Formula High School

2010-2011

Formula High School is a Technology Education program offered at many schools around Wisconsin and even one in Indiana. This program dates back to the 08/09 school year, its prototype year. Started by the Technology Education teachers Jeremie Meyer and Mike Besel; the two wanted to teach a class that would allow students to use all of the knowledge gained in math, science, and engineering classes to make one complex vehicle. The participating schools this year are Racine, Green Bay Preble, Green Bay Southwest, Ashwaubenon, West DePere, Grafton, Shawano, Sheboygan South, Waunakee, Waukesha, and New Castle Indiana.

Based off an open wheeled race car manufactured by Sugar Grove Custom Cars, the Mysterian M5, each team had to design critical components of the vehicle while following a comprehensive list of rules. This made it possible to keep the cars safe, allow improvements year to year and finish them in the allotted time.

Near the end of the school year, all of the participating teams from around the area meet up at the Road America racetrack. This is the most rewarding part of the course where student's ingenuity and ability to fix things on the move is truly put to the test.

Absolutely NO fabrication will be allowed at the track events.
FHS officials reserve the right to disqualify a team if the officials believe there is a safety hazard present on the team's vehicle.

Overall Sizes:
Wheelbase: 81" – 87" measured from center of front spindle axle to center of rear axle.
Width: 50" to 58" measured to the outside edge of the mounted tire.
Max Overall Length: 144" including body shell.
Ground Clearance: 2" MIN – 6" MAX
Vehicles not within these measurements will not be allowed to compete, even as an exhibition. Vehicle widths and wheelbases are set to ensure a safe and stable vehicle for the track day events. Specifications must be followed. **There will be no exceptions.**
Chassis: All teams must use the supplied chassis model as the base for their vehicle. Chassis MUST be constructed to the chassis model within 1" of specifications. All frame members shown on the model must be present in the completed chassis.
Roll Bar Tubing: 1 ½" round mild steel tubing, 0.083" (14ga) wall thickness. Roll bar tubing must be a single continuous piece. NO SPLICING ALLOWED. Driver's helmet should not be excessively forward of the roll bar protection when seated in the vehicle.
Bracing: 1" round mild steel tubing, 0.083" (14ga) wall thickness.
Floor: 0.0747" (14ga) mild steel sheet, stitch welded to the bottom frame rails. The minimum weld stitch pitch should be no more than 1-3.
Body Shell: Teams must use an approved FHS fiberglass body shell. If a team chooses to use an alternate body shell, that team must submit approval directly to FHS officials. The only approved body shell materials are: fiberglass, Kevlar, carbon fiber or 0.032" aluminum sheet. Aluminum must either be polished or painted.
Appearance: All FHS vehicles must be painted, gel coated, or powder coated with school and sponsor decals appropriately placed. Bare metal frames will not be allowed.
Mandatory Decal List (List may change at later date):

- Sugar Grove Custom Cars
- Fiberglass Solutions
- Road America
- Briggs & Stratton

Decals must be placed in a position where they are easily seen from both sides of the car. FHS officials reserve the right to add to the mandatory decal list at any time.
Firewall: .032" or thicker aluminum or mild steel sheet must be used for a firewall between the driver and the engine compartment. Teams must try to make all reasonable efforts to fully seal the driver's compartment from the engine compartment. Teams should try to keep all gaps to less than ½".
Safety Harness: All teams must use a 5-point safety harness, installed to safety harness manufacturer's specifications. Harnesses certification stickers must be within five years of event date.
Engine: Briggs & Stratton 16 HP Vanguard V-twin ONLY. To further clarify, we are accepting engines in the 3034xx and 305xx (horizontal) and the 3037xx and 3057xx (vertical) model line. Provided the engine is designated as a 30 cubic inch, OHV, "V-twin" engine that is rated at 16hp, and falls in the range listed above, it will be accepted. No other

engine will be allowed. NO power adders or modifications to the engine allowed, except for wiring extensions, throttle and choke connections. Engine must have a throttle return spring attached directly to the throttle shaft arm. Governor may be removed/disconnected. See suggestions in regards to RPM limit.
Teams have asked if they can use an engine other than the recommended Briggs & Stratton. The reasons why there is only one approved engine manufacturer:

Eliminates the need to use restrictor plates to equalize engine power levels.
Common parts which allows teams to help each other out at the track.
Limited availability of appropriate sized and capable engines from other manufacturers.
Simplifies the inspections process for track officials.

Kill Switch: Two paddle type kill switches are required. One switch shall be located in easy reach of the driver and labeled appropriately. The second switch shall be located on the left side of the rear roll bar but above the body shell. This location is shown on the chassis model. The switch will be marked with a red vinyl or painted 3" equilateral triangle and labeled ON/OFF with .25" high contrasting color text. Both switches must be demonstrated to effectively shut off the engine.
Fuel system: Teams may relocate the stock Briggs and Stratton vacuum fuel pump to allow proper fuel supply to the pump. NO electric fuel pumps. Fuel tanks/cells must be commercially available, designed for fuel use and installed to manufacturers specifications.
Exhaust: Exhaust outlet(s) must extend past the body shell by a minimum of 1".
Transmission: Centrifugal clutch with a single overall gear ratio. No CVT or multiple gear transmissions allowed.
Overall Gear Ratio: Open. Teams are allowed to gear for various track configurations.
Tires: DOT rated tires. No racing slicks or trailer tires allowed.
Overall tire diameter: 24" maximum
Suggested tires sizes: Front: 175/50-13 Rear: 205/60-13
Rim: 13 x 6 steel rim, 2.5" back spacing suggested
Front Spindles: All teams must use standard VW Beetle spindles, ball joints, eccentric adjusters, rotors and disk brake calipers. No modifications allowed to these parts.
Rear Brake: All teams must utilize a standard VW Beetle brake caliper, actuating a single brake rotor keyed or splined to the rear axle. At least one rear tire must transmit braking power to the ground. This caliper will also be on a separate hydraulic circuit from the front brakes.
Suspension:

All teams must have a minimum of 1 successful year of FHS experience before they may incorporate an IFS/IRS suspension.

Teams designing/building and IFS/IRS system must incorporate production spindles, brakes and uprights.

Teams must supply engineering drawings and or pictures of their design to FHS officials for approval before manufacturing their system.

Minimum Rear Axle Diameter: 1 ¼"
Steering: Rack and Pinion ONLY, no go-kart steering allowed.
Steering Wheel: Steering wheel must be either a continuous round or "D" shaped wheel. No butterfly style steering wheels allowed.
Minimum Tie Rod Diameter: ¾"

Driver Safety: All drivers must use the following safety equipment:

- DOT or Snell rated full-face helmet, manufactured within 5 years of event date
- Neck collar
- Closed toe shoes
- Long pants
- Long sleeve shirt/jacket
- Gloves
- Impact rated eye protection, minimum rating of Z87.

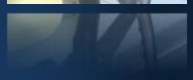
No sweats pants or windbreaker pants allowed.
Safety Glasses: All team members must be wearing safety glasses when actively participating in repair or adjustments to the team vehicle.
Overall Rule of Conduct: Students must present themselves in a professional manner. Teams will be disqualified and removed from the track in any team member does not follow directions from the officials.
SUGGESTIONS:
Rear axle bearings should be placed as close to the inner side of the wheel hub as possible to limit axle bending/twisting. Some teams have run up to a total of four bearings across the rear axle.
Chrome Moly Steel axles suggested. Low quality axles have bent under load.
Gear ratios: A good rule of thumb is to start with an overall gear ratio of 8:1 and then gear for the existing track conditions and individual vehicle response.
Chain tensioning devices: Use a sliding engine base set-up to adjust chain tension. There was a much higher incidence of thrown chains when using idler sprocket assemblies.
Install shaft collars on both sides of the rear hub assemblies. This is extra insurance to keep the hubs in place on the axle.
Fasteners: Teams should try to use at least grade 5 or higher fasteners, with nylock nuts, when possible.
Standard Formula High School wheel bolt pattern: 4 on 4”B.C., 2.5” back spacing.
Exhaust: Teams have run both open pipes and mufflers. The engines seem to work the best with some type of muffler. Individual team chassis dyno testing is suggested.

RPM: Engines should be limited to 4500 RPM. Teams run a risk a valve float above that RPM.
NORAM Enforcer clutches have shown a much higher durability than the NORAM Mini-Cup clutch.
When using a NORAM Enforcer clutch, install a spacer behind the clutch to eliminate the chance of the clutch sliding towards the engine.
Use Loc-tite on the crankshaft bolt. This reduces the chance the bolt will come out, dropping the clutch on the track.

Our third hour team consists of four seniors that attend Preble High School. Brian Janus (far left) has taken the Introduction to Engineering and Design (IED), Advanced Engineering and Design (AED), Civil Engineering and Architecture and Engineering Design and Development (EDD) courses. He focuses on the computer work such as team updates and designing parts of our car on the Autodesk program. He also took part in measuring and cutting parts of our chassis as well as helping lay up the fiberglass mold and wiring the vehicle. Devan Downey (middle left) has taken the Small Engines, Fabrication Restoration, IED, AED, EDD and a Research and Development (R&D) courses. He welded a large part of the chassis, designed the throttle and brake mechanisms, and also trimmed the new body mold from our friends at Fiberglass Solutions. Brendan Taylor (middle right) has taken the IED, AED, Residential Construction, Woodworking, Advanced Woodworking and Printing Processes. He helped with laying up and trimming parts of the fiberglass mold as well and also helped with some welding of the chassis. Matt Rentmeester (far right) has taken IED, Introduction to Technology and EDD courses. Matt worked on lathing parts of and mounting the master cylinder for the brake mechanism and was also taught how to weld so he could take part in the assembly of the chassis. He too helped lay up, cut and trim parts of the fiberglass mold.

Part Description	Manufacturer	Model Number	Cost	Qty	Total Cost
Master Cylinder Assembly	California Import Parts	VWC-113-611-015-BH	$39.95	1	$39.95
Brake Fluid Reservoir	California Import Parts	VWC-113-611-301-L	$5.50	1	$5.50
Thrust Washer	California Import Parts	VWC-111-405-661	$1.75	2	$3.50
Ball Joint Eccentric	California Import Parts	VWC-131-498-319	$28.45	1	$28.45
Upper Ball Joint	California Import Parts	VWC-131-405-361-F	$12.95	2	$25.90
Lower Ball Joint	California Import Parts	VWC-131-405-371-G	$12.95	2	$25.90
Disk Brake Conversion Kit Blank Rotors	California Import Parts	ACC-C10-4121	$269.95	1	$269.95
Disk Brake Caliper Used for rear axle	California Import Parts	C13-98-1150-B	$64.95	1	$64.95
Front Brake Rubber Hose	California Import Parts	VWC-311-611-701-B	$9.45	2	$18.90
Dust Cap	California Import Parts	VWC-111-405-692-B	$2.75	2	$5.50
U Joint for Rack and Pinion	California Import Parts	C26-425-160	$24.95	1	$24.95
Splined Shaft for U-Joint	California Import Parts	C26-425-164	$8.50	1	$8.50
Universal Chrome Steering Shaft	California Import Parts	C26-425-011	$32.95	1	$32.95
Chrome Steering Bearing	California Import Parts	C26-425-013	$12.95	1	$12.95
14" Rack and Pinion	California Import Parts	C26-425-150	$99.95	1	$99.95
Quick Release Steering Wheel Hub	California Import Parts	C26-415-100	$16.95	1	$16.95
Brake Hub for 1 1/4" Axle	BMI Karts	600503	$14.95	1	$14.95
Sprocket Hub - 1 1/4" Axle	BMI Karts	600243	$28.95	1	$28.95
35 Series Split Sprocket	BMI Karts	6053**	$14.86	1	$14.86
35 Series RLV Extreme Chain	BMI Karts	400635GG	$14.95	1	$14.95
Steering Wheel 10" DIA	BMI Karts	410200	$21.99	1	$21.99



1 1/4"" Tubular Steel Axle Bearing Mount Kit	BMI Karts	400415	$24.95	2		$49.90
44" 1 1/4"" Tubular Chrome Moly Axle	BMI Karts	601444	$43.50	1		$43.50
Gearbox	Hilliard	N/A	$275.00	1		$275.00
13 x 6 Steel Wheels 2.5" BS 4 holes on 4" BC	Bassett Racing Wheels	N/A	$65.25	4		$261.00
Formula High School Fiberglass Body Shell	Fiberglass Solutions	N/A	$350.00	1		$350.00
16 HP Briggs V-Twin Engine, with clutch assembly With Shipping	Donated by Briggs and Stratton	N/A	$0.00	1		$0.00
1 1/2" Square Tubing 11 ga 40 feet	SI Metals	N/A	$1.47	40		$58.80
1 1/2" Round Tubing 13 ga 20 feet	SI Metals	N/A	$1.66	20		$33.20
1" Round Tubing 13 ga 40 feet	SI Metals	N/A	$1.19	60		$71.40
RCI Aluminum Fuel Cell	Summit Racing	RCI-2010A	$95.95	1		$95.95
R.J.S. Racing 5 Way Harness	Summit Racing	50502-18-23	$59.95	1		$59.95
Drive Hub 1 1/4" Axle 4 on 4" BC 1/2" Studs and Lug Nuts	Jegs.com	056-9030	$25.99	2		$51.98
Roll Bars	US Auto Force	N/A	$40.00	1		$40.00
Comet TAV 2 Torque Converter	Small Engine Suppliers	218352A	$209.95	1		$209.95
Mini-cup Enforcer Clutch	Noram	N/A	$171.75	1		$171.75
Total Cost			$2519.38			

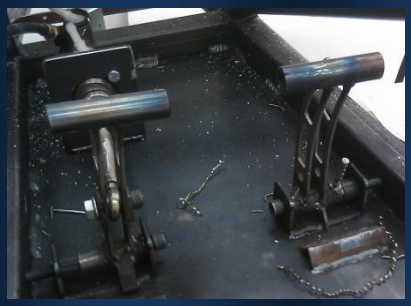
In order to improve our car from past years, we focused on trimming the overall weight, as well as distributing it more effectively. To do this we moved main components such as the battery from behind the seat to the front of the car. To lessen the weight we also invested in an entirely new differential, with help from one of our sponsors Kaplan Automotive. This differential allows more power to the outside wheels while cornering and cuts it to the inside wheels reducing slipping which should allow us to enter and come out of the turns faster than other teams. For the backend we incorporated angle iron to retain the overall strength but reduce the weight, versus using all 1 ½" steel tubing. The seat and firewall have also been redesigned with lightweight aluminum. We dropped down the steering by approximately six inches in hopes to gain more torque through the corners. Throttle and brake mechanisms have also had to be modified to be more appealing and weigh slightly less than last year's car.

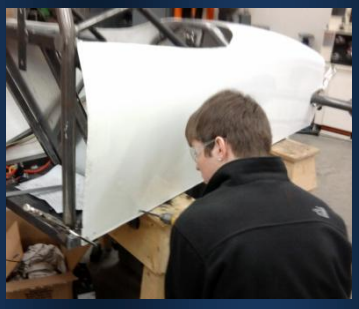
Deleer's Car (Last Year)

Stealth Car (This Year)

After the design process was well underway, we could begin on construction. This was difficult throughout the course of the year because we had less than 50 minutes of work time in class each day and had to communicate with the other half of our team as to what everyone should be doing. Sometimes our various hours clashed, but we were able to work out our problems and create a professional vehicle worthy of our terrific sponsors.

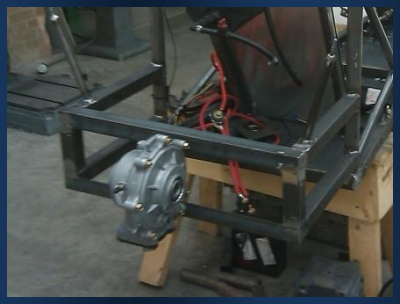

Beginning of chassis


Brake and throttle controls


Mounting fiberglass body


Wiring: front view


Wiring: rear view


Rear-axle assembly


Battery mount


Completed bare chassis


Painted body and chassis


Rear brake


Wind visor


Front-left axle

Day 1 – After the gates opened we quickly unloaded our car from the trailer oblivious of the troubles that lie ahead of us. After only one run on the track, our exhaust nearly fell off the engine; only one bolt of the four was still tight. To fix this we ended up using Loc-tite on all the bolts and had to force a standard bolt into a metric socket that had been stripped of its threads. Soon after, our brakes began to fail and we noticed a leak in the linkage between the soft and hard brake lines; this was an easy fix with tape.

Day 2 – This day started off much like Day 1, with problems. Our car ran great, but as soon as it got out of the gates the key fell out of the drive shaft and the car didn't move. We dropped down the clutch and quickly replaced the problem key. The next thing to fail was the throttle cable. As soon as the car got onto the track it wouldn't slow down; the kill switch worked well in this situation. We had to replace the cable completely with a new one and fix part of the throttle pedal that broke off in the process. Instead of welding a new pin on, we sent a bolt through the pedal, wrapped the cable around it a few times and secured it with multiple lock nuts. We noticed the drive chain was loose as well, so we quickly repositioned the engine. From this point on the car ran smoothly.

Unloading

Fixing throttle

Fixing exhaust

Formula High School
Briggs Motorplex Track Day
April 30 – May 1, 2011

Tentative Track Schedule

Saturday, April 30	
8:00	Track Gates Open
8:15 – 10:00	Tech Inspection
10:00 – 11:00	Driving Techniques – Mike Kertscher
11:00 – 12:00	Lunch
12:00 – 3:30	Open Track Time (one vehicle at a time!)
4:00	Track Closes
Sunday, May 1	
8:00	Track Gates Open
9:00 – 12:00	Oval Track Timing
12:00 – 12:30	Lunch/Track configuration changes
12:30 – 3:30	Road Track Configuration
3:30 – 4:00	Track Clean-up
4:00	Track Closes

Thank You
Mr. Jeremie Meyer!

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