Renewable Energy Terms

Horsepower—Rate of Energy Flow

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Derivation: Horse *is from Old English* hors *and Old High German* hros, *literally* a runner. Power *is from Vulgar Latin,* potere, *meaning* to be able.

With so many technical terms like joule, amp, and watt, it's a bit surprising to see "horsepower." Why do we still use a term like this when talking about a technical subject? Where did it come from? What does it mean?

Eighteenth century Scottish inventor James Watt came up with the term to quantify the power of his improved steam engine. He estimated that a strong pony, working for eight hours, averaged 22,000 foot-pounds per minute. Watt increased this figure by 50 percent (upgrading from pony to horse), and the accepted meaning of 1 horsepower (hp) became 33,000 foot-pounds per minute.

A foot-pound is the amount of work done when lifting one pound, one foot. So 33,000 foot-pounds per minute could mean that Watt's theoretical horse could lift 33,000 pounds to a distance of 1 foot—or 11,000 pounds to 3 feet, or 1,000 pounds to 33 feet, or 1 pound to 33,000 feet—in a minute.

"Power" is the rate work is done. "Horsepower" is a unit of power and also a rate—notice the "per minute" in the definition. In the United States, we generally talk about electrical power in terms of watts—another unit of power. Electric motors are rated in horsepower, and with internal combustion engines (ICE), we always use horsepower. In other parts of the world, watts are often used for both. As Scottish electrical nerd Hugh Piggott says, "A lot of people do not realize that mechanical power and electrical power are basically the same thing—the rate of energy flow from one place to another by different means."

It is possible to convert horsepower to watts. The theoretical definition of 1 horsepower is 746 watts. But it's not really that simple where the rubber meets the road. Manufacturers of engines and motors are often enthusiastic about rating their products. Solar pumping guru Windy Dankoff says that in practical terms, 1 horsepower in electric motors is equal to about 1,000 watts, once you factor in the losses.

When you're looking at a motor, it's not always clear what the manufacturer means by "horsepower." Some labels for horsepower—such as peak, developed, no load, brake, stall, or market rated—do not indicate the continuous duty output you'll get in real life.

Rated and measured amperage can help you get some sense of the horsepower. But different motor types have different levels of efficiency, so their current draws will vary somewhat. And each motor has different torque (turning force) and rpm characteristics, which can affect the delivered horsepower significantly. DC motors have a higher overload torque that doesn't fall off as much at lower rpm as in AC motors. So a 1 hp DC motor is not equal to a 1 hp AC motor.

Short of using a dynamometer (a device that measures horsepower), you have to rely on the best specs you can get from the manufacturer. Try to get "true horsepower" ratings so you can compare apples and apples. Industrial electric motors (as opposed to consumer goods) tend to use true horsepower ratings.

When it comes to internal combustion engines, you have to adjust your thinking again. Because of differences in rating methods, and differences in how engines and motors develop torque and horsepower, a typical 1 hp engine is not equal in output to a typical 1 hp electric motor. Generally, you can assume that a 1 hp electric motor will do the work of a 2 to 3 hp ICE.

How about coupling engines with alternators to make homebrew battery chargers? You have to deal with electric motor/alternator horsepower and ICE horsepower again. In *HP42,* page 28, Richard Perez recommends a 5 hp engine for a 1.6 KW car alternator (100 amps at 16 VDC) because a smaller engine may not be able to push the alternator to full output.

I wonder if James Watt would be surprised that his down-to-earth measure of work has lasted for more than 200 years. In our increasingly complicated and technical world, it's refreshing to have a measure grounded in traditional farm and transportation life. And it makes it easier to remember that "power" is the capacity to do work at a certain rate, whether it's a horse, an engine, or a motor that's working for you.

Access
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