Automatic Transmission and Power Steering Filters

Keeping Your Automatic Transmission And Power Steering Alive Forever

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For all of its complexity, the automatic transmission has been almost forgotten in the oil filtration department. For many of its 70-plus years, minimal filtration was considered "good enough." No longer. Today's electronically controlled transmissions are much more sensitive to lubricant contaminants, yet the OE filtration systems haven't evolved all that much. And if you think the auto trans is forgotten, realize your power steering has no filter at all.

With people keeping their trucks longer these days, preventive maintenance becomes even more important. If you want to keep your truck longer or work it harder, we thought you'd like to explore some filtration options for extending the life of your automatic transmission and power steering and keeping them going virtually forever.

Fluids and Contamination

The majority of automatics have only a screen or panel filter on the pump suction in the pan. Modern pan filters average about 100-micron filtering efficiency (see the sidebar), with older screen filters as poor as 200. For comparison, an average engine oil filter can remove particles about 25 microns in size. In nearly 30 years of study, engineers John Eleftherakis and Ibrahim Khalil defined the failure modes of automatics due to contaminants and determined the typical types and allowable amounts of contaminants. The results of those studies have been published in various Society of Automotive Engineers (SAE) technical papers since 1990.

While an improvement in filter efficiency on the suction side would be beneficial to an auto trans, that's been a very difficult engineering problem to solve because the flow needs are so high and the available space is so small. SPX Filtran, an industry leader in filtration products, will soon be introducing a major upgrade in that area, a pleated panel filer of about 40-micron capacity, but according to them it's not likely to trickle down to older applications.

Where does this contamination come from? Of the total amount found in the average 70,000-to 120,000-mile transmission with no fluid changes, some 25 to 30 percent is from normal wear (called Type 2 contamination). The more significant portion comes from the manufacturing process (or remanufacturing process, as the case may be) and is called Type 1 contamination. Better manufacturing processes have reduced Type 1 levels, but Type 2 will always be an issue.

According to Eleftherakis and Khalil, the typical makeup of contaminants is about 51 percent steel, 21 percent copper (copper wool clutch linings), 11 percent aluminum, and 7 percent lead (from bushings). Some 82 percent of the particles are larger than five microns in size, though only 15 percent of them are larger than 15 microns. Some are as large as 400 microns.

Trans failures come when contaminants decrease the operating efficiency of the internal valves that operate the transmission. The long-term issues are from the abrasive wear of small particles, which causes internal leakage and lower pressures. Larger particles can cause valves to jam outright. Anything that reduces apply pressure allows more clutch slippage. The advent of electronically controlled solenoid valves has made the problem worse because a solenoid is nothing more than an electromagnet that attracts the ferrous contaminants.

The most user-friendly method of measuring oil contamination is the ISO Cleanliness Code. There are two codes: the earlier two-digit (e.g., 18/14), which is still in common use in the automotive field, and the three digit (e.g., 18/14/11). For the two-digit code, the first number indicates the number of particles larger than five microns, and those larger than 14 for the second. The three-digit code shows the particles above 4, 6 and 14 microns in size. The actual number in the code (e.g., the "18") is the range of counted particles, in this case indicating 1,300 to 2,500 particles (see sidebar). Dropping from 18 to 17 indicates a 50-percent drop to 640 to 1,300 particles.

So what's "clean?" That varies according to the equipment. Even new oil is not perfectly clean. The manufacturer may offer some minimums, but the basic truism according to Magnefine inventor Len Kelsey and others is, "No system ever failed from being too clean." Ford likes to see counts no higher than 18/15 and GM 19/16, and the import manufacturers prefer cleaner numbers than those. During decades of destructive testing, Eleftherakis and Khalil determined that around 19/16 or better is safe, but anything above 21/18 is a danger area in all transmissions.

What Can You Do?

The one obvious method of removing contamination is to change the lubricant, but there's a hitch. A high percentage of the time, you're draining and wasting perfectly good transmission fluid. That's hard on the wallet, the global resource bank, and the environment. Fluid changes have been made more difficult in recent years because you can only drain 30 to 40 percent of the total fluid volume in the trans. (Penny-pinchers at the OEMs eliminated converter drain plugs years ago.) Fluid exchanging machines can take you a good part of the way in that regard, but leave accumulated wear materials in the pan if it's not dropped, cleaned, and the filter replaced.

Experts in contamination think the very first change is the most important to remove the Type 1 contamination. It can amount to as much as 75 percent of the accumulated material generated in the life of an automatic. Some experts even advocate a change (including pan drop and filter) within the first 100 miles for that reason, but if you change it within 5,000 miles, you get the chance to eliminate the break-in material, too. After that, you can follow the factory interval according to driving conditions.

Another option is to introduce an external filter into the equation. These filters are usually installed in the transmission cooler circuit, which directs a certain amount of hot oil out of the converter for cooling. This is only a percentage of the total oil flow in the trans, but an inline filter will eventually clean the oil and keep it that way.

Now we'll introduce you to filtration products from two well-known manufacturers. We had the opportunity to test both products and verify their efficiency via oil analysis.

Magnefine

The Magnefine is a small inline filter that comes with either a billet aluminum or Nylon 66 housing. It inserts into the cooler line and is offered to fit 5/16-, 3/8- and 1/2-inch OD line. It contains a 35-micron filter (nominal) but also a magnet. With approximately 51 percent of contaminant particles being ferrous, it will catch nearly all of those, regardless of size. A bypass valve prevents the unit from plugging up and decreasing cooler line flow. Boss Products recommends a 30,000-mile service interval for this filter.

The Magnefine was developed in Australia by Boss Products and underwent significant testing there. When introduced to North America, it was offered both to the OEMs and the aftermarket. The aftermarket glommed on instantly. After putting them through a battery of qualification tests, Ford and Chrysler gave them part numbers, but some other OE manufacturers use them as well.

The Ford and Mopar in-house misers didn't go quite so far as letting them install them on all new cars or trucks, but mandate their use when a remanufactured automatic is installed. That prevents contaminants trapped in the cooler from the initial failure, or Type 1 material from the rebuilding process, from killing the new trans.

You can use the Magnefine on power steering systems as well. Installing it on the return hose can significantly increase power steering life. According to Boss Products, it has been especially beneficial to reducing leakage in rack and pinion steering systems.

Our test mule for the Magnefine was an '05 Ford F-150, with a 5.4L V-8 and 4R75E electronically controlled automatic and rack-and-pinion steering. The truck was showing about 15,000 miles at the start of the test. The transmission fluid had been replaced at 11,000 miles with Royal Purple Max ATF. At the time of the change, which was done as a break-in change, it was noted that the pan magnet was loaded up with Type 1 debris. That observation inspired this article.

After taking an oil sample, we installed the Magnefine on the cooler return line and took the final oil samples at 2,269 miles. The initial sample was a very clean 15/12 ISO code, and we worried about seeing a noticeable change. Those very good numbers were due to the fresh oil and the SPX Filtran pan filter that was replaced at the oil change. Filtran uses MicroFelt media which delivers a better-than-average 80 microns nominal rating and would give you a small edge over the average "bargain" filters, many of which Filtran claims are 100- to 150-micron at best. Our fears about the Magnefine were unfounded. It dropped the ISO Code down to a squeaky-clean 12/9 by the end of testing.

We also installed a Magnefine into the return line of the rack and pinion steering and ran it for 552 miles before resampling the oil. The ISO code dropped from a dirty 20/17/12 to a clean 17/15/12. Similarly, when installed into the long-overdue-for-an-oil-change power steering of our '86 test rig, it dropped the code from a filthy 21/18/14 to 18/16/13 in just 289 miles.

Racor

The Racor division of Parker Filtration is legendary in the commercial diesel realm. They offer more fuel and oil filtration products than we have room to tell you about. Some years back, their commercial vehicle grapevine indicated the need for a retrofit high-flow transmission filter product, so they developed one that would fit most automatics, large to small. Among the tests used to vet the product was installing them on a large fleet of ambulances experiencing early transmission failures. In the long-term tests, according to Racor, failures dropped to just about zero, and the ambulance company saved about $230,000 in repairs and maintenance the first year.

The Racor LFS kit comes with an aluminum filter housing, fittings, mounting bracket and a high-flow, high-capacity spin-on filter. An array of ready-made hoses is available separately in assorted lengths and diameters to accommodate most applications. You can also have hoses made locally or plumb the unit in with tubing if you prefer.

The heart of the Racor LFS kit is a synthetic media filter with 234 square inches of media that delivers a 7-micron nominal rating and 10 microns absolute. It flows eight gallons per minute (gpm) in new condition, which makes it large enough for many big commercial applications. A typical light-truck cooler circuit flows no more than three to four gpm, and many are under two gpm. A quick check of the books showed many medium duty truck transmissions flowing six to eight gpm. The Racor filter is also equipped with a bypass. Racor recommends a 30,000-mile service interval in a hard-worked medium duty truck.

Our test rig for the Racor LFS was an '86 F-250HD with a C6 automatic and 137,000 never-torn-down miles. The oil had been changed 3,000 miles previously with synthetic Royal Purple Max ATF. The older, hydraulically-operated C6 uses a screen, so we expected it to be dirty despite the change, but in only 423 miles it dropped the ISO code from 16/13 to 14/11. That's stunning, considering the low mileage interval. Obviously, the filtering threshold for the Racor LFS is pretty high. By the way, we can't think of any reason why the Racor couldn't be installed on a power steering system as well, though we didn't try it.

Notes on Installation and Testing

We eventually installed both units on both trucks to test the ease of installation, but our lubricant analysis was done with only one unit on each truck. We partnered with Blackstone Labs in Fort Wayne, Indiana, to do the contamination analysis on our oil. In a marathon testing session, we were able to watch our rack of oil samples go through the process.

Both units are simple to install, but there are some considerations on where to place the filters. If you are starting with a new truck, the best place to install either filter is in the cooler outlet line from the trans. Debris buildup in the cooler over time is somewhat inevitable, so placing the filter before the cooler(s) prevents that occurrence. If you buy a new truck, get that filter on ASAP for maximum protection.

If your truck is starting out with some miles or you are installing a rebuilt trans, both Racor and Boss recommend putting it on the return line. It's nearly impossible to get all failure debris from the cooler, and nearly impossible to rebuild a trans that ends up totally clean internally. Better trans shops are now installing inline filters with rebuilds.

Conclusion

Both these systems proved that they could take the ATF well below the range Eleftherakis and Khalil concluded was ideal. On top of that, both these systems are affordable, easy to install, simple to service, and could significantly add to the life of the transmission and reduce the number of times the fluid must be changed.

Comparing the two systems is difficult and essentially comes out a draw. The Magnefine is cheaper and simpler to install initially, but the Racor is easier to service down the road. The Racor filter element alone costs about the same as the Magnefine, but has about 5 times the contaminant-holding capacity and could be run over a much longer service interval. We noticed a 5-degree operating temp drop with the Racor due to the extra plumbing. It's a nose-to-nose finish alright, but one your transmission could greatly benefit from.

Filter Glossary

Absolute Micron Rating: The smallest particle size a filter can catch.

Micron: Micrometer, which equals one millionth of a meter, or 0.00003937 of an inch. A human hair is about 70 to 100 microns in diameter. White blood cells are 25 microns. If you have really good eyes, you can see something of about 40-micron size.

Nominal Micron Rating: The size particle a filter can catch 50 percent of on the first pass.

ISO Cleanliness Codes*

ISO Code Range	Particle Count Range
10	5-10
11	10-20
12	20-40
13	40-80
14	80-160
15	160-320
16	320-640
17	640-1,300
18	1,300-2,500
19	2,500-5,000
20	5,000-10,000
21	10,000-20,000
22	20,000-40,000

*Note: Entire code range not shown.

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