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OHIO FABRICATORS COMPANY

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White Paper

The Suction Line: Keeping It Clean

This paper focuses on one area where filtration is an absolute necessity: the suction line. Controlling contamination and keeping fluids clean can extend the life of system components that work together to complete an operation. Installing filtration devices in strategic locations can allow a system to operate at peak efficiency.

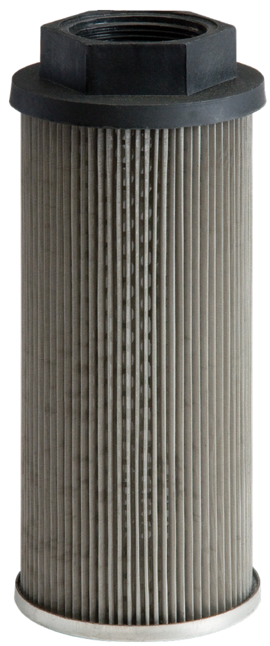
The most important component in any system is the pump. It is the heart of the system. Look at it this way: If the human heart quits functioning, what happens? Bodily functions cease to operate and death occurs. That is why the pump can be referred to as the “heart” of the system. If it ceases to operate, the system stops functioning. Therefore, to keep the system operating smoothly and efficiently, the pump needs to be protected. The suction line is the first location in a system where filtration needs to be installed.

Sump or suction strainers are the most effective types of filtration for this purpose and are designed to be installed in the suction line in one of three locations:

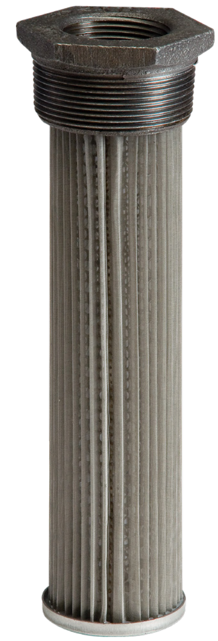
1. **A suction strainer** can be installed submersed in the fluid at the bottom of a reservoir
2. **A tank-mounted strainer** can be installed through the side-wall of the reservoir from the outside
3. **A removable strainer** inside a housing can be installed in-line, outside the reservoir between the pump and the reservoir

If option 1 or 2 is selected, it is critically important the strainer be installed well below the minimum oil level of the fluid in the reservoir. If the fluid level would ever fall below the strainer, exposing the media, aeration may occur, most likely damaging or possibly destroying the pump.

Some feel that if there is adequate filtration in other areas in the system, a suction strainer is not needed. Again, I go to my favorite subject: fluid cleanliness. It is true the suction line doesn’t require “fine” filtration. If the suction line filtration is too fine, it could cause cavitation and damage or possibly destroy the pump. Suction strainers are designed to do exactly that; “strain,” keeping the larger particles from passing through and into the pump. Besides, protecting the pump with an inexpensive strainer shows wisdom. You can spend as little as $20.00 or as much as $70.00 or more, depending on the pump size requirement, therefore, protecting the “heart” of the system.



1. Suction Strainer



2. Tank-Mounted Suction Strainer

3. Removable Strainer

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Let's touch on contamination for a moment. Simply stated, contamination is anything that doesn't belong in the fluid. When introducing what is generally considered clean fluid, the first component the fluid will pass through is the pump. After the fluid has passed through the system and returned to the tank, the first component the fluid will pass through again is the pump. With contamination being the #1 enemy of any system, the #1 priority should be removing any contamination at the first juncture. Take a look at the chart below to see that even "new" oil is never really "clean" oil. For example, a 100 ml sample of tested hydraulic oil, direct from the supplier, has 6,500 particles of contamination the size of 26-50 microns. Also, a 1 ml sample of new oil has 10 particles of 51-100 microns in it. Pumps are built to take a beating. They are tough. However, they also are the most important component. This chart shows that "new" oil is never totally "clean" oil.

Is New Oil Really Clean?

	No. Particles in 100 ml	# Particles in 1 ml
5-10 microns	128,000	1,280
11-25 microns	42,000	420
26-50 microns	6,500	65
51-100 microns	1,000	10
101+ microns	62	0.62

Listed below are some general rules of thumb to follow when designing a typical hydraulic system, depending on what type of pump is being installed. Figuring standard hydraulic fluid (150 SUS) at a standard operating temperature (100°F), the flow rate should not exceed 4 ft/sec.

The three most common types of pumps used today are the piston, vane, and gear pumps. What follows are some examples of levels of filtration that should generally be used to protect each type of pump.

Piston Pump
- Low pressure: 250-500 psi
  – 100 mesh (149 microns)
- High pressure: 1,000-2,000 psi
  – 200 mesh (74 microns)

Vane Pump
- Low pressure: 250-500 psi
  – 60 mesh (238 microns)
- High pressure: 1,000-5,000 psi
  – 100 mesh (149 microns)

Gear Pump
- Low pressure: 250-500 psi
  – 30 mesh (595 microns)
- High pressure: 1,000-3,000 psi
  – 100 mesh (149 microns)

Keep in mind, these are general rules of thumb for typical applications. One thing is for certain, there are many different systems with many different applications, performing many different functions. Always consult a filtration specialist if you have any questions regarding your specific application and equipment.

Next, should a strainer have a bypass? That means are there ever, under any conditions, should unfiltered fluid be allowed to pass through the pump? The answer is, "yes." There are a few reasons to include a bypass on your suction strainer.

1. **Cold weather start-ups.** This is a temporary occurrence. When the system is started, the hydraulic fluid is at its most viscous condition and therefore, may not be able to pass through the strainer easily. When this happens, the pump could cavitate and become damaged or worse. It is wise to allow unfiltered fluid to pass through the pump until the system reaches standard operating temperature, at which point, the fluid then will easily pass through the strainer protecting the pump. The bypass is only used a safeguard.
2. **The process fluid is too viscous.** Besides the issue of cold weather start-ups, some systems run a process fluid that is more viscous than standard hydraulic fluid. Therefore, a bypass should be used with the strainer, again protecting the pump against possible cavitation. As contamination builds up on the strainer, the pressure drop will get to the point where if a bypass is not in place, the strainer may collapse and cavitation could occur.
   - A sub-note regarding viscous fluids and bypass valves, there are a couple of other matters to be considered, too.
     i. Is it possible to oversize the strainer? The more screen area there is on a strainer, the lower the pressure drop will be.
     ii. Using a filtration size that is more open than the one installed. For example, if a 60 mesh (238 microns) strainer is being used, can you use a 30 mesh (595 microns) strainer instead? This would also lower the pressure drop. Review the application to see if this would be a viable option.
3. **Systems that are not regularly maintained.** If an operation is not going to be monitored and maintained properly, contamination build-up on the suction strainer could reach a point where the strainer becomes indexed, or close to it, reaching an unacceptable pressure drop. Cavitation will most likely then occur. An even worse case is the strainer may actually collapse. It is then a better decision to allow unfiltered fluid to pass through the strainer than to allow a situation where the pump, and therefore the system, break down.

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Monitoring should always be done on every system. Waiting until you hear the pump screeching to service it could prove detrimental to the entire operation in a lot of different ways. Each application must be looked at for proper component installation. Modifications should be made, when required, on any existing system and application when warranted.

What if there is a question as to what the level of filtration of a suction strainer should be? As mentioned earlier, you can always call a filtration specialist. Remember, too, collectively consider what type of pump is being used, the viscosity of the fluid, the flow rate, the system pressure, and the line size when it comes to strainer selection. The suction line is never a place for "filtering." "Straining" is the more correct term when referring to a suction strainer. Generally speaking, "straining" refers to 200 mesh (74 microns) or coarser, while "filtering" refers to anything finer than 200 mesh.

Suction strainers are never meant to be a system's only defense against contamination. I have yet to hear a valid reason for not using a suction strainer to protect the pump. If the pump manufacturer states they require a certain level of filtration to protect its pump in order to keep its warranty in effect, then by all means, follow their instructions.

It is also wise to use some sort of portable filtration device to clean and polish the fluid in the system at regular intervals and, also, when introducing new fluid into the system. A filtration device should also be installed in the pressure line and return line, as well. Don't forget to install a tank breather to prevent airborne contamination from entering the system. Discussion of these areas is for another time, however.

A familiar term known to many is called "reactive" maintenance. This refers to fixing a problem only after something has gone terribly wrong. This type of maintenance screams of inefficiencies, downtime, a broken system, and one of money being flushed down the drain. Remain one step ahead in servicing and maintaining the system so the operation can be a smooth running one at all times. My philosophy has always been if you don't have time to do it right, how are you going to find time to do it over.

Take a "proactive" approach to maintenance to ensure your system is running as smoothly and efficiently as it can. This includes proper design, regular monitoring, fluid analysis, and preventative maintenance. Suction strainers have one purpose and one purpose only, to protect the pump. System filtration should start there. A suction strainer is an inexpensive, yet a very wise investment that will safeguard the "heart" of your hydraulic system, and in doing so, prolong its life.