

Top Speed

The top speed of a vehicle has almost nothing to do with the mass of the vehicle (apart from bearing friction and tyre losses which, in terms of power consumed at top speed, are minimal). The two major factors are power and aerodynamic drag. The equation to get a pretty good approximation of top speed of a vehicle is that relating power to drag:-

$$P = \frac{1}{2} \rho C_D A v^3$$

where P is the power in Watts, ρ is air density (1.3), C_D is the coefficient of drag, A is the frontal area in square metres, and v is the velocity in m/s. To see how well this works, let's take, for example, a modern Falcon XR6 and an old 4.1 Cortina.

The XR6 produces about 110kW at the wheels, has a C_D of 0.31, and a frontal area of about 2.4 square metres. In the case of the Cortina, the numbers are 60kW, 0.48 and 2.2.

To get top speed:

$$v = \sqrt[3]{\frac{2P}{\rho C_D A}}$$

For the XR6, this equates to 66.6m/s or 239km/h. The XR6 has been tested at over 230km/h, so this seems pretty reasonable. For the Cortina, the speed is 48.4m/s, or 174km/h, which is pretty lineball with the tests for the car. An interesting exercise would be to test the numbers for your own favorite car, remembering to use power at the driven wheels, not at the flywheel.

And again, note here that it is peak power, not peak torque, which is the important engine performance variable.

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