

# FRANKLIN AID



Franklin Electric



Franklin Application/Installation Data (AID) ... For The Professional Driller-Installer

Vol. 25, No. 4, July/August 2008

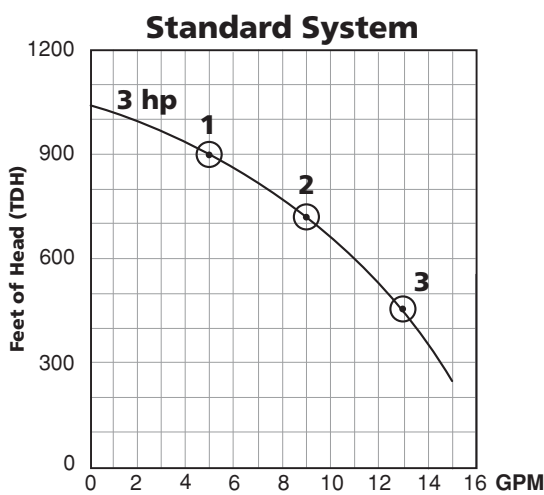
## Pump Curves, VFDs and Pressure Reducing Valves

Understanding pump curves is critical to any submersible application, whether it is controlled by a standard pressure switch, a variable frequency drive (VFD), or a pressure reducing valve (PRV). In addition to helping you produce the right amount of water, avoid conditions that may be harmful to the pump (e.g. upthrust), and maximize efficiency, understanding pump curves can help you actually visualize and understand the differences between standard systems, VFD systems, and PRV systems. This issue of Franklin AID will walk you through the steps you need to do that.

### Background

As you know, pumps come in a variety of sizes, and the characteristics of their associated curves vary accordingly. In general, all pump curves describe the combination of flow and pressure a pump can produce. For example, in Figure 1, a 3 hp, 10 gpm pump generates 5 gpm and 900 feet of total dynamic head (TDH) at point 1. At point 2, it generates 9 gpm and 720 feet of TDH. At point 3, it generates 13 gpm and 460 feet of TDH, and so on.

In reading pump curves, there are some important caveats to remember. First, a pump will always operate somewhere along its pump curve, but never above or below it (that is, never off the line). Second, pump curves generally describe the performance of the pump at a single speed, normally 3450 rpm for two-pole motors.

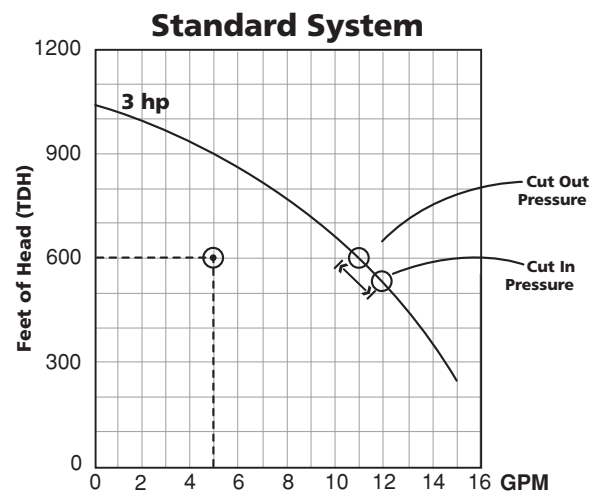


(Figure 1)

Now imagine an application that requires a 10 gpm, 3 hp pump whose pump curve is shown below in Figure 2. Irrigation is part of this installation, and during irrigation, a long running delivery of 5 gpm is needed. We have 485 feet of lift and friction losses, plus a delivery pressure of 50 psi, for a total dynamic head of 600 feet: 485 feet + (50 psi x 2.31) = 600 feet.

Using a conventional system and a 30/50 psi pressure switch, the pump will cut in at the point shown on the pump curve below. That is, the pump will cut in at 550 feet: 485 feet + (2.31 x 30 psi) = 550 feet. As a result, the system will build pressure until it reaches the cut-out pressure of 50 psi. This point is shown as the cut-out pressure on the curve below. At this point, the pump will shut off, and the cycle will start over again when the delivery pressure drops to 30 psi.

What is interesting to note is that in order to achieve the desired delivery pressure, the system must produce more flow than needed. In this case, the pump turns on at 12 gpm, 7 more gpm than the 5 gpm the system actually needs.



(Figure 2)

Because a standard pumping system delivers more water than necessary, 7 gpm more in this case, it frequently cycles on and off. As an alternative, variable frequency drives and pressure reducing valves can eliminate the cycling and maintain a constant pressure of 50 psi at 5 gpm. Here's how they work.

## Franklin launches new website

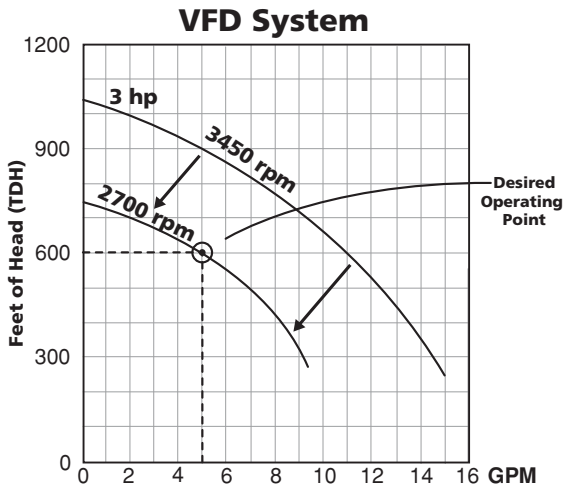
Franklin Electric recently launched a redesigned website at [www.franklin-electric.com](http://www.franklin-electric.com). Information specific to water systems can be directly accessed at [water.franklin-electric.com](http://water.franklin-electric.com). In addition to its new look and feel, the site includes a more in-depth model search and a one-stop repository called the Information Library for brochures, technical manuals, and other downloads.

Check it out and let us know what you think!



**Variable Frequency Drives (VFDs)**

A variable frequency drive, such as Franklin Electric's SubDrive controller, maintains constant pressure by altering the motor and pump speed as water demand changes. Instead of operating along a single curve, a pump on a VFD operates on an infinite number of curves that exist between its minimum and maximum speeds—30 and 80 Hz, in the case of a SubDrive controller. Essentially, every time the pump speed changes, the pump finds its operating point on a different curve within its range of performance. Figure 3 illustrates how a VFD would work in the same application as above. Instead of cycling like a conventional system, the VFD would operate the pump continuously around 2700 RPM, thereby providing a constant delivery pressure of 50 psi (600 feet TDH) at a steady flow of 5 gpm.

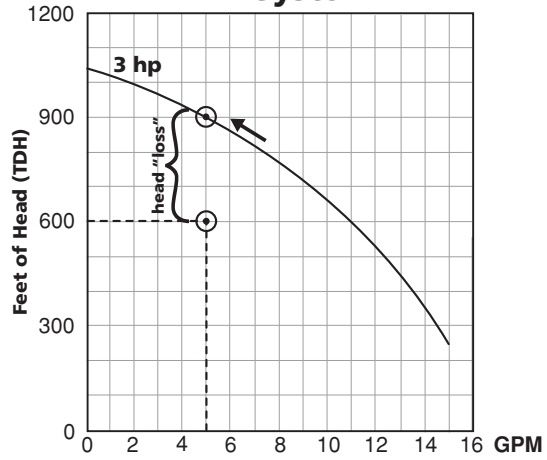


(Figure 3)

**Pressure Reducing Valves (PRVs)**

Pressure reducing valves offer another option to maintain constant system pressure and eliminate cycling. Like a conventional system, a PRV operates the motor and pump at single speed of 3450 rpm, but it mechanically restricts the amount of water and pressure that can pass a given point. Using the same example, although we only need to generate a steady flow of 5 gpm at 600 feet of TDH, the pump generates over 11 gpm at that same point on the curve. To get to 5 gpm, we must move to a different point along the same pump curve. With a PRV, we accomplish this by restricting the flow and forcing the pump to operate at 900 feet of TDH so the system can operate at 5 gpm without cycling. Refer to Figure 4.

**PRV System**



(Figure 4)

It is important to understand that even though only 600 feet of TDH is needed, the PRV creates a restriction to force the pump to operate at 900 feet of TDH in order to achieve a steady flow of 5 gpm. The difference between these two points (600 and 900 TDH) is how much head we throw away in this application. In this example, we waste 300 feet of head, or the equivalent of 130 psi.

PRV restrictions have significant implications for power consumption and motor cooling in the pump unit. That is, the more TDH is thrown away (i.e. the larger the system restriction), the more power is consumed. In addition, the more flow is restricted, the less cooling flow there is past the motor, which requires a minimum amount for proper operation. Finally, in cases where a PRV almost totally restricts flow (flow approaches 0), the motor may operate in a near deadhead condition.

**Summary**

Using a pump curve to perfectly match a pump and motor to your system requirements allows you to realize better efficiency, less wear and tear, and longer pump and motor life. Although there are several types of systems that will deliver the water you need, pump curves can help you understand the advantages and limitations of each. When you have all options available to you, it is easy to see that a VFD offers the most efficient way to match performance with demand. Contact the Hotline at 800.348.2420 if you have any questions.

**TOLL-FREE HELP FROM A FRIEND**

Contact Franklin's toll-free SERVICE HOTLINE for answers to your questions on submersible installations. When you call, a Franklin expert will offer assistance in troubleshooting submersible systems and provide answers to your water systems questions.

Franklin Electric SERVICE HOTLINE 800-348-2420 FAX 260-827-5102  
www.franklin-electric.com



**Franklin Electric**  
QUALITY IN THE WELL

PRESORT STANDARD  
 US POSTAGE PAID  
 FORT WAYNE, IN  
 PERMIT #1039

