Surge in Centrifugal Blowers and Exhausters

Surge in a centrifugal blower or exhauster is similar to “pump cavitation” in a liquid pump. There are actually two types of surge, volumetric surge and pressure surge. While they are in most ways similar, their cause in a system can differ.

Volumetric Surge :

The design of the first impeller in the blower really determines the surge point. The internal volume of the impeller is exhausted in each revolution and must be replaced. If the incoming flow is less than the necessary replacement volume, the machine suffers volumetric starvation.

Now, at this point,the machine enters “pressure surge” as the machine attempts to create as much vacuum as possible to move more flow, and will momentarily stabilize at this level. But, internal recirculation will heat the gas in the unit, lowering the gas density and reducing the ability to hold that stable vacuum. At this point, air or gas will flow back though the blower into the inlet piping system.

A good example of this would be a central vacuum system. If all the inlet valves are closed, once all the air in the piping system is exhausted, the machine will starve for air and go into surge. This will cause air to “surge” back into the exhauster from the outlet, and fill the vacuum in the inlet piping. The process repeats itself until a sufficient volume of air is admitted to the inlet piping.

In a landfill gas system, this can occur if the field valves are closed or restricted to a point where there is insufficient gas flow to prevent surge. The system surges and will suck outside air back through the flare. However , usually, there are flame arrestors and check valves in the system to limit this back flow.

Other things that can cause surge are restricted inlet valves, dirty air filters, jammed discharge or inlet check valves or any other system component that can restrict the flow of air or gas into or out of the centrifugal unit.

Pressure Surge :

Pressure surge is similar to volumetric surge, but the causes in the systems can be different.

A pressure surge happens when the differential pressure or vacuum requirement of the system exceeds the maximum capability of the blower or exhauster.

An example of this would be a waste water treatment plant where all the discharge valves are closed . The blower will attempt to pressurize the piping system to a pressure equal to it’s maximum capability., but can’t discharge the air. As above, the system will stabilize for a moment until the internal circulation heats the air slightly , reducing it’s density and reducing the ability of the blower to hold that pressure. At this point, all the air in the discharge piping system “surges” back through the blower and the process repeats.

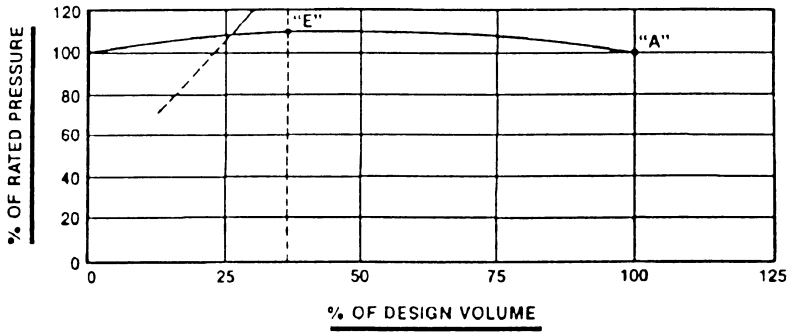
If you look at the diagram below, you will see that for most blowers and exhausters, the surge flow point and the maximum vacuum or pressure point on the curve are the same (shown as E).

Operation at or near the surge point is dangerous, since operation in surge can cause overheating of the impellers, high axial stresses as the rotor pulses back and forth, possibly leading to bearing failure.

A machine operating near the surge range can drop into surge due to factors such as gas temperature changes, barometric pressure changes or changes in gas composition and density (common in landfills) or even increased plugging of the inlet air filter.

Operation in a safe area to the right of the surge point (A) is highly recommended.

The surge point is usually the cut off point at the left of the performance curve for your particular machine.



There is no such thing as a “surgeless” centrifugal. However certain impeller sizes and configurations may exhibit such light surge that no mechanical damage to the machine will occur.

The period between “surges” and how violent the effect is directly related to the size of the piping systems. A very long system utilizing large pipe will take longer to pressurize and depressurize during the surge process. However the damage that can occur to the blower is more severe due to the larger mass of the volume of air.

Shorter systems will have a short “surge cycle”.

How to detect surge :

There are several indicators of surge. The most simple is the “huffing” sound created as the air pulses back and forth through the blower. This can be a rapid or long duration surge depending upon the piping system.

Another indicator would be a pulsation in the amperage drawn by the motor. The amperage will increase as the machine moves air, and when the surge back flow happens the amperage will decrease.