HotMod build project

1. Part 1: The donor car.

In production years 1978 ? 1987, the General Motors (GM) corporation adapted all of their 108" wheelbase midsize cars to a common frame. Whether it was an Oldsmobile, Buick, Pontiac or the popular Monte Carlo bodies and nameplate, if it was the midsize GM passenger car built these years, they all rested on a 108" GM metric frame.

At that time being the largest selling line of domestic passenger cars, these cars could be found everywhere, and were the last of the rear wheel drive midsize passenger cars that GM would build in mass quantity.

Many of these cars are still on the road today, and many more still can be found in wrecking yards. Parts are still available, and they have been adapted for use by racers everywhere.

These cars were a natural choice to use as the 'HotMod' for all of the above reasons.

'HotMod' rules dictate the use of OEM parts for the suspension. The rules are written so that everything (with the optional exceptions of the upper control arms & rear end housing) is required to be the stock parts that come standard on the midsize GM metric frame.

When locating a donor car for your build, and your starting from scratch, make sure all the suspension components are there and in usable condition. If this is the case, you have everything necessary to turn your donor car into your future racecar.

The more that is usable when you buy the car, the farther along in the process you will be. If you intend to run a 350 GM engine and automatic transmission, look for a car, possibly still in service, that has all of this. Many small car lots, or the local Bulletin Board type magazines may have the jewel your looking for.

If you aren't as picky, or need less, scour the local wrecking yards. If none are available at the time, tell the yard operator what you want, and why you want it. Give him a card with your phone number on it, and ask him to call when he gets a unit in. A car that has been wrecked may be suitable provided any possible frame damage is limited to areas that can be removed. Stay away from a car with a damaged front frame horn unless you are willing to put it on a frame machine prior to starting the actual build.

There has been concern that these cars are impossible to find. In my efforts, I haven't found that to be the case. It's true that salvage operators are crushing cars, but are just as happy to sell them as they are to crush them. Don't expect them to pull the body for nothing, though. That is the reason some are finding it harder to find these cars. There out there, but salvage operators expect to make their money off of them, and no longer disassemble them as they once did in the past. Either make arrangements for the salvage operator to pull the body if you wish, or be prepared to take it home and do it yourself. You can then haul the remnants off to the crusher to recoup some of your money.

Remove the front and rear suspension, and set off to the side for future use.

Remove the exhaust hangers, old brake and fuel lines and bumper braces. You won't need or will be replacing all of these. Leave the rear crossmember to frame rail braces in place for the time being. If nothing else, they will keep the frame braced as your wrestle it around in the following steps.

Once you have the frame stripped bare, you need to either sandblast or spend some up close and personal time with your future pride and joy by applying a wire brush to remove years of surface rust. This is a time consuming and physical part of the process, but it will pay big dividends as we advance through the build process. Remember, rust makes for an extremely poor weld, so

time well spent here will save future time.
The GM metric cars have 2 unique features.
They were the first frames that were totally robotically welded, and they made of 100% recycled steel.
While neither of these facts mean much other than you now have the ability to impress your friends in a friendly game of automotive trivia, it does create a couple necessary steps before proceeding past the bare frame stage.
First, these car frames were more prone to rusting out than before due to the quality of steel. The rear frame rails behind the rear shock mounts can be replaced, and this is one of the reasons why. The frames were notorious for rusting out in that area. Check where the sway bar bolted into the frame, and around the areas of the body mount bolts. These were also areas for extreme rust.
Take a welders "slag pick" and go around the frame, sounding it for weak spots. Don't be afraid to strike it hard enough to make sure that the steel is sound. Now is a good time to remind anyone involved to be sure to wear safety glasses or goggles when working with any striking tool, or grinding on any weak spots. You can fix a frame, but your eyes are invaluable. Same thing goes for your hands. Learn to wear work gloves during these projects. Rough edges can lead to researching the date of your last tetanus shot, otherwise.
Fix any bad spots by welding in a steel patch. Since you have the welder out already, carefully look over the frame seams and weld areas. Because the automated welding procedure worked on an average speed and heat range for the metal being welded, these frames sometimes exhibited less than textbook welds. Careful examination may show you cold welds, burn throughs, or areas where the robotic welder missed the joint area altogether. Take your time, look the frame over thoroughly and grind and weld anything that looks suspicious to you. Once you have finished with this process, you have completed the most labor intensive of the work to get your HotMod on the track. The frame has been readied, and it is the foundation of the entire build process.
Next, we lay out the frame supports and roll cage.

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Part 2: Laying out the frame & cage

After some serious investment of sweat equity, you now have a stripped frame that has the surface rust removed, and any suspect areas repaired.
It is now time to lay out the frame work that will become the roll cage.
For more veteran racers who have built their own cars in the past, this may seem a simple step, but for the novice this can seem overwhelming at first glance.
One very important thing to remember before we dive into this part of the project: If you are not a competent welder, find someone who is to weld the cage. This is not the time to begin to learn the art of welding. The cage, seat and safety harness mounts need to be installed by someone who is an experienced and skilled welder. Your future health may depend upon this! Do not shortcut this step. Practice your welding skills on non-critical pieces like frame tabs and bumpers, but leave the welding that directly relates to driver safety to someone who understands and knows how to weld correctly.
In regards to a roll cage, 3 possibilities exist.
You are installing a previously used cage from another race car.
You are installing a pre-manufactured "kit" cage.
You are going to fabricate your own cage "from scratch".
If you are having the roll cage installed by a "professional" race car builder, you can ignore the

following, but for most of the rest us, the following may be useful.
Before starting this process, take the time to do a little investigative research of your own. Look at some of the professionally built modified class cars that presently run at your home track. Talk to the driver and crew first, though. Most guys are willing to offer advice or show you their cars provided you introduce yourself prior to snooping around the car.
Make notes if you need to remind yourself of things you want to incorporate into your build. You will notice that nearly all the cars have the right (passenger) side of the roll cage tied to what is designed as a frame stiffener in the HotMod rule book. This basically runs in a straight line from the front to rear clip. Be mindful of this when you install your roll cage. This alone will save you time and materials, and make the fabrication process much simpler. Steve Smith offers an excellent line of "how to" books dedicated to auto racing. Access to the internet may also provide you a quick study on roll cage and frame design. Many chassis manufacturers have websites which include photos of a bare chassis. While this doesn't allow you to actually measure anything, you can get an idea of how the "pros" go about designing an economical frame and cage.
Mating a previously used cage to the GM metric frame can be a lesson in compromise, or as Mick Jagger sang, "You can't always get what you want".
Unless the cage you are using also came from a like frame, you will need to be creative in mounting the cage to the frame. Install the driver's side lower frame work (door bar base) either to the left frame rail, or to the optional external frame stiffener.
(See rule 1B, the HotMod allows for frame stiffeners on both sides of the frame. By incorporating this on the right side between the front & rear frame turn outs, you can narrow your cage, thereby decreasing the right side weight percentage. This will also provide additional driver room, and keep the seat further inside the door bars.)
Install the cage back as far as possible on the passenger car frame. A word of advice here: It may be a good idea to "mock up" the rear end in the chassis to be positive that the left rear tire won't contact the back of the cage. This is the case with anything you feel could become a future fit problem through the entire build process. Mock fitting anything prior to final installation, when it concerns welding, is always a smart move. Incorporating an "X" in the frame, and the use of "outriggers" to tie into the right side frame rail will add rigidity to the chassis (make sure the "X" won't interfere with the transmission tail shaft or driveshaft!).
If the old cage has right side door bars, you'll probably need to remove them. An "X" in place of these door bars will add strength, save right side weight, and allow you to correctly install the body later on.
Many of the present HotMod cars in competition incorporated the use of cages that originally were Late Model or Open Wheel Modified chassis's. This is a good option, but be mindful of a couple things when adopting these to your build. Pay close attention to the cage location on the donor chassis, adopting that to your build, and be mindful of the dimension from the mid-plate (rear motor mount) to the center line of rear end. Using a saw rather than a torch to cut the cage from the donor chassis will save you some future work, as well.
If you decide to go with a pre-manufactured "kit" cage, make sure that the main components are made from 0.95 wall thickness D.O.M. (drawn over mandrel) tubing.
These should include the driver door bars, main hoop, halo and upright bars. Electric weld tubing is satisfactory for many places in a race car, but the main roll cage and door bars should always be DOM tubing. For best results (both during construction and in competition) the tubing should

be low carbon mild steel. Stay away from chrome moly tubing. It's physical characteristics make it brittle if incorrectly welded, and it is very pricey.
Buying a kit cage is a lot like buying a suit.
Different material, styles, and sizes, but if you buy off the rack you get it cheaper than going to a tailor who will give you the fit you desire.
There are many fine cage kits and applications available, most of which are reasonably priced because they are built in volume. Take the time to decide what you need before purchasing, and make some phone calls to these companies if the cage width, height or length you desire isn't a 'stock' item. The possibility exists that a cage built to your specs can be purchased for only a marginal difference in cost.
Make sure before purchasing any kit cage that all the tubing is notched to fit. This is a time consuming process to do on your own if that isn't the case. Irregardless, you need to be prepared to do some of this with any kit cage. The joints should fit as close as possible before final welding begins. Always tack weld bars in place before finish welding. This will save you major headaches should you encounter a problem later.
Remember, an 'x' or diagonal bar is all you need in the right side door area, so make sure they are aware of this when ordering a cage. You can save some money on the cage cost.
These kits also come with straight sections of tubing to use as you see fit.
An "X' in the cage behind the driver is always a good idea, and some variation of it should be incorporated into your roll cage. Saving weight here (the roll cage) is never a good idea. If you've never raced, or raced in a class that requires a minimum weight, it is hard to gauge what your car may weigh "dry". This refers to the car without any ballast, fuel or fluids. The HotMod minimum weight rule is 2400 lbs., the same as current TSMA/AMRA style modifieds. The HotMod rear suspension is much simpler than what the TSMA/AMRA modified rules permit, and thus is much lighter. Most of the TSMA/AMRA modifieds still weigh in very near the minimum required. Understanding that, you need to realize that when building your HotMod it isn't necessary to look for ways to save weight, by installing an ultra-light roll cage.
A race car's overall weight is actually divided into 2 different "types" of weight. There is 'sprung' weight, and 'unsprung' weight.
'Sprung' weight refers to the weight the cars springs see. The springs support and react to the weight of the car.
'Unsprung' weight is weight that actually is out of the springs control. This is weight that is below the spring level. This is the rear end, it's components and the front lower control arms, for example.
Any knowledgable racer will be able to tell you a heavy car with light components is better than a light car with heavy components. The reason for this is that you can adjust for 'sprung' weight with springs and set-up options. 'Unsprung' weight cannot be compensated with anything other than a lighter part replacement. That option isn't available in the HotMod, and quite honestly, the 'unsprung' weight of these cars is already minimal. By keeping the majority of weight between the axles, as HotMod rules allow, the car has better weight distribution. Long story made short, don't attempt to sacrifice safety for weight in the main cage area. A few extra pounds here will have little affect on the overall weight or weight distribution.
Consider a couple of words of advice.
More isn't necessarily better. I've seen cars that look like tanks when finished just because the guy building it decided everything from the headlight covers to the ash tray needed roll bars.

They installed roll bars in areas that more endangered, rather than protected the driver. Never add a bar in an area where the drivers head could come in contact in an accident. A properly installed main cage, using correctly sized tubing should do the job without adding a bar "just because we had tubing left over". If a bar doesn't serve a needed purpose, chances are it doesn't need to be installed.
Secondly, triangulation is the key to strength. Each leg of the triangle transfers the load the next member. Providing the car is properly triangulated, the resultant loads transfer to the springs and shocks. They then do their job in a predictable manner. Radical handling problems can sometimes be traced back to chassis flex. This problem is nearly impossible to detect, and can be baffling when in the garage doing chassis set-up.
The required O.E.M. suspension on these cars isn't designed to react like the current 4 bar cars in the Late Model & modified divisions. Many of these are designed to flex, making the entire frame a sort of torsion bar. Some of these chassis's also need to be replaced fairly often, as the flex fatigues the steel so quickly that soon cracks develop, and the car no longer "works" as it did originally. Build your car so the springs do the work the high priced Detroit engineers intended, and you'll be much more satisfied with the end results.
The final option is to build a cage from scratch.
If this is your choice, congratulations! You are a "do-it-yourselfer" of the first order with the patience of Job, and a garage full of neat tools.
This will require (in no particular order) a band saw, tubing bender, tubing notcher, angle finder, and a 20 cup coffee maker since you will be spending a tremendous amount of time in the garage. Unless you have experience with figuring the radius of bends, be prepared to haul off a large pile of scrap tubing bent in variations of the letter L.
All joking aside, building a cage from scratch is a time intensive project, requiring a great deal of measuring and lay out work. The payoff to this is getting exactly what you want, with the satisfaction of knowing it's your own craftsmanship and design.
The main cage is now in place. Next time we'll install bars to the front & rear clips.
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Part 3: Completing the roll cage
Our project car is beginning to take shape, as we have completed the installation of the main cage.
We've tried test fitting everything we felt could be in conflict before the expert welder of the group completed the welding of the roll cage.
We now will go about bracing the rear and front of the car frame, tying them to the roll cage itself. We'll refer to these ends of the frame as the front & rear clips.
A "professional" race car builder must first take into account his suspension mounting points. These are critical to insure that the springs and shocks don't run out of travel, bottoming out in either direction.
You won't need to be concerned with these dilemmas, as the HotMod rules require the suspension and shocks mount in the original O.E.M. stock locations.
That is specifically the reason for the rule, as a matter of fact.
The front bay bars extending from the cage to the front clip will serve 2 basic purposes.
First, they brace each individual frame horn.
Secondly, they provide mounting points for the radiator support and the hood pins.
The height of these bars (distance from the top of the frame to the bottom of the bar) on nearly all

modifieds is predicated on the height required to properly mount the front shocks. Since this isn't a concern for you (starting to appreciate that stock mount suspension rule, aren't you?) the front bay bars become less critical, and more of a choice of preference. You will need to tie them together after determining the radiator location, so try to keep the bars parallel.

The tail of the car, or rear clip, will require a little more figuring, but again, since the suspension isn't involved, it becomes a matter of preference. (That stock suspension mounting rule was a stroke of brilliance, eh?)

The factors we need to consider are the size and proposed location of the fuel cell and battery box. If you wish to remove the stock rear frame rails and fabricate the tail section you will need to incorporate that step at this time. The stock rear frame rails can be removed to the rear of the rear shock mounts only (see rule 1A). The rear shocks mount in a steel plate that also serves as the upper rear spring bucket. If you have decided to fabricate the tail section, take the time to get an approximate height of the bumper end of the frame rails. This will get you in the ballpark for your tail section height. The length of the replacement frame rails is dictated by the dimensions of the fuel cell you intend to use. Chances are you won't need the frame rails to be any longer than the present stock rails, and possibly not as long. A thought to remember when calculating the rear clip length: This area is primarily for mounting the fuel cell, rear bumper and the rear body and interior brace. The longer it is, the more material it requires for the interior and quarter panels. Consult the rulebook for minimum & maximum dimensions (pages 11 & 12). If you calculate a little now, you may save a few dollars later on.

If you remove the stock rear frame rails, cut both frame rails in the same location, making the cut as close to perpendicular to the floor as possible, and at the back edge of the shock mounts. Next, tie the 2 OEM frame rails together with a length of box tubing that is capped at both ends, and cap off the exposed ends of the stock frame. This serves a couple purposes, bracing the rear suspension and clip, in addition to providing a foundation point should the rear clip need replaced due to damage. Should you take a bad hit to the rear of the car, it's better to let the frame to the rear of the suspension absorb the damage. If bent beyond straightening, replacing it becomes a much easier process.

You may want to narrow the tail of the car up by moving both fabricated rear frame rails inboard a bit. Remember to verify that the fuel cell will fit (but this shouldn't be a problem).

It is important to brace the rear cross member and spring/shock mounts to the cage.

Install a diagonal down brace from the top of the cage to the tail of the frame. On the drivers side of the car, this bar should extend from basically behind the driver's head to the rear, and be close to parallel to the rear frame rail. If you are able to line this diagonal bar up with the frame rail, it will make the interior deck installation a little easier.

Off the diagonal down bars, install braces to the spring / shock mounts, taking care to avoid any future conflict with spring buckets. If you are planning to install weight jack bolts on the rear, or modify the upper spring bucket to accept a different height spring, install this brace bar after the spring bucket fabrication is complete.

Install a brace bar from each side of the main cage to the rear cross member, near the rear suspension arm mount. This brace bar should be kept as short as possible, and angle downward from the roll cage to the cross member plate. This will brace a high stress area that will see much higher forces placed on it than what Detroit engineers originally intended.

Additional bars are needed to protect the driver's feet, and possibly triangulate the front clip if desired, but for this step it's best to have the motor in place and determine the amount of room

needed for the headers. These bars, while important, can be fit as a choice of preference after the necessities are installed.
If you still have the rear end under the car, and you intend to take advantage of the motor set back allowed in HotMod competition, this is the time to lay out your motor mounts.
This step isn't as intimidating as it sounds, but will require patience.
A bare engine block with a transmission bolted to it will make the process easier. If you have your rear motor mount (or midplate) bolt them between the block and tranny as they would be mounted in the car.
If the frame is on jackstands, try to level the car as much as possible.
Measure from the center line of the rear end (from both sides of the housing) forward 70 inches (see rule 8b), and make a distinguishable mark on the frame. Remember that the rear should be as close to the correct ride height as possible when determining this dimension.
The motor can set farther forward, but cannot set any further to the rear than the 70" dimension.
Now that we have the distance we desire from the rear end, we need to determine the height the engine will set in the frame. If you have a racing style oil pan, a good rule of thumb is the bottom of the pan should be no lower than the bottom of the stock front crossmember. Setting the engine with the pan installed on a piece of box tubing or 2 x 4's, and using a floor jack to manipulate it into position will make this easier. Making sure the 2 x 4's hit under the frame rails when jacking the motor up will simplify this. Use caution that the motor and tranny are secure. This can be a hazardous step.
Without getting into some complicated math that I am certainly unqualified to explain, the engine height has a great deal to do with the cars roll center and center of gravity height. With asphalt race cars, the general rule of thumb is "low and to the left".
Dirt cars aren't quite as simple, and generally react better to a higher center of gravity, and a more balanced loading for the suspension. The roll center determines how weight is transferred through the forces of cornering, acting as an invisible axis for the weight mass to rotate about. Too high is just as detrimental as too low. What we're shooting for is a happy medium.
Once the motor mounts are installed, the engine can be raised by use of spacers or shims, but lowering it will be next to impossible without refabbing the motor mounts.
For this reason, I suggest using the bottom of the cross member = bottom of oil pan height as the baseline starting point. I think you'll find this baseline to work, and besides, any lower and the bottom of the oil pan will be caved in or drag. If you desire to initially raise the engine, and have positive results, you may have found the happy medium we were searching for!
At your 70" marks (or forward), weld in a 0.95 wall vertical roll bar between (and perpendicular to) the lower frame member and upper bay bar on each side of the chassis. Square the back of the engine block to the rear end housing, making sure that the engine is in the centerline of the car frame, and keeping the driveline relatively level.
This plays an important part in the life of the driveshaft's universal joints.
You can now fabricate the mounting brackets to support the rear motor mounts from the previously installed roll bar uprights.
While you have the motor in position, you have the opportunity to also fabricate your driveshaft hoop (see rule 6B & it's illustration), radiator support, and front motor mounts. Again, check you headers for fit before installing any front end bracing.
The front motor mounts are can be fabricated in the same fashion as the rear mount.
With the engine in place, build to the mounting plates. Some chassis builders weld a diagonal bar

from the side of the front frame horns to the front cross member, and then install an upright from that to the bracket. Use 0.95 wall tubing for this, and install a couple of diagonal braces from the top of this upright to the frame. A lot of torque, weight and lateral stress will be placed on the motor mounts, so don't be afraid to use gussets to help spread the loads.
(When building the 'Project HotMod' car, we mounted the engine slightly higher in the chassis with good results. One noticeable concern was the considerable driveshaft angle. After a full season of racing, no universal joint failure or driveshaft problems resulted, but this is something to keep in mind on your build.)
The radiator should fit in between the front cross member and fan. If this is the case, the supports can be welded of the back of the cross member. If needed, the cross member can be notched to allow the radiator to fit (see rule 1B). Check out the mounts on a variety of different modifieds at the track (they are all basically the same) and adapt this to your car. Install a cross bar running horizontally in front (and below the top of) the radiator, tying each of the front engine bay bars together. Install a pair of forward facing tabs that are slightly inside of the radiator's core width. These tabe should angle downward slightly, lining them up with the top of the radiator. We will use this later as the top radiator "hold down". You also need to weld in a cross bar in the area of the now vacant front cross member that will absorb the frame loads that the engine used to brace. Weld this bar in at the approximate height where the front motor mounts were previously located. This bar plays an important part in eliminating front chassis flex.
I strongly recommend bracing the front frame horns (see rule book page 13) in some fashion. Make sure that whatever you install doesn't interfere with any of the steering members. At the very least, install a crossbar between the 2 frame horn, and weld a couple body tabs (angled towards the top of the radiator) to anchor the nose piece.
There is no right or wrong way to do much of this work. It may involve a great deal of trial and error before you are satisfied. Assisting a friend in a race car build several years ago, we installed and cut the front clip off a car 3 times before we were finally satisfied. That car went on to win opening night of the season, and recorded multiple feature wins and a couple of track point titles before being sold.
The moral of the story is the time and work you invest now can pay big dividends later on the track.
Next, we'll tackle the body & interior supports, and install bumpers and rub rails.

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Part 4: Bumpers, rub rails and interior mounts

If you've followed this project from the start, you are well on the way to getting the steel fabrication portion on the project completed.
You also have come to realize that much time can be spent with little visual progress made. Don't despair, Bunky. This is typical for anyone in these steps of the project, irregardless of experience. If you've went to the trouble of correctly fitting the tubing before welding, rather than just stuffing a bolt into the gap and welding (never a good practice) your time has been well spent. Learning to properly fit things in place prior to welding may take a bit longer, but it will eliminate the need to cut out and refabricate mistakes, and allow you to be proud of your craftsmanship.
As with any build project, there are times that show lots of progress with little work. Unfortunately, for the impatient among us, some of these steps will come later.

It's been my subtle suggestion all along to build a durable car. I hope you've picked up on these hints. The HotMod wasn't intended to be a throwaway car. It should last, if properly maintained and avoiding a catastrophic wreck, for several seasons. The rules won't obsolete it with new technology yearly, so building a safe car (that must weigh 2400 lbs. anyway) is our primary goal.

An overlooked but important part of any race car is driver comfort. Installing the seat, pedals and steering to fit the driver's frame is a step that many take for granted. It is also a step that requires more than one person. If the driver is particularly tall, sacrifices may have to be made in order to fit everything up, but take the time now to maximize the driver's comfort in the car.
If you have installed an X in the frame, you're next step would be to install your seat and safety belt mounts in the car.
Your racing seat and belts should always mount to the frame and cage structure. There is never an viable excuse for doing this another way. In the event of a serious wreck, the seat, safety belts, and subsequently the driver need to stay with the roll cage. Michael Waltrip survived a horrendous crash at Bristol in 1990, in part due to properly mounted belts and seat. If you learn anything from this project, it should be that properly installed and maintained safety equipment holds priority over anything else you'll do. If you can't afford the required and adequate safety equipment, you need to put the project on hold until you can afford it. Do it right, or don't race.

There should be a frame member (part of the cage) that runs under the bottom of the seat. Place the seat in the car and have the driver sit in the seat, adjusting it to the angle he prefers. Using this information, weld tabs to the frame member to anchor the seat base. An outrigger from the cage to the shoulder height area of the seat back can now be installed. Take care not to make this a potential spear or future hazard for the driver. Remember to take the driveshaft into account when installing the seat. The lap belt mounts should route the belts across the pelvic girdle. Most of the present day fabricated aluminum racing seats have a hole on each of the sides to train the lap belts through. These holes generally provide an accurate indication of the needed location for the lapbelt mount brackets. The shoulder harnesses should mount only slightly lower than the drivers shoulder height, primarily pulling back, rather than down, on the driver. Severe internal injuries can result from improperly mounted lap belts, and unnecessary pressure can be placed on a drivers back due to shoulder harnesses that "drapes over" the driver. The back of racing seats also has a hole to train the shoulder harness belts. NEVER drape the belts over the seat.
In the event of a hard frontal collision, the driver can slip through the shoulder harnesses, and suffer unnecessary injuries to the chest (heart & lungs), face and neck areas because of this oversight or shortcut.
Use adequate and properly welded brackets, good quality and proper length bolts with lock nuts when installing your safety belts. This is definitely not the area to cut corners.
The anti-submarine belt should also be installed. This little belt, also know as a "crotch strap" has gotten a bad reputation as an unneccessary item. Nothing could be further from the truth. Driver's who are hesistant to use this belt have no doubt done so because of the dreadful fear that their future "social life" could be endangered should this belt come into service. While it is true that the belt could keep a driver from submarining under his lap & shoulder belts, the real practical service this belt provides is keeping the lap belt from "creeping" up the drivers torso. Any driver with experience generally tightens his belts when opportunities arise. The anti-submarine belt keeps the belts in place and properly aligned. Broken ribs and internal injuries could result in

hard frontal collisions if the belts ride up the drivers stomach area. I always used the anti-sub belt, and know many others who do as well. None of us presently sing soprano or ever had injuries that resulted from use of the belt. Make sure you employ it's use if you don't already do so.

Prior to installing the rub rails and rear bumper, we need to determine the body & interior deck dimensions. For some this may be simple, but those who are building their first car from the ground up may find some of the following helpful.
It helps to have the car frame at ride height, but isn't absolutely necessary.
HotMod rules allow for some body/interior deck rake. Don't go nuts trying to make your car look like a doorstop, and you probably won't have any problems.
First consider the window opening desired. Rules allow for 12' minimum to 18" maximum opening. Unless your driver's build runs on the slight side, I suggest a window opening larger than the minimum required. Today's race cars are generally built so tightly in regards to the window opening, it would appear to the casual observer that a degree in limbo dancing is a prerequisite to being able to drive. Watching some of our healthier sized drivers snake their way in & out of the window area of the LM & Modified cars cause concern in their ability to exit the car in an emergency.
When satisfied with the opening, wrap some masking tape around the rear roll bar upright, indicating the door heigth desired. From this point, run a straight edge across to the passenger side bar, level, and tape that bar for height.
1" box tubing can make a frame work to run from the car frame to support the rear deck. I advise angling this from its mounting point at the frame back toward the rear of the car, making the interior mount slightly rearward of the frame mount. A couple of inches or so will do the trick.
Use a string or chalkline to get an idea of the run from proposed front firewall to back of the interior decking. The interior can have a 4" maximum overall rake (see rulebook page 12, line item 10) so let this be your guide.
For the car to look correct when finished, and ease the interior and body installation, use a this stringline as a guide for your interior support mount locations. Build your front firewall uprights off the the front bay bars at the rear motor mount location, or no farther than 72" foward of the centerline of the rear axle (see page 12, line item 11). Some adjustment on front and rear mount heights may be required before you are satisfied. Adjust the mount that will run across the rear of the main hoop (behind drivers shoulder area), again using a stringline. For width, the body can extend no further than 2" outside the right frame rail, and needs to be no wider than required to cover the driver side door bars. Maximum interior/body width is 66 inches, so keep this dimension in mind.
Some folks frame these deck support mounts by running a length of tubing from front to rear on the drivers side. They are then able to tie this bar into the top door bar, providing a support for the top of the drivers door. While this isn't necessary or required, it may be a something you may find useful in your build.
You will need a minimum of 6 tabs per side of the car to install body bracing. A couple on each side the rear clip, welded horizontally to the exterior side, should serve to brace the quarters. A couple on the lower frame rail between the front and rear tires, along with a tab on the front & rear cage upright halfway up the door should suffice for the side bracing. Weld a couple of tabs on the front and rear of cage to bolt your roof down.
With the front firewall location determined, locate the mounts for your brake, and if needed,

clutch pedal. If your master cylinders are firewall mount style, mock up your firewall and clamp the pedal to it at the location desired by the driver. Build your mounting plate and bolt to pedal. Next build the frame work to support the pedal, remembering the prior geometry lesson on triangulation. Brake pedals can see a surprising amount of force applied by the driver, and need to be mounted solidly. Flex in the brake pedal must be eliminated. Pedal mounting kits are available, and may be a good investment. You may need to do some additional fabrication to suit your chassis, but this can be a real help for minimal investment.
The same can be said for the steering column bracket. Use a straight piece of tubing along wth the steering wheel to determine the location your driver prefers for the steering. Tack the mount to the cage's dash bar, and determine the location for the steering quickener mount if you intend to use one. Installing the quickener near the firewall make the steering column installation less aggravating. Otherwise, it’s a shot in the dark trying to determine where the firewall should be hole sawed for the column to pass through. This is also the time to install the driver protection windshield bars. The rules require a minimum of (3) 5/16" steel bars. You can install these bars directly from the cage's upper halo to the dash crossbar, but I suggest another step. A few chassis builders install a crossbar above the interior level, welding the vertical bars to it. This additional step will make the interior installation much simpler and easier.
Add some chassis tabs to the dashbar area to anchor your guage panel. These will come in handy when later doing the sheet metal work.

Bumpers and rub rail don't need to be fabricated out of heavy wall tubing. To correctly do their job, it's best if they are made of lighter material. The intent of all of these is to absorb any punishment, rather than passing on the force of the blow to the main frame. Better for them to bend than the frame itself. Properly installed, they can be unbolted and straightened or replaced. Again, take time to look at different option for these on present modified cars. Different chassis builders install all of these in various but similar ways. All have went to the trouble of determining the most economical design for their chassis. If you find something you like, adapt it to your build.
Don't feel too badly about using someone elses ideas on your project.
Professional chassis builders do this as well, and besides, it's been said that "Imitation is the sincerest form of flattery".
Consult the HotMod rulebook (see rule 12A-H and diagrams on pages 12 & 13) for specifics. External rub rails are required between the wheels (door area) but aren't required around the quarter panels. The rear rub rails are strictly optional, and can be run either inside or outside of the body. Rub rails can't extend further than the outside plane of the tires. Any exposed rub rail ends must turn in toward the body and be capped. Soft plugs work great for capping tubing and are inexpensive. Rear bumpers must either be cut flush and capped at the chassis mount, or make a 90 degree bend and be parallel to the frame rail. An exposed rear bumper end can make for a deadly spear in an accident, thus the reason for the rule. Be sure the rear bumper incorporates a fuel cell protector (rule 12 G) where the cell bottom is lower (or higher) than the bumper.
For the rear bumper and rub rail mounts, an easy and effective practice is to weld a short section of larger tubing to the frame, allowing the bumper or rub rail to frame member to slip inside. Drill and bolt through the entire deal, and you have a neat and removable installation. Be mindful that the rear rub rail mount on the drivers side of the car not be pointed at the driver. This should mount behind the driver, and not be long enough to get into the driver should it take a hard shot.

Any rear rub rail must mount directly into the sides of the frame to avoid puncturing the fuel cell. Again, rear rub rails are optional.
Front bumpers are nearly all designed the same, with how they mount to the chassis as the only noticable difference. A nearby muffler shop with a tubing bender can be a great source for bending bumpers. Exhaust tubing is sufficient for bumpers, and unless your driving style includes liberal usage of the “chrome horn”, can be pretty durable. Likely more durable than the former friendships you had with guys you booted out of the way.

If you have determined your fuel cell and battery locations and mounts, and have welded them in (remember to weld a bolt to the frame near the battery for the ground connection) you should be close to being ready to paint the frame and cage. Take the time to roll the car around on it's sides to weld anything underneath. Ask someone else to check all the welds to determine that everything has been completely welded. Another set of eyes is always helpful when looking the car over at any time. When satisifed that the welding is complete, you are ready to squirt some paint.
We’ll talk sheet metal fabrication after you have the frame painted.
HotMod build project
Part 5 : Sheet metal fabrication
If you now have your project car frame & cage painted, you can begin the interior installation. As we’ve mentioned previously, you may be experienced in this work, and could have a better system of doing much of this. As always, there are multiple ways of getting the same results, and what I pass on is nothing more than my personal experience and observations.
If you’re planning to tackle this work, and it’s your first time attempting this, I’ve found it much easier to have a lay out table for the sheet metal rather than to crawl around on the floor. This usually consists of nothing more than a couple of 55 gallon drums and 4 x 8 sheet of plywood. Some needed tools include shears (electric, air or good old hand shears), a carpenters square, tape measure, sharpie marker, a long straight edge (aluminum angle works great!), tin snips and some vice grips or clamps. Sheet metal worker’s hand tongs or a pair of “duck bill” vise grips will also come in extremely handy.
Hopefully, you have access to a sheet metal break. If this isn’t the case, you may need to locate one you can use, or be prepared to improvise.
You need the capability to be able to make 90 degree bends for the panel seams. I’ve seen guys clamp the panels to work benches and hand bend, use pliers to make the bend after marking a bend line the length of panel, and even knew of a racer who used a door and it’s jamb to get his 90 degree bends. The latter method resulted in replacing the door and it’s hinges after ruining both.
Where there’s a will, there’s a way.
For simplicity sake, we are going to assume you have access to a break, and will be working with prepainted 4’ x 10’ aluminum sheets. While it hasn’t been my practice to specifically name brands or manufacturers up to this point, I need to do so in this case.
I have worked with aluminum sheets of differing grades and quality. Some have been adequate, some poor, but I have never been anything but wholly satisfied when working with ‘WRISCO’ aluminum products. Their 4 x 10 sheets come pre-painted and the finish side is covered with a tough layer of plastic sheeting. They have a fairly wide choice of colors, which is great for a guy like me who hates to paint. Past painting experience created an overspray mess in the garage, and

generally spending more than I intended to get the job done correctly, so it also saves money versus trying to paint the body & interior panels. The grade of aluminum used is of good quality, and can be bar folded (doubled over) without splitting. I have saved a dollar or 2 per sheet in the past by purchasing an unknown quality of aluminum, then kicked myself because of the results. If you are going to fabricate any aluminum, my advice is to seek out and purchase aluminum sheeting produced by 'WRISCO'.

There is a wide selection of choices for rivets. I use mill finished rather than painted heads. If you change body colors, you don't have to paint the rivets is my thought.

"Exploding" rivets (the mandrel end opens and expands against the button head) are a little more expensive, but work great, especially when replacing the rivet in a crashed panel that has the original rivet hole "wallowed out". A word of caution when installing these with an air riveter: don't get your finger close to the back side of the rivet! These can pinch down unmercifully on your fingers.

Take the time to measure your interior deck panel lengths, and calculate how to optimize the use of the aluminum sheeting.

An old carpenter's saying definitely applies here, as you should "measure twice & cut once" to avoid costly mistakes. If you do make a mistake, set the piece aside. Chances are good that you'll be able to use it later on for something else.

Speaking of carpentry, approach this part of the project with a carpenter's mindset. Just like an old house that is being remodeled, your car probably is somewhat less than square. Remember this when installing the interior and use the factory edges on the aluminum sheeting where possible to make things square. No matter how you do it, there will be plenty of trimming to fit involved.

Just like building a house, we first must have a good foundation. For the interior, this is the floor pan. The floor pan should run from front to rear firewall, and fit snug between your seat belt mounts (or the inside car drivers frame rail). The front right edge needs to be angled inward to accommodate the transmission. The outside (along the frame rail) should be straight. I recommend bending a 90 degree 1" (minimum) lip along these sides if possible. Bolting the seat in through the floor pan anchors it in place. Do this before advancing to any further sheet metal work. If the floor moves at all, it messes up future sheet metal work tremendously. I strongly suggest building the driveshaft tunnel out of the same material as you use for the floor pan (see rule 2 J). If a whirling driveshaft ever gets loose, you'll thank yourself for this. The tunnel should be tall enough to clear the driveshaft safety loop, and can bolt or rivet to the inside floor lip.

So much of the cockpit area is dependent on how the cage is constructed that we won't even attempt to go about the steps here, but instead recommend to again investigating how some of the cars in your area are constructed. Also consider that it's sometimes better to build panels in a multiple pieces, rather than going through the aggravation of prying, twisting and cursing in the attempt to fit the single panel. The front firewall will be a perfect example of this for many attempting this project step for the first time..

Because you don't need to consider things such as lift or pull bar mounts, the passenger side of the interior can be slanted towards the passenger side window opening. This could be an asset, should the driver encounter difficulty making an emergency exit.

The cockpit area should be functional, but is a matter of personal taste in regards to its design, and should be completed prior to installation of the interior decking.

When you are ready to start the interior deck, get out the string line, carpenters square and tape

measure.
I've seen some excellent craftsmen who have lined up every interior seam front to rear, going to the trouble of hiding every rivet head from view. While this is impressive, we aren't about to go to that degree of difficulty for this build.
I have always preferred to build the rear deck panels (from the main hoop back to the tail of car) before building around the driver's compartment.
The reasons are these panels are generally bigger, require less notching around the roll bars, and should be fastened into place prior to installing the front panels.
Always overlap any front panels over the rear panels (ie: doors over quarter panels).
If you were a high school scholar in basic geometry, or even drafting, the following steps will be clear.
We will make the rear outside panels first. Tie your string line at the front deck support, and stretch it to the rear. Adjust the string to just touch the outside most roll bar, making the dimensional width measurement the same at front and back. Use your carpenters square to verify that your string line is perpendicular to either the front or rear support. Remember to use this support as your baseline starting point for the remainder of the interior fabrication and installation process. Hopefully, your panel dimensions should be a true rectangle, rather than some strange trapezoid shape.
A 'work around' for this is to measure the overall panel length and width, remembering to add for 90 degree bends for the seams.
If using a decent break, it will stiffen the panels to install a ½" bar fold (hem), and then install a (1") 90 degree bend. Do this on the factory edge, and fit the panel in place with the bent edge against the roll bars, lining up the front (or back) edge with the deck support you plan to use as the baseline. Make a mark underneath the panel at the outside end of your front & rear supports. You should now be able to make the outside bend, and have a good fit. Repeat this step for the other side of the interior.
Anchor these panels in place with a couple of rivets or a 'cleco'. These little boogers act as a "temporary rivet", and are great for this kind of fabrication work.
I don't recommend notching the outside panels around the roll bars. These panels are the ones that may need repair or replacement if damaged. Weakening them with notching makes them more difficult to fix or fabricate if needed. Never notch both panels around a roll bar. This creates a weak point where the interior will droop and eventually crack.
Next, build the panels that will fit around your cage's rear roll bar(s). Take into account where your fuel cell filler cap is located, and avoid installing a panel seam in this area.
Three (3) panels in the interior area work well. They're width is entirely up to you.
If you've squared the outside panels relatively close to the true rectangle shape, go ahead and bend up the panels that will fit around the roll bars. Place them on the supports, and measure at the front and rear to make sure they are equally distant from the panel they will anchor against. Mark the area around the roll bar on the interior panel, using the same dimension for your depth of cut around the roll bar as the distance between panels.
If you desire a tight fit, a cardboard template will make for a closer fitting panel.
If you use hand snips to make cuts, take the time to use a file & clean up those jagged edges. Kids seem to love to run their hands over everything (in fact I believe it's a requirement for the "rights of passage" from childhood). Save them, the track inspector, your crew or yourself the pain of a cut caused from jagged edges anywhere on the car.

For the center filler panel, use the same steps as we did previously on the outside deck panels. When you bend your final 90 degree seam, make the panel just a bit narrower than your mark indicates. The panel will go in place without force fitting, and the rivets will draw everything up nicely. If you plan to install an fuel cell cap access panel, piano hinge works well for the door. A simple round opening that will accept whatever you use to fill the cell (fuel jug or funnel) works just as well. Taking the time to cut this opening before final installation works best.

If you are satisfied with the rear deck, anchor down the panels with rivets on the rear supports, and then crawl under the car to rivet the panels down the seam. The front of these panel will be riveted after installing the front decking.

Before doing this, if you haven't installed the fuel cell you may want to do so now, rather than later removing the rear deck when you find it won't fit when attempting to install from below. If you use plastic coated aluminum, don't forget to peel back the protective sheeting at the seam areas and cross braces before riveting.

Take care to make sure the panels are kept level, and use vice grips rather than your (or an unwitting assistant's) fingers to hold the panels together. There are few things that can ruin an otherwise pleasurable day in the garage like reversing a drill bit buried in a finger.

When riveting the interior and body into place, try to remember that you're building a race car and not a skyscraper. While we certainly want the panels secure, try to suppress the overcoming urge to go crazy riveting panels every couple of inches. Deck panels generally need only the corners and a rivet or 2 in the middle fastened to the cross supports. Rivet the ends of both seams underneath and at each side of the roll bar openings, then space the rest of the rivets. With your hand spread open, the distance between the tips of your thumb and little finger (about 8" for me) is plenty close enough between these rivets.

Installing the front panels (passenger side) can usually be done with 2 panels, the outside one fitting over the roll bars, while the inner panel makes a filler to fit to the drivers' compartment. Usually the outside panel will slide back over the main hoop, and inwardly over the right side 'windshield' bar. Use the string line again to determine the outside panel width after squaring against the inside edge of the 'windshield' upright roll bar. Use the same steps as we did for the center panel in the rear for the filler panel to the driver's area.

Finish the area out around the footbox, driver's door and dash panel, and you have the decking completed. Hopefully, the scrap left over is contained in a pickle bucket (seriously!) rather than piled in the back of a truck.

It's been a full day, so stand back and admire your craftsmanship before taking your coffee thermos and going to the house. Don't forget to turn out the light!

We'll make the car a roller in the next edition of 'Project HotMod'.

Hot Mod Build Project. Parts 6-10

2. Part 6: Making the chassis a roller.

Things have really started to take shape with the project car. The cage is complete, the interior and decking is fabricated, and now we are ready for the next step.

We need to clarify some things before going further. As we work through some of these steps, you may become discouraged, thinking it requires a truck load of "speed parts" to build a competitive car. Nothing could be further from the truth. HotMod rules were specifically written to accommodate the limited budget racer.

We will cover parts that may be outside of your budget, but within the rules as the project progresses. This build is an overview, and not vehicle specific. I've seen some feature winning cars in my days running nothing but springs, shocks, etc, that came either from the junkyard or what the donor car came equiped with from Detroit. Because of suspension limitations, these cars don't require a lot of "bells and whistles". Likewise, the engines required are about as basic as you could ask for in an economy class. Don't be intimidated by build steps or parts that won't apply to your race car.

Pay attention to detail and preparation, as those more often determine final results.

Since we took the time to mock up a lot of the suspension when we needed to do so, you may have completed some of the proposed steps we will go through on this part of the build process. Some of this may still be useful, as your specific project works its way to conclusion.

We'll start at the front of the car, and look for problem spots as we assemble.

Clean and disassemble all used parts to ensure they are capable of withstanding the stress that racing will place on the suspension. If you want your craftsmanship to show, get out the spray cans, and put a "Sherwin Williams overhaul" on everything before assembly.

While folks tend to concentrate on the power train when it comes to racing, other than safety, the two most important components of any successful race car are brakes and steering. If either fails at the wrong time, the results can be dangerous and expensive. Replace any suspicious parts. "Do unto it, before it does it to you". Worn out parts are just accidents waiting to happen, and create headaches when trying to set the front end.

Steering box mounting bolts can sometimes be rusted so badly that they need replaced. I have seen them nearly rusted in two, so replace them if needed. Use the large octogon shaped factory washers that came from the factory. These act as lock washers, and do the job intended very well. Check all tie rod ends and adjustment sleeves. On used parts, do yourself a favor at this time by cleaning the threads. This saves aggravation in the future.

Ball joints take a tremendous amount of force and need to be in top shape to allow the front suspension to work correctly. Replace any bent or worn ball joints.

It may be a smart move to tack weld the ball joints into the control arms, but don't go overboard. If you ever have to replace the ball joint later, you'll understand this.

The control arms may need new bushings installed. Stock O.E.M. style, neoprene or steel type replacement bushings are affordable, and should be installed before final bolting of the control arms into place. If using bushings with grease fittings, install the bushing so that the fitting can be most easily accessed with the grease gun. Using "NEVERSEIZE" where the mounting bolts ride in the bushings (especially where no grease fitting exists in the bushing) may be a good move.

When installing the spindles and rotors, replace any damaged seals or bearings. Metric spindles are prone to bending more easily than most when the front wheels contact equal and opposite forces, such as other race cars and guardrails. An inexpensive insurance policy is a set of "spindle savers". These rest against the inside of the spindles, being held in place by the lower ball joint and outside tie rod end nuts. A minimal amount of grinding may be required to allow them to fit in place, but don't go nuts with the grinder. These should fit snugly against the spindle. Their cost is

approximately $20 for the pair, and in my opinion are well worth it versus the time and cost to replace a spindle. They don't make the spindle indestructible, but are a good investment. Install cotter keys in everything that allows. The pros don't shortcut this simple step, and neither should you.

Make sure all grease fittings are operational, and replace any that aren't. Greasing the front suspension will be an important part of your weekly maintenance program.

When installing the brake calipers, check for torn seals. The pins should be smooth, and allow the caliper to float as designed. You can pry out and discard the caliper rubbers that the pins pass through. These are mostly to deaden brake noise for passenger cars.

If you intend to run the factory rear drum brakes, replace any leaking or faulty wheel cylinder. If any of the springs or keepers look faulty, now is the time to make repairs.

Some may prefer to convert the rear brakes to discs. This isn't a difficult or expensive process, and also serves to keep errant axles from exiting the rear end housing should a c-clip keeper fail or axle break in a GM rear end.

A bolt on or weld on mount for a metric caliper can be purchased through any number of parts warehouses. The Chevy S-10 4 wheel drive pickup front rotor will slide right over the metric axle wheel studs. Some grinding of the outside edge of the axle flange may be required. Make sure everything (wheel included) fits properly prior to any welding of the caliper mount.

While on the subject of lug studs, do everyone from the infield workers to flagman and spectators the favor of replacing the stock studs with competition replacement pieces. A tire and wheel can be a deadly projectile capable of bounding over barriers like a deer. Rules require 1" lug nuts, but don't mandate replacing the studs.

At the very least, knock the stock studs out and press in studs manufactured for racing purposes. A great way to address this would be to replace all studs with 5/8 " course thread studs with 1" lug nuts. These are available in an affordable kit form at most parts warehouses. It will require a 43/64" drill bit to drill out the present lug stud holes. Use a drill press if available, as a ½" drive hand drill will eat you alive if the bit gets hung up!

If you have a buddy (or more) who may be building one of these cars, split the cost of the ($10) drill bit and the expense for this very worthwhile upgrade is minimal to all.

Additionally, be sure all wheels needed on the car are the same bolt pattern. A car with different bolt pattern wheels creates the unnecessary need for a larger spare inventory. The metric suspension has a 4 ¾" bolt pattern. Staying with this bolt pattern also simplifies future repairs or part replacement. Bolt pattern adaptors are also an option.

When it comes time to invest in a set of racing wheels for the car, spend your money wisely. There are many different wheel manufacturers out there, but there can be a tremendous difference in the quality. I have seen tires pop off the rims, then have the outside of the rim roll up like putty when it dug into the track. An insufficient inner bead, and poor quality steel turned this guy's investment into scrap recycling material.

I strongly suggest using AERO racing wheels. They are top quality, made in America by Americans, and are the most durable steel racing wheel on the market today. Check out a Nascar race on TV, and what you'll see in the pits are AERO wheels. These are the same wheels they sell to weekend warriors like you and I, and in my opinion are the hands down choice for the economy racer. The cost of various manufactured racing wheels are very comparable, but quality is another matter all together. AERO wheels

last longer, can take more abuse (wheel banging), and are better made than any steel racing wheel I've found on the market. Better to invest once in quality than multiple times on sub-par parts.
If you intend to stay with the drum brakes that come standard on the GM metric frames, remember that the drum brakes can take more fluid volume to move the shoes against the drum than is required for disc brake assemblies. The O.E.M. master cylinder will often have a much larger chamber for the rear brake fluid. If you are installing aftermarket brake pedals and master cylinders, this may be noteworthy.
Drum brakes are adequate, but can be much higher maintenance than disc brakes.

Brake line plumbing can be time consuming and expensive. If you're totally redoing the brake lines and have never used plastic lines, I encourage you to give it a try. Plastic lines are far cheaper and much easier to route than steel brake line. Plastic lines are durable, and not as easily damaged as you might think. Short of purposely cutting or putting a torch directly to the lines, they are very tough to damage. If you do damage a line, repair is easy and cheap as well. I know some very successful racers who have used the same set of plastic brake lines for 3 years, using them again this season on the 3rd different chassis. It's difficult to get that kind of use out of steel lines!
Secure whatever brake line you choose well. Nylon zip ties work nicely for this and are inexpensive. Any unsecured brake line is an invitation to disaster. Vibration could cause failure at a fitting, and loosely secured lines are easy targets for debris to snag.
Concerning brake pads, shoes and fluid, you'll get what you pay for, so base your purchase on the need. If you use the brakes heavily, building quite a bit of heat in the brakes, better quality brake linings and fluid are the smart move. Bench bleeding the master cylinder will save time and brake fluid. You may bleed the brakes later in the project, and feel that all air in the lines has been evacuated. Air may still exist, and a subsequent "final" bleeding of the lines a few days later should quickly eliminate all air pockets. Good braking is an important part of your overall chassis package, as well. Having a solid pedal and reliable brakes will aid the driver's confidence and ability race competitively in close quarters. The "I lost my brakes" excuse after bouncing off the side of a fellow competitor only holds water the first time you use it.
Before installation of the rear trailing arms, clean off surface rust and look them over carefully for weak or damaged spots. These arms can be reinforced, but not altered (a definite rule violation). If the trailing arms or housing mounts need bushing replacement, the options are the same as for the front control arms.
Shocks, springs and their adjusters (if you are using them) can now be installed. Without knowing what your particular car weighs, and the engine setback, it is difficult to provide accurate advice for the springs needed. Variables such as different driving styles, track banking and length also will come into play when making a spring selection. A good rule of thumb is no more than a 100 lb. split in spring rate across the front, and no more than a 50 lb. split across the rear springs.
For example, you might consider starting out with a 750 lb. left front and 850 lb. right front spring.
On the rear, a 200 lb. left rear with a 175 lb. right rear spring may get you close to where you want to be for the initial set-up.
Springs are rated on the weight required to compress the spring 1 (one) inch after the

initial inch of compression.
The car should never fully compress any spring. Should this condition occur with the right front spring, expect a terrible push condition. This is also known as "understeer", as the car refuses to turn. A coil bind of the right rear spring will cause "oversteer", or as most refer to it, a loose condition where the car wants to spin out. While coil bind set-ups are presently a hot ticket and the cause of much discussion in NASCAR's premier division, it is never good for a dirt car.
Don't expect your HotMod to be the spectacular 3 wheeling beast that you see in the current Late Model and Modified divisions. The suspension geometry that you will be working with is far different, and not designed to promote that kind of response under acceleration. What will be needed is balance and weight transfer. Take this into consideration and don't get overly aggressive when deciding on spring rates for your car.
Many parts suppliers have reference tables listed in parts catalogues. These can be a good source of information in regards to spring rate applications.
If you're on a tight budget, there is a formula available to determine spring rate based on wire diameter and the number of coils. I have successfully used this to cut down front springs to the desired rate. If you choose to do this, be prepared to wear out some hacksaw blades. Using a torch to cut (or collapse) springs ruins them.
Chances are very good that your needed spring rates should closely match what the current modifieds at your track use. If you are stumped on where to start, seek out a driver who you trust, and ask him for an idea on where to start in regards to springs.
If you will be purchasing racing shocks, consult the manufacturer or parts warehouse you will be using. They want your business, and should be happy to help. Be prepared to provide pertinent information so they can advise you on what they believe will work best for your application. They may need to know the cars weight, wheel base, springs, or even track length and banking to base their decision.
Never be afraid to pick up the phone and call the manufacturer. They are the experts, know their product best, and can offer invaluable advice. Just because your name isn't Moran, Moyer or Bloomquist doesn't mean that advice isn't available when requested, and your money spends the same as anyone else's.
Learn to also educate yourself. Don't always take what others say (this article included) as "the Gospel". What works well for one might not be the answer for others. Developing the ability to independently analyze and dissect problems will serve you well, and at the same time make you a better racer.
Your project car should really be starting to take shape. Likewise, the build project is starting to see the homestretch ahead. We'll set the engine and tranny in soon.

Part 7: Engine & Transmission installation

While this portion of the HotMod build project is titled "Engine & Transmission installation", it will actually broad brush that work, and focus more on obscure details.
The reason for this is the assumption that you (or someone that is assisting on this project) is capable on doing much of this work without step by step details.
What we can provide here are hints to make your work easier and improve reliablity.
We ask that you take an extra moment in planning the work of setting the motor in place. This will undoubtably be the heaviest "part" installed in the car. Use caution and warn others in the work area to avoid placing themselves (along with hands and feet) in areas that could be considered dangerous. I have witnessed rigging and lifting failures at these moments, but

thankfully no injuries occured. Avoid getting hands in areas that could be pinching hazards, and take your time when installing the engine.
If the motor mounts are correctly lined up, this step and the subsequent transmission installation should go smoothly. If installing a standard transmission, make sure you have installed the pilot bushing before the transmission is bolted onto the bellhousing.
NEVER get under the engine area before the motor mounts are installed and the engine is secured. While this may seem obvious, there may be an over-ambitious crew member who you need to keep an eye on.
Header installation may be as simple, but if you didn't have the engine in place before now, you may find the headers won't fit. If it requires a slight modification to the header, it's not a big deal, but don't mash the header tubes nearly shut to clearance a roll bar or mount. Modified headers are available in a variety of styles, and are generally cheaper than most Late Model or Street Stock headers. Remember that your HotMod engine isn't high compression, so you won't need long tube headers for this project.
The driveshaft should have adequate clearance from the driveshaft hoop. After installing the driveshaft, use a floor jack and run the suspension through it's full range of motion.
Take note of the clearances at both the hoop and front yoke. It is important that the slip yoke is always adequately in the transmission (but never buried) through the entire rear suspension travel.
Be certain the front engine pulleys properly line up to avoid throwing belts in the future. I never had power steering on my previous cars, prefering to channel all available horse power to the rear wheels. Being considerably older, but only marginally wiser, I wouldn't race a car without power steering now. The use of power steering is far more widely accepted than it was "in those days". A power steering pump also works as a tensioner pulley, and versus a 2 pulley system, helps avoid thrown belts.
Present racers also use an alternator. I would recommend this for your project car as well, especially if you run an automatic transmission. Maintaining a fully charged battery can be the difference in the car starting (and running through the races completion) and being trailered early.
Securely mounting the radiator is a must. A radiator full of fluid is fairly heavy, and more than one good run has been ruined by the radiator vibrating loose. If it appears that the radiator tanks may come in contact with the frame, a piece of vinyl plastic (like the Late Model's use for skirting) riveted to the car frame will help keep the steel car frame from wearing a hole in the radiator tank. Radiator fins must be able to allow air to pass through the radiator area to transfer heat from the coolant into the atmosphere. An adequate radiator for the use is a necessity. Excessive heat is a power robbing engine killer. Poske's has a variety of very reasonably priced aluminum racing radiators in stock (a 19"x 24" radiator is about as large as you can fit if installing behind the front crossmember) . This is a better option than the unknown O.E.M. factory radiators that were never intended for the stress & vibrations of racing.
Use spacers if needed to get the optimum air flow affect when installing the fan. A shroud may be needed later should other measures not provide adequate cooling. (Make sure you're engine isn't too lean on fuel. Leaning out an engine can boost power, but at the cost of excessive heat and burnt pistons).
Other measures include slowing the water pump with the use of pulleys, or installing a restrictor in the intake inlet. These are both designed to slow the flow of coolant, allowing it to remain in the radiator longer. This provides more time to dissipate heat.

I recommend the use of anti-freeze as an additive to the cooling solution. This lubricates water pump bearings as opposed to a straight water solution coolant. Other aftermarket solutions are also available that act the same.
Some are hesitant to use anything but straight water, citing that a blown head gasket could result in the anti-freeze wiping out engine bearings. A straight water solution will do the same, so take advantage of the benefits of cooling solutions. Use a good quality radiator cap. A pressurized system is required for optimal cooling system performance. NEVER remove a radiator cap on a hot engine. The resultant pressure and steam could badly scald anyone in close proximity. Always relieve the pressure first!
If you plan on running an automatic transmission, you should also run a transmission cooler. I don't advise running the cooling lines to a stock radiator, even though it may come equipped for transmission cooling. Purchase an aftermarket transmission cooler, and install it under the interior decking level. (see rule 7A). If you mount it horizontally, build a air scoop to force air through the cooling fins. The cooler will be less likely to be damaged by debris if mounted in this way.
There must be some sort of scatter shield installed, unless you have a "blow-proof" bell housing. Drag racers use an aftermarket blanket that wraps around the bell housing area. I've even seen conveyor belting used for this. There is a very reasonable steel shield sold by most parts warehouses. It bolts in the same holes as the tranny mounts to the engine. Steel blow-proof bell housings aren't available for automatics, and are pretty pricey, especially compared to this $40 piece.
When installing the shifter and carburetor linkage, take time to make sure these work smoothly and don't hang up. This is particularly critical in regards to the accelerator linkage. It should clear the air cleaner and firewall. An accelerator hung wide open isn't the kind of thrill anyone needs to experience. A racing accelerator pedal with the toe pull for such emergencies is a nice addition.
I'm not a big fan of accelerator cables being used in competition for this very reason. Cables are nearly impossible to maintenance, and if frayed can provide unexpected suprises at inopportune times. My advice is to stay with a manuel linkage.
Use a minimum of two (2) carburetor return springs (see rule 9B).
Install a throttle stop to avoid ruining your carburetor.
Beefy shifter linkage is advisable, especially if you're running a standard transmission. Try to keep all linkages correctly aligned for best results and smooth operation.
A multitude of guages are nice, but useless in competition. Seldom (if ever) in "the heat of battle" will you think of glancing at the gauges. At best, you may remember to look at the gauges during caution periods. This is the reason warning (or "idiot") lights have become so popular. Some may choose to run these lights only, versus any guages.
I prefer installing 2 guages that I feel are a necessity: Oil pressure and Water temperature.
All other guages are "window dressing" in a class like the HotMod division, in my opinion. A tachometer is a nice, but even it isn't a neccessity.
Let your budget be your guide in regards to gauges.
Install the gauges just below the driver's normal sightline. A quick glance down will provide him a view, if he wishes.
An old time way to install the gauges was to adjust the gauge so that the indicator needle would be pointing straight up when the engine was operating normally under racing conditions. If the

needle deviated off top dead center, a quick glance would allow the driver could notice the guage indicating possible problems.
Use good quality ignition and starter switches. Water proof switches are prefered.
After a rain out, we unloaded the car at home one evening. Standing around longer than we usually would, the car started to lunge forward. While this was amusing at first, things soon went into the panic mode when the car nearly pinned one of the kids against the work bench. Water had found it's way into the starter button, making up the circuit.
The ignition switch should be accessible to emergency crews in emergency situations, but not located where a slip of the driver's hand can accidently kill the power to the engine. Believe it or not, this is not that uncommon of an occurance.
Where wiring passes through the firewall, use grommets, or bundle wires and run through a vacuum (or similar) rubber hose to avoid cutting the wire's insulation.
Use the least amount of wire needed to do the job, and NEVER use the same colored wire (insulation) for everything. Labeling the wires is a nice touch.
If you use crimp connections, use good connectors and pliers, and consider a heat shrink wrap. If you take the time to solder the connections, go to the head of the class!
Route wiring neatly and use nylon wire ties to anchor wiring. A rats nest of wires is a recipe for failure, and when it happens, will be a nightmare to diagnose and fix.
Make sure you have good ground connections. Some electrical problems can be traced back to this simple fix.
Another inexpensive, but extremely handy item is the installation of the old style Ford firewall mount solenoid. These make a tremendous terminal point for wiring.
Route the battery cable hot wire to this point, and distribute your power from here.
Route your fuel line in the most direct route down the right side of the car to the fuel pump, keeping it out of harms way. Keep it on the inside of the frame rail.
Use an adequate amount of ties to support this line. If you install an inline filter, place the filter in a accessible location. Steel or rubber line designed for fuel delivery are fine.
I know this should go without saying, but copper or aluminum line is not suitable as fuel line under any circumstance. These will inevitably fail, often at fitting connections.
'RCI' has an inexpensive and well built economy fuel cell. The can is powder coated safety red, and is much better built than many of the older fuel cell cans that look like the local sheet metal duct shop did the work. The can's steel is heavier than sheet stock, and the cell has a tip over valve that shuts if the car gets upside down. This is a very important safety feature. These cells also feature a newer style threaded screw type filler cap, are available in 22 gallon size with the top feed and vent (a must per HotMod rules), and are very reasonably priced. These 'RCI' cells are a good value for the economy racer.
Make sure your cell is adequately secured. I tend to go into the over-engineering mode on the fuel cell mounts myself, but remember the amount of weight it supports,and it's location. Better safe than sorry on this item.
If you've went to the trouble of installing a brake bias adjuster, make sure that the adjustment mechanism is within the driver's reach, but out of the way. If you've never used one, and are buying used, clean and lubricate the adjuster well. Make sure the adjustment rod is at mid travel and the master cylinders work evenly before installing the driver controlled adjuster. Occasional maintenance is required to ensure this piece operates as needed.
On our build project, we used 'Wildwood' hanging pedals and master cylinders. There are other

options available, but past experience has shown these to be dependable, top quality pieces. We also installed the brake adjuster, as the 'Wildwood' brake pedal comes with the adjustable balance bar. Properly mounted and maintained, 'Wildwood' master cylinders have provided many racer's seasons of reliable service, and affordable rebuild kits make these units a good investment. The hanging pedals allow the master cylinders to be mounted higher on the firewall than floor mounted pedals, serving 2 purposes.

Being installed higher than the brake calipers eases the brake bleeding process, and generally keeps the master cylinders in an area less succeptible to damage.

Install roll bar padding (not some cheap foam insulation) wherever a driver's head, or extremeties can hit a roll bar. I went the route of installing something that "seemed" as dense as roll bar padding myself once. It may seem as good, but believe me when I tell you that it doesn't work the same. I had a good helmet, but was all but knocked out in a wreck when my noggin bounced off the roll bar covered with my "wannabe padding". Roll bar padding is designed to absorb punishment so that your body doesn't have to. No matter how tightly you belt yourself in, studies show that you can stretch unbelievably in the deceleration of an accident (ever see those crash dummy videos?).

If nothing else, install it anywhere your driver's head may come in contact with a roll bar or solid object.

On the subject of helmets, too many racers only concern involves cost. They have no clue about the stickers (if any) inside the lining of what they are wearing.

Your helmet should have the latest 'Snell' Institute sticker inside. If no Snell sticker is in the helmet, give it to the kids to play with, and buy a real helmet. Every 5 years the Snell Institute tests helmets for safety. Those who pass their regimen of tests earn a Snell classification rating, and are designated as such with the sticker inside the helmet.

An 'SA' helmet sticker indicates that the helmet was approved for 'S'ports 'A'pplication.

The 'M' sticker indicates that the helmet is approved for motorcyclists. The SA helmets are subjected to different tests than the M rated helmets. The SA helmets also include fire retardent linings and stitching.

There is no more important piece of personal safety equipment than your helmet. To correctly do it's job, it must fit your head, and be worn as the manufacturer requires.

If you have a damaged or substandard helmet, do yourself and your loved ones a favor and replace it.

Plainly speaking, if you have a $5 head, wear a $5 helmet.

If you haven't thanked those who have been helping you on this project, now is a good time to do so. Crewman don't help on a race car for glory or fame, and no one can afford to pay for help. Most just enjoy the challenge, competition, or want to be a part of a team effort. Their time could just as easily be spent elsewhere, so don't forget to reward these friends with a sincere 'Thanks!' when the work is finished.

We'll have some real fun installing the body next!

Part 8: Body Fabrication & Installation

If you've followed the progression of this project, you'll remember when we noted earlier in the build how progress may seem slow through some stages. This will be one of the steps where a little work will really show a lot of progress.

Hopefully, it will also be one of the more enjoyable parts of "project HotMod", as you have the ability to craft the car's appearance.

For those who have never done this before, remember to consult the rulebook for specifications in regards to body dimensions. They are designed to be a helpful guide. Also keep in mind this is an open wheel modified car. It has no front fenders, and no stock appearing nose or tail pieces are required or allowed. As with the roll cage construction, you also have a variety of choices for the body.

a. Purchase a "store bought" body from one of a number of suppliers.
b. Use an O.E.M. steel body.
c. Fabricate a body out of sheet metal or aluminum.
d. Use a combination of any or all the above.

If you choose to purchase a pre-fab body, you can expect to do some alteration to fit your particular car. These are, for the most part, 1 size fits all. Some body manufacturers are now starting to tailor their product to your specifications. They will provide a variety of styles and colors to choose from, and you can supply the dimensions needed. Expect to receive some needed guidance from these folks. I've seen some of these bodies, and they look nice, but make certain that the advertised price includes shipping costs.

Sometimes you can find a local who is into subsidizing his racing budget by fabricating or bending out bodies. If you are able to do the layout work, only requiring him to use the break for the needed bends for body lines, etc., the cost may be negligible.

Providing you have an inexpensive resource, and don't mind the extra work involved, using an O.E.M. body can be a fairly economical option.

It will weigh slightly more, but that weight will be well behind the front wheels. These cars must weigh 2400 lbs, so the extra a steel body may weigh may be a moot point if you end up hanging lead to meet the minimum requirement.

Rules allow any passenger car body, including foreign makes, so let your imagination run wild. A modified body only requires sides from the firewall back, so the front fenders and bumper aren't needed. You can even use the hood, trimming it down to what is needed to cover the engine compartment.

Measure the interior decking overall length. When searching for a body to install, keep this dimension in mind. Too short and you'll be back looking for other longer panels, or fabricating the sides, which is also totally acceptable.

Gut the body panels down to the outer skin, ridding them of excess weight.

Hang the gutted quarter panels on the interior, using the wheel opening as a location guide. If the quarter panels extend to the rear edge of the interior decking and the doors front edge will line up with the interior decking front edge, and still overlap the quarter panel by an inch minimum, you've accomplished the goal. You'll probably have to fabricate the A-pillar, windshield posts, and nose panel, but if you also managed to use the O.E.M. roof (again, see rules for allowable dimensions) you have saved money while building a unique looking car.

Make sure no sharp edges exist before riveting the body onto the car. This step should be included for all, regardless of materials used.

The downside of installing an O.E.M. body is the extra time and labor involved. Besides the initial gutting out of the body skin, there may be some true body work required, and certainly some painting involved. Unless you have free access to needed body work supplies, tools and paint, this can quickly eat into any money saved by this choice.

The choice for most will be to fabricate the body. Sheet steel is very inexpensive, but

will also require painting.
Did I mention how much I hate to paint?
We will use 'WRISCO' manufactured 0.40 gauge 4'x10' sheet aluminum for this project. As we've mentioned earlier in the build project, prior satisfactory experience with this product is the reason for the choice.
Over the course of the last 25 years or so, I've learned what I like in regards to the looks of a fabricated body. I've also been a part of fabricating a few of these. Some were pretty crude initially, but still served the purpose. I have found if you don't have the tools needed, it can be pretty tough to get the desired results.
Look around the pits and get an idea of what you want your car to look like and how to accomplish it before ever starting the body build.
Refer back to the installment on fabricating the interior in regards to the tools needed to do this work.
If you've never attempted this before, a material saving move would be to make patterns prior to cutting any aluminum. Cardboard appliance boxes work nicely, and most generally a single template will work for both sides. Saving the wheel opening material when initially cutting out the quarter panels (by not cutting that material out of the sheet) versus cutting the entire opening out afterwards may save you some aluminum. Keep the sheet metal break's usable bed length in mind when determining the quarter & door lengths.
Another consideration is the fact that plastic skirting isn't allowed for HotMod body construction. This is important to remember as you lay out the body panel heights.
My advice is to make the doors no taller than the dimensions between the deck and bottom of the frame rail. Any larger will virtually guarantee they will drag at some point. I've seen dirt cars whose body fabricator evidently mistook the car for an SCCA sports car, building the body sides so low they appeared to be designed for "ground effects". This probably looked great in the level floored garage.
If they didn't drag the car's sides off loading it on the trailer, they soon found out that the track's cushion would alter the body design. I've seen the right side peeled off when the lower front door corner dug into the track, so don't get carried away.
Put a 2 x 4 or something similar against the lower frame rails and get a measurement to the deck. Any slope in the interior will show in the taper of the door dimension. If you will be bar folding the edges, remember to add this to the overall measurement. Dovetailing the quarter panels may also keep the rear edge from digging into the ground when unloading the car from the trailer.
I can't stress enough the old carpenter's adage of "measure twice, cut once" to avoid mistakes. A little time making notes and determining material needed for body panels will allow you to get the most out of your investment in material.
A fellow low budget racer shared some advice I still use when laying out the body panels. Take a quarter panel out of the end of a sheet, making the panel 4' long. This will make the quarter panel extend from the tail of the car to approximately midway over the rear tire. Measure the remainder of the sheet, and determine how best to use what's left.
On a modified body, you have the advantage of needing less material. The hood needs only to be as wide as required to cover the engine compartment. There will be a nose panel identical to the hood width required. These, in addition to the doors & roof will be your next largest panels.

Any bend or break in the body panels (particularly the bigger or long pieces) will add rigidity, but it also creates a point for the aluminum to split or tear. Panels without sharp bends are much easier to remove and repair than those with “body lines”.
The intent of the body rules is to keep these cars appearance as “open wheelers”. The body should NOT be flared, bowed, bent or installed with the intent to “cover” the rear wheels. Don’t attempt to circumvent this part of the rules, and chances are you’ll get along fine with the inspector in regards to you cars body style and installation. In plain English, the tires should be the widest point on the car, without exception.
Factor in any material used in the bar folds or 1” 90 degree bends.
A door and quarter can come from a sheet, with the remainder used for vertical edge panels for the roof, hood & nose, windshield posts, etc.
Chances are that a minimum of three (3) sheets of aluminum will be the least you can get by with for the body. A normal box of rivets contains 250 count. It’s amazing how quickly you can go through these installing a race car interior and body.
Some cars are difficult to fabricate a good looking body due to the cage design.
Try to center the roof side to side. This will “balance” the appearance. Set the roof back on the cage, but not so much that the front roll cage hoop shows. This will add rake to the windshield posts, giving a sleeker appearance to the car. Make sure your windshield posts have some kind of bend line running lengthwise for a stiffener.
In my opinion, nothing looks worse than a car with a short, forward mounted roof. This makes the car appear to be an El Camino or even worse: the Flintstone family sedan. If you are short on materials, the roof can be made from multiple smaller panels. I’ve seen this done with good results, but have no experience doing it myself.
You can rivet the body sides directly to the edge of the interior. This eliminates the need for an overlapping bend, and saves a small amount of material. The upside to the 90 bend at the top of the sides is the added strength to both the interior and body panel. I’ve done them both ways and have no personal preference.
If you need to cut a hole for the rub rail, crawl under the car and mark it on the door using the mount as a guide. It may be easier to cut this hole before fastening the door in place. Some may choose to notch the door if the bar is close to the rear tire opening. Take your time, and cut the wheel openings to match the tire radius. Many a race car’s appearance has been ruined when these are botched.
Once the roof and quarter panels are in place, you can get an idea of what you like for the sail panel shape & size by running scotch tape from the roof to the quarter panel. If you made cardboard side templates, it might be well to do the same for this piece. Mark your templates and put them in a safe place for further use if you’re satisfied when the build is finished. This saves you time on your next body installation.
The sail panels can rivet to the outside of the quarters, or be sandwiched between the quarters and interior. Use the same method with the windshield posts.
Again, don’t go bananas riveting panels together. The 8” (or more) rivet spacing rule applies just as well here as it did when installing the interior.
Panels like the roof and hood can be bowed, or rolled to get a desired effect. Bend a 1” 90 on the outside edges, and make a mark where you want the bend to begin. There is a sheet metal workers tool designed to make these bends by crimping along the 1” bent portion of the sheet. You can accomplish the same results with a pair of pliers, but don’t get over-zealous or the aluminum will tear. Pinch the 1” area in the jaws and twist the

pliers, moving along the direction desired, and repeating as needed. This area has been weakened, so it may need a small straight panel running the length of (and riveted to) the 1" dropped edge to maintain the curvature. Mark the backside, and cut to fit the panel's dropped edge before riveting.

Avoid riveting to the roll cage. A hole drilled in the roll bars only creates a point for the tubing to split, and provides an access point for moisture. Tubing can rust from the inside out. This is undetectable, making it extremely dangerous. Chassis builders never drill roll bars. They weld tabs or mounts directly to the tubing. I've seen water drain from a roll cage that had the roof riveted directly to the halo & hoop. The roof acted as a collection pond, and the bars filled with water. Had this frozen, the bars would have burst from the pressure if not for the cage builder using a good grade of D.O.M. tubing. Even as it was, the rust damage was undetectable and unknown. Keep this in mind when looking at obtaining a used roll cage.

Run the hood pins up against the bottom of the hood when you determine its location. Secure the hood, then take a rubber mallet, and rap the top of the hood at each pin location. The indentation will allow you to drill the pin location. I like the cam locking hood pins far better than the old style hair pins for racing applications.

Use heater hose to space the hood front to desired height. The back of the hood should overlap and rest on the front interior deck. The nose panel should extend over top of the hood front. If you feel creative, the nose panel can be made removable, or can have a hinged upper half. This can be handy for front end adjustment, but certainly isn't necessary. The nose panel can't extend past the bumper, so don't get carried away going for the "aardvark" look. This panel must also fit it between the front bumper mounts. Anchor the nose panel solidly. It catches a lot of debris and protects the radiator.

Use 1" aluminum angle and flat strap for the body bracing. I've used the scrap from the aluminum sheets for angle many times by doubling it over and using the break to bend a 90 length wise. This doesn't work near as well for the bracing from the frame to the body, so stick with the 1" strap for that purpose. Use bolts with locknuts at the strap ends, and rivet the angle to the body. The body should hang relatively perpendicular to the interior (see rulebook inside rear cover), so base the brace lengths accordingly. The object of the braces is to support the body, but give under impact, saving unnecessary damage to the car's body or frame. The strapping can be removed and straightened. I've tried using other materials over the years, but in my opinion this method seems the cheapest, easiest and most durable. Never run bracing that could become a spear to penetrate the fuel cell or driver.

I've seen some pretty ugly cars that ran like a 'scalded dog', and some that were show pieces but weren't very competitive. Looks are nice, but don't make a car fast. As you step back to admire your work, I hope your car has the look of a winner. Next, we'll put the finishing touches on "project HotMod".

HotMod build project part 9: finishing touches

We are nearing the completion of the build process, but often a surprising amount of work usually remains to reach the goal of putting the car on the track. As we've done in the past, we will provide some insight on little thought of details rather than covering the obvious.

If you've not yet started the engine, let me allow a couple of words of caution. First, create a source of ventilation to permit exhaust fumes to escape the work area. This

could be as simple as opening the garage door, but get some fresh air into the area so you don't fumigate yourself. Second, make the car mobile before attempting the first firing of the engine. I nearly learned a very hard lesson when the carb backfired, igniting the cup of primer gas in my hand. With a garage full of interested bystanders, my only choice was to drop the cup. The car was on jack stands, and I was standing inside the fender. Fortunately, I had placed the fire extinguisher within reach for just such an emergency. The fire was quickly extinguished, and we went back to work, but I have carried the memory of what could have happened since. Don't set a trap for yourself like I did, and always have a fully charged and working fire extinguisher in the garage.

A couple of driver compartment details may need addressing. If your gauges are mounted above the interior level, you need to construct a deflector to shield them from debris. The same goes for your hands. Some sort of debris deflector should be installed at least as high as the steering wheel. A rock thrown from a spinning tire hitting an exposed finger or knuckle will generally make you call for the stewardess to fetch a barf bag to your seat. This is the reason that wire screen is required between the windshield upright roll bars. I like the 1' x 3' wire mesh. Paint it black and you'll never notice it when racing. You might think it's unnecessary, but see if you still feel the same after running a full season. You may be amazed at the amount of punishment it has absorbed. I feel this should be mandatory on all dirt cars, everywhere.

Have the driver climb in the car, buckle up and install the steering wheel. Is it in an uncomfortable position? Does he have to look through the steering wheel? If the answer to either of these is yes, you need to do some work and adjust the steering column. The steering column should have a minimum of two (2) universal joints and a clamp collar installed on the front side of a frame mount. This prevents the column from pulling off the steering box, or becoming a spear (aimed directly at the driver's chest) in the event of a hard front end collision. I have seen some pretty scary solid steering shaft installations in my time.

Have the driver adjust the belts to properly fit him (or her). You may need to cut off the excess seat belt material. If you do this, melt the new exposed end with a lighter (not as easy as it sounds, as the belt material is fire resistant) to keep the material from fraying. Now is the time to make absolutely certain that the driver is comfortable with the accelerator pedal location, etc. Mount the fire extinguisher in an accessible position, but not where the driver will be banging his elbow off the bottle every time he turns the wheel. Ideally, the driver should be sitting in the middle of a 'safe zone'. If the roll bars are exposed, install roll bar padding where his elbow, knee or ankle would contact it in a crash. The cage upright near the pedals immediately comes to mind. Take the time to eliminate any potential hazards in the driver's compartment.

If you haven't painted the driveshaft and any weights you may install, it also needs done. The weights are also required to have the car number painted on them. Make sure any added weight is secured with a minimum of (2) ½" bolts. Use large washers & lock nuts. If you are shortening the driveshaft, maintain the same u-joint orientation when you prepare to reweld the yoke in the tube. Remove the universal joint to insure the heat from welding the yoke doesn't damage it. The yoke must be absolutely squared in the tube before welding. Take your time, or have someone with a lathe cut the tube. A driveshaft that's even slightly bowed, bent, out of balance, or misaligned u-joints will vibrate the fillings out of your teeth at speed. It can also damage the

transmission and rear end, and injure a driver if it gets into the cockpit. This is one of the too often overlooked parts of a race car. Grease and inspect the universals every week during the race season as a part of your maintenance program.

If you haven't installed a mini-spool, you'll need to lock the rear axle by welding up the planetary spider gears to the carrier case. Clean everything well before and after this procedure. Seek out someone familiar with this procedure before ruining a ring and pinion attempting this if you have no experience with differentials. The same can be said if you are planning on replacing the ring and pinion gears. There are steps required to 'set up' the gears to insure the desired performance and life of the gears. If buying new, the gears will come with installation instructions that must be followed. If replacing with used gears, seek out help unless you have prior experience.

If using a GM rear end, the stock axles are held in the carrier housing by c-clips, a horse shoe shaped retainer that rides in a recess near the differential end of the axle. The carrier housing has a center pin, held in place by a set screw that separates the axles. When the pin is removed, the axles can slide into the carrier, allowing the c-clips to be removed. The axle can then be pulled from the housing. The planetary gear system inside the carrier case is referred to as the 'spider gears'. These allow a passenger car to turn without 'dragging' one of the rear tires. This system is good for passenger cars, but lousy for racing. If you weld the planetary gears to themselves and the carrier, you 'lock' the rear end, forcing both axles (and tires) to rotate equally. Clean everything with a 'brake clean' type of aerosol cleaner, wipe out and let dry. These fumes are harmful to breathe and extremely flammable, so, as my Father always said “heed this warning, and govern yourself accordingly”.

When ready to weld, crank the heat setting up on a stick welder, and tack everything in place, rotating the assembly to do so. Remember, the axles and center pin must still be able to pass through the planetary gears, so alignment is critical. DON'T WELD ON THE PIN OR AXLES !!! When satisfied that everything is properly aligned and tacked in place, put some serious weld to these. The weld doesn't have to be pretty, but substantial. When done welding, spend time with a slag pick and wire brush to remove any flux or contaminants that will later float around, eating up the gears. If you use a product such as 'Permatex' for the cover gasket, remember that a little goes a long way. (Note: We have found through personal and others experiences that the GM 7.5 metric mini-spools available are generally poor quality. If using this rear end, it’s best to weld up the spider gears. The cost of the mini-spool and it’s inevitable failure make it a poor choice for competition, and it is a bear to remove the axles when the mini-spools splines strip out).

Your gear ratio needed is dependent on how many rpm’s you want to turn. Generally, for West Virginia Motor Speedway you’ll likely need something in the 4:56 ? 4:86 final drive range, and even this is dependent on how hard you wish to turn your motor. Your final drive ratio will be determined by the transmission output multiplied by the ring and pinion ratio. For example, you have a 3 speed standard transmission and intend to run in 2nd gear. Put the transmission in 2nd, and mark the input and output shafts at top dead center. Rotate the input shaft, counting the revolutions of both shafts until the marks again line up. The input should rotate more revolutions than the output shaft. Divide the output rotations into the input shaft rotations to determine the output ratio. You could come up with numbers like 1.5 ? 1.75, meaning that for every rotation of the

output shaft, the input shaft must rotate 1.5 ? 1.75 times. For simplicity sake, we'll use the gear ratio of 1.5 transmission final drive.
Determining the rear end ratio is simpler. Divide the number of teeth on the pinion gear into the number of teeth on the ring gear. GM gear sets are limited for these metric framed cars, so if you're attempting to use the donor cars differential, you'll probably end up with a rear end gear ratio of 2.42 ? 3.08.
We'll use the 2.42 gear for this example, simply because it is the most commonly installed in the GM metric mid-size cars. Transmission output multiplied by rear gear ratio equals final drive ratio: 1.50 x 2.42 = 3.63 (or a 3.63 final drive) This final drive probably won't be satisfactory. Those running automatic transmissions often run low gear to get the final drive they desire. I don't think that will work with a standard transmission, but play around with the numbers and see what you come up with. (Running low gear really spins the transmission components, making it absolutely necessary to run an adequate scatter shield!) Another solution is searching the wrecking yards for a lower gear ratio ring & pinion, or purchasing a new ring and pinion in the ratio you prefer. (Note: The Ford 9" rear ends are an option, beginning in 2010. Gear sets are more readily available for these rear ends. The 7.5 GM metric rear end gears are available in a ratio of 4:56. 9" Ford rear end gears are available in even lower ratios)
For those who are totally inexperienced, these gear selections come in sets. They can't be mixed and matched. A chipped or partially broken tooth on a set of used gears will soon cause the gears to fail.
Once the body work is completed, you'll be ready for lettering. This used to be a job for a sign painter, but the days of hand lettered race cars has seemingly passed. Vinyl lettering has nearly made the sign painter extinct in the racing world. The demand for graphics has brought in the advent of 'the wrap'. A race car's appearance is seemingly dependant only on how much you are willing to spend, and the computer program quality of the sign shop.
I was fortunate when I raced. My brother was skilled with the paint brush and had lettered race cars for others. His ability saved me the cost of having the car lettered elsewhere.
I like a nice looking race car as much as anyone, but I feel that some folks have gone way overboard when applying graphics on today's dirt cars. I may be old fashioned, but some of these things look like the vinyl machine threw up on the car. It's a mess!
The car will need numbers on the sides and roof, with small numbers on the nose for the track line up crew. Make the numbers large, and of a highly contrasting color. What looks good in the garage often won't cut it for the scorers. Purple on black, or red on blue just doesn't stand out enough when trying to score 18 cars turning 15 second laps. Anyone who ever tried to score a race will also tell you that chrome style vinyl simply looks like a mirror as the car flashes by their vantage point after the lights come on.
If you purchase vinyl lettering, and install it yourself, have a spray bottle of water mixed with a small amount of liquid soap handy. Mist the adhesive back of the lettering and the panel it applies to, being careful to avoid allowing the adhesive parts to touch each other. This will allow you to adjust the decal after initially installing it on the car. (Don't use aerosols! The decal will show gas bubbles after installation.) After applying the decal and getting it situated where you desire, use a squeegee to force the air

bubbles out from underneath. A small 'bondo' spreading paddle works well for this. Depending how much you have put on the VISA card in the build process, you may want to use it for this step, thereby rendering it unfit for further use. (It's a joke, I say joke, son!)
Even if the driver is a humble or modest person, put his name on the roof. Any sponsors listed on the car should be lettered large enough that it doesn't require the Hubble telescope to be read from a distance.

Speaking of sponsors, it's great to have them, but don't waste a lot of time pursuing the elusive big dollar sponsor. The folks that will "sponsor" you are the same group of friends or acquaintances that help you because they desire to see you succeed. Chances are they will see little increase in sales if they are a businessman by placing their name on your car. Your obligation is to avoid embarrassing them or costing them business by doing something immature or foolish when at the track. Don't become a liability to sponsors.
Most sign shops have examples of the different font (style) of lettering available. You can ask, but don't expect them to offer you a deal in exchange for running their logo on your car. Chances are good that you aren't the first one through their door suggesting this idea.
You can attempt to letter your own car, but painting the lettering yourself is a lot more of a job than you could imagine. Even the cheapest of needed supplies are expensive, and unless you are extremely easy to please, be prepared to develop lowered expectations.
If you haven't loaded the car on the trailer, do it prior to the afternoon of the first trip to the track. This seems like a trivial thing, but making sure the car will fit, the ramps are adequate, and you have the means to secure the car properly ahead of race day is smart.
If you have the car construction completed, you are ready to 'set up' the car.
The tire pressures and any tire stagger (difference in tire circumference) should be set as needed for competition, and fuel added. Some prefer to scale full of fuel; others prefer to have the fuel level at something that would represent the fuel burn off during a race. I would recommend scaling the car at (or near) 3/4 full of fuel. The fuel load won't burn off very quickly, especially consider the class engine rules. Fuel load can be a set-up tool to get the percentages you desire.
This involves putting the car on a set of scales at each wheel and determining the load each wheel's spring is supporting. The spring adjusters can be used to increase or decrease weight percentage at each wheel accordingly. Keep in mind the car must weigh a minimum of 2400 lbs. Factor in the drivers weight, even if you don't use it in the set up process. The rules dictate that the minimum ground clearance at the frame rails is no less than 5'. Use this as a starting point if you have no pre-conceived idea of what you expect in regards to the final settings.
When adjusting the springs, try to keep the car relatively level. Attempting to adjust too much on any one corner will likely put the car in a bind. Generally speaking, the rear of the car should be slightly higher than the front.
Dividing the totals of the rear or left side wheels weight readings into the total weight will provide the rear and left side weight percentages. The left rear tire should reflect more

weight than the right rear, and adjusting on the right front spring will show results on the left rear. Weight will primarily transfer diagonally, and the scale readings will bear this out.
Some good numbers to initially use would be 52% left side weight and 52% rear weight. If you can get numbers like these, take some measurements for a ride height reference (lower control arm and axle tube to the bottom of the frame) and button things up.
If there is a need to add bolt on (ballast) weight, it's best to bolt this inside frame area, between the front and rear wheels. This may go against what others have told you, or you have observed. Moving the weight to the rear of the differential will result in a "pendulum effect".
If you have no access to scales, an old timer's trick was to place a large socket on a floor jack, then place the jack under the direct center of the rear end, and raise the rear of the car. The right rear should leave the floor before the left rear. The old timers would use a 1 quart oil can (oil once came in cans?!!) as a 'feeler's gauge'. When the left rear tire was just leaving the floor, it was said the 'wedge' was correct if the oil can would barely pass under the right rear tire. I'm not advocating this method, but it will provide a visual to determine if you're set up is close.
A necessity is setting the caster, camber and toe out on the front end. As with the weight percentages, these front end settings are merely starting points. You may have settings that you prefer, or work best for your particular car.
Start out with numbers close to these.
Caster: RF +6 to +7 degrees; LF +3 to +4 degrees.
Camber: RF -1 1/2 to -2 degrees; LF +1 to +1 1/2 degrees.
The front tires should be 'toed out' approximately ¼" or less. The means if you measure across the car at the front tires, the distance across the front of the tires (at hub height) would be ¼" greater than the distance measured across the rear. Always use just one (1) of the tie rods (usually the right side) to make this adjustment.
A car that's 'toed in' tends to wander. Toeing the front end out adds stability, but too much toe out creates drag on the tires and steering linkage. If you bang wheels with another car, or hit anything with the front wheels, check the toe for changes. A modified requires more precise driving than cars with wide bumpers, or fenders that can absorb punishment. If your previous driving style was based on relying on the bumper, and 'driving by feel', you quickly need to break that habit. To be successful in a modified, you'll need to 'keep the front wheels clean'.
The build is basically complete. We have tried to supply an overview for the first time or inexperienced car builder. Hopefully, these articles have provided some help. Nothing can replace 'hands on experience' in regards to the racing. If you have a source of information that is willing to provide advice, by all mean take advantage of it. Most racers are willing to help a sincere new racer. Learn to listen more than you speak, and when you ask questions, make them intelligent ones. Providing answers or advice on the obvious grows old quickly, even to the most patient mentor.
A great deal of individual research went into these articles, including pricing needed parts. Seeing as how "Project HotMod" started out as an idea, and little else, the actual build project was greatly aided several folks (too many to name here without accidentally forgetting someone whose help was greatly appreciated) to make it a reality. They know who they are, and I am indebted to all for their assistance.

We still have one final article to follow, as we conclude 'project HotMod'
Part 10: Enjoying the experience

Hopefully, your own "project HotMod" is well on the way to completion. If our series on the build has been informative, or at least humorous, it's been worthwhile. This final installment is intended to assist those who are new to the whole race night process, providing some suggestions to better enjoy the racing experience.

Racing has changed a great deal in my lifetime, even at the local level. Some of these changes have been for the better. Safety for all has been greatly improved. I can't remember the last time I witnessed the purse being cut, which was a common problem when I raced. Successful tracks have also worked to create a family atmosphere and provide programs for the young fans. Unfortunately, there have been changes that have proved detrimental to the overall health of the sport as well. Rising costs have made it very hard for most to compete, especially those who want to break into the sport. Technology has made great advances in racing, but at the cost of exclusion or elimination of many potential or former racers. The HotMod division will hopefully fill the void left by the rising costs of racing at the local level.
Have a mental checklist to be sure everything you'll need is packed in the hauler before leaving the shop to head to the track.Years ago, I realized I had left my helmet at home when my class was called to the track for hot laps. It was my first trip to compete at a new track, and in the excitement, the helmet didn't get packed. Fortunately, I was able to borrow a helmet from friends that raced in the Late Model class or I would have been an unhappy spectator. It's amusing now (the first helmet I borrowed fit like a mop bucket!), but was pretty embarrassing back then. If you have nothing such as work or family commitments that hold precedent, arrive at the track early, especially for the first couple of nights. Arriving late only adds stress to an already hectic day. Arriving early allows time to get the car and equipment unloaded, check out the tracks agenda for the night, go through inspection (expect to be teched), etc, without feeling rushed. Even if you aren't the nervous type, the excitement and adrenaline of getting on the track with your new car will take its toll. Getting behind early seems to last all night, so avoid it if possible.

Pay attention to the order of events, and be prepared when it's your classes turn to be on the track. The more seat time you can get, the better. Take every possible advantage of practice time. There's no better way to improve as a driver. If it's the first ever hot lap session for the car, don't attempt to break the track record the instant the flagman drops the green flag. Feel the car out first, determining if the brakes, steering and suspension react predictably before "getting up on the wheel". After this first session, go over the entire car with a fine tooth comb looking for loose bolts or other possible problems. If everything looks and acts as you believe it should, then you have a green light to put the car through it's paces at full song.
Also remember that hotlaps aren't a paying event. No one likes to shake their car down with the guy who consistantly wants to "win" hotlaps. Crashing, or taking someone else out during hotlaps due to overly aggressive driving is foolish. No matter when, crashing

eliminates track time, and it is very hard to improve as a driver or improve the car's set up if all you do is fix it between races. It is far better, especially for a driver learning the skills of racing, to take the checkered flag rather than a wrecker ride back to the pits.

Attend and pay attention at the driver's meeting. When you've raced for 25 years you'll be forgiven for a lapse of attention, but until then, take the driver's meeting as a necessary experience. Know which race you're in and where you line up. Nothing is more frustrating for the track staff, fans, and even fellow racers than a competitor who regularly seems to be clueless in this regard.

Learning to be a good racer involves more than just going around the track faster than everyone else (although that's a good start!). When on track, locate the caution lights, and be aware when they change. Many accidents can be avoided by being aware of your surroundings, and that includes the caution lights and flagman. If you don't already do this, train your vision to look as far ahead as possible. Too many new racers look no farther than the end of the car's hood, and this will quickly get them in trouble. Massage the accelerator, rather than slapping it to the floor. Use the throttle like there is an raw egg under your foot, and first learn to maintain car control. Speed will come, but if you get the reputation as the 'class squirrel', it's pretty hard to live down. Learn to run a consistent line, and soon you will be seeing the speed increase you desire. Smooth equals fast in every type of racing.
If the traffic lights change from green to yellow (caution), don't immediately come off the gas and slam on the brakes. If someone is close behind, they may be unable to react quickly enough to avoid your car. Roll out of the gas, looking for the problem so that you don't become part of the caution. If the lights turn red, indicating a total stoppage, the procedure is the same. The difference is that you need to come to a complete stop as soon as practicable. Don't park in such a way as to block any emergency vehicle attempting to enter the track or the accident scene, and certainly don't drive through the accident area. If fuel is spilled on the track, driving over the area could ignite it.
Use caution about sticking your left arm out the window to indicate you are slowing down. The car behind may be committed to passing below, making this a very risky move on your part. I cringe every time I see someone's arm come out that driver's side window with other cars speeding past. Since the HotMod's don't run a spoiler, using your right hand to signal those behind should be adequate and a whole lot safer. Locate the track line up workers, and be aware if they are in the area. If they are directing cars for realignment, be aware of this and follow their orders.
When you exit the track, or any time you are driving in the pit area, use some common sense. Race time is over. Children can be especially oblivious to cars moving close by, so use caution. This is especially true after the track lights come on. The track is usually lighted far better than the pits, and your eyes will need a moment to adjust.

There is an unwritten rule that I hope everyone will adapt for their race program. It's called "the Golden Rule".
For those not aware, this rule states "Do unto others as you would have other's do unto you". Simply translated, treat everyone like you want to be treated. This doesn't mean just on the track, but in the pits as well. If you want respect you'll earn it by giving it to

others. If you didn't like an on-track call, don't ‘go off’ on the nearest track official. Chances are good they won't have a clue what you're screaming about, and the only thing you’ve accomplished is gaining a reputation as a hot head. Nearly everyone working at a race track does so because they love the sport, and want to be involved in some way. It’s certainly not for the pay. Act civil to the track staff and most will go out of their way to provide an answer or accommodate a request. If you are involved in an on-track deal, don't storm into someone's pit looking for an explanation, or even worse, looking for trouble.

This is never the way to win friends or influence people! Learn to keep your emotions and thoughts (and words) to yourself until after the initial anger or frustration has passed. Many times things become clearer “after the dust has settled”, so to speak. More than likely, what appeared to be deliberate was a mistake on someone's part, or a combination of circumstances. It happens to the professionals (see Mark Martin’s Atlanta Busch race explanation), so don’t expect perfection at the local level. No matter what happened, if you treat these setbacks with a calm and mature manner you'll gain respect from all involved and make your experience more enjoyable in the long run. It's a long season, and you'll be racing with these same folks for a long time, possibly years. Most of the folks who have raced successfully for any length of time learned this lesson years ago. Don't allow your crew, friends or fans to bait you into these feud types of situations, either. Someone has to be the responsible adult, and “the buck stops” with you.

Never borrow anything you don't intend to return or replace with an equal or better piece. Most folks who race are honest and hard working, willing to help out when they can. Some have been burnt playing "Good Samaritan" to a guy they didn't know who had no other intention than stealing the part or tool. Believe it or not, there are folks like this out there. Be mindful of this when asking to borrow anything.

Finally, you can call it ‘bending the rules’, ‘looking for the gray area’ or whatever you prefer, but cheating is cheating. Play by the rules, or be prepared to suffer the consequences when caught. You’ll have no one to blame but yourself when it happens.

The "Golden Rule" works well away from the track, also.

Finally, always remember this is a hobby, and is intended to be fun. Big money took a lot of the fun out of some classes in racing years ago. You won't be putting food on the table in this class, so make sure you don't take it off the table in order to race. The same can be said for the time involved in fielding a car. Don’t put working on the car ahead of the kid’s ball games, dance recitals, etc. Always take care of the real responsibilities in life ahead of racing.

It’s very easy to lose perspective on what is really important. If your a family man (or woman), hopefully the rest of the family is involved and enjoys the experience as much as you do. Involving your family makes racing much more positive and enjoyable. Racing can be extremely challenging, highly competitive and the greatest sustained adrenaline rush you may ever have the fortune to enjoy. You can make friends and memories that will last a lifetime while living out every child in the grandstands dream. Much like the old ‘Wide World of Sports’ introduction, you’ll have the opportunity of enjoying “the thrill of victory and agony of defeat”.

Some of us have never outgrown those thrills, as racing remains our creative outlet, competitive thrill and source of enjoyment. Hopefully you'll realize the same. Good luck, God’s blessings, and let's go racing!
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