is the only electric car team to race in five states. We attend two races in Nebraska, two in Iowa, one in Michigan, one in Illinois, and three races in Wisconsin. All of the tracks provide different racing conditions with races lasting either 60 or 90 minutes.

West Point, Nebraska

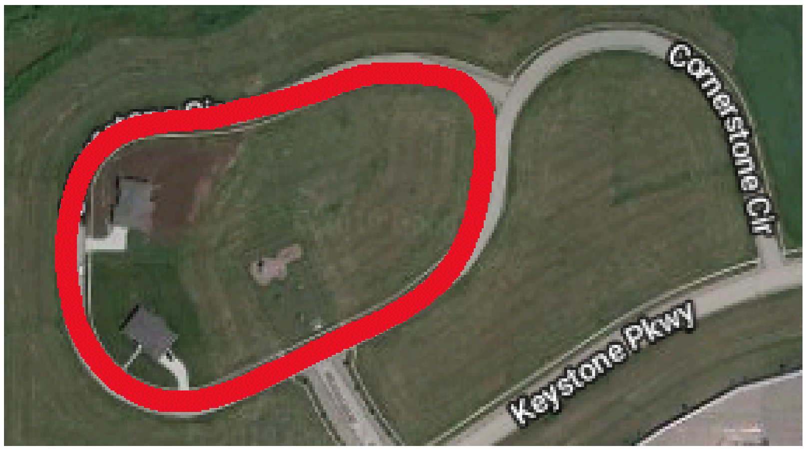
April 6th, 2019

West Point, NE – Cuming County Fairgrounds in West Point, NE is the first EVERON race. While we have been to this location many times, this is a new course. Instead of four 90-degree turns, this new course only has one. We look forward to running on this new course.

University of Wisconsin Platteville

Platteville, Wisconsin

April 12th, 2019 and April 13th, 2019

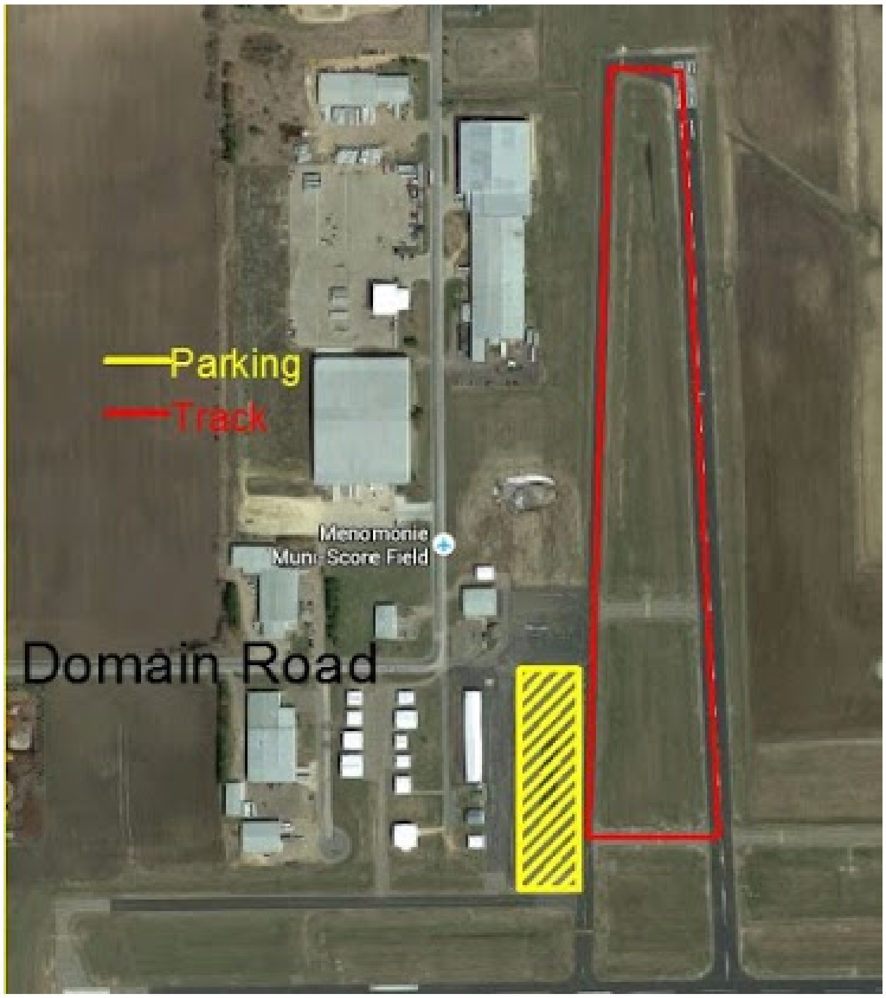


Platteville, WI- This is our first year racing in Platteville and we aren't entirely sure what to expect. The breaking and handling is held at a separate location then we move to the track, which is pictured above. The track is ovular and appears to be on residential streets.

Stout

Menomonie, Wisconsin

April 26th, 2019 and April 27th, 2019

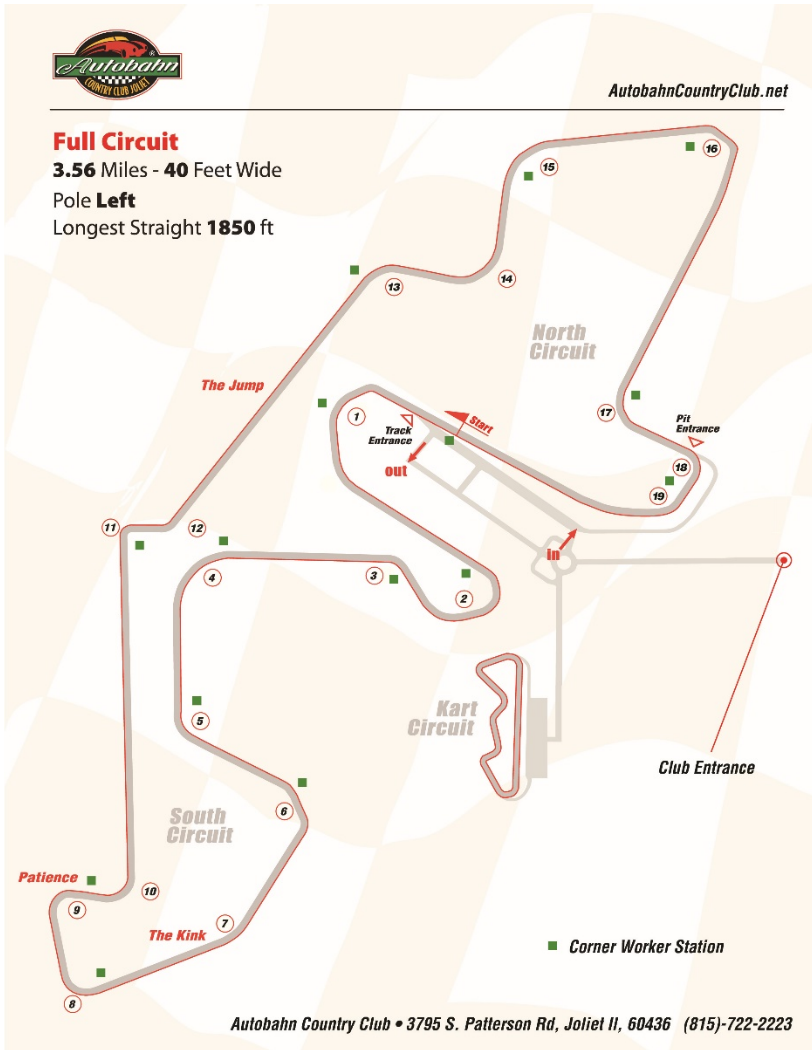


Menomonie, WI – This is the north set of runways at the local airport. Last year was our first time running here. All four corners can be challenging with traffic. As the first race in Wisconsin last year, we learned that electric cars do not do well in the snow. Drivers quickly learned not to attempt short cuts (keep it on the pavement).

Autobahn

Joliet, Illinois

April 28th, 2019 and April 29th, 2019



Joliet, IL – Last year was our first year at this course as well. Race organizers split the course so we ran only the South portion of the track (approx. 2 miles). While the goal is not to break down, it is a long way back to the pits when it happens here.

Wayne, Nebraska

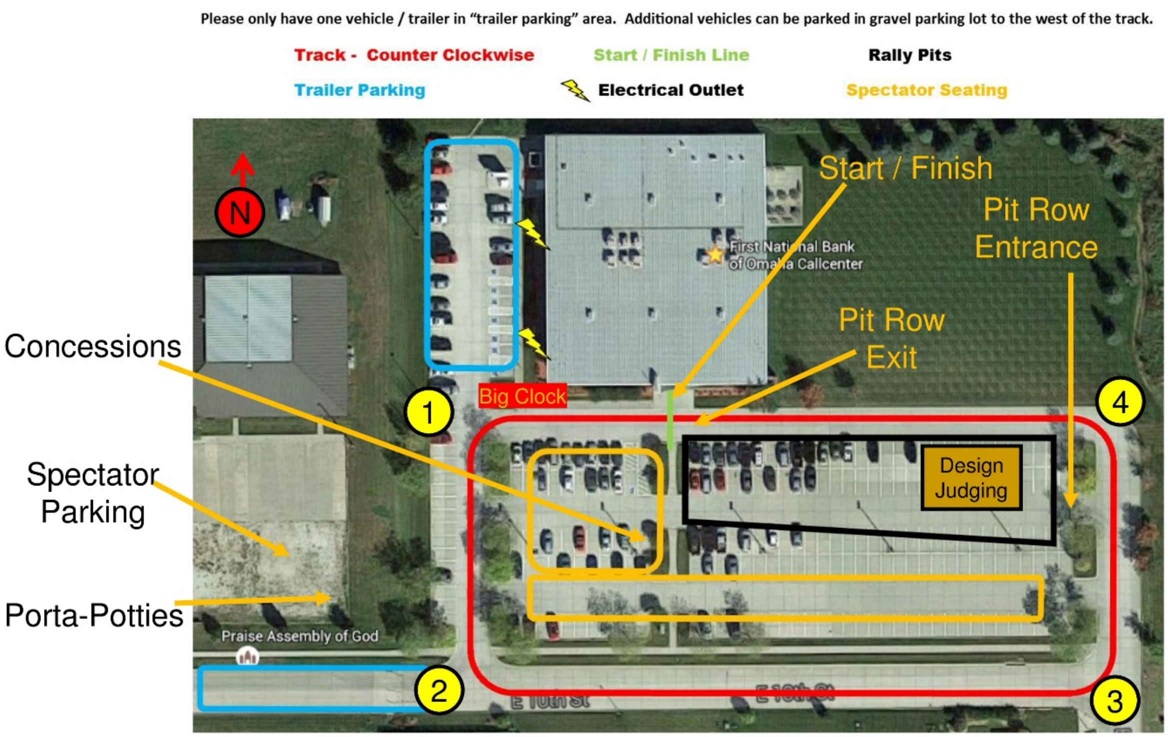
May 4th, 2019

First National Bank of Omaha Call Center
1110 East 10th Street
Wayne NE

90-Minute Heats

1 = Turn Number

1 Lap = 0.3 miles

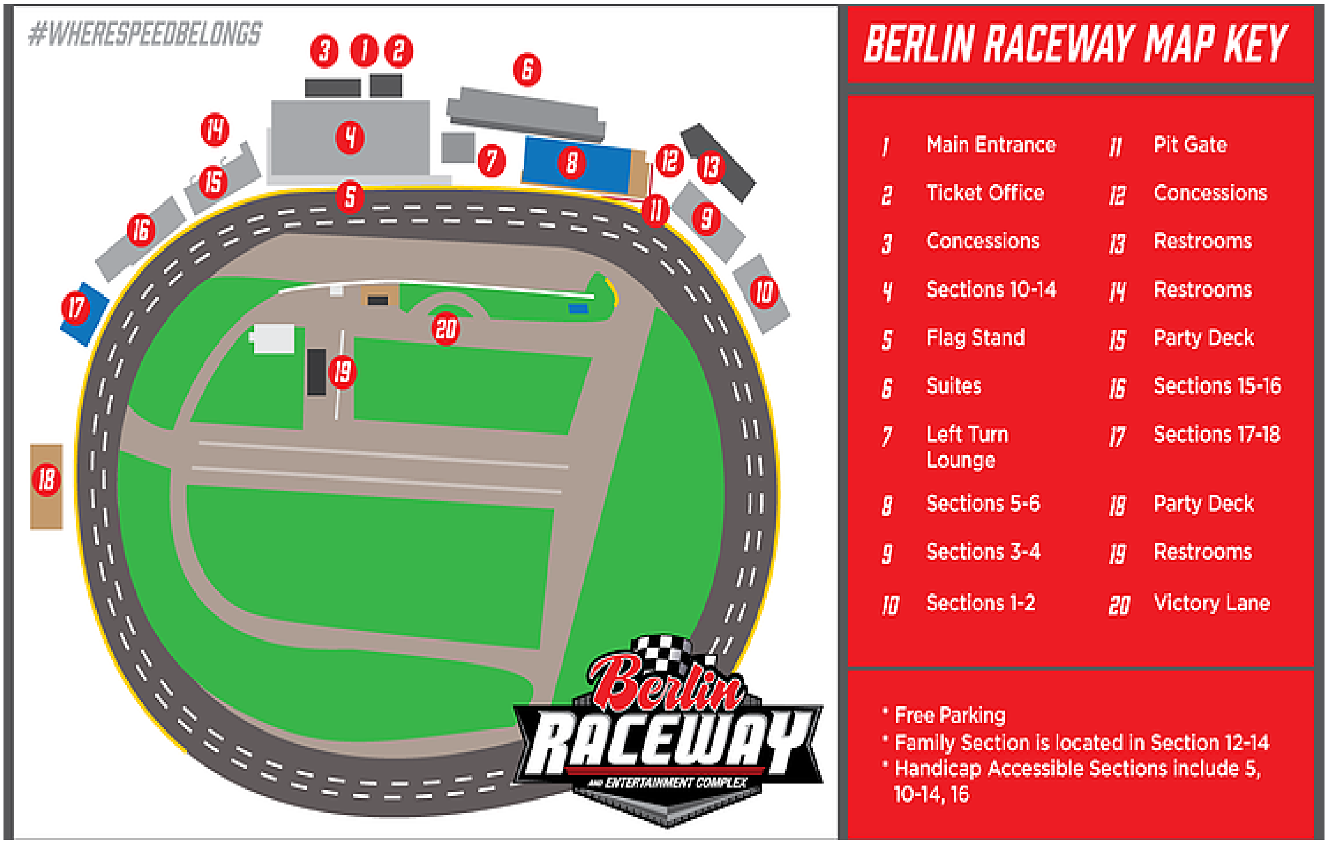


Wayne, NE – Wayne is an EVERON race in Wayne, NE. The track is a tight rectangle around the bank's parking lot. Pits are located in the middle of the parking lot. Wayne is a 90-minute race with two mandatory driver changes/ pit stops. Obstacles include gutter drains and curbs.

Berlin

Marne, Michigan

May 10th, 2019



Marne, MI – Berlin Raceway in a 7/16-mile, stock car, asphalt oval with pit lanes in the center. The oval is three lanes wide all the way around and is banked in the corners. This track is the most perfect rack we race on. It averages 4mph faster than Hawkeye Downs (our other speedway).

Road America

Elkhart, Wisconsin

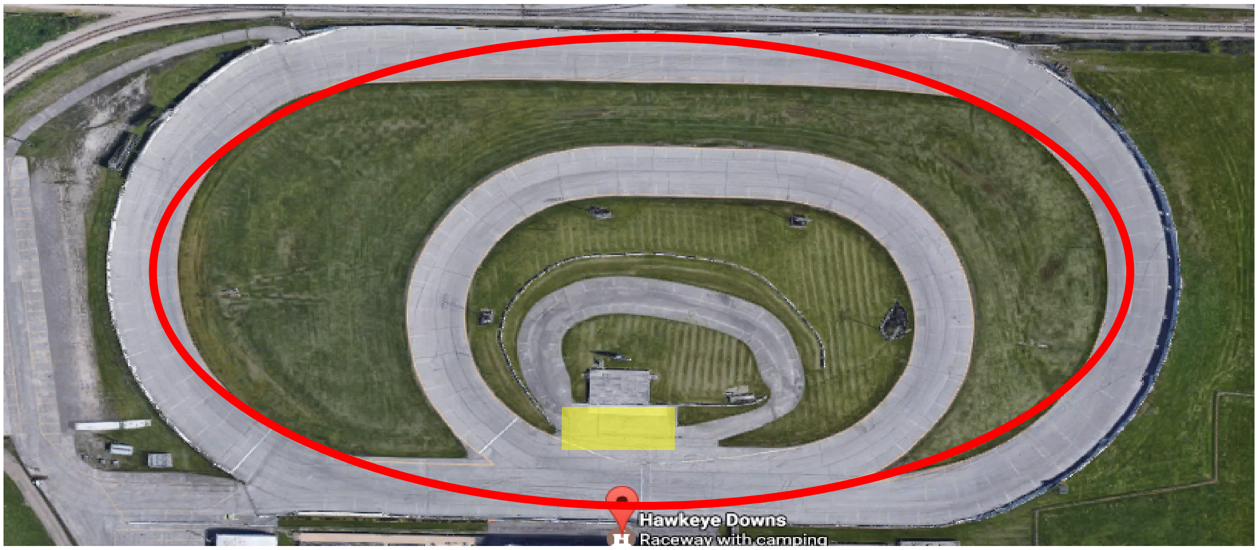
May 13th, 2019 and May 14th, 2019

Elkhart, WI – Road America's track is 4.05 miles long, making it the longest course on which we will race. This course qualifies as a road course, consisting of right and left turns. Braking and handling takes place in a parking lot near the pits.

Hawkeye Downs

Cedar Rapids, Iowa

May 18th, 2019

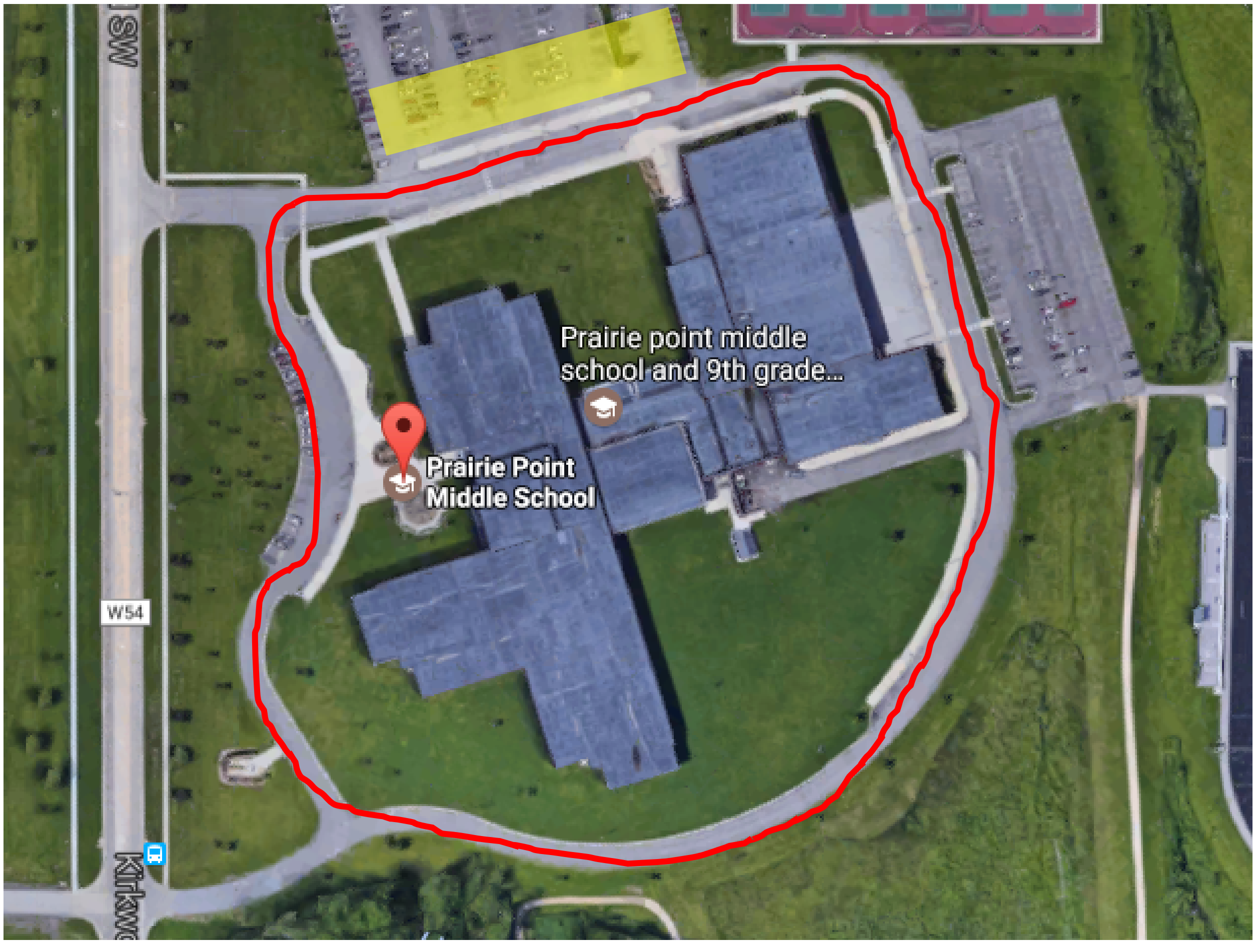


Cedar Rapids, IA – Hawkeye Downs Speedway is a ½-mile, asphalt, oval. This track is not perfectly graded, the back straightaway is uphill, and there are numerous larger cracks in the surface of the asphalt. Pits are located right in front of the lap counters and trailers are parked on the small 1/8-mile oval. Braking and Handling competitions are also held on the front and back straightaways.

Prairie

Cedar Rapids, Iowa

May 19th, 2019



Cedar Rapids, IA – Prairie Point Middle School is our last race of the season. We race on the road surrounding the school and pit in the parking lot adjacent to the track. Difficulties with this track are turns 1 and 4, storm drains along the backstretch, and the final leg of the track is a slight uphill. Turns 1 and 4 can be dangerous, because they are very sharp and tight turns, when cars wreck on this track it typically on one of these two turns. Storm drains located on the back half of the track are marked with cones for students to avoid hitting and damaging their cars.