SUSPENSION WORKSHEET

STEP 1: MOTION RATIO

In developing a basic spring setup, your first step is determining your Motion Ratio. A different formula is needed for the type of suspension your race vehicle utilizes: A-arm or Beam axle. Please take into consideration the Angle Correction Factor in your computation.

A-ARM SUSPENSION - (SEE DIAGRAM 1)

MR Motion Ratio
d1 Distance from spring centerline to control arm inner pivot center (in) or (mm)
d2 Distance from outer ball joint to control arm inner pivot center (in) or (mm)

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

BEAM AXLE SUSPENSION – (SEE DIAGRAM 2)

MR Motion Ratio
d3 Distance between spring centerlines (in) or (mm)
d4 Distance between tire centerlines

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

ANGLE CORRECTION FACTOR

ACF Angle Correction Factor
A Spring angle from vertical (see diagram 1)

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

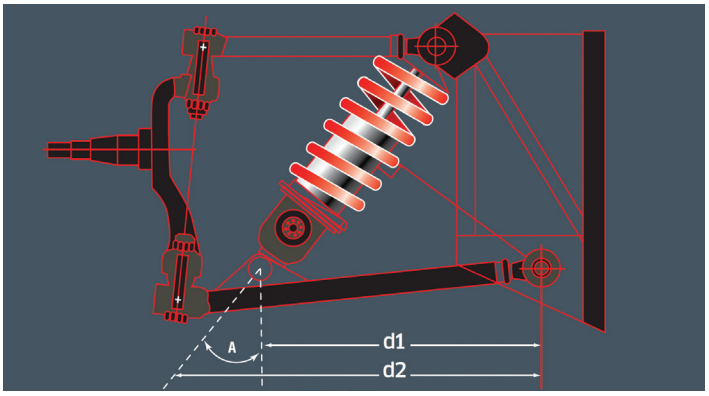

DIAGRAM 1 (A-ARM SUSPENSION)

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 in account.

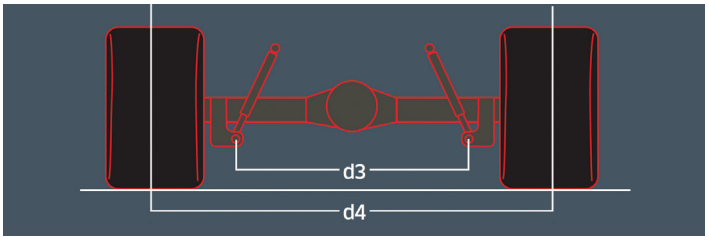

DIAGRAM 2 (BEAM AXLE SUSPENSION)

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 as shown in step 1. The motion ratio is only used for calculating roll resistance, not for suspension frequencies.

STEP 2: WHEEL RATE

Wheel Rate is the actual rate of a spring acting at the tire contact patch. This value is measured in lbs/inch or N/mm, just as spring rate is. The wheel rate can be determined by using the formula below.

WHEEL RATE (NON BEAM)

WR Wheel Rate (lbs/in) or (N/mm)
C Spring Rate (lbs/in) or (N/mm)
MR Motion Ratio
ACF Angle Correction Factor

$$WR = (MR)^2 (C) (ACF)$$

STEP 3: SUSPENSION FREQUENCY

Suspension Frequency refers to the number of oscillations or “cycles” of the suspension over a fixed time period when a load is applied to the vehicle.

SUSPENSION FREQUENCY (CPM)*

SF Suspension Frequency
WR Wheel Rate (lbs/in) or (N/mm)
Sprung Weight Vehicle corner weight less unsprung weight

$$SF = (187.8)\left(\sqrt{\frac{WR}{\text{sprung weight}}}\right)$$

*CPM= CYCLES PER MINUTE

SUSPENSION FREQUENCY IN HERTZ DIVIDE BY 60

$$\frac{SF}{60}$$

TIP 1: CALCULATION OF WHEEL RATE FOR A GIVEN FREQUENCY

WR Wheel Rate (lbs/in) or (N/mm) (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) or (N/mm)
WR Wheel Rate (lbs/in) or (N/mm) (see step 2)
MR Motion Ratio
ACF Angle Correction Factor

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