

Car Setup and Troubleshooting Guide

Taken from "Performance Handling" by Don Alexander

Effect of Suspension Changes

Before making changes to suspension components and settings, it is good to know how the changes will effect performance and ride. The following chart will help give you a general idea of the effect a specific change will make to handling and ride.

Spring Rate Changes

Modification

Increase front and rear rate

Increase front rate only

Increase rear rate only

Decrease front and rear rate

Decrease front rate only

Decrease rear rate only

Effect on Suspension

Ride harshness increases; tires may not follow bumps causing reduced traction. Roll resistance increases.

Front ride rate increases. Front roll resistance increases, increasing understeer or reducing oversteer.

Rear ride rate increases. Rear roll resistance increases, increasing oversteer or reducing understeer.

Ride harshness decreases; tires follow bumps more effectively, possibly improving traction. Roll resistance decreases.

Front ride rate decreases. Front roll resistance decreases, decreasing understeer or increasing oversteer.

Rear ride rate decreases. Rear roll resistance decreases, decreasing oversteer or increasing understeer.

Antiroll Bar Changes

Modification

Increase front rate

Increase rear rate

Decrease front rate

Decrease rear rate

Effect on Suspension

Front roll resistance increases, increasing understeer or decreasing oversteer. May also reduce camber change, allowing better tire contact patch compliance with the road surface, reducing understeer.

Rear roll resistance increases, increasing oversteer or decreasing understeer. On independent rear suspensions, may also reduce camber change, allowing better contact patch compliance with road surface, reducing oversteer.

Front roll resistance decreases, decreasing understeer or increasing oversteer. More body roll could reduce tire contact patch area, causing understeer.

Rear roll resistance decreases, decreasing oversteer or increasing understeer. On independent rear suspensions, more body roll could reduce tire contact patch area, causing oversteer.

Shock Absorber Changes

Modification

Increase rebound and bump rates

Increase rebound rates only

Increase bump rates only

Decrease rebound and bump rates

Decrease rebound rates only

Decrease bump rates only

Effect on Suspension

Ride harshness increases.

On bumps, tires may leave track surface.

Body roll resisted; outside tire loaded too quickly; car won't stabilize into a turn.

Ride harshness decreases; car may float over bumps.

On bumps, tires follow track surface more effectively; car may continue to oscillate after bumps.

Body rolls quickly; car is slower to respond to turn-in.

The Importance of Tire Temperatures

In the course of testing the handling of a car, use tire temperatures and driver feel to make adjustments. It is critical to monitor tire temperatures often. They offer valuable clues to the setup of the car. The areas of adjustment that tire temperatures are used for include: tire pressure, camber, body roll, shock settings, wheel width and transient handling response.

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Troubleshooting Tire Temperatures

<u>Reading</u>	<u>Handling problem</u>	<u>Reason</u>
Front tires too hot	Understeer	Front tire pressures too low.
Rear tires too hot	Oversteer	Rear tire pressures too low.
Inside edges too hot	Too much body roll	Too much negative camber or too much toe-out.
Outside edges too hot	Too much body roll	Too little negative camber, too little toe-out or too much toe-in or wheel width too narrow for tire width.
Center of tread too hot		Tire pressure too high.
Inside/outside edges of tread too hot		Tire pressure too low.
All tires too hot		Compound too soft for track and ambient temperature conditions.
All tires too cold		Compound too hard for track and ambient temperature conditions or car not being driven to limit.
Front tires too cold		Inadequate load on front tires.
Rear tires too cold		Inadequate load on rear tires.

Solving Handling Problems

The key to setting up your suspension is in diagnosing what the handling problems are and resolving how to fix them. While car enthusiasts often baulk at the "black art" of suspension tuning, there's no reason to. As with working on the mechanical aspects of an engine, the trick to suspension tuning is in the troubleshooting; there is always a cause and an effect.

<u>Problem</u>	<u>Manifestation</u>	<u>Solutions</u>
Steady state understeer	All turns or low-speed turns only	If front tire temps are optimum and rears are low, stiffen rear antiroll bar; if front temps are too hot, soften front (most likely). If front tire pressures are optimum, decrease rear tire pressure. Increase if chunking occurs. Improper front camber. Too much body roll at front, causing excessive camber change.
Steady state understeer	High-speed turns only	If front tire temps are OK, increase front downforce. If front tire temps are too hot, reduce rear downforce.
Steady state oversteer	All turns or low-speed turns only	If rear tire temps are optimum, with fronts too low, stiffen front antiroll bar; if rear temps are too hot, soften rear antiroll bar (most likely). If rear tire pressures are optimum, decrease front tire pressure. Increase if chunking occurs. Improper rear camber.
Steady state oversteer	High-speed turns only	If rear tire temps are OK, increase rear downforce. If rear tire temps are too hot, reduce front downforce.
Corner entry understeer		Front shocks are too soft in bump resistance. Too much front toe-in; use a small amount of front toe-out.
Corner exit understeer		Rear shocks are too soft in bump. Front shocks are too stiff in rebound.
Corner entry oversteer		Rear shocks are too soft in rebound. Rear ride height is too high (too much rake) compared to front.
Corner exit oversteer		Rear shocks are too soft in rebound. Too much rear toe-in or any rear toe-out.

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Straightline instability		Tire pressure is too low in one or more tires. Too little positive front caster. Too much front toe-in or any toe-out in rear.
Straightline speed too slow		Too much overall downforce. Too much toe-in or toe-out. Ride height is too high.
Excessive steering effort	All turns	Too much positive caster. Front tire pressures are too low.
Chassis or suspension bottoms		Spring rates are too soft. Shock absorber bump rates are too soft. Inadequate suspension travel. Inadequate ride height.