

Top Speed Calculation

Parameters and Definitions

Z = Redline (or other RPM to use)

T = Tire Width (mm)

A = Aspect Ratio

D = Rim Diameter (in)

R_T = Transmission Gear Ratio

R_F = Final Gear Ratio

Computation

1. Find the RPM of the drive axles. Let's call this variable "Y".

$$Y = \frac{Z \text{ engine revolutions}}{1 \text{ min}} \times \frac{1 \text{ driveshaft rev}}{R_T \text{ engine revs}} \times \frac{1 \text{ axle rev}}{R_F \text{ driveshaft revs}} = \frac{Z}{R_T R_F} \text{ axle RPM}$$

2. Find the angular velocity of the axles in radians/second units. Call this variable "ω".

$$\omega = \frac{\frac{Z}{R_T R_F} \text{ revolutions}}{1 \text{ min}} \times \frac{2\pi \text{ radians}}{1 \text{ revolution}} \times \frac{1 \text{ min}}{60 \text{ sec}} = \frac{\pi Z}{30 R_T R_F} \frac{\text{radians}}{\text{sec}}$$

3. Find the tire radius. Call this variable "R".

- a. Find the rim radius. Call this R_R.

$$R_R = \frac{1}{2} D \text{ in}$$

- b. Find the tire sidewall height. Call this "H". Remember that aspect ratio is simply the tire height divided by the tire width (multiplied by 100 to make it a percentage). Therefore, the tire sidewall height is the aspect ratio divided by 100 and then multiplied by the tire width. Make sure that you remember to convert the tire width from millimeters to inches.

$$H = \frac{A}{100} \times \left(T \text{ mm} \times \frac{1 \text{ cm}}{10 \text{ mm}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \right) = \frac{AT}{2540} \text{ in}$$

- c. Combine the radii in Part (a) and Part (b) above to get the total radius.

$$R = R_R + H = \left(\frac{1}{2} D + \frac{AT}{2540} \right) \text{ in}$$

4. Convert the angular velocity to linear velocity in mph units. Call this "v". Linear velocity is angular velocity multiplied by the radius of rotation.

$$v = \omega R = \frac{\pi Z}{30R_T R_F} \frac{\text{rad}}{\text{sec}} \times \left(\frac{1}{2} D + \frac{AT}{2540} \right) \text{in} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mile}}{5280 \text{ ft}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{1 \text{ hour}}{60 \text{ min}}$$

$$v = \frac{\pi Z}{1056R_T R_F} \times \left(D + \frac{AT}{1270} \right) \text{mph}$$

Sample Calculation

This example demonstrates how to find the top speed (assuming the speed limiter has been disabled) for a stock 1990 Nissan 240SX. The stock tires are 195/60R15. The gear ratio for fifth gear is 0.759:1, and the final gear ratio is 4.083:1. The redline is at about 6000 RPM. The numbers in the tire code (195/60R15) correspond to the following measurements:

[width in millimeters]/[aspect ratio][construction code][rim diameter] ↔ 195/60R15

Parameters

$$Z = 6000$$

$$T = 195$$

$$A = 60$$

$$D = 15$$

$$R_T = 0.759$$

$$R_F = 4.083$$

Calculation

$$v = \frac{\pi Z}{1056R_T R_F} \times \left(D + \frac{AT}{1270} \right) \text{mph} = \frac{\pi (6000)}{1056 (0.759) (4.083)} \times \left[15 + \frac{(60)(195)}{1270} \right]$$

$$v = 139 \text{ mph}$$