



FERROUS METAL FILTRATION

Oil is the "lifeblood" of any drive gear. Oil helps lubricate the gears, cool them, keeps small contamination in suspension and helps wash larger contamination away. That's why cleanliness of the oil is so important, it helps determine how long a gear or bearing for the gear will last.

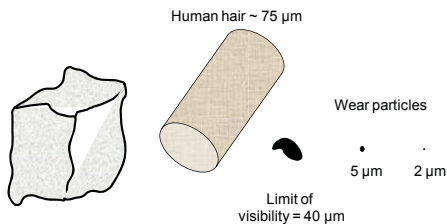


We all know that new oils are not necessarily clean oils. Sometimes just filling or topping off an oil level can add large amounts of foreign contaminants to an oil. That is why it's recommended to pre-filter all oils before use and to keep filtering them even while they are in-use.

We also know that all gear driven systems will generate wear, during start up and normal operation. Those wear metals in the oil need to be removed from the oil or it will cause the lubricating oil to act like liquid sand paper, generating more contamination until something breaks. That cycle is known as degradation and the only way to break that cycle of destruction is through filtration.

The contamination must be removed.

Now here's where we have all had difficulties breaking the degradation cycle. Conventional filters only remove specific size particulate. A 10 micron filter will filter contamination that is 10 micron in size and larger, a 25 micron filter will trap particles 25 micron and larger. Most all of the smaller sized particulate and sub micron sized particles (the liquid sand paper) passes right on through most filters.



Left unchecked this large amount of small particulate (known as silt) will continue to generate more and more contamination, causing premature wear and premature failures.

To augment the performance of a filter and to address the smaller sized particulate, a line of high powered magnetic filtration products were developed. Manufactured with Rare Fullers Earth (Neodymium) magnets, the strongest grade available; they were installed onto three different types of products for filtering gear oils.

(A fridge magnet will measure approximately 60-80 gauss in field strength, the magnets we will be discussing are all 14,000 gauss. Much more powerful)

Highest Power is the Magnetic Filters

There is a square aluminum housing with a lower inlet port and an upper outlet port on the opposite side, so all the oil being circulated through the filter must pass a high powered magnetic rod this is mounted vertically inside the filter housing. Contamination will collect on the stainless steel rod. Inside the stainless steel rod are many neodymium magnets with each magnetic field opposing each other. That arrangement makes up a single rod with many high strength fields inside of the stainless steel rod.



These can be mounted in nearly any oil circulating line but work best when oil is passing through them slowly. The slower the oil velocity passes through the magnetic filter, the higher the concentration of particulate that will be removed. To clean, the magnetic rod is removed, wiped clean and replaced. This means that it is reusable for many years. Clean magnetic rod vs. used magnetic rod.

Medium Power is the Magnetic Sticks

These anodized aluminum blocks have multiple high powered magnets and can be magnetically adhered onto the sides of spin on filters, onto oil reservoirs, transmission pans and nearly anywhere that ferrous metals need to be replaced. Manufactured in three sizes (3" green magnetic stick for small spin on filters, 5" gold magnetic stick for medium sized filter elements, and 7" silver magnetic stick for large filter elements). Each size is color coded and the longer the magnetic stick, the larger the magnets that used for stronger pull force. Best performance would be to place 2 or 3 sticks on each filter element, so the oil has a better chance of passing by a magnet around the circumference of a filter element. When the filter elements plug up and are replaced, the elements can be cut open for inspection or even analysis of the retained debris (it's also a great visual to see all the debris that was removed by the magnets). Magnetic sticks are very inexpensive, simple to use and reusable.



Low Power Magnetic Plugs

Most all gear oil reservoirs have drain plugs and in some instances they even have magnetic plugs, but too often those are ceramic type low powered magnets (200-500 gauss rating). They don't have much magnetic power, so they don't actually collect much debris. By utilizing a neodymium magnetic plug, the magnetic drain plug will collect and retain much more ferrous metals and keep them out of oil circulation. Even though a magnetic plug only has one magnet & one magnetic field, it will still collect debris and can be cleaned when the oil is changed out. They are the least expensive of the magnetic products and are also reusable.



So which product is best for filtering gear oils?

The higher the magnetic strength, the more contamination that will be removed, also the closer the oil comes into contact with the neodymium magnet, the better the performance will be. The magnetic filters will provide the highest strength, the magnetic plugs the least expense and the magnetic sticks are the middle ground. Having a variation in the types of magnetic filtration products provides a couple of different solutions and methods to experiment with which product works best for a specific requirement.

What if my gear oil is already being filtered?

It does no harm to have both magnetic filters and conventional filters; in fact they augment one another very well. It has been estimated that by merely adding a high powered magnet to a conventional filter, the efficiency of the conventional filter can improve 20-30%. That is worth repeating. By adding a high powered magnet to your existing filter, you can improve that filters efficiency 20-30%!

What do magnets really remove that my filter won't?



One would believe that a magnetic filter would only capture ferrous particles, but in reality they capture non-ferrous materials also. Some particles become statically charged by the oil flow, those will be retained by the magnetic field. Also through a process known as "static adhesion" where a piece of debris non-ferrous becomes trapped between the magnetic rod and a piece of ferrous material. The non-ferrous particle can become sandwiched and retained. The largest concentration of particulate removed by a magnetic filter will be ferrous. As explained previously, a magnetic filter will also remove particles that are very small and even microscopic in size. Contamination this small will normally pass straight through a conventional filter.

One of the first tests we conducted on magnetic filtration was to install a magnetic stick onto an oil filter on one of our company trucks. We ran the truck-for 3000 miles with conventional motor oil, then removed the filter & cut the element open. Dark circles appeared where retained contaminants that were prevented from circulating in the motor oil. An engine is much like a gear, it requires a break-in period that will generate wear particles and normal wear will generate additional contamination. By reducing those smaller particles we can extend the life of the oil and all the equipment that utilizes it. We can keep it from generating additional wear and keep our lubricating oils cleaner, and lasting longer.

The second magnetic experiment we conducted was to attach a 7" long magnetic stick to the transmission pan on the same truck and ran for 5000 miles (the truck had 25,000 original miles before the test). The contamination in would typically settle to the bottom of the transmission pan (like in a gear box or gear drive system, only to be re-suspended back into the oil during start-up and normal operation. The magnetic stick caught and retained this contamination, preventing it from coming into contact with the gears.

Subsequent tests have been conducted on gear oils, turbine oils, hydraulic oils, compressor oils, cutting solvents, water lines, and diesel fuels. The most interesting fact was how universal magnetic filtration has been and how the "high powered magnets" can pull contamination out of & keep it out of nearly any oil or liquid. Since heavy gear oils are the most difficult to filter, magnetic filtration has become one of the most economical ways to begin filtering those heavy oils. They allow us to address the smaller sized particles that are generated during break-in and normal wear and keep that liquid sandpaper out of our lubricating oils. That success is due entirely to the strengths of the neodymium grade rare earth magnets.

- The 14,000 gauss rating of these magnets is taken by measuring 7000 gauss on the north plus 7000 gauss on the south pole or by measuring the field strength between the gap of two magnets, a north pole aligned to a south pole.

- The magnetic products described in this article have magnetic pull forces from 6.2Lbs (a single magnetic plug) to over 200Lbs of pull on the large magnetic stick and filters.

Magnetic pull force is usually calculated by the following formula;

$F(\text{in grams}) = .00016 \times \text{magnets field measured in gauss} \times \text{magnet face area in square cm}$. Pound of pull is also a vertical measurement of pull force required to pull the magnet in a straight linear movement, to break the magnetic field.

•Typically neodymium magnets have a shelf life of 100 years or more. We do know from experience that their life is affected greatly by shock and heat. Neodymium magnets are very brittle and break easily. Even with our .0002" nickel coating on the outside, they will break if they are dropped, beaten or abused. Their 100 year life will be shortened if exposed to temperatures above 180 degrees F. But if kept away from shock-loads and high temperatures, they will last a long, long, long time.

"I believe that magnetic filtration will one day play a significant role filtering all oils, engine oils, hydraulic oils, turbine oils, machining oils, compressor oils and essentially all lubricating oils. This will include gear systems, automobiles, hydraulic systems, and eventually all systems that utilize oils. High powered magnetic filters are relatively inexpensive (compared to oil costs and down-time costs), they are reusable, and best of all simple to use; making them an excellent value. The improvement in oil quality and life extension with improved filtration is too difficult to ignore". Says Steve Anderson.

Steve Anderson is a certified Fluid Power Specialist with +30 years experience. In 1998 he founded Y2K Fluid Power to manufacture contamination control products he patented. He is a published author, instructor and has helped companies around the world to address oil filtration and contamination control.

In 2008 Y2K was purchased by Dakota Fluid Power, Inc of Sioux Falls, South Dakota.



3500 No. St Paul Ave., Sioux Falls, SD 57104

www.y2kfluidpower.com