

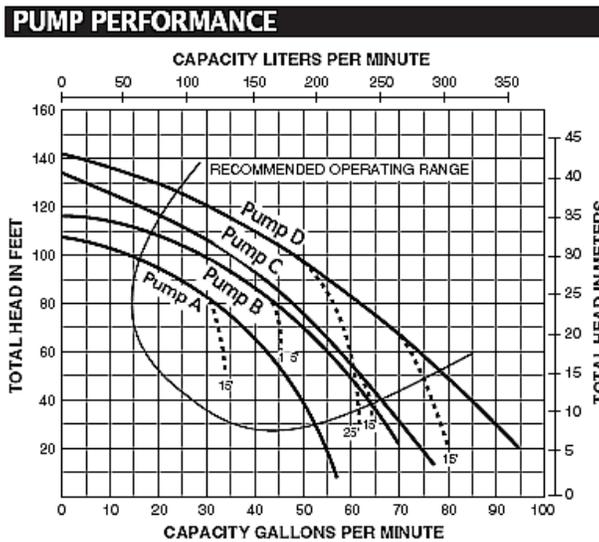
WHITE PAPER

Pipe Sizing 4: Understanding Performance Charts & Curves

Introduction

In looking for pumps, you may find performance given in a box chart, or a curve (graph). The Curve is on the bottom and the Box Chart is on the top. They say the same thing, but differently.

| PERFORMANCE (Capacity in Gallons Per Minute) | | | | | | | | | | | | | | | | | | | | |
|--|----------------------|-----|-----|-----|-----|--------|-----|-----|-----|-----|--------|-----|-----|-----|-----|--------|-----|-----|-----|-----|
| Disch. Press. PSI | Pump A | | | | | Pump B | | | | | Pump C | | | | | Pump D | | | | |
| | Distance Above Water | | | | | | | | | | | | | | | | | | | |
| | 5' | 10' | 15' | 20' | 25' | 5' | 10' | 15' | 20' | 25' | 5' | 10' | 15' | 20' | 25' | 5' | 10' | 15' | 20' | 25' |
| 10 | 53 | 52 | 50 | 48 | 46 | 67 | 66 | 64 | 61 | 59 | 70 | 69 | 67 | 64 | 62 | 90 | 88 | 86 | 82 | 80 |
| 20 | 45 | 42 | 39 | 37 | 35 | 59 | 56 | 54 | 50 | 47 | 61 | 59 | 56 | 53 | 50 | 79 | 76 | 72 | 70 | 65 |
| 30 | 35 | 31 | 27 | 24 | 18 | 48 | 44 | 40 | 37 | 32 | 50 | 48 | 44 | 41 | 37 | 66 | 62 | 57 | 55 | 50 |
| 40 | 17 | 10 | | | | 31 | 26 | 20 | 10 | | 36 | 33 | 25 | 23 | 19 | 50 | 45 | 42 | 37 | 32 |
| 50 | | | | | | | | | | | 16 | 9 | | | | 30 | 23 | 20 | | |



NOTE: Dotted lines indicate performance reduction at high suction lift.

Defining the Issue

Understanding how to use these performance charts and curves can help in selecting the proper pump for a given installation. This paper will describe the use of this information.

Solution

Note there are four different HP pumps in this series: 1, 1 ½, 2 and 2 ½. To understand what friction loss does on the suction side of the pump let's take a look at the 1HP box chart (Pump A). When looking at the chart on the left side there is a column titled PSI with ranges from 10-50 in 10 pound increments. It gives the four pumps and their HP across the top. Below them is "Distance Above Water".

Most people believe "Distance Above Water" means vertical feet, but it really means vertical feet and friction loss. Note each pump has 5 columns with lift numbers that read 5, 10, 15, 20 and 25. Those numbers represent vertical lift *plus* friction loss in the suction side piping.

Look at the flow rate of the 1HP pump (Pump A) at 30 PSI with 5' of lift: It says 35 GPM; and at 10' it says 31 GPM, and so on. We would be losing about 4 GPM for every 5' of lift because it would be that much more difficult for the pump to lift the weight of the water that far. To prove the point that the curve and box chart are saying the same thing, go down to the curve. Using the formula FoH = PSI x 2.31, 30 PSI is equal to (roughly) 70 Feet of Head. if we add the PSI to the lift we would get 75' of TDH (Total Dynamic Head.) Looking at 35GPM on the curve you will note that we are at about 75' TDH (note the red lines on the curve). Do the same for the other flow rates at 30PSI and you can begin to understand how the curve was made.

An Example

Using a pump to pull water from a lake in order to run a few sprinklers. The pump is sitting on a very short pier, 4' above the water. The 1 ¼" suction pipe is 10' long so it remains under water even if there are waves. The sprinklers need 20 GPM in order to spray properly.

Using the standard friction loss chart for 1 ¼" plastic pipe, we find the friction loss will be:
6 FoH per 100' of pipe X 10'/100' pipe = .6 FoH This is fairly negligible

Another Example – A Draught

There was a draught where the lake dropped by 6' making the vertical lift 10' but to get far enough out in the water we had to add 90' of pipe.

Now our friction head gives us this math:

6 FoH / 100' of pipe X 1 (we now have 100' of pipe) = 6 FoH due to friction. Add that to the real lift of 10' and we have a total Suction Lift of 16' FoH. The pump feels like it's pulling water from 16' down. Because of this, the pump's performance drops off a bit.

But, as mentioned in the White paper titled "Pump Sizing 3: Suction Side", if we increase the suction side pipe by 2 pipe sizes we bring our friction loss down by 5' giving us the ability to lift 4 more gallons and making the pump work much easier. On the box chart above this is very easy to see.



One Last Note on the Pump Curve

There is one more curved line on the pump curve that has not been addressed. That is the curve indicating the 'Recommended Operating Range' for this particular group of pumps. The pump will perform much better if you choose operating conditions that are inside that curve.

Continuing to look at "Pump A" we see that if we ask this pump to perform at flow rates below about 16 GPM, or rates above about 52 GPM it will be performing outside of its best efficiency. On the left side of the curve it can mean that the pump is too big for the job. The pump is building a lot of pressure, and we are probably going to waste electricity running this one. On the right side of the curve it means we are approaching full flow. The chance of cavitation occurring inside the pump is increased if we run the pump in this area.