Pump ED 101

Parallel Pump Analysis

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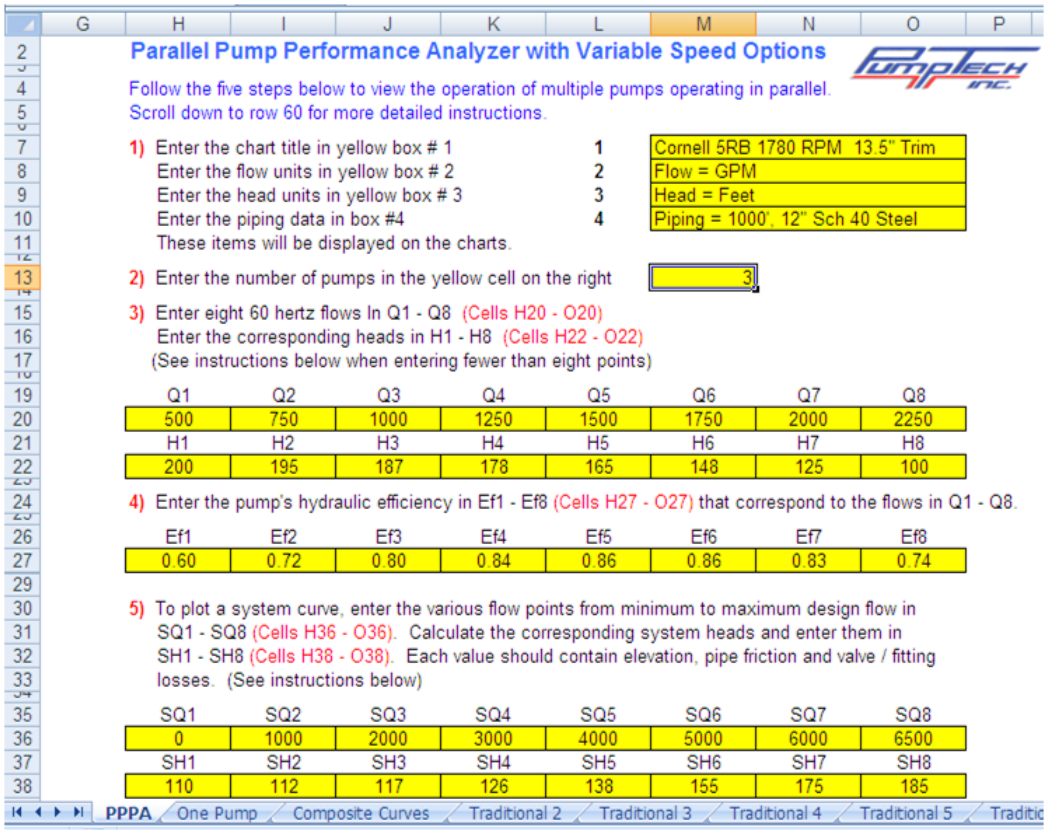
In my opinion, the system curve is the single most important component of the pump selection process. After all, it is the system curve that determines the operating point on a pump's performance curve. Other things such as materials of construction and special features can be reviewed after the hydraulic selection. That said, the system curve is even more important when an application requires multiple pumps operating in parallel.

When you think about it, multiple pumps present a challenge to the system designer. If a system is designed for three pumps to operate at BEP when running in parallel, chances are that one or two pump operation will result in an operating point well to the right of BEP. If a three pump system is designed for two pumps to run at BEP, the third pump will likely push all three to the left of BEP. As the number of pumps increases, it becomes even more difficult. A good example is the wastewater force main. Seldom does any combination run at BEP. Fortunately a combination of variable speed and across the line control can keep multiple clear water pumps at or very near BEP. Unfortunately this technique can be problematic with wastewater pumps since lower inlet velocities can lead to ragging at the vane entries.



Parallel Pump Performance Analyzer with Variable Speed Options

Follow the five steps below to view the operation of multiple pumps operating in parallel.
Scroll down to row 60 for more detailed instructions.

1) Enter the chart title in yellow box # 1 — 1 — Cornell 5RB 1780 RPM 13.5" Trim
Enter the flow units in yellow box # 2 — 2 — Flow = GPM
Enter the head units in yellow box # 3 — 3 — Head = Feet
Enter the piping data in box #4 — 4 — Piping = 1000', 12" Sch 40 Steel
These items will be displayed on the charts.

2) Enter the number of pumps in the yellow cell on the right: 3

3) Enter eight 60 hertz flows In Q1 - Q8 (Cells H20 - O20)
Enter the corresponding heads in H1 - H8 (Cells H22 - O22)
(See instructions below when entering fewer than eight points)

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
500	750	1000	1250	1500	1750	2000	2250
H1	H2	H3	H4	H5	H6	H7	H8
200	195	187	178	165	148	125	100

4) Enter the pump's hydraulic efficiency in Ef1 - Ef8 (Cells H27 - O27) that correspond to the flows in Q1 - Q8.

Ef1	Ef2	Ef3	Ef4	Ef5	Ef6	Ef7	Ef8
0.60	0.72	0.80	0.84	0.86	0.86	0.83	0.74

5) To plot a system curve, enter the various flow points from minimum to maximum design flow in SQ1 - SQ8 (Cells H36 - O36). Calculate the corresponding system heads and enter them in SH1 - SH8 (Cells H38 - O38). Each value should contain elevation, pipe friction and valve / fitting losses. (See instructions below)

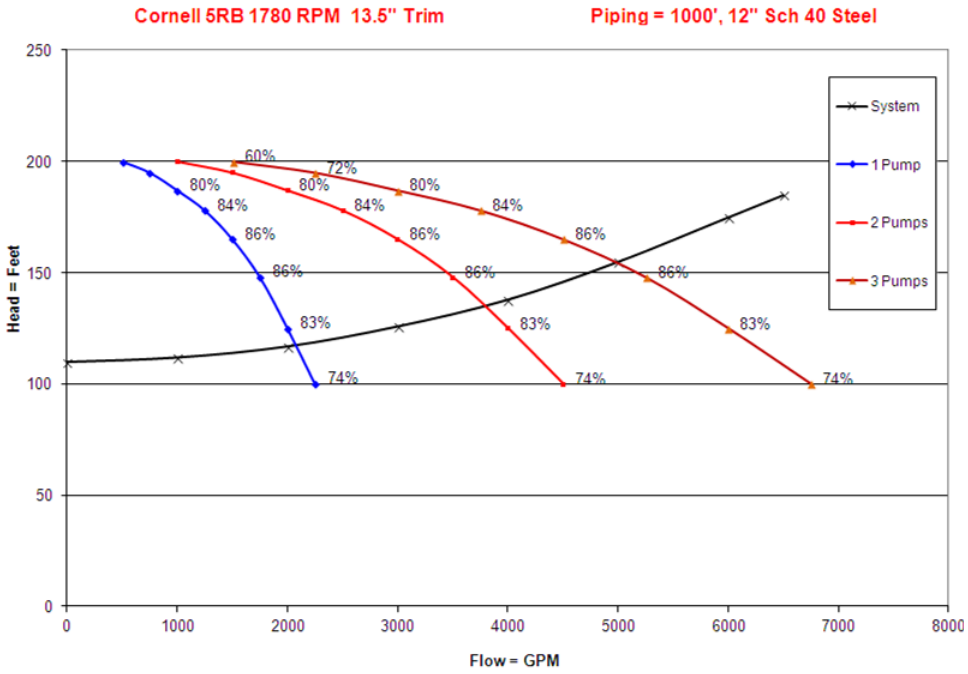
SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8
0	1000	2000	3000	4000	5000	6000	6500
SH1	SH2	SH3	SH4	SH5	SH6	SH7	SH8
110	112	117	126	138	155	175	185

PPPA | One Pump | Composite Curves | Traditional 2 | Traditional 3 | Traditional 4 | Traditional 5 | Traditic

My Parallel Pump Performance Analyzer is designed to evaluate both across the line and variable frequency operation. It allows

you to select a pump that will operate at BEP when several are running and view their operating points when all or fewer are running. It also shows the effect of VFD operation of single and multiple pumps. It is designed for use with up to eight identical pumps.

Figure 1 is a screen shot of the data entry tab. The data required include the number of pumps that will be operating in parallel; the flow, head and hydraulic efficiency points for a single pump and the flows and heads necessary to generate a system curve. In the example the system curve is designed for maximum flow and a maximum of three pumps were selected to run in parallel. The various tabs at the bottom of Figure 1 plot pump performance for various pump combinations in across the line and variable speed operation.



The "Traditional" tabs show across the line, parallel operation for two to eight pumps. Figure 2 is the Traditional 3 tab. It shows a three pump parallel flow of 5000 GPM at a hydraulic efficiency of 86%. Two pumps can produce about 3750 GPM at 84% efficiency and a single pump produces 2000 GPM at about 78% efficiency. Based on this operating point, it would be advisable to get the manufacturer's approval if a single pump will be running across the line for extended periods of time.

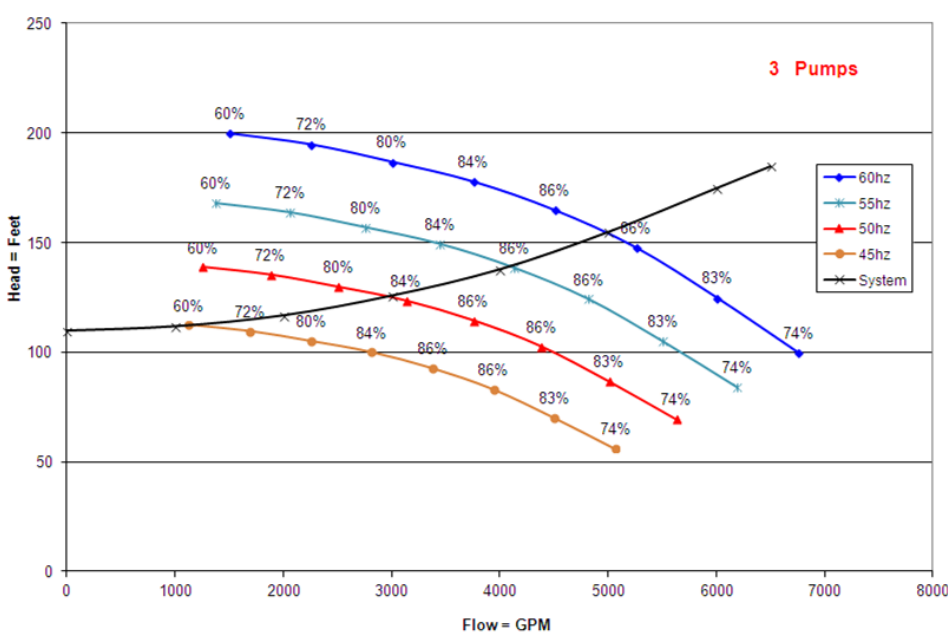
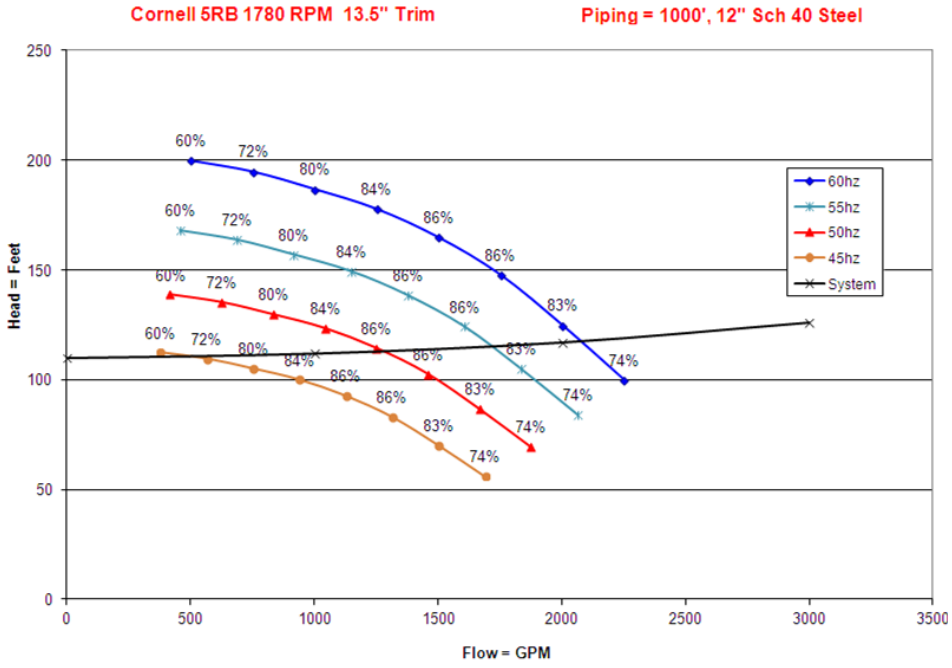


Figure 3 is the plot from the "Composite Curves" tab. It shows the variable frequency curves for the number of pumps entered on Line 2 of Figure 1 and assumes synchronous control. Under variable speed control, the three pumps can provide flows down to 4000 GPM while remaining at BEP efficiency. They can maintain 84% efficiency at flows as low as 3100 GPM. If the number of pumps entered in line 2 of Figure 1 is changed to two, the Composite Curves tab will show the variable frequency curves for two pumps. Although these curves are not shown, two pumps can maintain 86% efficiency from 2600 – 3200 GPM and can maintain 84% efficiency down to 2000 GPM.

Figure 4 is the plot from the "One Pump" tab. When operated across the line, this pump operates well to the right of its H/Q curve. Under VFD control it will operate at BEP from 1250 GPM to 1550 GPM.



The Parallel Pump Performance Analyzer can provide you with the information necessary to properly select and operate multiple parallel pumps. It is available on the "Pump Evaluation, Selection & Testing Tools" page at www.PumpEd101.com.

Joe Evans is responsible for customer and employee education at PumpTech Inc, a pump & packaged systems manufacturer & distributor with branches throughout the Pacific Northwest. He can be reached via his website www.PumpEd101.com. If there are topics that you would like to see discussed in future columns, drop him an email.