

## Multiple Pump Operation by Ross Mackay

One of the challenges that face pump users quite frequently, comes into play when more than one pump is required to operate at the same time on the same system. With such multiple pump systems, there are two arrangements where the operating characteristics of the different pumps can be considered to provide a single combined performance curve.

One arrangement is a Series Operation, where one pump discharges directly into the suction of the second pump, with both pumps delivering the same flow rate, but sharing in the development of the combined pressure.

Another arrangement is the Parallel Operation where each of the two (or more) pumps takes its suction from a common header, and discharges into another common header, thus sharing the flow while operating at the same head.

### Series Operation

This arrangement is frequently used where a larger pump cannot operate with the NPSH being made available from the system. A smaller pump is therefore installed upstream of the larger one to boost the Suction Pressure to the larger pump.

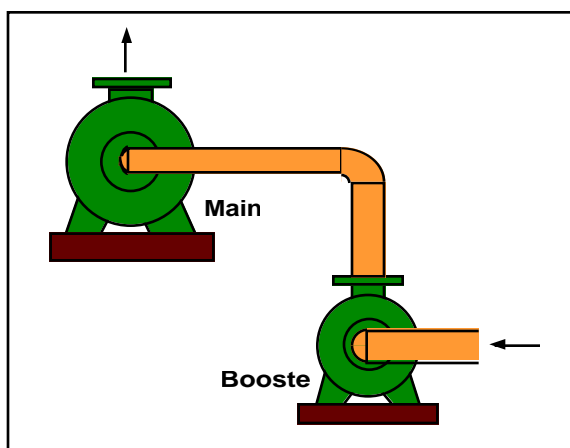


Figure 1

It should be noted that in the Series Operation, the only essential similarity between the two pumps is that they must both be able to operate at the same flow rate. The pumps can deliver totally different levels of Head as long as they operate at the same capacity.

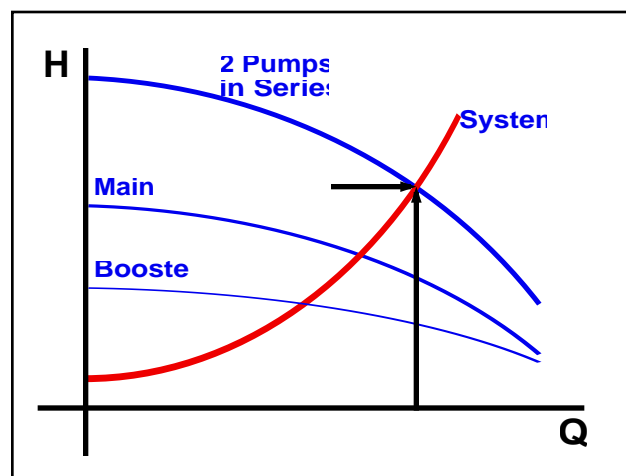


Figure 2

The ultimate example of Series Operation is the multistage pump where the first impeller pumps into the second and then the third, etcetera. This results in a high pressure pump with all the impellers operating at the same capacity.

Let's Get Practical. In some pumping arrangements we can have multiple pumps that operate on two systems that are closely combined, but are not in a true Series Operation and cannot be considered as such. One such example would be when one pump is supplying the flow and pressure for one system, while the second pump is bleeding off the first system to deliver a lesser flow to another system. While one pump is indeed discharging into the suction of the second pump, it is doing so at a different flow rate. Consequently, they cannot be treated as though they were operating in series.

## Parallel Operation

In the more common Parallel Operation, banks of pump are combined in order to handle a high fluctuation of flows in a common system. This arrangement is widely used in the Water Treatment business, where the potable water being supplied to a sub-division from the treatment plant, will experience huge fluctuations in demand from one time of day to another. The use of multiple pumps on the same system allows the pumps to be switched on and off as required to meet the varying demand.

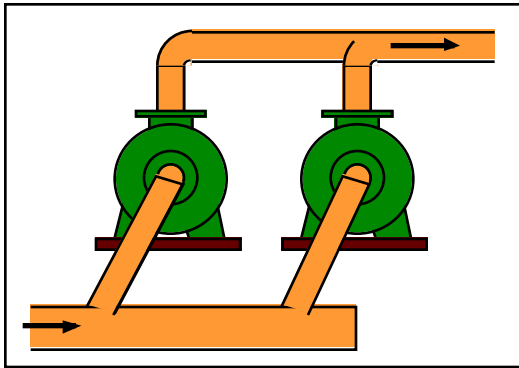


Figure 3

In such arrangements, all the pumps take their suction from a common source and discharge into a common header. Each pump will operate at the same Head, but share the Flow Rate with the other pumps.

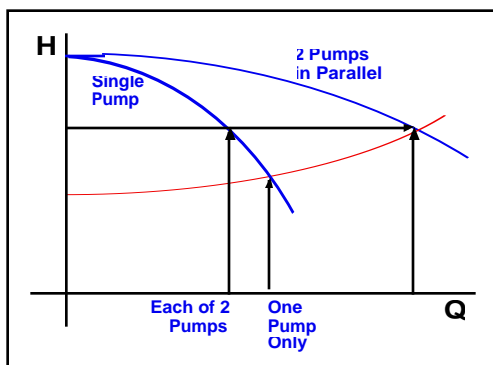


Figure 4

Because of the slope of the System Curve, the pumps in this arrangement will each operate at a lower Flow Rate when operating together, than they would if they operate alone on the same system. This is particularly relevant on multi-pump arrangements and requires careful selection to ensure the most efficient and stable operation.

## Too Many Pumps in Parallel

These systems are also susceptible to the danger of putting too many pumps in parallel on the same system; particularly if they exceed the number of pumps for which the system was originally designed. As each pump operates at a lower Flow Rate when operating together, than they would if they operate alone on the same system, a steady increase in numbers of pumps will reduce the flow rate through each pump. This could result in the final pump adding only a fraction of its capability to the system output as is indicated in Figure 5

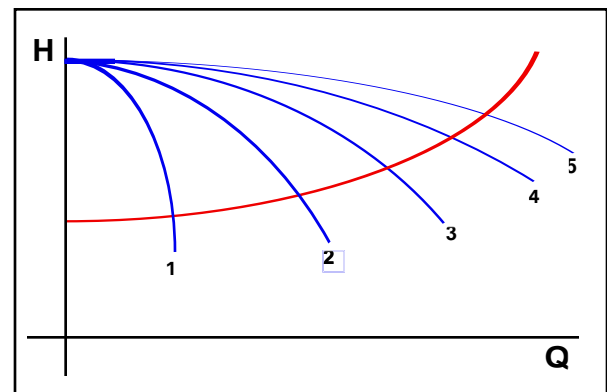


Figure 5

## Variable Speed Difficulties

Another practical problem with two pumps in parallel can occur when one of the pumps has a variable speed driver. This arrangement is also frequently used to fluctuate the total output of both pumps.

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Under the condition when one pump is slowed to a speed lower than the other, the combination of head and capacity of both pumps will involve the slower pump only after the shut-off head of that pump is reached. At that point only, the capacity from the slower pump will be added to the capacity of the faster pump to provide a combined output.

A similar situation can occur if two pump styles with different performance curves are installed and operated in a parallel arrangement.

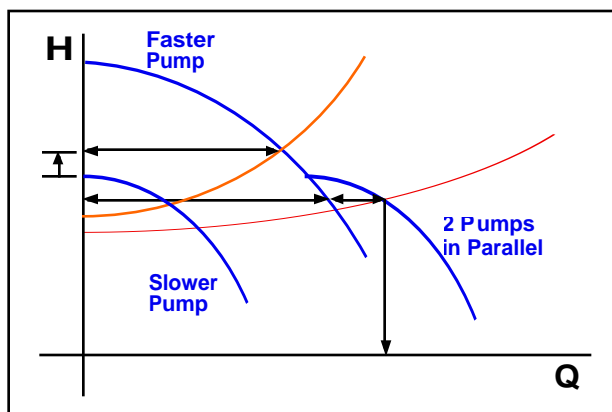


Figure 6

However, if the system curve moves to a steeper slope, where it cuts the “combined” curve at a head which is higher than the shut-off head of the slower pump, then that slower pump will not be contributing any flow to the system. At that point it becomes essential that the slower pump has a non-return check valve on its discharge, or the faster pump will be reversing the flow backwards from the discharge header into the discharge nozzle of the slower pump. This can impose a significant reverse torque on the impeller of the slower pump with severe results.

### Piping Arrangements

Multiple pump arrangements provide a great temptation for the system designers to ignore the rules of piping..... and with serious results.

Poor piping arrangements are almost normal in packaged systems where multiple pumps are used.

It is essential that proper piping practices are maintained for each pump in the arrangement, such as:

- no elbows on the suction nozzle of the pump
- zero pipe strain on the pump.
- a straight run of 5 to 10 times the pipe diameter to the suction nozzle
- both sets of piping to be, at least, one size larger than the pump nozzle
- use of an eccentric reducer on the suction side, with the flat side up

With multiple pump arrangements it is essential that both the hydraulic and mechanical aspects of system design be considered in order to ensure a high degree of reliability.

*Ross Mackay specializes in helping companies reduce pump operating and maintenance costs through consultation and education.*

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