



by Greg Hillary

Look at almost any conversion chart and you will find the following conversion.

$$1 \text{ hp} = 33,000 \frac{\text{ft} \cdot \text{lb}}{\text{min}}$$

But what does this have to do with pressure washers? Most people in the pressure washer industry are familiar with some of the following formulas to calculate horsepower.

$$\frac{\text{gpm} \times \text{psi}}{1714} = \text{Hydraulic Horsepower}$$

(Exact hp delivered by the water at the pump outlet.)

$$\frac{\text{gpm} \times \text{psi}}{1460} = \text{electric brake hp}$$

(Approximate hp required at pump shaft.)

$$\frac{\text{gpm} \times \text{psi}}{1460} \times \text{gasoline engine hp} = \frac{\text{gpm} \times \text{psi}}{960}$$

(Approximate engine hp rating required.)

Another term that is very familiar is the “cleaning unit” (CU). You can calculate how many cleaning units your pressure washer has by using the following formula.

$$\text{CU} = \text{gpm} \times \text{psi}$$

The cleaning unit and horsepower are related because they are both units of power. Knowing this and a couple of the unit conversions below, we can see where the number 1714 comes from.

$$\text{gpm} = \frac{\text{gal}}{\text{min}} \quad \text{gal} = 0.13368 \text{ ft}^3 \quad \text{psi} = \frac{\text{lb}}{\text{in}^2} \quad \text{in}^2 = 0.00694 \text{ ft}^2$$

Therefore, a Cleaning Unit equals:

$$\text{CU} = \text{gpm} \times \text{psi} = \frac{0.13368 \text{ ft}^3}{\text{min}} \times \frac{\text{lb}}{0.00694 \text{ ft}^2} = 19.26 \frac{\text{ft} \cdot \text{lb}}{\text{min}}$$

And:

$$1 \text{ hp} = 33,000 \frac{\text{ft} \cdot \text{lb}}{\text{min}}$$

Then:

$$1 \text{ Hydraulic Horsepower} = \frac{33,000}{19.26} = 1713.39 \approx 1714 \text{ CU (at pump outlet)}$$

Pressure washer pumps are typically considered about 85 percent efficient so:

$$1 \text{ Electric Brake hp (at pump drive shaft)} = 1714 \times 0.85 = 1457 \approx 1460 \text{ CU}$$

Gasoline engine horsepower is not rated the same as electric motor horsepower, and it has been found that for every one electric (pump shaft) horsepower required it takes approximately 1.5 gasoline horsepower rating to pull the same load. A gasoline horsepower rating is only about 67 percent of a hydraulic horsepower.

The appropriate multiplier for a particular engine may differ a bit from 1.5, depending upon whether the engine is a side-valve or overhead-valve type, as well as other engine design details. Additionally, the type of drive (direct, belt, or gear) may have a small effect. The CETA PC100 performance standard provides more details on that.

Greg Hillary is Engineering Manager at Mi-T-M Corp., a pressure washer manufacturer. *cr*