2016 and Newer
Chassis Manual

Technical Information Available at 515-432-6972
9:00am-4:30pm Monday thru Thursday
9:00am-2:00pm Friday

At Harris Auto Racing we facilitate our own chassis design and manufacture race cars and components to the highest standards. We work very hard in the development of our chassis and test on track performance to base our technical advice on, offering the best technical service in the industry. We offer complete service to our chassis as well as servicing all major chassis brands with chassis repair and parts service. All product lines we offer, in our opinion, are the best on the market and we settle for nothing less.

We also manufacture our own body and interior kits in house and they can be made for any chassis brand by simply filling out one of the body measurement charts.

Our technical lines at times can be very busy, so we ask that you be patient and understanding when calling. We will get your technical questions answered. You can also send an email to one of our technical support staff to help answer your questions via email.

Our goal is to give you the best products and service available, which in turn will translate into winning racetrack performances.

WE WANT YOU TO OBTAIN THE BEST PERFORMANCE POSSIBLE.

So please help us help you! By following these guidelines, we feel that you will be able to get the maximum performance from your Harris Auto Racing chassis. Proper maintenance and weekly preparation is key to winning races and the following information will help you reach that goal!

As a service to every Harris Auto Racing customer, your initial scale and align charge will be waived when you purchase a new rolling chassis. We ask that you follow our “starting point list”, which can be found on the following page before bringing your car to us to scale and align.

Cars that are brought here for set up that do not meet that criteria will be charged the hourly shop rate for however long it takes to prepare the car for set up, so please come prepared.

As we said before, our technical lines are very busy and we ask that you please read this information before calling us with questions. The majority of the questions we answer on our tech lines are located in the set up manual, so please read it to save us both time. If you do not understand something you read in this manual, call us and we will be happy to help.

General Chassis Recommendations

When setting up your chassis, we recommend that you follow the same procedures every time in order to get the most consistent results. The following is a starting point list, and if you are bringing your car to us to scale, please complete the list before bringing it here:

- Methanol | 20 gallons of fuel in the cell (28 gal cell)
- Gasoline | 12 gallons (17 gal cell)
- Install “scale tires.” You should try to use the same set for consistency purposes
- 1” Stagger on the front. 2-3” Stagger on the rear.
- Correct wheel offsets: see below
- Check ball joints to make sure that they are not bent. Check shocks, upper and lower “A” frames, center links, tie rod assemblies as well to make sure they aren’t bent. All of these will cause scaling, problems, not to mention chassis handling problems.
- Set ride height and front end alignment. Front end needs to be close to having the correct camber.
- Everything must be complete to ensure an accurate set up.
- Cars brought here for set up that do not meet the above criteria will be charged the hourly shop rate for how ever long it takes to prepare the car for set up: please come prepared!!
- Before calling us with scaling questions or problems, please complete the above list.

The following is a weekly list that you should follow in order to maximize the performance and consistency of your chassis:

1. Install scale tires with proper wheel offsets
2. Check fuel level (should be as stated above)
3. Unhook twin tube shocks, leave gas pressure shocks hooked up
4. Set rear end alignment
5. Set ride heights
6. Set front end alignment
7. Check total weight and balance
8. Add weight (if needed)
9. Reset ride heights
10. Set correct percentages
11. Re-check front end alignment
12. Re-check rear end alignment and pinion angle
13. Hook up shocks if needed
14. Check car completely

Set Up Procedure

1. **Install scale tires**, with proper wheel offsets. You should have a set of tires and wheels (with correct offsets) that you use for scaling purposes. This will eliminate one variable and make it more consistent when you scale. If not use your race tires with the proper offsets, stagger, and air pressure. If you use Index Plates make sure they are properly calibrated to simulate correct stagger.

Wheel Offsets		**Air Pressure**			
		G-60	KK-704	Wissota.	UMP 40
LF:	2” offset	LF: 10 psi.	LF: 10 psi.	LF: 8 psi.	LF: 10 psi.
RF:	2” offset	RF: 15 psi.	RF: 14 psi.	RF: 14 psi.	RF: 15 psi.
LR:	2” offset	LR: 10 psi.	LR: 10 psi.	LR: 7 psi.	LR: 10 psi.
RR:	3” offset	RR: 14 psi.	RR: 14 psi.	RR:12 psi.	RR: 15 psi.

IMCA Sportmod 3” (all 4)

2. **Check fuel level**. You should always have the same amount of fuel in your cell when you set up your car. We recommend that you scale with remaining fuel that would be left in your car at the end of the race. If your track turns dry slick, having a larger fuel cell, like 28 or 32 gallon, will enable you to add more fuel and get a higher rear weight percentage if needed.

3. **Unhook the shocks** if using twin tube design, any gas pressure shocks or RR coil over should remain hooked up.

4. **Aligning the rear end**. Having the rear end squared in the car is very critical. If these settings are incorrect, it will cause handling problems as well as scaling difficulty.

   a. **Setting the rear end front to back** – Start by setting the 2 lower 4 link bars at 15” center to center of the rod end and the uppers at 18” center to center of rod ends Locate the LR lower arm in hole 5 and the LR top arm in hole 4. Locate the RR lower arm in hole 3 and the RR top arm in hole 3. Most sanctioning bodies the rule states 72” from the back of the engine block to the center of the axle housing. This will put the rear-end square in the car. Trail the right side to free up if needed some cases have seen 1-1 ¼” right side back.
   b. **Indexing the Birdcages** - The birdcages need to be indexed at 2-3° on LR and 0° on RR Adjusting the top 4 link to set birdcage to desired angle. Be sure that the ride heights are set prior to setting birdcage index and reset ride height, keep in mind ride height will change index. In most cases setting the bar lengths is sufficient.
   c. Setting the rear end right to left.
   Measure and set at 6” from the inside of the inside upper right frame rail to the right side of the pullbar upright on both quick change and 9” housings.
   d. **Setting the Panhard Bar**
   J-bar: Start with the J-bar located even to 1” below the center of the pinion of both 9” and quick change. The frame mount should start 5-6” from the bottom of the 1 ¾” main rail to the center of the rod end on the frame side of the j-bar.
   Rear Panhard (IMCA Sportmod): Start 3” below center of axle tube with 14° angle in the bar.

   d. Before setting the scaling your car we recommend pulling the RR axle out of the drive flange to insure no rear suspension bind on the rear end.

5. **Set your proper ride heights**. ****Front measurements are taken by measuring from ground level to center line of the lower control arm bolt on the front side of lower control arms. Rear measurements are taken between the top of the axle tube and the bottom of the top outer frame rail. Make sure your starting measurements are as follows:

Note: These frame heights are the new starting frame heights when scaling car in future. If driver weighs more than 200 pounds add difference in weight to drivers seat prior to adjusting initial frame heights.

Initial frame heights:

LF: 8”	RF: 7 ½”
LR: 13-14” (Depending on Bite #)	RR: 12 ½”

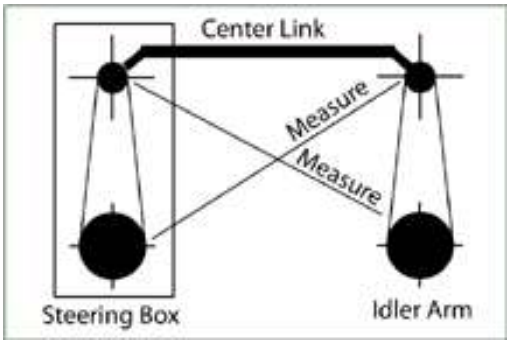
6. **Set front-end alignment** (to the follow settings).

	Caster:	**Camber:**
Left Front:	2 - 3°(+)	4° - 5 1/2°(+)
Right Front:	4 1/2°- 6°(+)	5° - 6 1/2°(-)
Toe Out:	¼”	

***When setting right front caster, you may choose to vary caster split slightly due to driver preference.**

To set your toe, start by squaring the idler arm and pitman arm. Make a mark on the steering box and the steering knuckle. In the future you will be able to use this mark to center your steering, adjust the right tie rod by squaring up the RF wheel with the right 1 ¾ round frame. Adjust the left tie rod to recommended toe out.

Our recommendation is have someone spin the tire and another person spray paint a line in the center of the tire as the wheel is spinning. Then scribe a straight line through the center of the paint as the wheel is spinning again. Now, repeat this process with the other front tire. When the paint is dry, roll the car forward and backwards (2 to 3 feet will do) to take the scrub out of the tires. (You may use toe plates however we believe scribing the tires to be more accurate.) Now you are ready to take the toe measurement. With one person on each side of the front of the car, slip a tape measure in between the tires, at the highest point possible on each side of the tire. It is important that both the front and backside measurements are taken at the same place on each side of the tire. For example, if you can only get your tape measure to clear 1/3 of the way up the backside of the tire, then you should use 1/3 of the way up the front side of the tire as well. The difference between your front and rear measurement is your toe out or toe in. For example, if the front measurement is 66” and your rear measurement is 65 7/8”, then you have 1/8” toe out. On a dry slick racetrack you can increase the tow to 5/8-3/4” to help increase front grip.



NOTE: If you are certain that you drew the line on the tire straight, but when you look at the drawn line on the tread of the tire, it does not look straight and wanders from the left to the right, that means either you have a bent wheel, or possibly a broken bead on your tire. You should check this problem further at this point.

Set the pinion angle - Torque Link. Set the proper pinion angle of (-) down using the torque link tube. This measurement for a solid torque link is 6-7° (-), any suspension using a non solid torque link 7.5-8.5°(-).

Torque Link Pre-load:

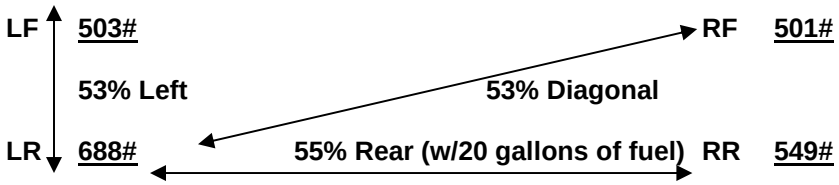
- **LW Puck Pull bar –** Set brake biscuit (red) preload 2 turns. Preload 1/2-5/8” (.600 primary gap)

- **1 Way –** Adjust ¾" nylock jam nut until 1 15/16" of the treaded shaft is exposed. Preload spring ¼" by adjusting (3) 5/16" preload adjuster locking nuts that contact the front spring plate. Progressive spring needs to be preloaded 3/8 –1/2".
- **2 Way** – Set brake biscuit (red) preload to 1/8". Preload spring ¼" by adjusting (3) 5/16" preload adjuster locking nuts that contact the front spring plate. Progressive spring needs to be preloaded 3/8 –1/2".
- **3 Stage** – Set brake biscuit (red) preload to 1/8". Aluminum adjuster nut for setting the travel on the inner biscuits need to be adjusted 3/8" from the back plate (3/4-1 1/4" biscuit gap). Preload spring ¼" by adjusting (3) 5/16" preload adjuster locking nuts that contact the front spring plate. Progressive spring needs to be preloaded 3/8 –1/2".
- **2 Biscuit –** Set brake biscuit (red) preload to 1/8". preload 1/4" recommended biscuit combination is yellow and blue on average traction, orange and blue on dry slick racetracks.
- **Spring recommendations –** 1200lbs or progressive for IMCA or without a spoiler. 1450 for open rules or with a spoiler.

7. **Check your weight balance** (front to rear, left to right, and diagonal RF/LR). If you need to add weight to make your car legal at your track, it should be added now. Add weight to arrive at the proper balance for the left and rear percentage. No weight should be added to achieve the proper diagonal percentage. Diagonal percentage can be added through the suspension. After adding weight, the ride heights will need to be reset. Your proper rear percentage setting will vary depending on the track conditions, rear suspension and driver preference.

LEFT SIDE: 53-55% **REAR: 54-55%** **DIAGONAL: 52-54.5%**

Baseline scale with a total car weight of 2,240#:



Base Line Wedge (LR bite #): 120-140#

High Wedge Setup : 220-240#
***High wedge setup typically likes stiffer RR spring and the Panhard lower on the housing**

- **To figure left side percentage: add left front weight to left rear weight, divide by total car weight.**

- **To figure rear percentage: add left rear weight to right rear weight, divide by total car weight.**

- **To figure diagonal percentage: add left rear weight to right front weight, divide by total car weight.**

The previous weight percentage diagram is made with the assumption that you have an average driver weight of approximately 200 pounds. You should achieve these approximate percentages **without the driver in the car**. The weights on the previous diagram are approximate and a baseline set up. The weight of you car may vary however the percentages are what you need to be concerned with.

- If your driver is more than 200 pounds, then you may want to have a slightly lower left side percentage; depending on how much over 200 pounds the driver is. The best way is to move the battery to the right to compensate.

- If your driver is less than 200 pounds, then you may want to have a slightly higher left side percentage, depending on how much less than 200 pounds the driver is. Add the additional weight on the x bar right behind the seat in the center of the drivers back.

8. **Add weight if needed**. Most tracks have a minimum weight rule; if that is the case you will probably have to add weight to your car. Most tracks include the driver in the total car weight, so keep that important point in mind when figuring the amount you will need to add. Also most sanctioning bodies require the weights painted white with your car number and secured with two 1/2" bolts for each piece of weight no matter what it weighs. When adding weight to the chassis it is very important to understand **balance** and how adding weight will affect the handling of your chassis. The location of weight added to the chassis will have a large affect on handling also. Depending on how much weight you have to add, some weight can be added by the drive shaft hoop area. This weight is very neutral and will hardly change any percentages. However too much weight to low will change the center of gravity. If you need to add a large amount of weight some will need to be added closer to the center on the main cage "X" bars by the torque link or you can add weight in front of your fuel cell. Adding weight to far back such as behind the fuel cell can cause a pendulum affect causing the car to go from a tight condition to a loose condition quickly depending on corner entry.

   Before you ever add weight on the car at the track, it should all be added at home and documented when scaling your car. Adding weight without knowing how it will affect your percentages can cause other handling problems. Make a chart with the weights added in different locations. This will help you understand how weight affects the **balance** of your car. The other element is fuel loss and the desired rear percentage at the end of a race. To compensate for fuel loss you might choose to add rear %. For example, if you normally burn 10 gallons of fuel during a feature you may need to add ballast to offset this. (Methanol weighs 6.65 lbs. /gal. X 10 gal. = 66.5 pounds.) You can put 65 pounds in front of the fuel cell, keep in mind that weight transfers better the higher it is placed (with in reason). You may want to experiment with locations. If you choose to add more (than the 60 lbs in the previous example) weight to increase your rear percentage you will want to raise the chassis up.

   Driver Tip: With a high rear tail percentage you will want to drive the car straighter on corner entry to gain the forward bite off the corner that high rear percentage will give you. Your corner entry speed may need to slower to increase exit speed and eliminate pendulum affect.

9. **Reset ride heights**. Go back to step 5 and reset your ride heights.
10. **Set correct percentages**. Go back to step 8 and make sure that your car has the proper weight percentages.
11. **Reset front-end alignment**. Go back to step 6 and make sure that your car has the proper alignment settings.
12. **Recheck the pinion angle** to make sure that it has not changed.
13. **Hook up the shocks**. Before hooking the shocks back up, check them to insure that they are in good working conditions. Compress and decompress them a few times. Check for any binds, air spots or dents. If you discover any of these problems, you will need to replace the shock. Worn shocks will cause inconsistencies in your car's performance. Now go ahead and hook the shocks back up.
14. **Check car completely**. Races are won with proper maintenance! The above list is a good starting point for weekly maintenance on your car. Also keep in mind that the more you race the more maintenance your car will need. You should complete this list after each night of racing.

Spring and Shock Rates:

	Modified	Sportmod	
LF:	600lbs, 5”x9 ½”	550lbs, 5”x9 ½”	7” 3.5C-8R
RF:	650lbs, 5”x9 ½”	650lbs, 5”x9 ½”	7” 3.5C-7R
LR:	200lbs, 5”x13”-16”	200lbs, 5”x13”	9” 9C- 2.5R
RR:	200lbs, 5”x13”	200lbs, 5”x13”	9” 4C-4R

These are baseline recommendations for your car. **Variables**, such as track condition, length, banking and speed will make changes necessary to obtain higher performance and response from your car. If you need to tighten the car on corner entry, you can **stiffen the left front spring by 50lbs.** If you need to help the car turn on corner entry you can **stiffen RF spring by 50lbs.** If you need to tighten the car up on corner exit **soften RR spring by 25lbs**

Rear Trailing Arm Locations and Adjustments

- ### Left Rear 4 Bar Control Arm Adjustments

The left rear lower control arm adjustment has the most effect with rear steer in the car. Raising the lower arm will increase rear steer on entry and exit. The upper control arm determines the amount of drive in the car and LR, and will have an effect on acceleration from the center out. Raising the upper link will increase drive in the LR tightening the car under loose conditions, while lowering will decrease drive in the LR under tight conditions.

Typically a good starting point would be #6 hole on the lower and #4 on the upper control arm. As the track slicks off as the event goes on it may be necessary to increase rear steer in the car and increase drive angle by increasing angle in the left rear control arms. A common adjustment is to raise the upper bar to hole #5 or drop one hole on the suspension cage. You can also increase chain hike to achieve the same result on a smaller scale.

- ### Right Rear 4 Bar Control Arm Adjustments

The right rear lower control arm adjustment also has a rear steer effect on the car as increasing angle on the arm will increase RR drive in the car on entry and exit. The upper control arm determines the amount of drive in the car on exit but also has some effect on entry. Decreasing the angle on the lower trailing arm will tend to tighten the car on entry and exit, while increasing angle will loosen the car up due to the change in roll steer. The RR upper control adjustment is a good adjusting tool as you lower the angle it will free car up on entry but will help car tighten up on exit. Be careful how much you lower the RR upper rod angle, having the rod too flat will give the car a loose-tight condition because the RR no longer carries an even load throughout the corner.

Typically a good starting point would be #3 hole on the lower and #3 on the upper control arm. As the track slicks over as the event goes on it may be necessary to decrease rear steer (lower rod) and drive in the RR (upper rod) to increase the forward drive of the car.

A good way to think of the 4 link suspension is that the upper rods are for traction (create leverage on the spring) and the lower rods are for steer. Both rods effect roll steer, spring indexing, and also act together to create the drive angle of that particular corner of the car.

- **Brake Floater Control Arm Location:**

  The left rear brake floater can be used to help control left rear 4 link suspension drop with brake application on corner entry. The brake floater arm should be located within 2-5° of the upper left 4 link bar angle. Too much angle will drive the car over on the right front and create handling issues. This is mainly a driver preference adjustment. We recommend starting without the brake floater.

- **Left Rear 2 Link Adjustments**

  The left rear control arm adjustment has the most effect with rear steer and drive in the car. Raising the lower arm will increase rear steer on entry and exit.

  Typically a good starting point would be #3 hole on the control arm. As the track slicks over as the event goes on it may be necessary to increase rear steer in the car and increase drive by increasing angle in the control arm.

- **Right Rear Control Arm Adjustments**

  The right rear control arm adjustment also has a rear steer effect on the car as increasing angle on the arm will increase RR drive in the car on entry and exit. Decreasing the angle on the lower trailing arm will tend to tighten the car on entry and exit under loose conditions, while increasing angle will loosen the car up under tight conditions.

  Typically a good starting point would be #5 hole on the control arm. As the track slicks over as the event goes on it may be necessary to decrease rear steer and drive in the RR and increase drive of the car by decreasing angle in control arm.

Panhard Angle

J-Bar height and angle will have an effect on body roll influencing side bite. A tight entry will be caused by excessive angle on the J-bar, lowering the J-Bar on the frame will help free the car on corner entry and through the center. If the car seems loose on entry and through the center increasing angle on the frame will help. Also if the car is tight on entry and through the middle it may be necessary to raise the J-Bar on the pinion or lower it to loosen.

*__Adjustment on rear end side yields double the effect.*__

Torque Link Adjustments and Recommendations

The base installation location for the pull bar would be center row location on the rear end housing 2nd hole up and front 2nd hole up on the pull bar mount. When determining which location to choose it is best to decide what you are looking for the pull bar to do. The more installed angle that you choose to use will increase the initial launch off the corner but will not carry as far down the straightaway. The less installed angle will give you more drive down the entire straightaway but will not give you that initial launch you may be looking for.

- **Pull bar lengths are 36”, 38”, 40” on the quick change and 38” on 9” plates**

NOTES:

Additional Notes:

Trouble shooting handling problems must be done in an orderly manner beginning at the flag stand, through corner entry, apex, exit and straightaway. **DO NOT** try to fix problems out of this order, because many times the cause of a later problem is related to an earlier one. A corner entry problem can help contribute to a corner exit problem. Fixing the corner entry problem will normally help fix the exit.

A car that is tight getting into the corner has the tendency of being loose off of the corner.

The effects of shock absorbers on body movement are temporary. They will temporarily hold the car up or down. A soft shock is more temporary than a stiff shock. However, in all cases the springs will provide the final effect. Shocks can only control spring actions not create them.

SHOCKS ARE WHEN – SPRINGS ARE WHERE

After you have washed your car a few times, rust may form on the threads, rod ends, and fasteners. This will make it difficult to disassemble and maintain parts. Before installation, you should apply anti-seize lubricant where needed to help alleviate this problem.

Sometimes you can have everything adjusted and tuned properly and still not be able to hook up. Don't forget the driver. Some adjustment is sometimes necessary here, too. Slowing the steering can promote smoothness as well as increasing the stroke on the gas pedal. Remember, smoother is nearly always quicker. Engine combinations also play a large part in forward bite.

With an 8" tire you can only use so much horsepower!

It is important to know what happens to the rear tires when suspension moves up and down. Rear steer under body roll and weight transfer can be valuable tuning area when working on corner entry and body roll problems.

More left side weight percentage can cause a loose condition on corner entry. More rear weight percentage can cause a push on corner entry and exit but it makes a loose condition in the middle of the corner.

Excessive left rear bite can cause looseness on corner entry(the left rear gets more traction under braking and wants to turn the car) and looseness coming off the corner (the tire loading is so uneven that neither tire works properly). Keeping bite in the 0-100 lbs range will work in nearly all conditions. If you find yourself believing that a significant change in bite or rear percentage would help your car do what you want it to, you may be better off to make spring or shock changes to promote bite. Avoid any set up numbers on your car that show an out of balance condition.

Rear tire stagger affects handling more than just when the car is accelerating. Keep in mind that the larger tire has more contact patch and usually more traction so the same qualities that turn the car when on the gas can cause the car to have difficulty turning when on the brakes. For example, large amounts of rear stagger creates a tight off the throttle entry problem. Adjusting brake bias can overcome some problems created by large amounts of stagger.

Side bite is sometimes confused with forward bite. If the car tails out in the corner when on the gas, making changes to increase side bite won't help. You need to concentrate on forward traction. Remember, the quicker you can get on the gas and go forward the sooner the car stops going sideways.

Moving the right side tires more in line with each other will effect traction coming off corners. Moving the right rear out will loosen the car on corner entry and exit.

A smaller master cylinder produces less volume and more pressure. Consequently, a smaller cylinder to the rear will give more rear brake while requiring some additional pedal stroke.

Proper balance in brake bias is extremely important for corner entry. If a car is too tight (or pushing) getting into the corner, adjusting brake bias to the rear it will loosen up the car. If a car is too loose getting into the corner, the opposite tends to apply.

The rubber seals and gaskets that are found in most racing type master cylinders are not compatible with silicone type brake fluid. Use a high temp Glycol based DOT 3 racing fluid for dependable performance.

The DOT designation on brake fluid indicates not only minimum boiling points but also other specifications such as compressibility, corrosiveness, moisture absorption, viscosity, chemical base and other. With all things considered, a high temp, DOT 3 Glycol based fluid, such as Wilwood Hi-Temp, is best suited for racing brake systems.

Due to the fact that the cars are now going faster, your brake system requires more frequent maintenance. Areas of concern are: brake fluid (due to overheating), cracks and bends in brake rotors/pads. Bent floaters, worn or loose rod ends. Additionally, you should look for these potential brake problems:

- Brake pads wearing at an angle. Due to the fact that the brake floaters are being run at an angle, it could cause your brake pads to wear at an angle. You need to check them often.
- If your balance bar hits your bolt on the pedal assembly, this will cause inconsistency in bias and possible bind. To fix, wire tie to make sure that the balance bar is in center so that the bar does not hit the bolt. Or you can tap a bolt from the bottom up with a 3/8" bolt. Call if you have any brake problems. **Brakes are very important part of your race car.**

NOTES: