Suspension tuning with the adjustable D-Spec by TOKICO

A Users Manual

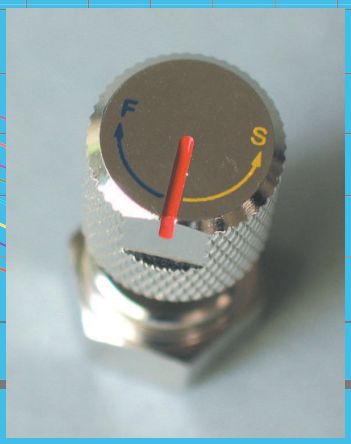






TABLE OF CONTENTS

WHAT IS THE D-SPEC?

Congratulations on your purchase of the new D-Spec from TOKICO. In the D-spec you now have access to some of the most advanced shock absorber technology available in the aftermarket. The unusually wide range of adjustment makes the D-spec an ideal shock/strut for tuning your suspension for a variety of motoring activities.

To set your shocks effectively, it is important to understand many of the variables that affect vehicle handling. This manual is designed to help you understand how different aspects of vehicle dynamics and suspension work. Understanding how individual components affect handling will help you determine which shock/strut setting is best for your purposes.

CAUTION

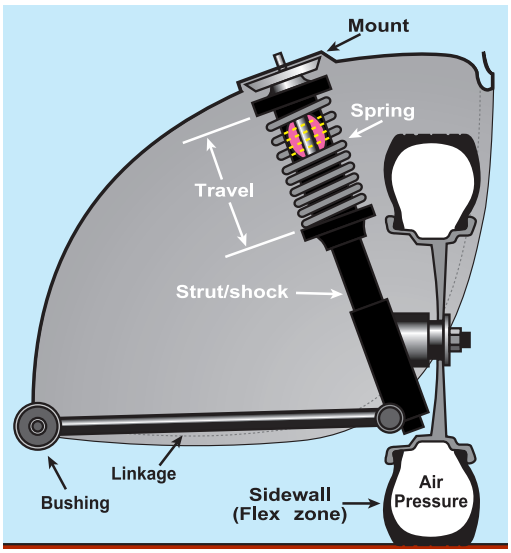
Because of the wide range of adjustment, it is important to read this manual thoroughly before adjusting the D-spec beyond the suggested starting points.

CAUTION

Because of the wide variety of vehicles and circumstances, this manual provides only general information about your vehicle and suspension. It is not a substitute for detailed and expert knowledge. TOKICO does not accept any responsibility for the setup of your suspension.

SUSPENSION

Tires and suspension make up a complete system, which is designed to manage vehicle dynamics. The figure shows some of the key components in a typical strut-type suspension. For maximum effectiveness, tires, wheels and suspension parts must work well together. Changing any one part can affect the way in which the other parts interact.



CAUTION

Suspension travel is not an actual component, but adequate travel is critical for proper suspension function. Too little travel can result in a rough ride, excessive bottoming, loss of adhesion and chassis or suspension part damage.

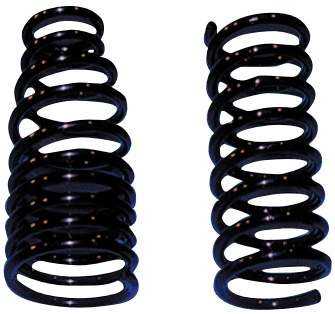
SPRINGS

Springs can be considered the heart of the suspension system.

- They support most of the weight.
- Determine ride height.
- Affect ride quality.
- Affect chassis stability.

If you wish to change your springs to lower sport springs, it is important to consider how you will use the vehicle. For street use, a moderate drop is best. How rough are the roads you will use, and will you be driving in winter conditions? These are a few of the questions you should ask yourself. If you lower the vehicle too far, it can cause a rough ride, poor handling and even chassis damage. The roads and driving conditions in New York are very different from those in Florida, Texas or even California.

Since shocks or struts must control the springs, it is important to use performance type shocks or struts when using sport springs. And it is important to replace the original springs with only quality well-designed performance springs.



CAUTION

Increasing spring rate stiffens the suspension. Up to a point this can improve handling. But a spring rate that is too high will cause ride harshness, a lack of adhesion on rough or slick surfaces and it can even cause stress-cracks in a chassis.

SHOCK & STRUTS

If springs are the heart of the suspension, then the shocks are the brains. Depending upon the surface and vehicle speed, the suspension has to deal with large amounts of energy.

It is the job of the shock absorbers to remove and manage excess and unwanted energy and motion. This is done by providing resistance to motion called damping force. Proper damping force will do any or all of the following:

- Help reduce body roll
- Improve traction
- Improve braking
- Enhance steering response
- Improve cornering ability
- Reduce pitch and dive

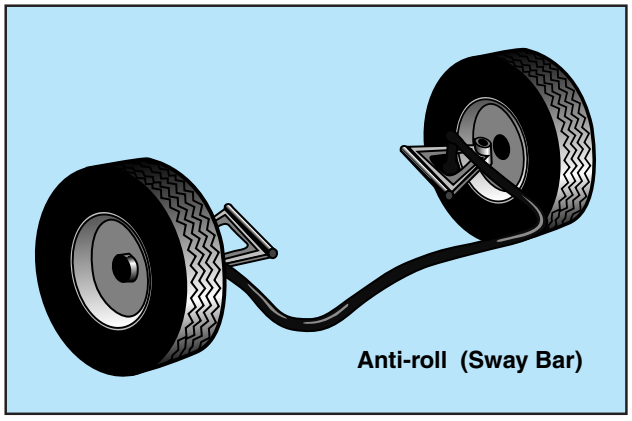
Shocks and struts should control, but not over-control, the suspension. This means having the correct amount of damping force for each situation.

Well-designed adjustable shocks/struts allow the vehicle owner to change the basic balance and behavior of the car for a wide variety of situations.

ANTI-ROLL (SWAY) BARS

Anti-roll bars are used to reduce body roll when a vehicle is changing direction such as during cornering. Bars allow manufacturers to use softer springs for better ride and control on rough surfaces.

Bars can be used as a suspension-tuning device. This is especially true when adjustable bars are used. While bars are often sold in pairs, there are times, (such as with some front-drive cars) when installing only a larger rear bar works quite well.



Anti-roll (Sway Bar)

CAUTION

Too much roll stiffness can reduce traction on slick surfaces like ice, snow and rain. It can also reduce traction on dirt or gravel.

ALIGNMENT

Alignment has a large effect on vehicle dynamics. In addition to poor tire wear, incorrect alignment can cause instability under braking and reduce cornering power. The three different alignment settings are toe, camber and caster. Depending on the car, toe and sometimes camber can be set at both the front and rear. If caster is adjustable it will be set at the front.

Toe

As Fig. 1 shows, toe is a measurement of the relationship between the front and rear of the tire. The tires can be toed in or out. Toe settings affect tracking, turn-in and steering response.

CAUTION

Incorrect toe settings can cause severe uneven tire wear.

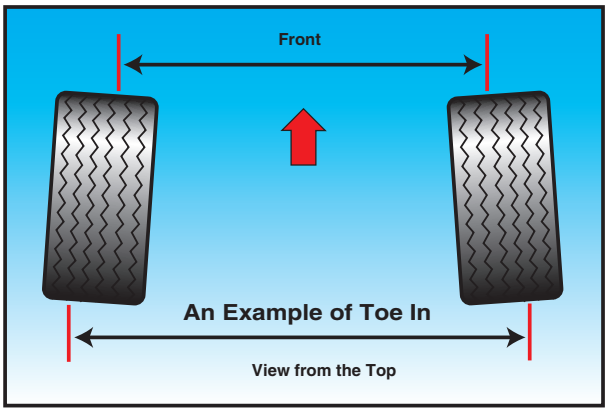


Fig. 1

Camber

Fig. 2 shows examples of negative and positive camber. The best adhesion during cornering comes from having a tire flat on the road. Due to suspension geometry and tire deflection during cornering, some static negative camber is usually needed for the tire to be flat during cornering. The best amount of negative camber depends upon the suspension design, the tires being used, and what type of driving is being planned.

Positive camber is virtually never desirable except on the inside front tire in oval racing. For street use, -1/2 to -1.25 degrees is usually an acceptable range.

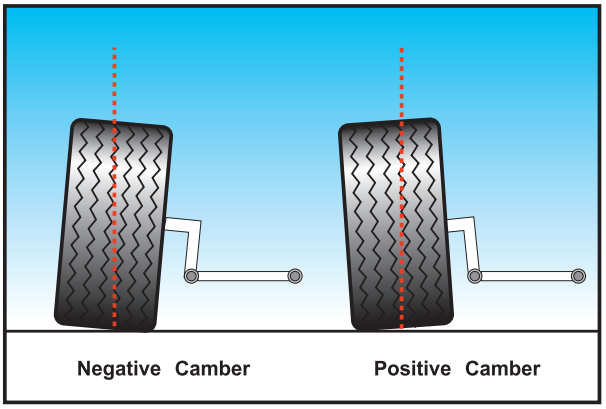


Fig. 2

Some cars may have limited adjustment or none at all. If you are doing performance driving, check with the tire manufacturer for recommendations.

Excessive camber can cause uneven tire wear.

Caster

In many cases caster is not adjustable. When it is adjustable, positive caster helps with straight-line stability. If a performance alignment is desired, it is best to seek out a shop that specializes in such alignments.

If you request a performance alignment setting, the alignment shop may decline any guarantee. This is due to liability issues.

TIRES & WHEELS

One of the largest gains in traction comes from wider tires and wheels, but it is possible to go too far. When considering wider tires and/or larger-diameter wheels, you should consider what your goal is. If performance is the primary goal, be careful not to go too far in size changes.

Large diameter wheels increase rotational inertia, which will in turn reduce acceleration and braking ability.

Another factor is the increase in unsprung weight. This can reduce traction by making it harder for the shocks to maintain good tire contact. The shorter tire side wall will reduce compliance. This can also reduce traction.

The chart shows the affect on side wall height as wheel diameter is increased. Compared to original, plus 1 or 2 is not a major problem. Plus 3 may have negative affects.

CAUTION

Too much tire pressure (especially in combination with a very low profile tire) will reduce compliance causing a harsh ride and reduced traction. The lack of compliance can also bend wheels and, over time, cause cracks in chassis and suspension parts.

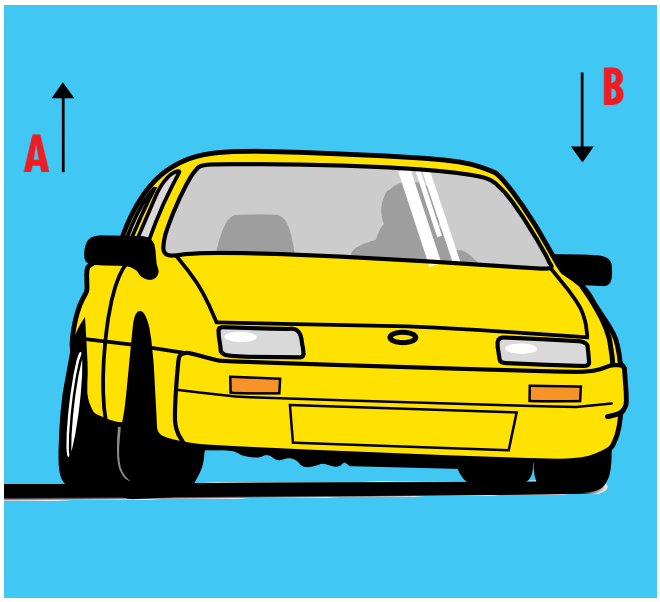
TIRE SIZE	195/60R14	195/55R15	205/50R15	205/45R16	245/35R17
RIM Diameter	O.E.M.	+ 1 inch	+ 1 inch	+ 2 inches	+ 3 inches
					
Width					
Profile	*60*	*55*	*50*	*45*	*35*

Chart courtesy of Pirelli

WEIGHT TRANSFER

Any time a vehicle changes speed or direction it generates-weight or load transfer.

The photo below shows a car under acceleration transferring weight from the front onto the rear tires For drag racing, rear-drive cars generally want to transfer weight onto the rear tires to help traction and launch speed. Front-drive cars want to minimize front to rear transfer because it can reduce traction at their driving wheels.



The figure to the left shows body lean because of side-to-side weight transfer. Weight is transferred off the tires on side A, onto the tires on side B. If, while cornering, the driver applies the brakes or gas, fore or aft weight transfer is also introduced. Depending upon the circumstances, such actions can either stabilize or unsettle a car (see Handling Balance).

HANDLING BALANCE

One of the most important keys to a good handling car is balance. Balance is ultimately even more important than adhesion. Without balance, a car can be almost undriveable.

Understeer (push) and oversteer (loose) are the usual measures of a well-balanced vehicle.

Understeer

Car "A" is in what is called an understeer condition. As you can see, the front wheels are turned towards the inside of the turn while the car is trying to go straight ahead. This indicates that the front tires have less traction than the rear tires.

Front-drive and other nose heavy cars tend to understeer in many situations.

Oversteer

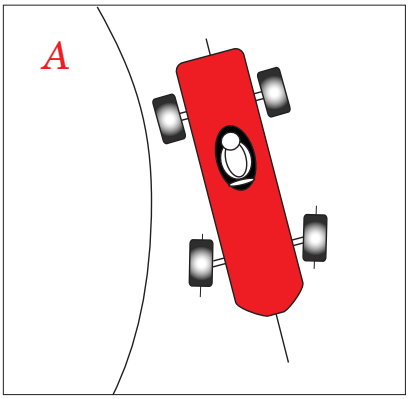
When there is more lateral traction at the front than at the rear, the usual result is oversteer. In the case of car "B", the wheels are turned toward the outside of the turn in an effort to keep the car from spinning. Oversteer often shows up on mid- or rear-engine cars. It can also be induced in a rear-wheel-drive car when engine power overcomes available traction.

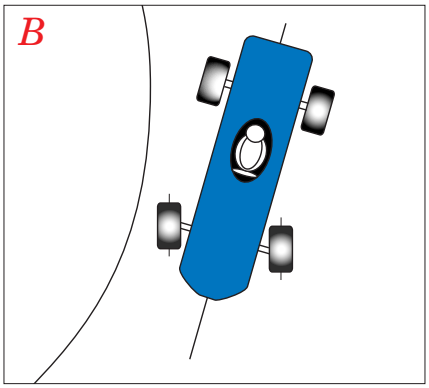
Some cars also have what is known as trailing or drop-throttle oversteer. In this situation, lifting off the throttle while turning transfers weight or load off the rear tires and onto the front tires. The result is more adhesion at the front causing the rear to tend to step or swing out. In extreme cases it can result in a spin.

Generally, neutral to slight understeer is desirable for road driving. Rally or dirt track racers often want to be able to induce controlled oversteer. Controlled oversteer is also used in the new track sport of drifting.

CAUTION

Changing the handling balance will affect the way your vehicle performs. However, even a perfectly balanced vehicle cannot defy the laws of physics. It is important to always use proper driving techniques and stay within the limits of your vehicle and prevailing conditions.





Correcting an understeer or oversteer condition depends on changing traction at the front or rear of the car. On most production cars, the only real adjustments are alignment and tire pressure. Adding adjustable shocks and changing bars or springs are other ways to change handling balance.

Each vehicle will have its own behavior. Front-wheel drive will handle differently than rear-wheel drive and front-engine cars tend to react differently than mid- or rear-engine cars.

The right hand column shows some general guidelines for changing handling balance (understeer/oversteer).

CAUTION

Not all cars will respond in the same way to tuning recommendations. Improper setup of your suspension can make your vehicle more difficult to control. Consult an expert about proper setup for your vehicle and driving conditions. There are also a number of books regarding chassis and suspension tuning.

Make changes one at a time and start out with tire pressures at or near factory recommendations for your vehicle. (This can be found in the owner's manual)

CAUTION

Improperly setting up the suspension on your vehicle (such as lowering it too far) will void the warranty on the D-Spec shocks or struts.

Reducing Understeer*

First try to increase traction at the front. Some of the ways to do this are:

1. Add negative camber at the front.
2. Reduce toe-in/add some toe-out.
3. *Soften front shocks.*
4. Increase front tire pressures.

If more traction at the front is not easily done, you can reduce traction at the rear.

1. Reduce negative camber at the rear (if adjustable).
2. Reduce toe-in or increase toe-out (if adjustable).
3. *Stiffen rear shocks.*
4. Reduce rear tire pressures.

CAUTION

Do not lower pressure too far!

Reducing Oversteer*

Increase traction at the rear

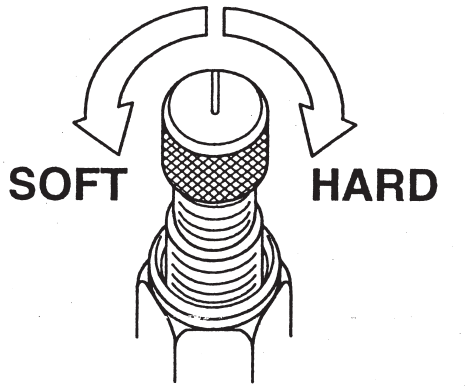
1. Add negative camber at the rear (if adjustable).
2. Reduce toe-out or add toe-in (if adjustable).
3. *Soften rear shocks.*
4. Increase rear tire pressures.

If traction cannot be increased at the rear, it must be reduced at the front.

1. Reduce Negative camber at the front.
2. Add toe-in.
3. *Stiffen front shocks.*

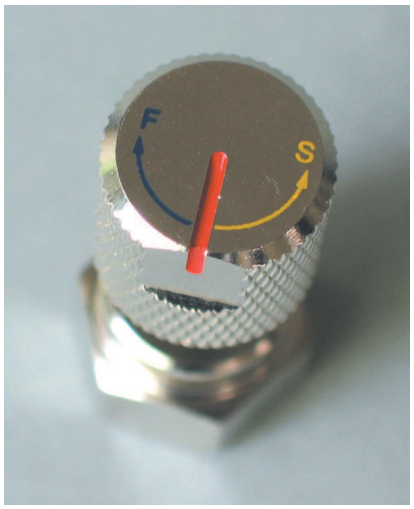
* Running out of travel by rolling on to bump stops in a turn, can worsen understeer or oversteer.

ADJUSTING THE D-SPEC



In between the extremes of full soft to full hard (which are quite wide), the D-Spec is *continuously adjustable*. But from a practical standpoint, we will use complete turns (360 adjuster degrees) for reference. The graph on page 12 shows an example of the different levels of damping force that each 360 degrees provides. (This graph is representative only. Each application has it's own specific damping curve shape and range).

The beginning point is full hard. Each adjustment shown on the graph represents a complete turn from full hard. To make an adjustment, turn the adjuster clockwise until it stops. That is full hard. Then turn counter-clockwise the number of turns or 1/2 turns you may desire. The D-spec adjusts both compression and rebound simultaneously.



Road Use

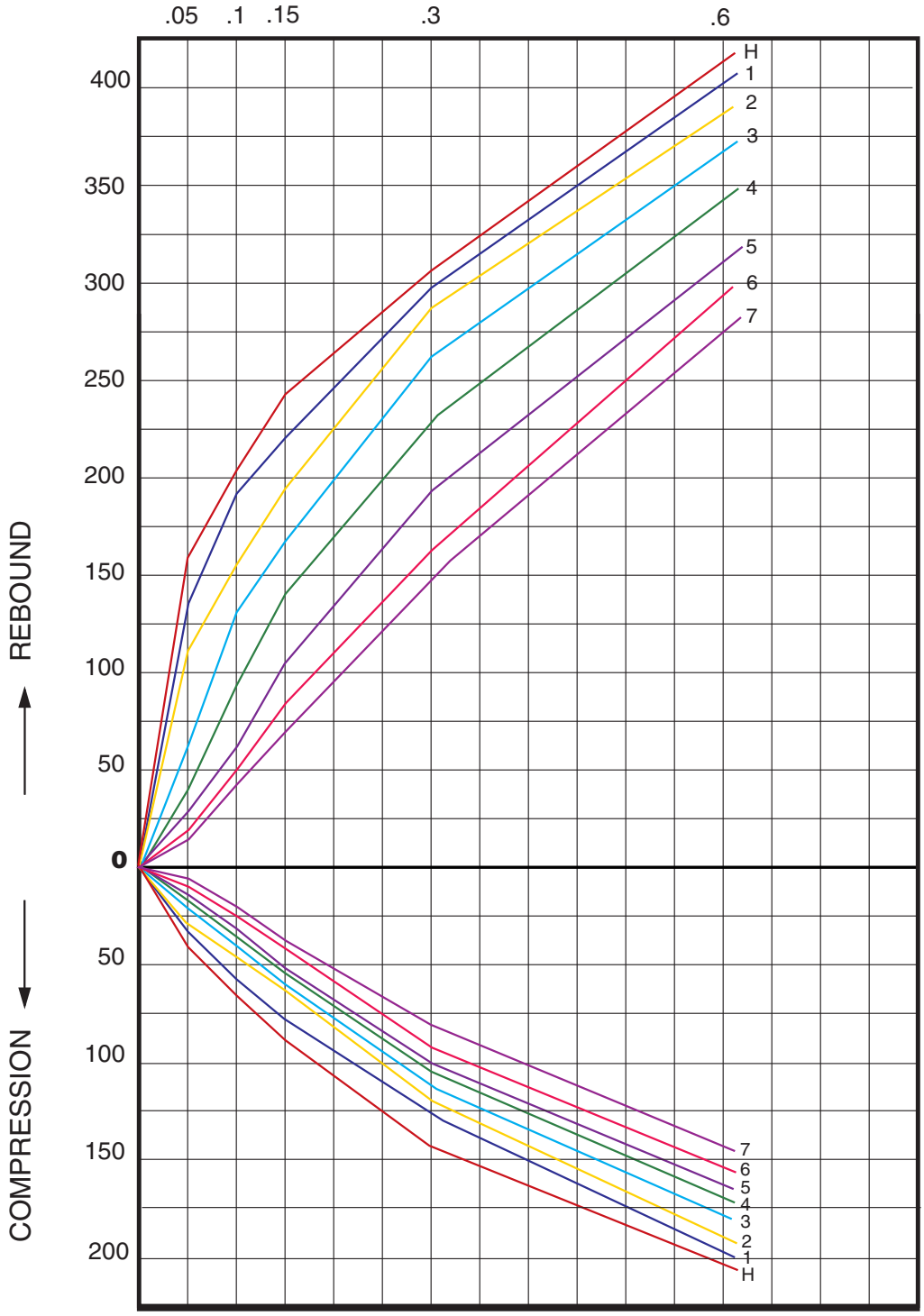
A good starting point for street use is 5 complete turns from full hard front and rear. Full soft is achieved at 7.5 turns from full hard. This setting may be slightly softer than the original equipment setting. If you are experiencing oversteer or understeer, adjust as necessary using the guidelines on page 10.

Tip extended too far.

CAUTION

Do not unscrew the adjuster screw too far. If you are uncertain about the current adjustment go back to full hard and start over.

For more information about the best adjustments for the D-Spec, refer to the sections on pages 10, 13 and 14.



CAUTION

Racing on the street is not only illegal, but it is also dangerous to both vehicle occupants and innocent bystanders. If you wish to drive in competition, there are a number of organizations set up to help you.

SCCA - Sports Car Club of America – Road Racing, Auto Cross, Drifting and Rally.

NHRA – National Hot Rod Association – Drag racing

IDRC – Import Drag Racing Association

NASCAR – Stock Car Racing

These are among a few national organizations.

There may also be local car groups in your area that can help.

These guidelines for using the D-spec in various kinds of racing are very general. Actual combinations of components will vary depending upon the level or class of racing being done, as well as the specific vehicle. Read rules books to find out about allowable changes. Then study some of the excellent books on race set-up or consult a race set-up specialist.

CAUTION

While the D-Spec is designed to be capable for a variety of motoring activities, the Limited Warranty does not cover racing activities. For more information, please refer to the limited warranty.

Road Racing & Auto Cross

Road racing and auto crossing rely on handling balance. Corner speeds are important, but getting back on the power as soon as possible is critical to fast laps. The best balance for a front-wheel-drive car will be rather different from a rear-wheel drive.

Front-drive tends to have a problem with understeer or push. Getting the car to turn-in well and getting on the power without too much understeer is important. Front-drive cars frequently need a lot of roll stiffness at the back so the car will rotate better in the turn. The increased stiffness can be gained with springs, bars and shock settings. Check the list on page 10 for reducing understeer.

Rear-drive cars must be able to turn in well, but they must also be able to exit the turn under power without too much power oversteer. How well a car enters a turn will depend on the specific car as well as the chassis set-up. Exiting a turn under power will depend upon chassis set-up as well as the amount of power available. Trying to decide on alignment, shock settings and tire pressures, can be helped by the guide on page 10.

Drifting

The sport of drifting has some similarities to road racing. One of them is rear-drive cars with a lot of power. But drifters need to carry a continuous drift, generating tire smoke. Avoiding too much rear traction is critical. Contact drifting groups for the best way to set up a car.

CAUTION

Drifting should be done only in sanctioned events.

Drag Racing

Once again, the best set-up will depend on the class being run and the car being used.

Front-drive cars need to reduce front to rear weight transfer as much as possible. Reducing front lift and rear squat requires a lot of front shock rebound, stiff rear springs and stiff shocks/struts. Full hard settings on the D-spec both front and rear. may be a good place to start.

Rear drive cars generally need front to rear weight transfer for maximum rear traction. Letting the nose come up easily can be accomplished by disconnecting the front sway bar, and setting the front D-spec shocks/struts at full soft (minimal rebound control). The rear shocks should be soft enough to maximize traction but not allow axle tramp. Full soft at both ends is probably a good starting point.

NOTES

NOTES