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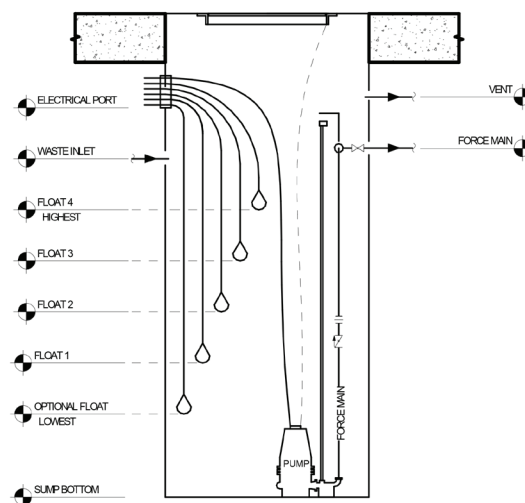
From Experience

Rising to the Occasion: A Look at Lift Stations

When we're talking about plumbing, the first rule, of course, is that water drains down. This means that the outlet of your drain will be lower than the inlet, due to gravity. However, what happens when the layout, design, or existing conditions of the facility don't allow for that?

The answer is often a lift station. A lift station does as its name suggests: lifts whatever comes into it and conveys it away. Usually that's waste...sanitary, process, or otherwise. This is achieved by using a vault (called a sump) with pumps within. Waste drains in from the inlet, and the pumps take the waste away. There are generally three reasons to install a lift station:

- 1. Discharge elevation:** The discharge of the waste is too low for gravity drainage and must be pumped to a different location or elevation.
- 2. Buffer tank:** If the process has large sudden waste discharges but is otherwise minimal-to-zero flow, a lift station can act as a buffer tank. This keeps drainage lines small and prevents overloading waste treatment.
- 3. Emergency containment:** Lift stations can act to separate standard waste discharge from emergency chemical spills. In standard operation, normal waste is pumped to the facility main. In case of emergency (fire, a chemical spill, etc.), the pumps cut off, and the liquid flowing into the sump discharges to the overflow line, usually to a containment tank for later disposal.



When designing a lift station, there are five key criteria that we examine:

- 1. Location:** Will forklifts drive over the manhole, or just foot traffic? Is it possible to place it somewhere that minimizes the inlet depth, therefore minimizing the overall sump depth?
- 2. Pumps:** What is the maximum rate of discharge required? This is balanced with sizing the sump volume as well. A well-designed lift station balances the amount of waste, duration of waste flow, how much the pumps can discharge, and volume of the sump.
- 3. Materials:** The materials of the sump, pumps, and other components are determined by what chemicals are in the lift station. This can vary from cast iron or PVC for things like sanitary sewer, to stainless steel or CPVC for more corrosive liquids.

- 4. Sequence of Operations:** Ultimately, the function of the lift is determined through the sequence of operations. This defines how much waste flows into the sump, when the pump or pumps turn on, when they turn off, when the alarms sound, and any specialized functions. This is accomplished by float sensors, which send electronic signals when waste reaches certain depths. Below is a typical lift station sequence of operations:

Waste starts flowing into lift station

- Float 2: When the waste fills up to this float, pump #1 turns on. The lift station begins to pump waste into the force main.
- Float 3: If the waste fills up to this next float, pump #2 turns on. A second pump is installed for redundancy, but it can also engage during higher flows.
- Float 4 (maximum fill level): This is the highest float, so an alarm will sound to alert personnel that the lift station has reached its capacity. This fill level should never be reached under normal conditions, so this alarm indicates an issue with the lift station such as a failed pump.

Waste stops flowing into lift station

- Float 1 (minimum design level): When this float is unactuated, all the pumps shut off.
- Optional Float: If this float is unactuated, an alarm will go off to indicate the water is below the minimum design level. The alarm notifies personnel to prevent damage to components.

- 5. Routing:** The discharge line from the lift station is usually called a "force main," since it's pumped out of the sump. Pressure is lost with distance and changes in pipe direction, so the size of pumps and their ability to provide the appropriate "lift" or pressure to overcome those piping losses need to be considered when sizing and selecting lift station pumps.

Through these steps, a lift station can be properly sized and selected for most facilities. Although at their core they're a hole in the ground with a couple pumps, they involve critical design factors that require careful evaluation and engineering.

Experience in Brief

How high should floats be set? It depends on use. Some factors that impact float heights include the volume of liquid that is needed to keep the pumps submerged, flow rate and duration of waste into the sump, and when the alarms need to sound all impact float heights. These floats are determined while the pumps are being sized, so it's a balancing game; the minimum flow out with maximum flow in, and maximum volume contained with maximum flow duration. Therefore, approaching sump design from a holistic perspective is critical, and it is more than simply "flow in must match flow out."

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