



Torque – Let’s Twist Again Like We Did Last Summer.....

While I was shopping around for my new SUV, I was especially interested in horsepower and vehicle weight but what about that other engine rating: torque? If you don’t understand it, I’ll give it a layman’s try here for ya’.

Torque and (horse)power are what engines produce when you turn the key and press the accelerator. Air and fuel ignited in the combustion chambers cause the crankshaft, transmission, and drive axles to “do the twist”, and no, not the Chubby Checker Twist. ☺ It’s a miracle of energy conversion: the energy in a gallon of gas efficiently changed to the energy needed for driving your car. Gotta’ hand it to those combustion engine inventors.

So what are the differences between horsepower and torque? Both play a role in performance but most of us don't really understand exactly how or why. Let's begin by explaining the technical difference between the two.

Horsepower is defined as “the amount of energy required to lift 550 pounds, one foot, in one second”, i.e., force, distance and time or the rating that describes how powerful an engine is (and yes, Mr. Watt really did use a horse ‘back in the day’ to figure this out). Distance and time are self-explanatory but force, specifically a “twisting force”, is what torque is all about. In fact, there’s not a single machine in existence that measures a car’s horsepower! It’s a man-made number. Horsepower is a product of torque and rpms’s. When a car’s performance is tested, its torque is measured using a dynamometer. Horsepower is an additional number that’s attained mathematically. For you physics-heads: $H = T \times \text{rpm} / 5252$, where H is horsepower, T is pound-feet, rpm (revolutions per minute) is how fast the engine is spinning and 5252 is a constant that makes the units jibe. To make more power an engine needs to generate more torque, operate at higher rpm, or both.

Torque is defined as “the moment of a force or system of forces tending to cause rotation or twisting” or how flexible or how much force can be expressed in a given gear. So simply, torque is nothing more than a measurement of twisting, or *rotational*, force. (For you Latin scholars, torque gets its name from the Latin word *torquere* meaning “to twist”.) When you turn the key, engine combustion forces a piston (or group of pistons) down in a straight line, which pushes on a connecting rod and turns the engine's crankshaft. It's this turning crankshaft where the twisting (rotational) force of torque initiates. From there the force is carried through a flywheel, transmission, driveshaft, axle(s) and wheel(s) before moving the car.

The measurement of torque is stated as “pound-feet” and represents how much twisting force is at work. You may have noticed, this measurement of torque does not include “time”. One-hundred pound-feet of torque is always 100 pound-feet torque whether it is applied for five seconds or five years. Horsepower and torque figures are usually expressed at a certain engine speed.

For example, on my 2006 MX5:

- Horsepower: 170 hp @ 6700 rpm
- Torque: 140 ft.-lbs. @ 5000 rpm

Higher torque numbers result in better acceleration for passing or getting the car under way and lower engine speed at a given load such as towing a trailer up-hill. One of the downsides of high torque is when there is limited traction. In snow, gravel, or wet pavements, high torque can make it easier to spin out. This could impact your ability to get moving from a stop to making the vehicle more prone to losing control when in motion. Additionally, how fast the car accelerates, its top speed, how fast it "feels", are all results of other components of the car such as transmission, suspension, programming, tuning etc.

To see how torque and horsepower interact, imagine an SUV at the base of a steep hill. The engine is idling and the gear lever is in the first gear or "D" position. As the driver begins to press on the throttle, the engine's rpm increases and force is transmitted from the crankshaft to each wheel, and the SUV begins to climb upward. The twisting force going to each wheel as the vehicle moves up the hill is "torque". This is because at low speeds the transmission's gears work to transmit maximum torque from the engine to the wheels. You want this because it takes more force, or torque, to move a vehicle that is at rest than it does to move a vehicle in motion. Conversely, once a vehicle is underway, you want less torque and more horsepower to maintain a high speed because horsepower is a measurement of work done and includes a time element such as wheel revolutions per minute necessary to maintain 75 mph. Okay, 65 mph. ☺

So, if you want a quick answer to the difference between horsepower and torque, just keep in mind that horsepower involves the amount of work done in a given time, while torque is simply a measurement of force and is thus a component of horsepower.

Here's a cool phrase I found about the relationship between horsepower and torque: "Horsepower is what you read about; torque is what you feel".

I hope you found the above interesting, fun, and informative. Zoom Zoom Safely!

Gail

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