

Let's Keep It Clean

By Dan Helgerson

It is well known within the Fluid Power Industry that the primary cause of failure in Fluid Power Systems is contamination. So, how do you know if your fluid is clean?

I went to see a customer to find out why his hydraulic gear pumps were failing so quickly. I had opened up his pumps and knew the problem was contamination but was not sure of the source. Something was clearly wrong in that his pumps were lasting less than a week.

The customer had purchased a used log loader and had mounted it on his old flatbed truck. He had purchased a new pump but everything else was used, including the fluid in the old hoses and cylinders.

I chatted with him for a while as I looked over the system and then mentioned that I did not see a filter on his system. He informed me that he had clean oil and did not need a filter. I asked him how he knew his oil was clean. He told me he had taken the cover off the reservoir and felt the oil. It felt clean! So he knew he did not need a filter.

What this man did not realize is that the particles that do damage in Fluid Power Systems are the ones between 10 and 25 micron in size.

The smallest particle that can be seen by the unaided human eye is about 40 micron. A red blood cell is about 7 micron. If the particles that do damage are not much bigger than a red blood cell, then feeling the oil is not going to provide very valuable information about its cleanliness. Granted, if the customer had stuck his hand in the oil and felt the grit, I would have to agree that the “feel” test proved it was contaminated. But the “feel” test is not a reliable standard for determining cleanliness.

Particles below 10 micron tend to be too small to get jammed between the mating surfaces of components. As long as the fluid keeps moving, they stay suspended and just pass on through the narrow passageways. The particles over 25 microns tend to be too big to fit between the mating surfaces. They stay in the fluid stream and get dumped back into the reservoir, unless of course some clever salesperson managed to foist a filter into an unsuspecting customer's circuit.

The particles that tear up a system are the ones that can get jammed between the moving parts. Now these particles are not usually nice and smooth like little pearls. They are nasty looking with sharp edges. When they get crunched between a valve spool and a housing, they may take a chunk out of the housing or else etch away at the sharp edges of the spool. And guess what? They create more nasty little particles! Once the process starts, if left unchecked, the fluid will be ready to fail even the “feel” test.

Now this is not to say that the smaller particles are not an issue. They are. As a matter of fact, the newest ISO cleanliness standards include keeping track of the little bitty particles below 5 micron. This stuff can be pretty nasty, too. When the fluid is moving at high velocity, these itty bitty particles act like a sand blaster and eat away at the surfaces as they zip by. If that weren't bad enough, these little guys will collect in the nooks and crannies of the plumbing and can make a spool stick or clog up an orifice.

So, I think we have established that a good “feel” test is not the right answer to “How clean is your fluid?”

The other wrong answer that I often get is, “I know my fluid is clean because I have a 3 micron filter.” (You can substitute the micron rating of your choice here but it’s still the wrong answer.)

The best filter on the planet will not keep your fluid clean if it is bypassing. Most filters have a bypass spring inside so that, when the filter begins to fill up with those pesky little particles, it doesn’t cause too much backpressure. The bypass spring allows the fluid to go around the filtering element and head on through the system still carrying its contaminants.

A bit of an irony is that filters tend to filter better as they get dirty. This is because the elements are made up of material that is full of little tiny holes with somewhat irregular shapes. When the irregularly shaped particles get stuck in these holes, the average size of the holes gets smaller and smaller, thus making the filter more and more efficient. However, this cannot go indefinitely. At some point, the backpressure builds to a critical level and something has to give, hopefully the bypass spring.

So, what is the right answer to the question of how to be certain your fluid is clean? The answer is, “Have it tested.”

Fluid testing is the only sure way to insure a proper level of cleanliness for your fluid based on the level of sophistication of the working components.

You can test the fluid with your own equipment or send it out to an independent lab. You need to know about the size and number of particles that are in the fluid as well as the type of particles that are in the fluid. This will give you valuable information as to what components are wearing out and can help in planning scheduled maintenance. It will also tell you if airborne contaminants are getting into the fluid so you can check to be sure your breather is filtering properly.

The fluid should also be sent to the fluid manufacturer for testing to be sure it still has the correct amount of additives. The formula for the fluid is often kept secret so only the manufacturer of the fluid can tell you how it measures up.

When getting a fluid sample to test, it is important to get the sample from the fluid stream while the system is working. If the sample is taken during down time, the particles you need to find may have settled to the bottom of the reservoir and your fluid may appear cleaner than it really is.

We have mentioned some of the ways contaminants get into the fluid such as normal wear, particles that are “breathed” in as the level in the reservoir rises and falls and the contamination from contamination as particles etch and jam in the system. An often-overlooked source of contamination is the new fluid that is added to the reservoir.

The standard cleanliness level of new fluid does not meet the requirement for most of your components. That shiny new 55 gallon drum of fluid sitting on the loading dock is likely to have a lot of particles in it, and remember; you can’t see them! The fluid should always pass through a filter as it is added to a reservoir.

If you keep your fluid clean and maintain good records, some manufacturers will extend the warrantee on their components. This is good evidence that we know that the primary cause of failure is contamination.

So, let’s keep it clean.