TOP SPEED CALCULATIONS
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Horsepower and torque are certainly key factors in determining your vehicles top speed but you must also consider other critical factors such as gear and final drive ratios, wheel and tire sizes and maximum safe RPM for your engine.

Intro

Most of the web top speed calculators use *engine* (maximum rev), *transmission* (gear ratios) and *tire* (sizes) data to calculate a so called "theoretical maximum speed". Understanding the way they do it it's pretty simple if we remember how a car puts it's engine's power to the ground and transforms it into motion.

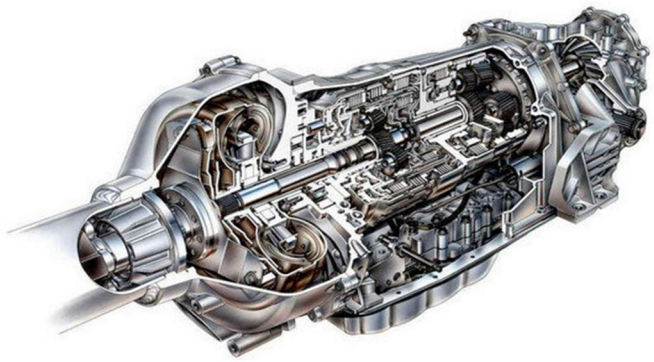
Engine maximum rpm

First of all there's the engines speed calculated as number of revolutions per minute (revs) that influence a car's top speed. Obviously the engine will give it's best on this matter at his maximum rev, so this value is the one to be used as engine influence over the top speed. Usually the maximum revs of an engine is where it gets to the so called "red line".

But not all of the engines have enough power to reach the red line in their highest gear and this fact divides cars in Rev-Limited and Drag-Limited. Those in the first category reach their top speed at maximum engine speed in top gear. Rev-limited cars have engines that don't generate enough power through the rpm range to overcome aerodynamic drag. (Please note that rev-limited cars are not the same with those equipped with a rev-limiter. The rev-limiter is a device found on most modern cars which cuts off fuel above the maximum engine speed). Drag-limited cars reach their top speed prior to maximum engine speed in top gear, when the engine reaches a point in it's rpm ranges where it cannot produce enough power to overcome aerodynamic drag. Determining the theoretical top speed of a drag-limited car using this type of a calculator is difficult, because the engine's maximum rev in top gear (our input data) is not the same with the redline on the rev meter.

Gear ratios

The engine's rev are propelled to the wheels via the transmission consisting generally from a gear-box and a differential. This devices get to modify the number of revs they receive from the engine using multiplication ratios. The gear-box has one ratio for each gear. We are mainly interested in the ratio for the top gear, on which cars usually reach their top speed (some cars with a 6-speed manual use their 6th gear for fuel economy on high speed cruising, so they may actually reach the top speed in their 5th gear – that because in the last gear they become drag-limited). Some calculators allow you to determine the top speed in each gear (in order to do that you in need to input all the transmission ratios your car's gear-box offers). The differential gets one final alteration of the revs received from the gear-box, therefore it's multiplication ratio is called the "final". The differential sends the revs to the wheels and those get to roll on the ground and finally transform engine power into motion. These transmission values are the most stabile in this equation, so generally just getting them from your car's manual should do, no need to wonder more about them. So, with the data collected at this point we know how many wheel revolutions per minute our car is able to offer at maximum engine speed.



Tire sizes

Now that we know how many time a traction wheel revolves in a minute at maximum speed, we need to determine what distance will the wheel cover in one roll. And that distance will be the tire's circumference. But, as we know circumference can be simply calculated using diameter, and a smart calculator will ask you to input a wheel diameter rather than a wheel circumference. Getting the tire's diameter is apparently simple, because it is clearly written on it. But the actual measurements vary depending on the manufacturer and type of tire. Your 225/85 tires could actually be 226.5/87.3 tires. Second of all, the diameter of your tires gradually diminishes as the tires wear. Sometimes tires can lose as much as 0.8 inches of their original diameter and still have some tread left. At 6000 rpm in fifth gear, a difference of 0.8 inches would equal almost 5 mph. Finally, the effective overall diameter of your tire will change under car weight and with temperature. The heat generated by high speed driving will have a marginal effect on tire diameter, but the car's weight pressing on it is really something to consider. Under vehicle weight, the tire is compressed where it meets the road, forming a contact patch. This compressed radius is the one that determines your final gear ratio. This Effective Rolling Radius will always be smaller than the overall radius.

Here's a simple way to measure the effective rolling radius. First of all make a mark on your tire's sidewall at the center of the contact patch and also mark the ground at this spot. Lightly move the car forward so that the tire makes one complete revolution and the mark on the sidewall is again at the center of the contact patch. Now make another mark on the ground at this point. Finally measure the distance between the two marks on the ground

in inches and divide that number by 3.14. That would be your Effective Tire Diameter. You don't need to worry about being accurate to the last 1/100th of an inch. Being within a quarter of an inch or so it's close enough.

But if you want to be really accurate for high speeds you should consider that at speeds over 150 mph, your tire pressure will increase by 7.5 psi. Which will make your tires "taller." So, if you want to account for this you should inflate your tires to 7-8 psi over their normal operating pressure before you measure them.

Theoretical top speed

All the above three steps completed you now possess your car's so called theoretical top speed, which neglects rolling resistance, wind drag and other variable in real world physics. To put it simple you will now know how fast your car can be in a vacuumed environment where there's no friction and where's nothing else, as a matter of fact, not even yourself. The relevancy of such information is therefore something each of us should consider on his own, but for a car fan it can be kind of fun.

Theoretical top speed neglects everything else about a car, but engine maximum speed, gear ratios and tire sizes. Therefore a Ferrari F430 and a custom Ford T Hot-Rod could have the same theoretical top speed. But on a less theoretical ground, with brick-like aerodynamics,

all of the Ford's body parts would have been ripped off long before reaching the F430's 198 mph top speed.

So, these kind of calculators are created to point maximum speed in an unnaturally simple environment. But this also makes them simple to use and user friendly. Imagine only that they would try to consider all the aspects involved by real life… How many of you know what is the coefficient of dynamic friction of your front wheel bearings, for instance? Also you shouldn't forget that even if you would possess such detailed information it would vary on temperature changes, humidity changes, air pressure changes and so on.

Here are links to a couple of calculators we liked most:
http://www.catherineandken.co.uk/sti/tyres.html
http://www.apexgarage.com/tech/gear_ratios.shtml

Some other calculators we have found determine top speed increment as a result of power increment. Unfortunately they are built for specific models, and therefore finding the one you need is not easy or in some cases not possible. Also their algorithm is questionable and based probably on owners experience on those vehicles.

CTS-V Gear Ratios:

Transmission	Manual	
	First Gear Ratio (:1)	2.66
	Second Gear Ratio (:1)	1.78
	Third Gear Ratio (:1)	1.30
	Fourth Gear Ratio (:1)	1.00
	Fifth Gear Ratio (:1)	0.80
	Sixth Gear Ratio (:1)	0.63
	Reverse Ratio (:1)	2.90
	Final Drive Axle Ratio (:1)	3.73

Transmission	Automatic	
	First Gear Ratio (:1)	4.02
	Second Gear Ratio (:1)	2.36
	Third Gear Ratio (:1)	1.53
	Fourth Gear Ratio (:1)	1.15
	Fifth Gear Ratio (:1)	0.85
	Sixth Gear Ratio (:1)	0.67
	Reverse Ratio (:1)	3.06
	Final Drive Axle Ratio (:1)	3.23

You should use the horsepower calculator to find out how much power a car would require at a given speed. If it doesn't make that much power, it can't go that speed no matter how it's geared.

CTS-V drag coefficient = 0.355 CTS-V frontal area (sq ft)=24.3

Top speeds are either gear limited or drag limited. Use the Gear Ratio Speed Calculator to determine which is the case for your particular scenario. To calculate tire diameter, consider that a car with 225/40R tires has a sidewall height of 3.54" (225 mm x 40/100 is 90 mm which is 3.54"). If it has 19" wheels then the tire diameter is roughly 26.08" (19 + 3.54 + 3.54).