Harris AUTO RACING

2001-2006

SET – UP MANUAL

MODIFIED

SPORT MOD / B-MOD

Dirt Modified Set-Up Manual
2001-2006

April 2010

Technical Information Available at 515-432-6972:
8:30am-5:00pm Monday thru Thursday
8:30am-4:00pm Friday

We manufacture our own chassis designs for modifieds. Besides offering a complete line of service to our chassis, we service all major chassis brands, whether it is chassis repair or parts lines. All product lines we offer, in our opinion, are the best on the market.

We also manufacture our own body and interior kits under the name Star Track Race Car Bodies. Bodies can be made for any chassis brand by simply filling out one of the body measurement charts.

WE WANT YOU TO OBTAIN THE BEST PERFORMANCE POSSIBLE.

Please help us help you! By following the guidelines, we feel that you will get the maximum performance from your Harris built car. Proper maintenance is the key to winning races and the following information will help you reach that goal!

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. If you do not understand something you read in the manual, call us; we will be happy to help you understand it.

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

The following are some of the top product lines we offer:

Aero Wheel	AFCO	AFCO Shocks	AFCOIL Spring
Bilstein	Brinn	Dynatech	Intercomp
Integra Springs	Integra Shocks	Kirkey	Kluhsman
KSE Racing	Michell Machine	Moog	MSD Ignition
Rebco	Simpson	Sweet Mfg.	Tilton
Wilwood			

AND MANY MORE….

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:

- 20 gallons of fuel in the cell. (Sport Mods – 15 gallons)
- Install "scale tires." You should try to use the same set for consistency purposes
- 1" Stager on the front. 2" Stager 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, and 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 chamber.
- Everything must be complete to insure 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 20 gallons)
3. Unhook shocks unless using gas pressure shocks or RR Coil over (Bilstein)

   (Right rear if using a coil over will need to remain 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
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 tire with the proper offsets, stagger, and air pressure. If you use Index Plates make sure they are properly calibrated to simulate correct stagger. To low of air pressure with the IMCA Hoosier can actually reduce forward drive.

Wheel Offsets

LF:	2" offset
RF:	1" offset
LR:	3" offset
RR:	3" offset

Air Pressure

	IMCA Hoosier	American Racer	Wissota Hoosier
LF:	12 psi.	12 psi.	8 psi.
RF:	15 psi.	14 psi.	11 psi
LR:	10 psi.	10 psi.	7 psi
RR:	15 psi	14 psi.	12 psi

IMCA Sport Mods are required to run 3" wheels on all 4 corners.

2. **Check fuel level**. You should always have the same amount of fuel in your cell when you set up your car. We recommend 20 gallons, as normally that would be what your car will have in it at the end of the race. If your track turns dry slick, having a larger fuel cell, like 30 or 32 gallon, will enable you to add more fuel and get a higher rear weight percentage. Car running methanol will need to start long races with a larger rear percentage because of the fuel burn off.

3. **Unhook the shocks** unless using any gas pressure shocks (Bilstein- Integra) or a RR coil over.

4. **Set your proper ride heights**. <u>These ***"MUST"*** be as close as possible to keep the roll center at the proper heights</u>. Front measurements are taken by measuring the upper control arm angle on the back side of the upper control arm. Rear measurements are taken between the bottom of the axle tube and the top of the under slung frame rail, measurements are as follows:

LF: 14 1/2°
LR: 2 ¾" Sq Tube Frame
LR: 4 ¾" Sq Tube Frame w/notch
LR: 5 ½" Rd Tube Frame

RF: 15°
RR: 2 ¾" Sq Tube Frame
RR: 2 7/8" Rd Tube Frame

5. **Set front-end alignment** to the follow settings.

	Caster:	**Camber:**
Left Front:	1 ½ ° (+)	3° (+)
Right Front:	3° to 4° (+) *	3° to 4°(-)
Toe Out:	1/8"	

*****When setting right front caster, you may choose to vary this 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 2" square or 1 ¾ round frame. Adjust the left tie rod to 1/8" 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 1/2" to help gain 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.

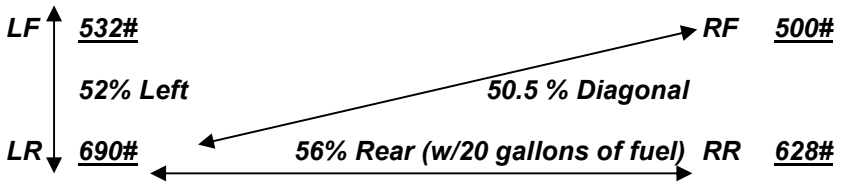
1. **Set your rear end alignment**. To square the rear end start by measuring from the back of the mid-plate to the center of the right axle tube 72". Adjust the bottom right trailing to achieve this measurement. Next measure from the center of the right axle tube forward to the 2 x 2 frame where the 2 link brackets mounts to. Record this measurement and adjust the left rear trailing arm to the same measurement. After squaring the rear end with the lower links, 4 link suspensions need to adjust the upper links indexing the birdcages at 0°. Check this by placing a level on the top mount of the birdcage. When scaling your racecar we recommend pulling the LR axle out of the drive flange to insure no rear suspension bind on the rear end. Having the rear end scared in the car is very critical. If these settings are off they will create handling problems.

2. **Set the pinion angle** -. Set the proper pinion angle of (-) down using the torque link tube. This measurement 2 Link rear suspension 7 ½ ° (-), 4 Link rear suspension 9° (-). The torque link should be preloaded 1/8".

8. **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. This is a baseline set up. Some drivers will vary from 35lbs to 120lbs of left rear (wedge) depending on the location of your springs and driving style. Your proper rear percentage setting will vary depending on the track conditions, rear suspension and driver preference.

LEFT SIDE: 51 ½% to 52 ½% REAR: 54% to 58% DIAGONAL: 50 ½% to 51%

Example for figuring weight percentages, with a total car weight of 2,350#:



- ***To figure left side percentage: add left front weight to left rear weight, divide by total car weight. In this example, 532 + 690 = 1,222 ÷ 2,350 = 52%***

- ***To figure rear percentage: add left rear weight to right rear weight, divide by total car weight. In this example, 690 + 628 = 1,318 ÷ 2,350 = 56%***

- ***To figure diagonal percentage: add left rear weight to right front weight, divide by total car weight. In this example, 690 + 500 = 1,190 ÷ 2,350 = 50.5%***

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 racecar 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 under 200 pounds the driver is. Add the additional weight on the x bar right behind the seat in the center of the drivers back.

9. **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. 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 torques 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 racecar 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 racecar. 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 additional weight to the rear. For example, if you normally burn 15 gallons of fuel during a feature you would need to add 100 pounds on to offset this. (Alcohol weighs 6.58 lbs. /gal. X 15 gal. = 98.7 pounds.) If you put 40 pounds in front of the fuel cell you'll need to put 35 on the right rear rail, and 25 pounds on the left rear rail and to keep the diagonal and left side percentage the same. 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 100lbs 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 driver 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*.

10. **Reset ride heights**. Go back to step 4 and reset your ride heights.

11. **Set correct percentages**. Go back to step 8 and make sure that your car has the proper weight percentages.

12. **Reset front-end alignment**. Go back to step 5 and make sure that your car has the proper alignment settings.

13. **Recheck the pinion angle** to make sure that it has not changed.

14. **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.

15. **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.

Rear Suspension Measurements

- **2 Link Rear Suspension:**
  These measurements are taken from center to center on the rod end.

  • Left Lower Arm: 20 ½" • Right Lower Arm: 20 ½"
  • Left Brake Floater: 19" • Right Brake Floater: 19"
  • Center of Rear End*: 17" Square Tube Frame 17 1/8" Round Tube Frame
  *Measured between the center bottom bolt of rear end third member and inside of right rear lower frame rail.

- **2 Link Rear Suspension: Short Arms**
  These measurements are taken from center to center on the rod end.

  • Left Lower Arm: 16" • Right Lower Arm: 20 ½"
  • Left Brake Floater: 19" • Right Brake Floater: 19"
  • Center of Rear End*: 17" Square Tube Frame 17 1/8" Round Tube Frame
  *Measured between the center bottom bolt of rear end third member and inside of right rear lower frame rail.

- **Trailing Arm Locations:** Counting from bottom to top

Starting locations:	LR:	Lower Rod	#4
	RR:	Lower Rod	#3

- **Trailing Arm Locations:** Counting from bottom to top
  At the Track Adjustments

Tacky Condition:	LR:	Lower Rod	#4
	RR:	Lower Rod	#5
Slick:	LR:	Lower Rod	#6
	RR:	Lower Rod	#2 or 3

- **Spring and Shock Rates:** *Base Set Up*

	Springs	Shocks - AFCO:	Shocks – Bilstein:	Shocks - Integra
LF:	600lbs, 5”x9 ½”	HAR 1	DP1 LF	HAR - LF
RF:	650lbs, 5”x9 ½”	HAR 5	DP1 RF	HAR - RFT
LR:	175lbs, 5”x16”	HAR 11	DP1 LR	HAR - LRT
RR:	175lbs, 5”x13”	HAR 12	DP1 RR	HAR - RRT
Dampener Shock:		HAR2	S7Z - 1090	HAR - PB

  - Chassis with a 9” rear end use a 7” axle dampener and chassis with a quick change rear end use a 9’ axle dampener shock.

  - 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 soften RF spring by 50lbs. If you need to tighten the car up on corner exit soften RR spring by 25lbs.

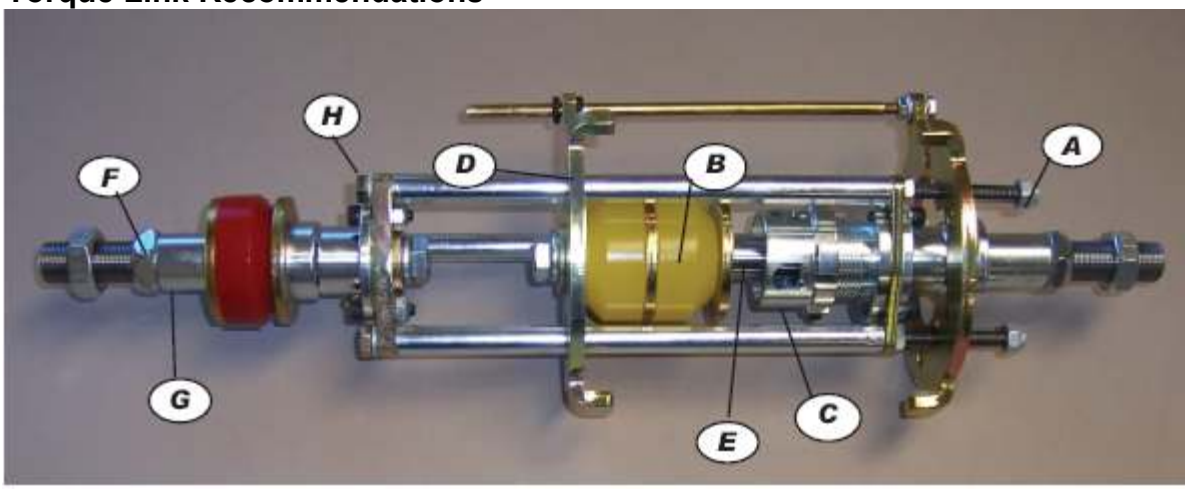
- **Spring and Shock Rates:** *Slick Set Up*

	Springs	Shocks - AFCO:	Shocks – Bilstein:	Shocks - Integra
LF:	600lbs, 5”x9 ½”	HAR 3	DP1 LF	HAR - LFS
RF:	550lbs, 5”x9 ½”	HAR 4	DP1 RF	HAR - RFS
LR:	175lbs, 5”x16”	HAR 13	DP1 LR	HAR - LRS
RR:	175lbs, 5”x13”	HAR 14	DP1 RR	HAR - RRS
Dampener Shock:		HAR2	S9Z - 1090	HAR – PB

- These are recommendations to use as a guide line. With a dry slick conditions corner entry speeds usually slow down. Some customers have had great success with softer front spring set ups. It all depends on the driver and his style or what makes him comfortable.

NOTES:

- **Torque Link Recommendations**



The 3 stage torque link uses a combination of a wire spring and poly spring bushings to absorb engine torque and increase traction to the rear tires. As engine torque is applied the wire spring will compress and the poly spring bushings will engage. As the spring bushings engage the spring rate will increase. This torque link is very tunable. Understanding the various adjustments which can be made is crucial to torque link performance.

1. Wire Spring Selection - A 5" OD. X 6-5/8" or 7" tall spring is needed. We recommend 1050#, 1200# or a progressive spring as a good starting point for most racers.
2. Wire Spring Preload - Preload the wire spring by adjusting the three 5/16" locking nuts (A). Preloading the spring 1/8"to 1/4" is a good starting point for a standard spring or 3/4" preload for the progressive spring. Be careful to adjust the nuts evenly.
3. Poly Spring Bushing Selection - The 3 stage torque link comes standard with two yellow 75 durometer poly spring bushings (B). The yellow bushings have proven to work well for a majority of racers, especially racers running open class mods, such as UMP and USMTS cars. IMCA Modifieds, or cars with less spoiler or motor may need softer bushings such as purple (60 durometer) or 55 durometer (orange) bushings.
4. Adjustment of Poly Spring Bushing Engagement - The point at which the poly spring bushings engage can be adjusted by turning the internal adjuster nut (C) in or out. To adjust the engagement point push the bushings and washers against the spring plate (D) so there is a gap (E) between the internal adjuster nut and the bushings. For an open class mod a 1/2" gap is a good starting point. For an IMCA mod a 3/4" gap is a good starting point. Increase the gap if the tires break loose during acceleration or when the track slicks up. Reduce the gap to bring the car out of the corners harder or when traction conditions are good. A 1/8" gap adjustment will affect performance.
5. Brake Bushing Tuning - The red brake bushing can be preloaded by adjusting the 3/4" nylock nut (F). Recommended preload is 1/8". The 3 stage torque link comes standard with one red brake bushing. The brake bushing spacer (G) can be removed and replaced with another poly spring bushing and washer. Installing a second brake bushing will reduce the spring rate of the pair of bushings by about 50%. This will tighten the car under deceleration. Softer bushings then the red can also be installed to tighten the car. When reducing brake bushing spring rate be careful the spring rate is not so soft it allows excessive negative pinion angle.
6. Torque Link Maintenance - Maintenance of the torque link is simple. Periodically grease both grease zerks. Only a couple of pumps are needed. Check the 1/2" bolts holding the shafts in place. You don't want the bolts to come loose. If you ever remove one of the 1/2" bolts apply Blue Loctite during reassembly. Periodically check the torque on the three 5/16" cap screws (H). The screws should be torqued to 29 ft/lb. using a torque wrench. Over tightening the cap screws can stretch and damage the cap screws. The poly spring bushings should be replaced annually or when the bushings loose excessive static height. The normal static height of the bushings is 1" to 1-1/16".

- Additional Notes:

Trouble shooting handling problems must be done in an orderly manner beginning at the flagman, though corner entry, apex, exit and straight chute. Don't 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 too tight getting into the corner has the tenancy of being too loose coming 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.

After you have washed your car a few times, rust may form on the threads making it very difficult to get the rod end to move. Before installing rod ends, you should put some anti-seize lubricant on them to help alleviate this problem.

Raising the front of the axle dampener shock will provide for tighter corner entry. However dampeners installed at angles greater than 10 degrees forward, especially 90/10 type can hinder the smooth movement of the rear suspension and cause a loose condition.

Sometimes you can have everything adjusted and tuned properly and still not be able to hook up. Don't forger 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 end 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 rear hang out in the middle of the corner.

Excessive left rear bite can cause looseness getting in (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 30-100 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. 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 the time when the car is accelerating. Keep in mind that the larger tire has more contact patch and usually more bite so the same qualities that turn the car when on the gas can cause the car to have difficulty turning when on the brakes. 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 bite. 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 effects bite coming off corners. Moving the right rear out will loosen the car on corner entry and exit.

Brake pads should always be matched front to rear as far as compounds are concerned. Even when different sizes are used, compounds should be the same. Using mismatched pads can cause the problems during early stages of the races when brake temperatures are not stabilized.

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 in corner entry. If a car is too tight (or pushing) getting into the corner, by adjusting brake bias to the rear it will tend to 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 floaters, worn or loose rod ends. Additionally, you should look for these potential brake problems:

- Excessively worn brake floaters. If you find that you are resetting your brake floater retaining rings, you need to change your bake floaters, as they are too loose from wear.
- 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 also 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 racecar.

NOTES: