Chapter Two:
Glossary of Suspension Terms

Introduction

This glossary of terms is intended to provide a brief and accurate description of both conceptual and component terms used in design, manufacturing, and tuning of R.I.T. Baja SAE Suspension Systems. For quick referencing this chapter is divided into two sections.

The first section of the chapter focuses on theoretical concept definitions used in describing the analysis and design of off-road suspension system dynamics. The second segment contains component descriptions and visual references.

Figure 1: (2005-2006)SLA A- Arm Rear Suspension
Glossary of Suspension Theory Terms

Camber
A measurement of wheel angle relative to vertical as viewed from the front or rear of the car. In a double A-arm system, camber is dictated mainly by control arm geometry.

Positive Camber occurs when the top of the tire tips away from the chassis. Commonly, a system in droop will have positive camber.

Negative Camber occurs when the top of the tire tips towards the chassis. Commonly, a system in compression will have negative camber.

Figure 2: Positive Camber
Figure 3: Negative Camber

Toe
A measurement of wheel angle relative to the centerline of the car as viewed from top. Toe can be measured by comparing the vehicle centerline to front of tire distance with the vehicle centerline to rear of tire distance. In a double A-arm “steerable,” or front suspension system, this is controlled by tie-rod length in conjunction with the steering system.

Toe In occurs when the front of the tires “pinch” into the centerline of the car.

Toe Out occurs when the front of the tires point away from the centerline of the car.

Figure 4: Toe In
Figure 5: Toe Out
Caster

A measurement of angle relative to the vertical as viewed from the side, between the axis defined by the upper and lower rod ends. Caster effects the amount of camber change during steering, as well as steering effort. Positive Caster is achieved when the upper rod end is behind the lower, Negative Caster is the inverse of this.

![Figure 6: Positive Caster](image)

Longitudinal Wheel Recession Angle

An angle formed by the A-arm’s pivot line, commonly measured from horizontal. This angle causes the wheel to recede in both the vertical and rearward directions during compression, allowing the tire to encounter obstacles at a slower rate as well as providing some level of damping during longitudinal or frontal tire impacts.

![Figure 7: Longitudinal Wheel Recession Angle](image)
Bump Steer
The amount of toe angle gain or loss that occurs during compression and extension. While driving over obstacles and during body roll the tires will “steer” without direct driver actuation.

Figure 8: Bump Steering

Ackerman Steering Geometry
Steering geometry parameter which allows wheels to turn on different radii about a single point. The turn center is formed from the intersection of perpendicular axes from all wheels. The **Ackerman Angle** is defined as the difference between the inside and outside wheel turn (toe) angles. Ackerman Geometry will cause the inside wheel to turn tighter than the outside wheel. This was originally invented for horse drawn carriages so the wheels would not scrub at low speeds and disturb gravel driveways.

Figure 9: Ackerman Geometry and Turn Center
Kingpin Inclination Angle
Measured in the front view, the angle between the vertical and an axis defined by the upper and lower ball joints.

Figure 10: Kingpin Inclination Angle

Scrub Radius
The distance formed between the contact patch centerline and the king-pin at the ground— in the front view.

Figure 11: Scrub Radius
Spring Rate
A measure of the stiffness of a spring defined as the pounds force per inch of spring displacement.

Wheel Rate
Is the effective spring rate of the suspension when force is applied at the wheel. This parameter is calculated from the spring rate through geometry of the suspension out to the wheel.

Progressive Wheel Rate
The geometry of the suspension linking components, including the shock and springs, used to create an increasing wheel rate (stiffness) during compression.

Body Roll
The tilt of the body relative to the suspension. This is encountered during turning where centripetal force will cause the chassis to lean to the outside of the turn, causing the outside suspension to compress and the inside to extend.

Roll Rate
A measurement of the chassis’s stiffness during roll. Defined as foot pounds per

Contact Patch
The contact patch is the area of contact between the ground and the tire. This parameter changes with many factors including tire pressure and wheel loads.
Ride Height
The static default position of the suspension system. Also can be termed as the height at which the car sits with driver weight with no external forces.

Jounce Travel
Compression movement of suspension. Also can be termed as the amount of available suspension travel in compression from ride height.

Droop Travel
Extension travel of the suspension. Also can be termed as the amount of available suspension travel in extension from ride height.
Basic Glossary of Suspension Component Terms

Anti-Sway Bar
Also known as anti-roll bar; a torsion bar link between left and right wheels that transfers wheel load laterally from one side of the car to the other. The direction of travel is the same; if the left wheel moves in compression in relation to the right, the anti sway bar will cause the right wheel to compress as well. This component is used to increase the roll stiffness of a suspension set-up and control body roll.

Outboard Assembly
The outboard assembly is the loosely defined package of components that lie outside of the a-arms or other “linking” members. Usually including: suspension upright, steering arm, hub, brake mount and caliper assembly, rotor, and the wheel

Tie Rod
A 2 force member used to connect steering arms to the steering system, and is fitted with rod ends or ball joints to allow for turning and suspension motion. The length of the tie rod controls the amount of toe in a wheel.
Upright
Mounted vertically (upright) between the upper and lower control arm’s outer rod ends. The upright is the foundation of all outboard systems: the spindle and calipers are mounted directly to it.

Steering Arm
The steering arm provides the third point (defining a plane) for linking to and controlling the outboard assembly. It is the primary input of steering force to the upright and outboard assembly.

Spindle
The shaft extending from the upright about which the wheel and hub rotate.
Hub
The component that interfaces the rotating wheel and the stationary spindle. Wheel bearings are housed by this component.

Steering Rack
The assembly that controls the steering of the car by converting the rotational motion of the steering wheel into linear motion of the front tie-rods. It is titled for its rack and pinion gear design.