# Pressure Perfect:

## Selecting a Multi-Pump Pressure Booster System

Maintaining the right water pressure is crucial for uninterrupted water flow, whether in a multi-story building, town water distribution, industrial cooling, or irrigation. When water pressure is insufficient, a pressure booster system is necessary.

### What is a pressure booster system

Pressure booster systems increase or maintain water pressure to ensure sufficient flow at delivery points, whether for a single fixture or multiple points like faucets, shower heads, and toilets in apartments, hotels, or office buildings.

### Pressure booster system applications

Maintaining adequate water pressure is essential to the smooth operations of a commercial building and ensuring customer comfort. Pressure booster systems are used to help maintain or increase pressure to ensure the proper flow of water is provided at all delivery points within the building.

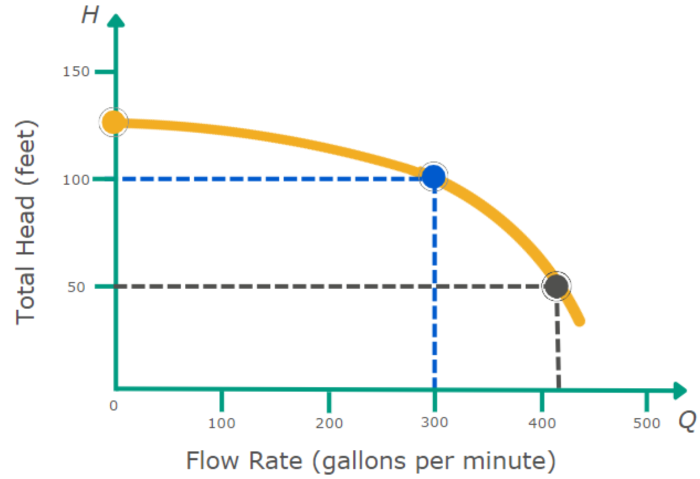
- **Residential:** Ensures adequate water pressure for household needs, including simultaneous use of multiple fixtures and appliances. Apartment buildings use boosters to maintain pressure for individual residences.
- **Commercial:** Provides proper water pressure in hotels, offices, and for lawn care and turf systems.
- **Municipal:** Maintains pressure for water treatment or distribution.
- **Industrial:** Supports manufacturing processes needing high-pressure water such as cutting, cooling, and cleaning.
- **Agricultural:** Ensures adequate pressure for irrigation systems and water distribution from wells to farms and livestock facilities.

### How does a multi-pump pressure booster system work

As water travels, it loses pressure due to elevation (static head) and friction (friction head). Elevation losses occur because of gravity, while friction losses are a combination (function) of flow volume, pipe size along with the length of pipes and number of fixtures, joints, valves, and other obstructions within the system. Friction losses are also influenced by pipe age and type. As pipes age, corrosion, and oxidation- and deposition-scale increase friction losses. Different pipe materials have varying roughness levels, which also affect friction loss.

A single, constant speed centrifugal pump performance is illustrated in Image 1. As water demand, or the flow rate (x-axis), increases, the Total Head (TH, y-axis), or pressure, decreases, resulting in unhappy users at the end of the system. For example, at 0 gallons per minute (gpm) water flow, TH is approximately 125 feet (yellow circle). As the flow increases to 300 gpm, TH drops to 100 feet (blue circle), and to 50 feet at 410 gpm (gray circle).

**Image 1: Single, Centrifugal Pump Performance Curve**

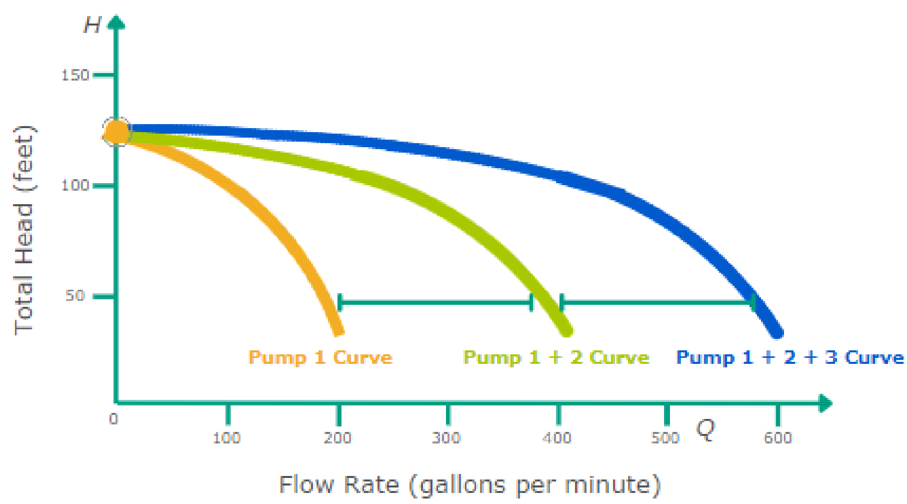



Sometimes, a single pump cannot provide sufficient pressure to overcome elevation and friction. For example, in a six-story building, lower floors may have sufficient pressure, but as water travels higher and encounters more joints and fixtures, the water pressure towards the upper floors decreases. An oversized pump might accommodate peak water usage but continues to run during low demand times, wasting energy and money. On the other hand, an undersized pump designed for the day's average water flow might be overworked during peak usage, reducing its lifespan.

Using multiple pumps in parallel can address these issues. Pumps in parallel, as used in a pressure booster system, are often utilized when the required flow exceeds what a single pump can supply or when the system experiences variable flow rates due to fluctuating high- and low-peak water usage. The pumps are switched on and off as needed. With a variable frequency drive (VFD) one pump can run continuously, while additional pumps activate during peak usage to ensure adequate flow. This design allows lower horsepower usage when demand is low, and additional pumps come online as demand increases. Pressure booster systems ensure adequate pressure regardless of water travel distance, number of fixtures, or time of day.

In a parallel setup, pumps share a common inlet and discharge, maintaining the same suction conditions. When multiple pumps operate in this configuration, they can split the workload evenly at the same TH, with the total flow equaling the sum of the pumps. For example (Image 2, yellow line), Pump 1 can deliver 200 gpm. Adding a second pump increases the flow by another 200 gpm (green line), and a third pump adds an additional 200 gpm (blue), resulting in the multi-pump system theoretically delivering a maximum water flow of 600 gpm.

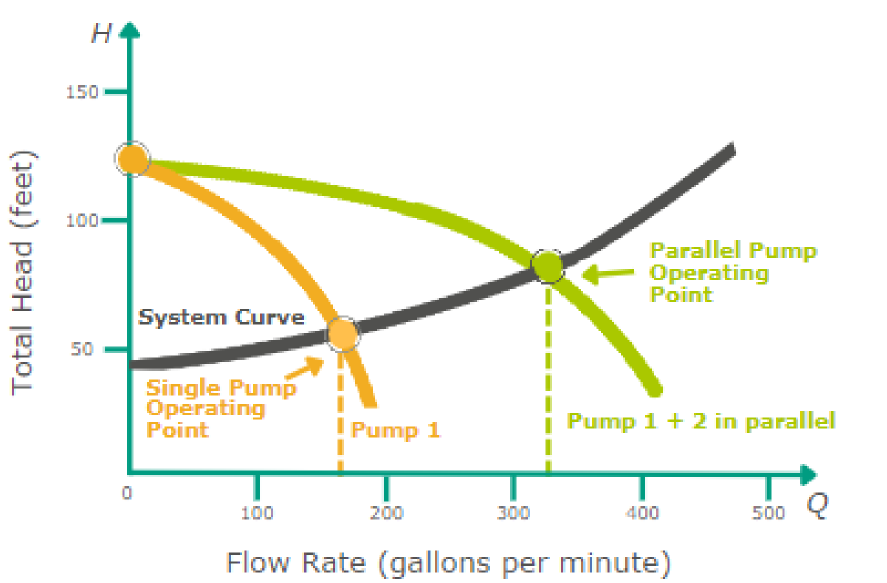
**Image 2: Parallel Pump Performance Curve**




But how does the pump system operate? Pumps operate along the system curve. Even though we have an additive flow with multiple pumps, we will see an increase in flow, but never the total maximum flow due to the system curve.

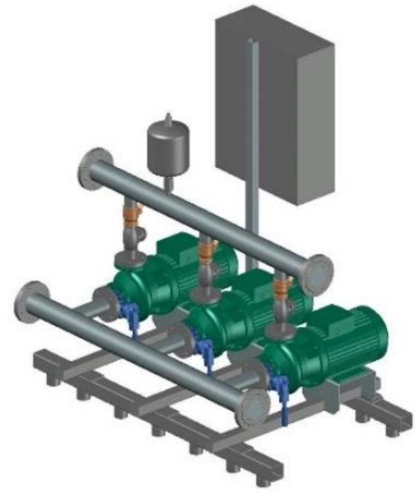
For example, Pump 1 has a maximum flow of 200 gpm, but its operating point on the system curve is 160 gpm at 50 ft TH (Image 3, yellow curve and point). When Pump 2 is activated, the flow increases to 320 gpm at a slightly higher head (green curve and point). Pumps will only operate along the system curve and may not reach their full maximum flow. The parallel pump operating point will move along the system curve from the yellow point to the green point as flow increases.

**Image 3: Parallel Pump Performance Curve**



## Factors to consider when sizing a pressure booster system

To ensure a pressure booster system is properly sized to meet the water pressure efficiently and effectively, consider these factors.



- **Total Head (TH):** This includes elevation and friction losses (head). Elevation losses are calculated by the total height in feet from the supply line to the highest fixture or point of discharge in the building. Friction loss is determined by size, age, and material of piping, and number of joints, valves, and other obstructions in the system that may slow water flow.
- **Gallons per minute (gpm):** Estimate the water demand based on the number of fixtures within the building. Plumbing engineers can use detailed charts in local and state plumbing codes to determine the required gpm using "fixture units" and converting these units to equivalent gpm with Hunter's Curve. The International Association of Plumbing & Mechanical Officials (IAPMO) provides guidelines on determining water demand.
- **Incoming pressure:** Assess the water pressure from municipal systems, which may not be sufficient to overcome static and friction head losses in the building. Compare incoming supply pressure with required building pressure to determine additional boost needed, referred to as differential pressure. For example, if the incoming water pressure is 20 pounds per square inch (psi) and 40 psi is needed, a booster providing the additional 20 psi will be required.
- **Type of pump:** Chose based on TH, flow, and performance needs. For limited space, consider compact systems with vertical pumps. Use single-stage pumps for lower TH requirements and multi-stage pumps for higher TH requirements.
- **Number of pumps:** Decide on simplex (simple pump) or multiple pumps for your system based on TH and flow, and redundancy needs. For critical systems, include a redundant pump to avoid downtime during maintenance or repairs. Consider a multiple pump system which can reach maximum flow for fire flow yet operate with fewer pumps or at lower speed for everyday demand.
- **Automation:** Determine how you would like to monitor and manage the pressure booster system. Multi-pump pump management systems allow for switch-over during or peak loads can contribute to energy savings. Advanced sensors and analytics evaluate the system in real time and make appropriate adjustments are needed.

A pressure booster system is a large investment, but one that can pay for itself easily and reduce life cycle costs. When considering a pressure booster system, avoid these common pitfalls:

- Under sizing or over sizing the pump
- Ignoring (possible) future expansion
- Neglecting to account for pressure losses due to static or friction head
- Failing to properly access incoming water pressure

## Wilo is Your Solutions Provider

Wilo provides consultants with ideal solutions with our pressure-boosting systems with variable frequency drives and automation to ensure constant pressure at all discharge points in equal measure. Wilo's pressure-boosting systems also ensure a sufficient volume flow and water pressure in this way, even in the event of peak loads.

Our expert team of engineers at Wilo can help you make the right choice. Reach out to us with your queries, and we will assist you in selecting an ideal pressure booster system to suit your unique water pressure and flow rate requirements.

*July 2024 | tlk*