Suspension Worksheet

In order to determine a basic spring setup, two important inputs are required: **WHEEL RATE** and **SUSPENSION FREQUENCY**

WHEEL RATE is the actual rate of a spring acting at the tire contact patch. This value is measured in lbs./in., just as spring rate is determined by using the formula below. See Step 2.

SUSPENSION FREQUENCY refers to the number of ciliations or "cycles" of the suspension over a fixed time period when a load is applied to a vehicle. See step 3.

In order to determine **WHEEL RATE** and **SUSPENSION FREQUENCY**, you must first determine **MOTION RATIO**. A different formula is needed for the type of suspension your race vehicle utilizes, A-arm or Beam axle. See Step 1. Please take into consideration the **ANGLE CORRECTION FACTOR** (shown in step 1) in your computation.

Step 1: Motion Ratio

A-arm Suspension (See Diagram 1)

MR Motion Ration

d1 Distance from spring center line to control arm inner pivot center (in.)

d2 Distance from outer ball joint to control arm inner pivot center (in.)

$$MR = \left(\frac{d1}{d2}\right)^2$$

Beam Axle Suspension (See Diagram 2)

MR Motion Ration

d3 Distance between spring center lines (in.)

d2 Distance between tire center lines (in.)

$$MR = \frac{(d3)}{(d4)}$$

Angle Correction Factor

ACF Angle Correction Factor

A Spring angle from vertical (See Diagram 1)

C Spring Rate (lbs. /in.

$$ACF = (\text{Cosine}\angle\,(A)(C)$$

Step 2: Wheel Rate (Non-beam)

Wheel Rate

WR Wheel Rate (lbs./in.)

C Spring Rate (lbs./in.)

MR Motion Ration

ACF Angle Correction Factor

$$WR = \frac{(C)}{(MR)^2\,(ACF)}$$

Step 3: Suspension Frequency

Suspension Frequency

SF Suspension Frequency (cpm)

WR Wheel Rate (lbs./in.)

Sprung Weight Vehicle corner weight less unsprung weight

$$SF = (187.8)\left(\sqrt{\frac{WR}{\text{Sprung Weight}}}\right)$$

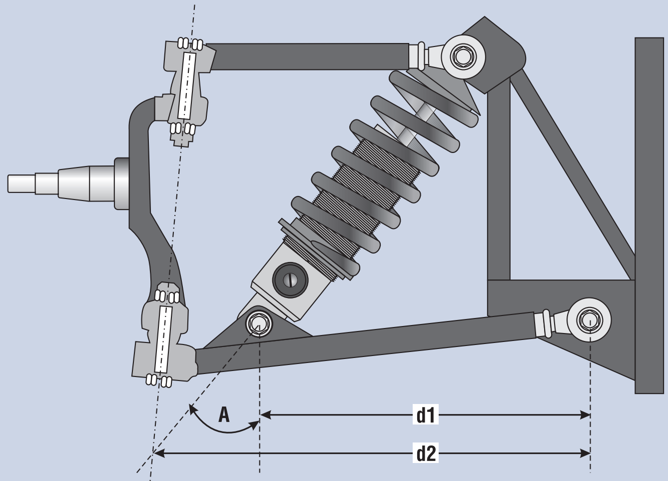

Diagram 1 (A-arm Suspension)
The motion Ratio is a lever arm effect of the control arm acting on the spring. If the spring is mounted at an angle, the reduced motion of the spring must also be taken into account.

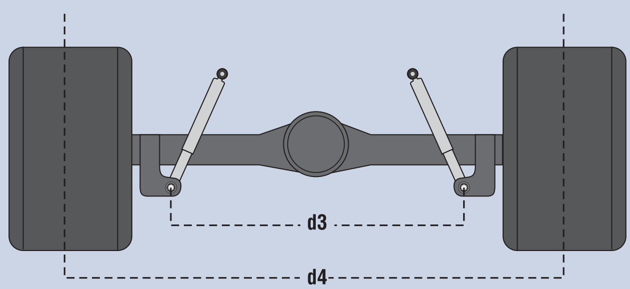

Diagram 2 (Beam Axle Suspension)
The motion Ratio of a live axle setup is shown here. Over two-wheel bumps, the motion ratio is 1:1. Over single-wheel bumps and during body roll, the motion ratio is as shown in Step 1. The motion ratio is only used for calculating roll resistance, not for suspension frequencies.

Tip 1: Calculation of Wheel Rate for a Given Frequency

WR Wheel Rate (lbs./in.) (See Step 2.)

SF Suspension Frequency (cpm) (See Step 3.)

Sprung Weight Vehicle corner weight less unsprung weight

$$WR = \left(\frac{SF}{187.8}\right)^2 \left(\text{Sprung Weight}\right)$$

Tip 2: Calculation of Spring Rate Needed for a Given Wheel Rate

C Spring Rate (lbs./in.)

WR Wheel Rate (lbs./in.)

MR Motion Ration

ACF Angle Correction Factor

$$C = \frac{WR}{(MR)(ACF)}$$