FILTRATION CONTROL SYSTEMS

# COMPARISON OF VACUUM FILTERS AND GRAVITY BED FILTERS FOR METALWORKING FLUID FILTRATION

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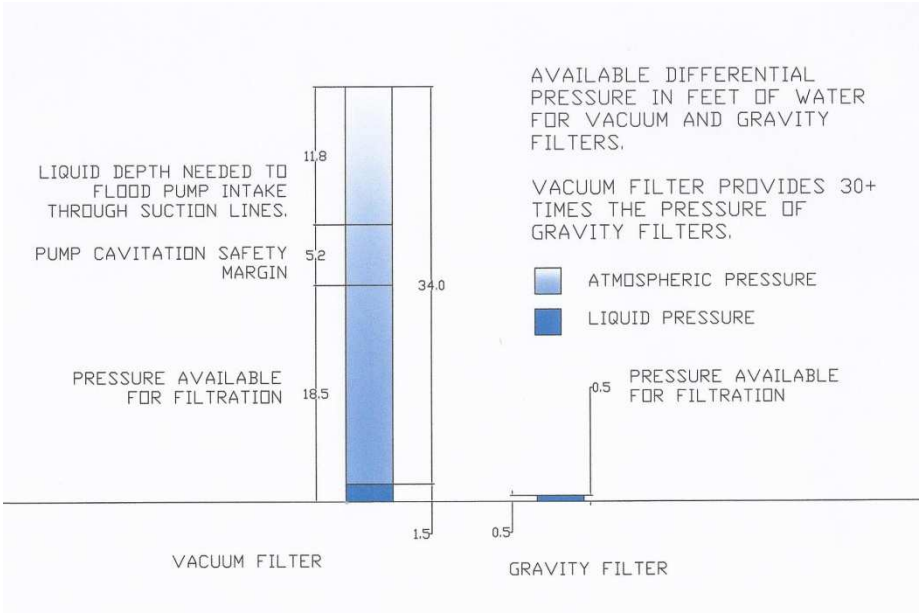
Metalworking fluids are essential to the productivity of most cutting, grinding and forming operations in terms of rate of stock removal, tool life and surface finishes obtained. The fluids cool and lubricate the metal/tool interface and carry metal particles, abrasives and chips out of the work zone. To avoid excessive tool and abrasive wear, poor surface finishes, premature coolant replacement and problems with solid contaminant build up on machines and in tanks, filters are frequently used. Two common types of automatic filters are vacuum filters and gravity bed filters. While both types of filters use non woven fabric filter media to remove solids from the liquid, significant differences between the types exist.

## Principle of Operation

Gravity bed filters create a pool of liquid above the media and gravity provides the motive force that pushes it through. Picture a drip coffee maker with a paper filter and you have a pretty good idea how it works. The force available to push the liquid through the filter is equal to the depth of the liquid. For water based coolants, the pressure exerted equals 1 psi for each 2.31 feet of depth. If a gravity bed has a pool of liquid 6” deep the force is 0.22 psi.

Vacuum filters work much like gravity filters except that, in addition to the weight of the liquid above the media, they also use the weight of the atmosphere to assist in pushing liquid through the media. The atmosphere exerts a force equal to water 34 feet deep or 14.7 psi. By creating a sealed vacuum chamber beneath the filter media, this force can be utilized to provide much more force than by weight of liquid alone.




Drawing from a sealed vacuum chamber, only a fraction of the total pressure available is needed to supply liquid to the pump intake. Typically, a safety margin is added in the design to keep the pump from cavitating and losing flow. The balance is available to overcome flow restriction due to the

filter media itself and accumulated solid contaminants that impede the flow of liquid. As shown above, ***vacuum filters provide 30-50 times the differential pressure available in a gravity bed filter***.

**Implications for Application and Use of Gravity and Vacuum Filters**

The biggest impact that the difference in available pressure makes in the use of these two types of filter is in filter size and liquid clarity.

In filtration, size matters. The resistance to the flow of a liquid through a filter varies with the square of the velocity, so that if the area of a filter is cut in half, the liquid velocity doubles and the flow resistance through the media increases by a factor of four.

Liquid clarity is impacted by available pressure because it requires a filter fabric with smaller openings and more twists and turns in the flow path to capture fine particles than it does to capture large particles. Filter media that has better particle retention performance also has greater resistance liquid flow. If the available pressure is barely enough to maintain the initial liquid flow, there will be no pressure left to overcome restriction due to accumulated solid particles and the media's service life will be too short and operating costs excessive. Increasing filter area helps, that's why cartridge filter elements are pleated, but there are real limits to how big a flat bed filter can be before the cost per square foot of plant area required for the filter becomes prohibitive. Using filter media that permits too many contaminants to pass through defeats the original objectives of filtration.

Gravity bed systems are better suited to low flow requirements and filtering larger contaminants. Their comparatively lightweight conveyor design limits their use to application with light to moderate solids loading. They are good entry level filters and their pricing reflects this lower flow, lighter loading capacity. For finer filtration, higher flows and/or heavy solids loading, vacuum filters edge ahead. They are more robust and costly, but minimize floor space requirement and provide low media use.

Flow rates above 40-60 GPM tend to favor vacuum filters as does filtration requiring effective particle retention below 20 – 40 microns. You can find recommended equipment selections on the Application Chart available on our TECH web page. Please contact Filtration Control Systems to discuss any aspect of your filtration application.