1/12th Scale Gear Ratios

A Definitive Guide for Drivers of All Levels

Background

1/12th scale cars are different to full sized racing cars in that they don't have gearboxes as part of their transmission. It's basically like having only 1 gear for the entire speed and rev range. Ordinarily this could pose a problem, but luckily the motors we use produce so much torque and power that it is quite easily manageable.

Most radio controlled model cars have a crown and pinion differential arrangement as well as a series of belts, pulleys and/or shafts to transmit power. These usually incorporate a ratio reduction which makes the calculation of the final drive ratio different to that of a 1/12th scale pan car. Since there is no reduction of this kind, a 1/12th scale car effectively has a final drive ratio of 1.

"1/12th scale is easier then" you might think? Sadly not! The fact that 1/12th scale tyres come in varying diameters means that another element enters the equation, and the following article aims to explain the effects of this and how we deal with it.

How to Calculate Rollout?

Since the gear ratio of the car is affected by several variables, we refer to the gear ratio in units of mm per rev (or mm/rev) – that is, the linear distance the car will travel for each revolution of the motor. This number is often referred to as the 'rollout'. A higher rollout will give more top speed, but acceleration will suffer, whilst a lower rollout improves acceleration to the detriment of top speed.

The equation for calculating the rollout is as follows;

$$R = (\pi D \div S) \times P$$

Where;
R = Rollout (mm/rev)
D = Rear Tyre Diameter (mm)
S = Spur Gear Size (teeth)
P = Pinion Gear Size (teeth)
π = pi (≈3.14)

The values can be substituted accordingly to re-arrange the equation. For example, if you had a desired rollout in mind and the spur size and tyre diameter are known, then you can calculate the required pinion gear size (note; this won't usually be returned as a whole number, so it is usual to round it to the nearest whole number).

A common sight on a 1/12th scale racer's pit bench!

Racer's Tip
You can use your iphone to help with gear ratio calculation; there is an application called 'GearIt' that can be used to calculate gear ratios and rollouts for any make/model/type of RC vehicle. Simply input the known elements of the equation to return the desired value. It costs less than a pound as is available from the AppStore – James Stewart

GearIt App for iPhone

What Affects the Rollout?

Looking at the equation above shows us that the rollout is affected by the tyre diameter and the spur and pinion sizes. For this reason it is important that you check your rollout whenever changing to a set of tyres that are a different size. A change in tyre diameter of less than 2mm can often be the equivalent of a tooth on the pinion gear, which is a significant change.

Where to Start in Selecting a Rollout

It is often difficult to know where to start with rollouts, as different motors and speedos all have different performance characteristics. Obviously the track makes a huge difference as well. Generally speaking you should aim to find a gear ratio which results in the car reaching top speed just before the end of the longest straight on the track; this is a good scenario to aim for. However, you should always judge changes by looking at the clock; gearing up or down from the above scenario will often yield faster lap times. So pay attention to the time sheets!

Some suggested starting rollouts for national sized tracks (≈28m x 14m track area)are given below (based on 2010/11 season tracks and electronics);

10.5 brushless motor with 1S li-po – 50mm/rev
4.0t brushless motor with 1S li-po – 35mm/rev

Summary

Gear ratios and rollouts are a common stumbling block for drivers new to 1/12th scale racing, so hopefully this article has made things a bit clearer.

As with anything, the best piece of advice is often to simply ask another driver for help. It is easy to get lost with modern day programmable speed controllers and brushless motors, so make use of any help that is available should you need it.