
XRAY XII
1/12 PAN CAR
SET-UP BOOK
XII
TWELVE
XRAY

CONTENTS

SETUP THEORY

This section is a basic overview to setting up your XRAY XII for the first time to ensure that you have a well-balanced, neutral-handling car.

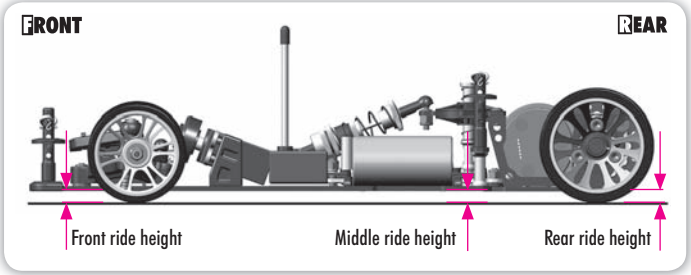
Car setup is a complex matter, as all adjustments interact. Fine-tuning the setup will make the car faster and often easier to drive near its performance limit. This means that all the effort you put into your car in preparing it and optimizing the setup will pay off in better results and more satisfaction.

If you choose to adjust your car set-up to better suit different track conditions, make small adjustments, one at a time, and see if you find any improvement in handling with each adjustment. We advise you to keep track of your set-up changes, and record which set-ups work best at different racetracks under various conditions. You can upload all your XII set-up settings to the XRAY's On-line Virtual Set-up Sheet Database at www.teamxray.com and can access your personal settings from anywhere. You can also benefit from all the set-up sheet knowledge and download the set-up sheets from XRAY factory team drivers.

Remember that for the car to work and respond to set-up changes properly, it must be in good mechanical shape. Check the well functioning of critical areas such as the free movement of the suspension, smoothness of shock absorber, and lubrication and wear of transmission parts after each run, smoothness of differential , T-bar correctness, and especially after a collision.

After rebuilding the chassis, or in case you become lost with your set-up, always return to the last set-up you have recorded, or use one of the setups posted for your car.

RIDE HEIGHT



Ride height is the height of the chassis in relation to the surface it is sitting on, with the car ready to run. Ride height needs to be checked in five places:

- **FRONT**: Front ride height is measured on the left and right edges of the chassis plate.
- **REAR:** Rear ride height is measured at the center of the rear pod plate.
- **MIDDLE:** Middle ride height is measured in the middle of the chassis plate where the pod and chassis connect (both left and right sides)

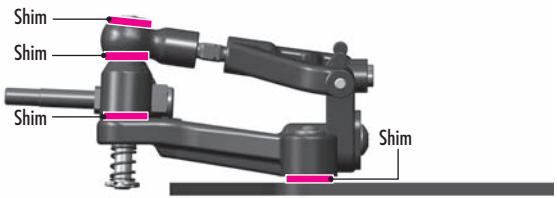
All five of these points should be set as close as possible to achieve a neutral-handling car. A good starting ride height would be 3–4mm depending on track type and surface.

IMPORTANT:
Measure ride height when the car is race ready (batteries, motor and electronics installed)

DECREASING ride height (lowering the car) increases overall grip and steering response, and is better on smooth tracks. INCREASING ride height (raising the car) increases chassis roll and is better on bumpy and asphalt tracks.

NOTE:
Recheck ride height every time you change tires or true tires to a different diameter.

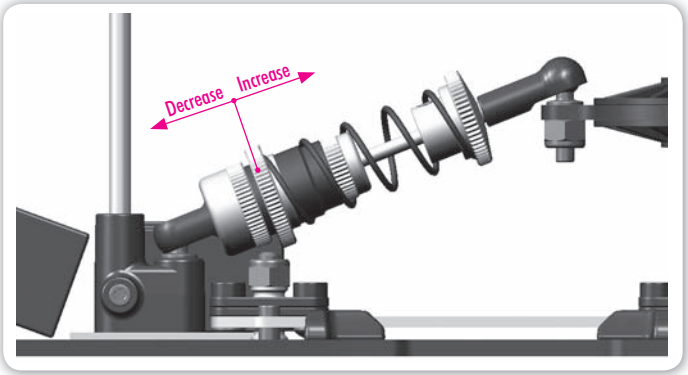
FRONT RIDE HEIGHT



Front ride height can be adjusted by placing shims at various locations on the kingpin and also under the front lower bulkhead. Ride height is influenced by the tire diameter. The amount of shims has to be the same on both left and right sides.

FRONT TIRE DIAMETER	SHIMS ON KINGPIN	SHIMS UNDER BULKHEAD
Small	Above upper arm = 0.5mm Above steering block = 1mm Beneath steering block = 0.5mm	0.5mm
Medium (initial setting)	Above upper arm = 0.5mm Above steering block = 1.5mm Beneath steering block = 0mm	1.5mm (3x 0.5mm)
Large	Above upper arm = 0.5mm Above steering block = 0mm Beneath steering block = 1.5mm	1.5mm (3x0.5mm)

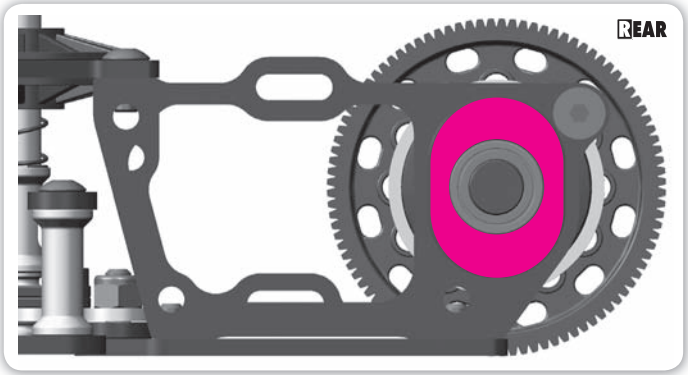
MIDDLE RIDE HEIGHT



Adjust middle ride height using spring preload.

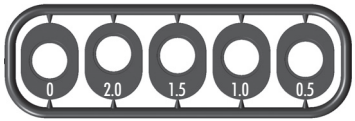
PRELOAD SETTING	THREADED PRELOAD COLLAR
Increase	TIGHTEN collar so it compresses the spring.
Decrease	LOOSEN collar so it allows the spring to expand.

REAR RIDE HEIGHT



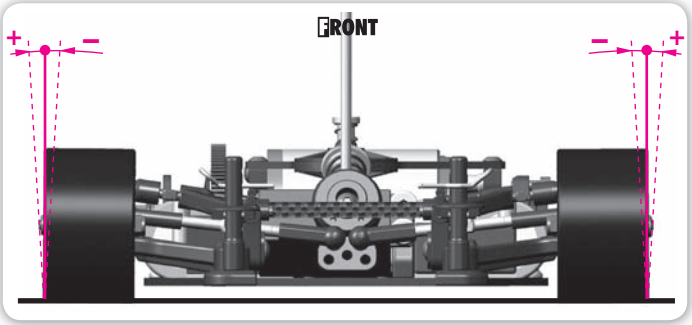
Rear ride height can be adjusted by the rear ride height adjuster bushings.

You must use matching bushings on both left and right sides to ensure the axle is exactly parallel to the bottom of the pod.



REAR TIRE DIAMETER	BUSHINGS
Small	Orient bushings so hole is offset towards the BOTTOM The smaller the tire, the more the hole is offset towards the bottom
Medium (initial setting)	0 offset bushings (hole in middle of bushing)
Large	Orient bushings so hole is offset towards the TOP The larger the tire, the more the hole is offset towards the top

CAMBER



Camber is the angle of a wheel to the surface on which the car is resting

Front camber can be adjusted by shortening or lengthening the front upper turnbuckles.

- **INCREASE** camber (wheel more angled) by **SHORTENING** the front upper camber link
- **DECREASE** camber (wheel more upright) by **LENGTHENING** the front upper camber link

It is important to have the same camber on both left & right sides. Camber influences the contact between the tire and driving surface.

We recommend adjusting camber to ensure the front tires wear flat and do not cone.

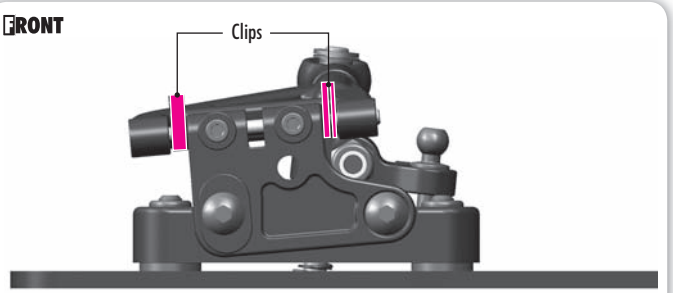
NOTE:
Check camber frequently. If the front tire is "coning," increase or decrease the camber until the tires wear flat. We recommend setting -1° camber as an initial setting.

CASTER

Caster describes the forward/backward angle of the front kingpin (and hence the front steering block) with respect to a line perpendicular to the ground. Caster angle affects on- and off-power steering, as it tilts the chassis more or less depending on how much caster is set.

A LOWER caster angle (kingpin more upright) is better on slippery, inconsistent, and rough surfaces.
A HIGHER caster angle (kingpin more inclined) is better on smooth, high-traction surfaces.

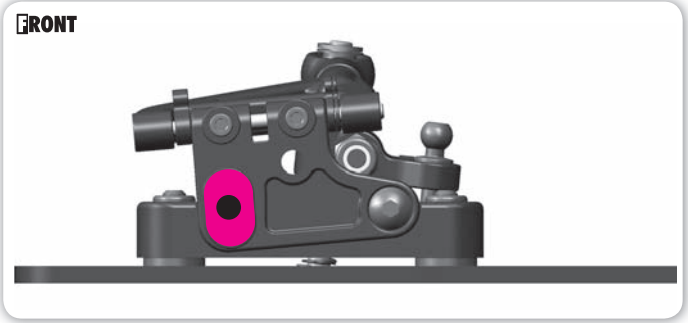
STATIC CASTER



Static caster is adjusted using clips on the front upper pivot pin.

- **INCREASE** front caster (kingpin more inclined) by moving the front upper arm more rearward on the pivot pin.
- **DECREASE** front caster (kingpin more upright) by moving the front upper arm more forward on the pivot pin.

REACTIVE CASTER



+ 0.5mm (7.5°) 0mm (5°) - 0.5mm (2.5°)

Reactive caster is used to adjust the amount of caster change when the front end of the car is compressing (diving) or decompressing (rising).

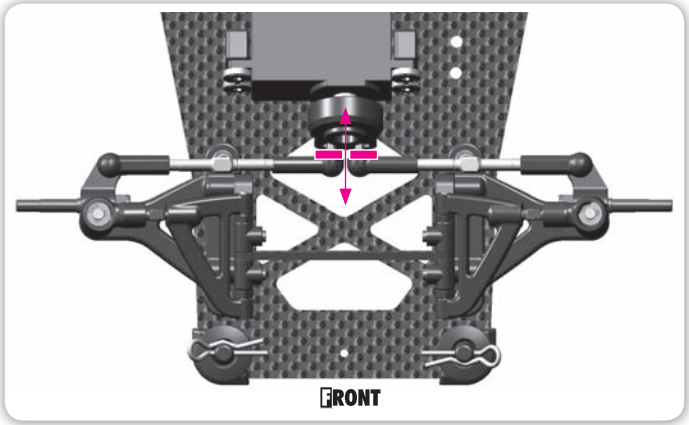
Reactive caster is adjusted by changing the angle of the front upper pivot pin by using the different inserts (supplied).

- The initial 5° reactive caster angle is a good starting point for car set up.
- INCREASING the angle to 7.5° will make the car react quicker and offer more steering.
- DECREASING the angle to 2.5° will make the car easier to drive smoothly into corners.

FINAL CASTER

REACTIVE CASTER POSITION	STATIC CASTER		FINAL CASTER
	CLIPS IN FRONT	CLIPS IN REAR	
	1+0.5	2	**1°**
	1	2+0.5	**3°**
	0.5	2+1	**4.5°**
	0	2+1+0.5	**7°**
	2+1	0.5	**2°**
	2+0.5	1	**3.5°**
	2	1+0.5	**5.5°**
	1+0.5	2	**7°**
	1	2+0.5	**9°**
	0.5	2+1	**10.5°**
	0	2+1+0.5	**12.5°**
	2+1+0.5	0	**5.5°**
	2+1	0.5	**7.5°**
	2+0.5	1	**9°**
	2	1+0.5	**11°**
	1+0.5	2	**12.5°**
	1	2+0.5	**14.5°**

ACKERMANN



Ackermann controls the difference in steering arcs between the front inside and outside wheels. The inside wheel always has a tighter arc in any corner.

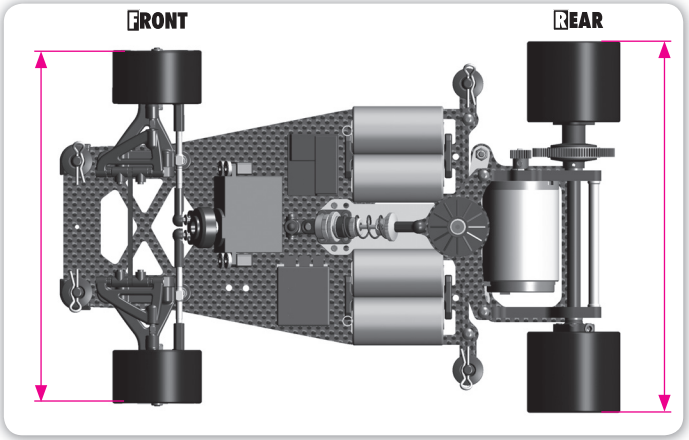
Ackermann can be adjusted by the number of shims that goes between servo saver and ball end.

- **MORE** shims under the ball end means **more** Ackermann.
- **LESS** shims under the ball end means **less** Ackermann.

MORE ACKERMANN - more steering into the corner, less corner speed, less traction in the chicanes.

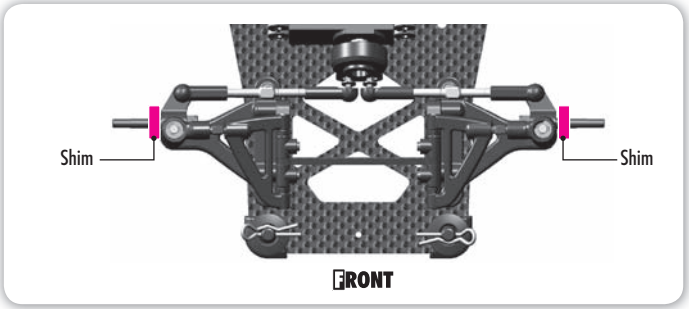
LESS ACKERMANN - less steering into the corner, more corner speed, more stabile in the chicanes.

TRACK-WIDTH



Track-width is the distance between the outside edges of the wheels, front or rear, and it affects the car's handling and steering response.

FRONT TRACK-WIDTH

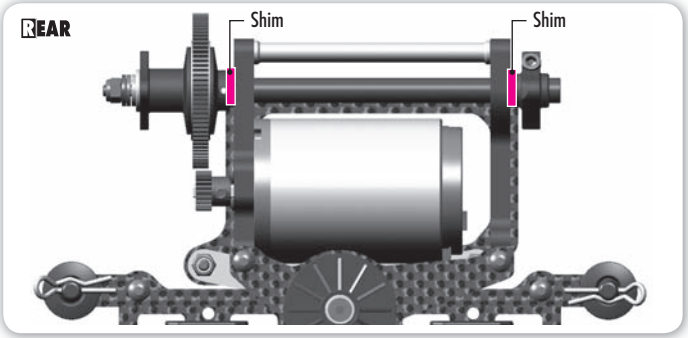


Wider front track-width decreases front grip, gives slower steering response, and increases understeer. Narrower front track-width increases front grip, gives faster steering response, and decreases understeer.

Front track width is adjusted by shimming the front wheels on the front wheel axles. It is important to use same shim thickness on both sides.

- **INCREASE** front track-width (wider) by using more/thicker shims behind the front wheel.
- **DECREASE** front track-width (narrower) by using less/thinner shims behind the front wheel.

REAR TRACK-WIDTH

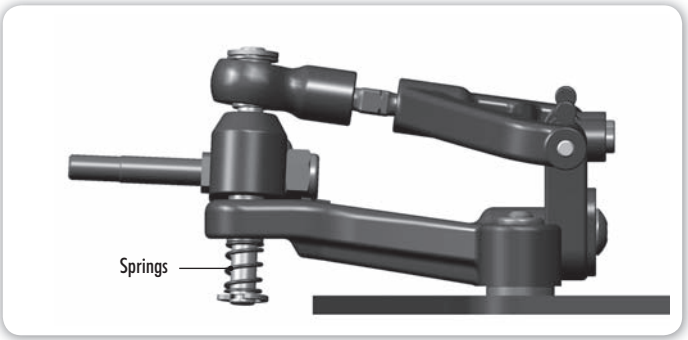


Wider rear track-width increases the stability of the car, increases rear grip at corner entry and middle corner, and decreases corner speed. Narrower rear track-width increases rear grip at corner exit, increases corner speed, and increases car responsiveness.

Rear track-width is adjusted by shimming the rear wheel hubs on the ends of the rear axle. Shims are located between the bearings and diff hubs. It is important to use same shim thickness on both sides. There must always be a small amount of side play in the axle to ensure it rotates freely and does not bind in the rear ball-bearings.

- **INCREASE** rear track-width (wider) by using more/thicker shims between the bearings and the hubs.
- **DECREASE** rear track-width (narrower) by using less/thinner shims between the bearings and the hubs.

FRONT SPRINGS



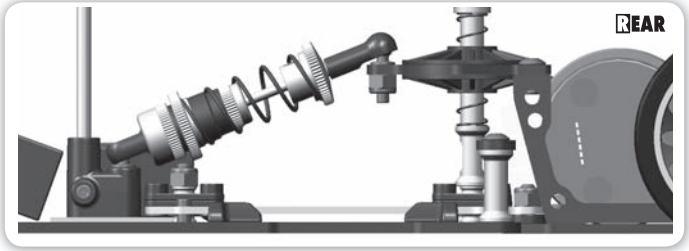
The XII comes with medium front springs which are best suited for most racing surfaces. Additional soft, heavy, and extra heavy springs are available as options.

Your choice of front springs is dependent on the track surface and traction level.
Changing to a SOFTER spring will aid on rough tracks, will help the car get into the corner quicker, and you will feel that you have more overall steering. As traction increases, to maintain the same car feel you can increase your front spring rate.

If your car has too much turn-in, go to a STIFFER spring; this will make the car easier to drive and be smoother in the corners.

FRONT COIL SPRINGS	
#372180	C=3.5 GOLD
#372181	C=4.0 SILVER
#372182	C=5.0 BLACK
#372183	C=6.0 GRAY

SHOCK ABSORBER



Damping, spring tension, and spring preload are all characteristics that determine how the shock performs.

DAMPING

Rear shock damping partially controls weight transfer of the car front-to-back and also controls the car over bumps on the track.

- Lighter damping lets the car enter a corner a bit harder and absorb a bumpy track, but the trade-off is slightly less drive coming out of the corner and a bit of wandering.
- Heavy damping lets the car be smoother entering a corner but it will feel a bit twitchy over bumps. The car will have more drive coming out of the corner. It is best to use this as fine-tuning when coming to a new track.

Rear shock damping can be adjusted by the use of different shock oils. It is recommended to use the XRAY 350 cSt shock oil that is included with the kit.

Other possible shock oils include:

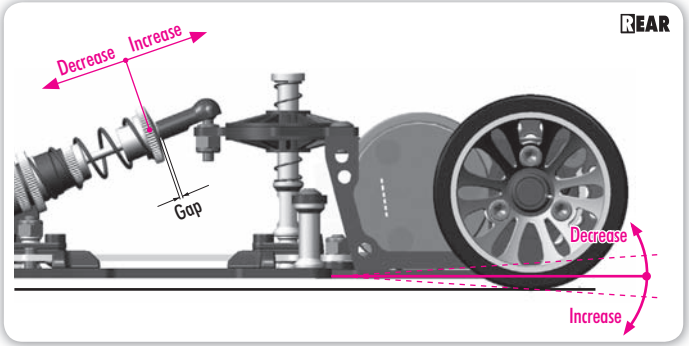
• 200cSt (#359220) • 250cSt (#359225) • 300cSt (#359230) • 400cSt (#359240)

SPRING

The kit provided spring works well in all conditions, however XRAY will offer tuning springs to help dial in your XII to any track condition.

- **SOFTER** rear spring allows more weight to be transferred to the rear of the car, resulting in better rough track handling over bumps but will reduce the drive of the car coming out of the corners.
- **STIFFER** rear spring results in better forward drive but sacrifices handling over bumps.

DOWNSTOP



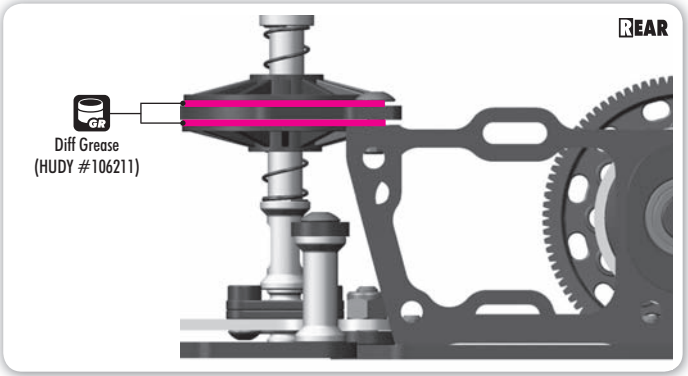
Downstop refers to the angle between the rear bottom plate and the chassis plate when the car is loaded, race ready, sitting on a flat level surface.

This race ready droop is dependant on the amount of shock spring preload. Increasing the center shock spring preload will stiffen the shock, decreasing the amount the car settles into the suspension. Typically, with the unloaded droop set at about 1 mm, we set the race ready droop to zero, meaning when placed on the ground, the car settles into the suspension 1 mm, enough to cause the rear bottom plate and the chassis to form a straight line.

Downstop can also be adjusted by the length of the shock, this will not change the characteristics of the shock as the preload will do.

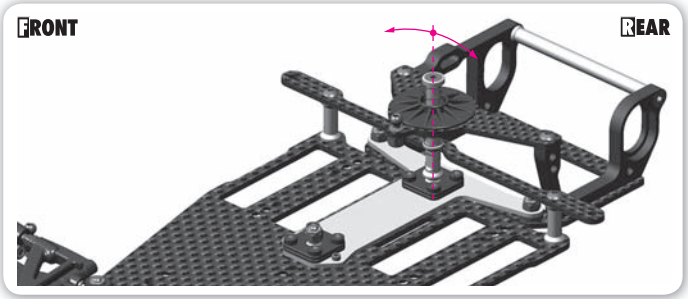
NOTE:
Downstop adjustment to effect the ride height of the car. Be sure to confirm ride height settings after adjusting droop settings.

POD DAMPING

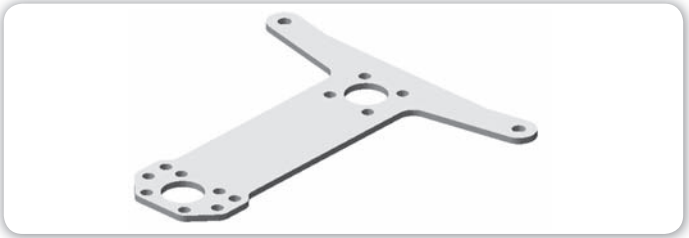


Pod damping controls the side-to-side motion of the car, and is controlled by the thickness of grease you use between the disks and the pod upper plate.

- **THINNER** grease (lighter damping) will allow the car to dive harder but it will also be more unpredictable.
- **THICKER** grease (heavier damping) will allow the car to stay a bit flatter and be easier to drive. If damping it too heavy the car will wander and feel loose.

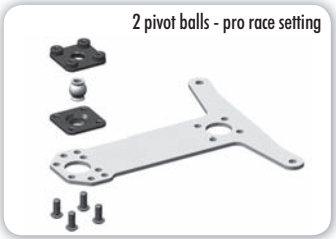


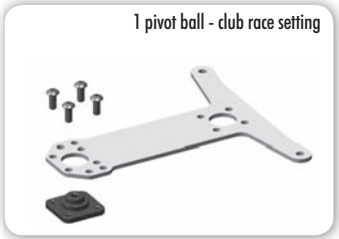
T-BAR



The XII comes with a T-bar designed for carpet racing. The T-bar is made from fiberglass and will fatigue from use, so you should always monitor the edges of the T-bar and replace it when you notice the corners turning white or if you start to see cracks form. A final indicator for changing your T-bar is if you notice the car is ill-handling from left to right, and is hard to tweak.

T-BAR MOUNTING SYSTEM





The XII uses a unique T-bar mounting method that allows for two different settings.

- **2 PIVOT BALLS - PRO RACE SETTING**

Both pivot balls are used to mount the T-bar to the chassis for more advanced adjustment possibilities (recommended for advanced drivers)

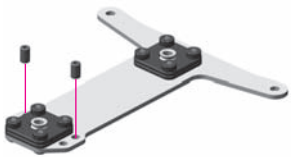
- **1 PIVOT BALL - CLUB RACE SETTING**

Direct mounting of T-bar to the chassis without the front pivot ball. This gives limited adjustment possibilities (recommended for beginner drivers)

T-BAR TWEAK SCREWS

Front holes

Rear holes



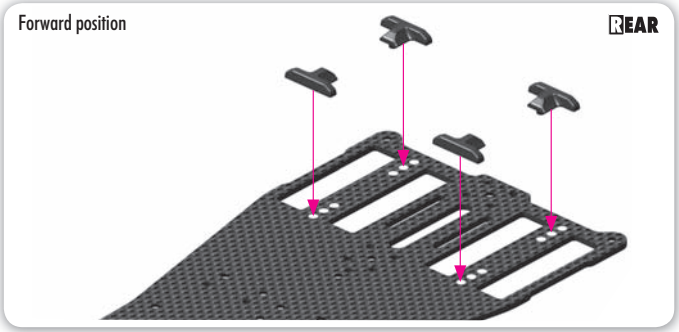
You can adjust the way the T-bar feels by changing the location of the tweak screws.

- **FRONT HOLES**: Putting the tweak screws in the pair of FRONT holes will have the effect of lengthening the T-bar and making it easier to drive and smoother but less responsive to driver input.

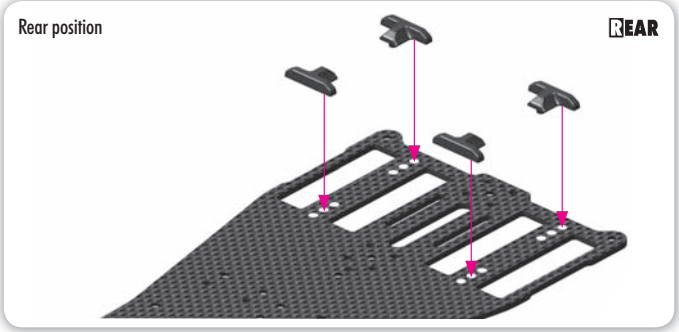
- **REAR HOLES**: Putting the tweak screws in the pair of REAR holes will have the effect of shortening the T-bar and making it feel more responsive to driver input.

BATTERY POSITION

Forward position



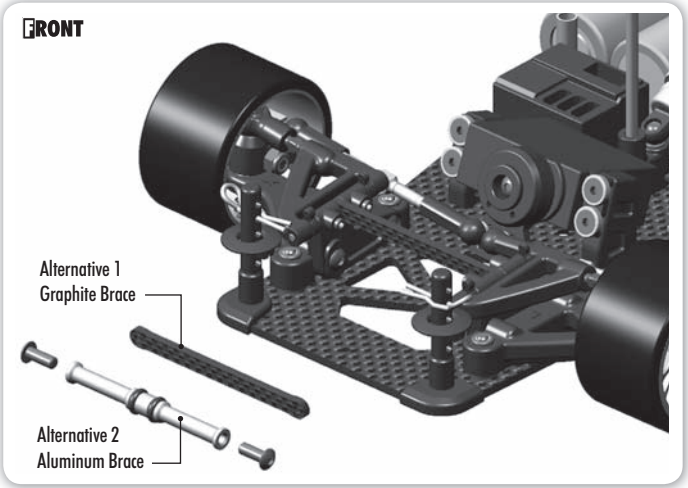
Rear position



Two battery positions are available on the XII chassis. The batteries can be moved forward or backwards by simply changing the location of the battery holders.

- **FORWARD** battery position increases the stability of the car, gives less overall steering, and more rear traction.
- **REARWARD** battery position increases overall steering and corner speed, but makes more rotation off-power.

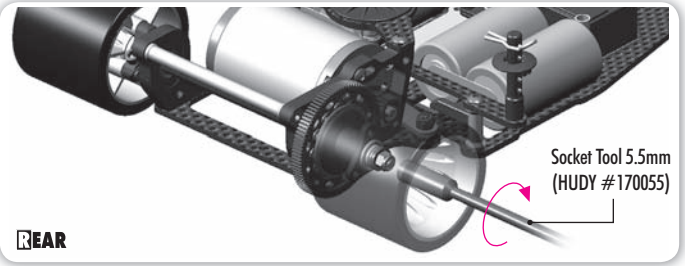
FRONT BRACE

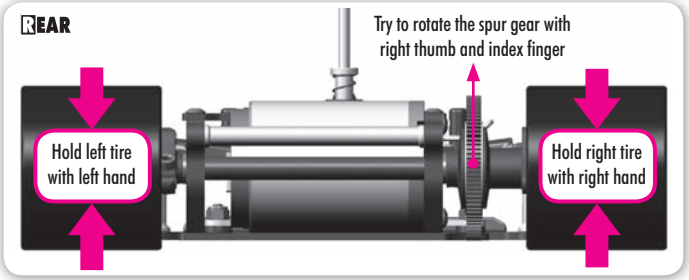


Two options are available for the front brace. A graphite brace is included as stock in the kit. An optional aluminum brace is available.

- The **GRAPHITE BRACE** was designed to stiffen the front end, and create a slight push. Producing a car that is very easy to drive for the average racer.
- The **ALUMINUM BRACE** provides more front traction compared to the graphite brace, this is recommended for low traction tracks where you need more overall steering. The aluminum brace is also aid in preventing chassis tweak in a hard crash.

REAR DIFFERENTIAL





While holding the rear tires with your hands, use your right thumb and index finger to try to rotate the spur gear. The spur gear should be very difficult to rotate. If you can rotate it easily, tighten the M3 nut at the end of the axle. Tighten the nut slightly and recheck the diff again. Repeat this action until the spur gear is difficult to rotate.

Before you tighten the nut each time, make sure to run in the diff a little bit. You can run in the diff by switching on the electronics. Use a little throttle and hold one of the rear tires. By this action you are running in the diff. Alternate between holding one tire, and then the other.

NOTE:
The differential must work smoothly and the spur gear must be difficult to rotate. If the diff is not working like this, it will have a negative effect on your car's performance. Make sure to regularly check if the diff is smooth. If not, you will have to rebuild the diff.

GEARING & ROLLOUT

Rollout refers to how far the tires roll for each motor revolution. With foam tires, the diameter decreases with each run so rollout is continually changing.

Proper gearing is one of the most essential tuning options required to maximize the performance potential of a touring car. The key to proper gearing is finding and maintaining the best "rollout" for each track environment, motor/chassis setup and driving style.

Rollout is the distance a car will travel in one revolution of the motor shaft. Pinion and spur gears are used to generate the rollout desired, considering the diameter of the tires mounted. Rollout determines top speed and acceleration. Usually a higher rollout will provide less acceleration and more top speed, and a lower rollout will be quicker off the line, but with less top speed. However, electric motors generate their maximum torque at only 1 RPM and lose torque as the RPM increases. With this in mind, it is possible to lose too much low-end torque needed to effectively accelerate the weight of the car out of a slow corner by undergearing to a smaller rollout and having the motor at too high RPM with very little useable torque. On the other side of the spectrum, if a motor is overgeared at too high of a rollout, the excessive torque will draw amperage from the batteries too quickly and cause the motor to heat up too fast and literally start to burn internally and destroy itself. A "best case scenario" is that your batteries won't last an entire race, and a worst case scenario is that your motor will be completely unusable to race again.

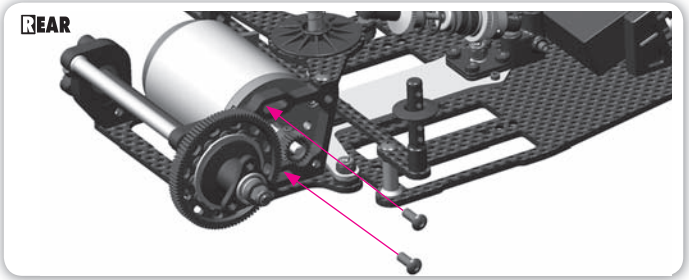
In order to accelerate the process of dialing in the best gearing combination at a track that you have never raced at, it is recommended that you ask fellow drivers using the same brand and model of motor for their rollout. Using this information and the calculations explained below, you will be able to match your car's rollout to theirs as a good starting point, regardless of the differences between cars.

You should adjust the roll out to maintain acceleration and top speed characteristics.

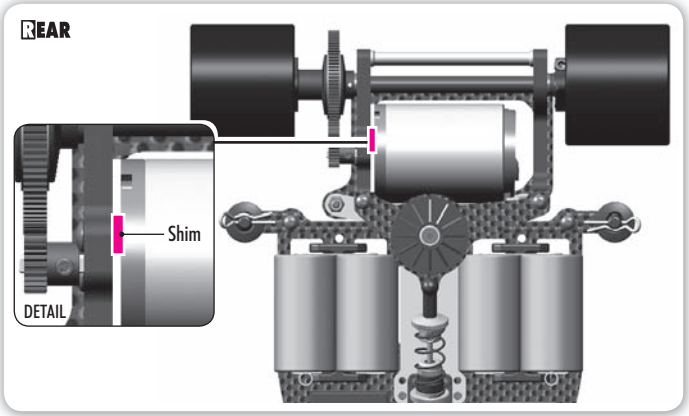
GEAR RATIO FORMULA: spur gear ÷ pinion gear

ROLL OUT FORMULA: (tire diameter x 3.14) ÷ (spur gear / pinion gear)

WEIGHT BALANCE



This chassis is balanced for brushless motors. When standard brushed motors are used, it is recommended to use additional shim between motor and the motor bulkhead in order to balance the weight transfer.



TWEAK

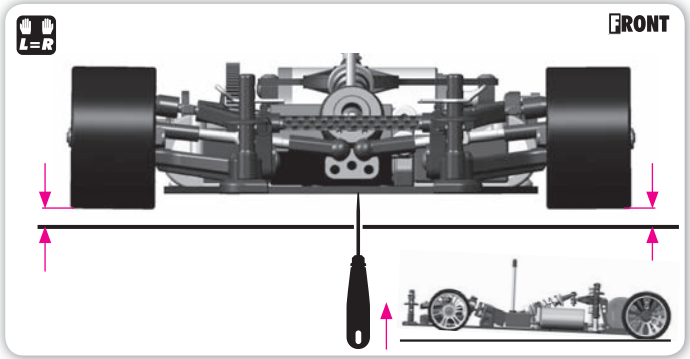
Chassis tweak is very important as it sets the weight balance of each front wheel equally. Tweak is adjusted by the screws in the T-bar. Tweak should be set on a race-ready car with all electronics and batteries installed.

There are a few things to consider before setting the tweak of the car:

- Front suspension should be smooth with no binding
- Front springs have equal shimming and not be over tensioned
- The rear pod should move as freely as possible
- Pivot balls should not be over tightened
- Speed control motor wires should be loose and not bind in any direction
- Brushless motor sensor should be loose and not binding any pod motion
- The car is centered and has equal & symmetrical rear track-width from the center of the pod
- L eft & right tires (as either end of the car) MUST be the same diameter

CHECKING TWEAK

1. Place the car on a flat surface.
2. Press down and release the car several times to settle the suspension.
3. From the front of the car, lift the car in the exact center of the chassis using a thin tool.
4. Observe if the front tires both leave the flat surface at the same time. If they do not, the chassis is tweaked.



ADJUSTING TWEAK

Chassis tweak is adjusted by tightening or loosening the setscrews that are mounted in the T-bar.

If FRONT LEFT wheel lifts first, the REAR LEFT tire has too much weight on it. Adjust the T-bar setscrews as follows:

1. Loosen the RIGHT setscrew by 1/8 turn.
2. Tighten the LEFT setscrew by 1/8 turn.
3. Recheck the tweak and repeat steps as necessary.

If FRONT RIGHT wheel lifts first, the REAR RIGHT tire has too much weight on it. Adjust the T-bar setscrews as follows:

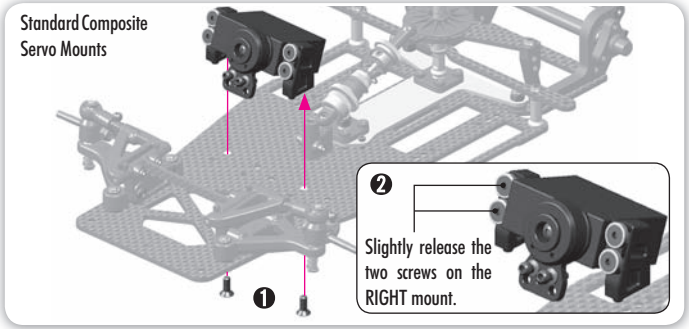
1. Loosen the LEFT setscrew by 1/8 turn.
2. Tighten the RIGHT setscrew by 1/8 turn.
3. Recheck the tweak and repeat steps as necessary.

If needed, adjust tweak until both front tires leave the ground at the same time. Always loosen one screw first, and then tighten the opposite screw the same amount until tweak is set.

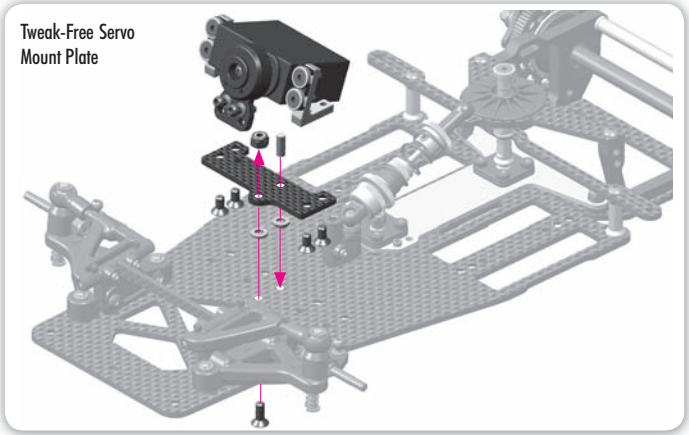
NOTE:
Make sure that both tires (at each end of the car) have the same diameter when checking and adjusting tweak. Tires with different sizes on left & right sides will cause handling problems (bias the result of tweak checking).

Properly tweaking the XII requires the use of additional tools. We recommend using the HUDY 1:12 Set-up System.

SERVO MOUNT TWEAK



It is very important to pay attention while mounting the servo to the composite stands included in the kit. The servo is positioned offset to the chassis centerline, and as such could easily produce unwanted tweak. To prevent tweak from the servo, we recommend mounting the servo to the composite mounts, then slightly release the two screws on the RIGHT mount.

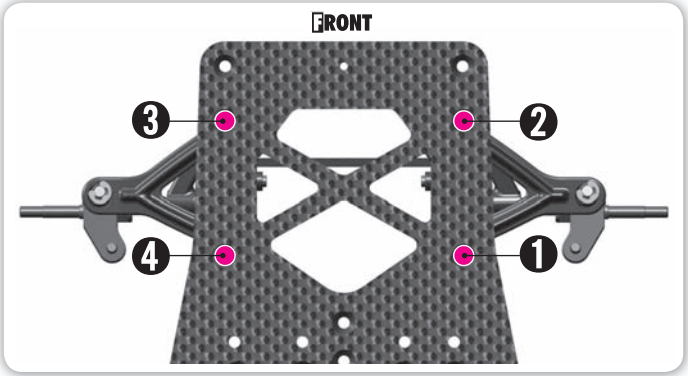


To eliminate the chassis tweak caused by improper servo mounting, XRAY offers an optional Tweak-free Servo Mount Plate which is centrally mounted along the centerline of the chassis while the servo is mounted independently on aluminum stands on the graphite servo mount plate. This design ensures that the servo is mounted independently of the chassis and will not produce any unwanted chassis tweak.

The Tweak-Free Servo Mount system is available in two sizes:
#376215 for Mid-Size Servos
#376216 for Micro Servos

SUSPENSION MOUNTING

It is VERY IMPORTANT to follow the tightening sequence as shown.



The front suspension is manufactured from composite material which may slightly move or bend when the mounting screws are tightened. As such it is extremely important to follow these steps to ensure tweak-free mounting.

1. Mount the assembled left and right suspension to chassis by installing the bottom mounting screws in the order shown. Tighten the mounting screws VERY GENTLY, and do not overtighten the screws.

2. Fully tighten the screws in exactly the same order as you installed them.

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