

## Horsepower

Here is a different kind of question. How much horsepower do I need to pull a trailer?

Sounds kind of complicated, but it's actually quite simple (if you have a friend that knows Physics that can explain it to you).

There are 2 formulas that need to be solved. The first is the horsepower needed to work against wind resistance, and the second is horsepower needed to climb a hill.

You will need to know two things for these formulas: the combined weight of your tow vehicle and trailer, and the overall "frontal area" that will create the wind resistance. The frontal areas that create wind resistance are the vertical surfaces such as the grill, windshield and the front of the trailer.

The combined weight of your tow vehicle and trailer is simple to figure out. Either take your tow vehicle and trailer to a weigh station or truck stop to have it weighed, or add the GVWR of the tow vehicle and the GVWR of the trailer together, to get the GCW. This last one will not give you an accurate weight, of course. But it will tell you what your maximum combined weight could be.

The frontal area of your tow vehicle and trailer may be a bit more difficult, but it only involves taking some measurements. Measure the following, and round up to the next 0.25 of a foot to make calculations easier:

Tow vehicle height (TVH)

Tow vehicle width (TVW)

Trailer height (TH)

Trailer width (TW)

Ground clearance (GC) (use whichever sits the lowest)

You really only need to measure whichever is the tallest (H) and the one that is the widest (W).

Frontal area (FA) =  $W \times (H - GC)$

Anything that moves, either by land, sea or air, has what is called a "drag coefficient". It has been determined (by scientists smarter than I am) what the DC is for different types of vehicles. They came up with a DC of 0.9 for a semi-tractor trailer rig. And since that is the closest thing they tested that matches the profile of most RV's going down the road, we'll use 0.9 in our formula.

Although there are other things that can factor into the DC, such as tow mirrors and the wind that is being deflected from the front of the tow vehicle to underneath it, or the air that comes back in between the tow vehicle and trailer to get pushed again, I am trying to keep it simple and won't bother with these factors.

Some shorthand for the formulas:

- HP = Total Horsepower
- HP1 = Horsepower needed for pulling on level ground
- HP2 = Horsepower needed for pulling uphill
- DC = Drag Coefficient
- FA = Frontal Area
- G = % of grade (when climbing a hill)
- WT = GCW as defined above
- S = Speed in miles (or kilometers) per hour

Okay, here are the formulas:

$$HP1 = (DC \times S \times S \times S \times FA) / 147,000$$

$$HP2 = (G \times S \times WT \times 88) / 33000$$

Example:

Lets say the trailer is the largest at 11' high and 8' wide, and the tow vehicle has a minumu ground clearance of 1'. The GCW is 15,000#

How much horsepower do I need to get up a 6% grade at 60 mph?

$$FA = 11 \times (8 - 1)$$
$$FA = 77 \text{ square feet.}$$

$$HP1 = (0.9 \times 60 \times 60 \times 60 \times 77) / 147,000$$
$$HP1 = 101.8$$

I need 101.8 horsepower to pull this trailer on level ground at 60 mph.

$$HP2 = 0.06 \times 60 \times 15000 \times 88) / 33000$$
$$HP2 = 144$$

I need an additional 144 horsepower to be able to pull it up the hill.

$$HP = 101.8 + 144 = 245.8$$

I'll need 245.8 horsepower to get that 15,000# rig up that 6% hill at 60 mph.

Now, what about torque, you say? Good question. Unfortunately, I don't have an answer for that one. But if you do, I'd love to hear about it. Send me an email, as

detailed and as clear as possible (remember, I'm not a scientist or mechanical engineer) and I'll get back to you.

Visit my web site at [www.geocities.com/dgrvweb](http://www.geocities.com/dgrvweb) for other topics on:

How much weight?

How to weigh?

How long?