

ne of the reasons the old Volkswagen Type 1 Beetle needed oil changes at roughly monthly intervals was because its engine had no oil filter. A crude strainer sufficed, which was emblematic of late 1930s' technology. Then there were the bypass oil filters that lasted into the '60s on some engines. They were externally plumbed, strained only about 10% of the flow of liquid lube and seemed more an engineering afterthought than an integrated system.

Besides that, the filter media of the past, whether for oil, air, fuel, or automatic transmission fluid, can only be termed primitive. Oil might have been forced through depth-media beds of cotton, felt, or even wood chips, air through horsehair mats or oil-wetted steel wool, and fuel through fine copper screening or sintered bronze. These materials could keep the rocks out of circulation, but excluding particles of a size best measured by the micron (one-millionth of a meter) was simply beyond their capabilities.

How different things are today. Whether spinon or cartridge type (the latter is becoming more and more popular among engineers with "green" tendencies as a means of keeping extra tons of sheet metal cans containing considerable amounts of waste oil out of land fills), every modern engine uses a full-flow oil filter. And all high-quality filters, such as those available from Subaru of America, for every other fluid and for intake and cabin ventilation air use media that bar the passage of truly minute abrasives and clogforming particles.

Along with vast improvements in the chemistry of lubricants themselves, advances in filtration are one of the chief factors in both the long maintenance intervals we enjoy today and in the incredible durability of late-model cars, Subaru vehicles being among the most impressive examples.

While you won't go wrong following the replacement intervals for filters (and, of course, for the fluids involved) stated in the owner's and service manuals for the Subaru vehicles you service, you should still have an understanding of filtering science and how it affects the policies of Fuji engineers. Armed with this technical knowledge, you'll have a much easier time justifying filter sales during your conversations with your faithful patrons.



A/C, heat or vent, what's circulating in the passenger compartment along with air? Pollen, dirt, dust, etc. The only thing between interior air pollution and your customer is the cabin filter.

#### **Cabin Fever**

We'll start off with cabin air filters, one of the hottest recent profit areas for auto service businesses. As you may have found out, most of the motorists out there in the real world are not even aware that there is such a thing, or that their cars in particular are so equipped. Yet over 55% of the vehicles sold in the U.S. today either have cabin filtration as standard equipment, or as an available option. That makes this whole area of service something you don't want to be missing out on.

While you might assume that the concept of filtering dust, dirt, bugs, etc. out of the air that enters the passenger compartment is relatively new, you'd be wrong. The credit for first refining heating and ventilating to this point goes to Nash, which company introduced the "Weather Eye" system in 1938. The brochures show a woman in a bathing suit smiling through an ice covered window ("...warm and comfortable, as if she were on a sunny beach on a mild summer day."), and three dapper looking gentlemen smoking up a storm in the back seat ("Smoke all you like! Stuffy air is instantly changed! Shut out all bugs, bees, insects..."). These miracles of climate control were accomplished by a filtered, fan boosted inlet set up that made sure air pressure was higher inside than out. Sometimes, however, a great feature is put into production before its time, so the idea lay dormant for many decades. Regardless, it's here now with a vengeance.

## Filters: Excluding Undesireables

So, how do you sell cabin air filters? First, by knowing a few things about them. For instance, there are basically three types. Particle filters were the first on the scene, and, as you'd assume, they keep out dust, soot, spores and pollen. A micro fiber fleece is used and may be electrostatically charged for higher efficiency.

Adsorption (as opposed to absorption — there's a difference) filters handle noxious gases and odors. Activated charcoal is the primary ingredient. It is highly porous, which results in a large surface area. Gaps 1/10,000th the diameter of a human hair mean that a huge volume of gas is able to come into contact with the charcoal, and impurities are bound to the surface.

Not surprisingly, the third type of cabin filter is a hybrid, which combines the particle and adsorption functions into one. The media elements may be blended, but are usually arranged in series.

These parts are not inexpensive, so you probably are aware of the fact that your profit on parts will be substantial when you replace them. What you may not be aware of is the SOA-recommended interval: Depending on the model, as frequently as once per year or every 7,500 miles, whichever comes first. Holy smokes — that's the same mileage interval as is given for oil changes for a typical non-turbo four-cylinder engine under Maintenance Schedule 1 (that's appropriate for Subaru vehicles that see light-duty, mild service). So, here's an income opportunity that you are in all likelihood not exploiting fully. Sure, it'll make that LOF ticket a lot bigger than the customer may be used to, but just showing him or her the old filter usually sells the job — who wants to be sitting in an enclosed space and essentially breathing through that filthy element? By the way, the owner's manual states:

"NOTE: The filter can influence the air conditioning, heating and defroster performance if not properly maintained."

Also:

"Contact your dealer if the following occurs, even if it is not yet time to replace the filter:

- Reduction of the air flow through the vents.
- Windshield gets easily fogged or misted."

That's what we call manufacturer support for service sales.

If even after offering all this evidence you still meet with resistance, you could simply mention a simple analogy that should put the situation into perspective, namely that of a home HVAC system. It's likely that very few of your customers would go a full year without changing that filter.

The procedure for extracting the old element and inserting the new is usually pretty simple, as is illustrated by these instructions for a late-model Forester:

**1.** Remove the glove box, which entails removing nine screws and one clip.



A new cabin air filter should be an easy sell, especially since Subaru recommends replacement every year or every 7,500 miles in many cases, whichever comes first (see owner's manual). Using the original equipment part from SOA will assure great performance and perfect fit.

- 2. Disconnect the glove box light connector.
- 3. Unhook the air filter cover and remove it.
- Draw out the old filter element, and replace it with the new one. Be sure that the arrow mark on the filter is pointing downward.
- Reinstall the filter cover, plug the connector back in and reinstall the glove box.
- **6.** Fill out and attach the service label to the door pillar on the driver's side.

One final word on this topic: According to a recent survey, more than 85% of all original equipment cabin filters in service today have never been changed. Whose fault is that? We'll have to say it's yours.

#### Straining Slippery Stuff

In the early days of the automobile, nobody gave much thought to filtering the engine oil, which isn't as incredible as it sounds considering change intervals were typically set at 500 miles or less. When this concept was finally adopted, it was in the form of the partial-flow filter set-ups mentioned above, which can still be found in heavy-duty trucks.

Because of its high profile, most of the action on the filter research front is in the technology that strains contaminants out of motor oil. The old-fashioned depth media we mentioned earlier may've done a pretty good job of removing particles, but there were big problems with flow, especially in cold weather, so pleated paper elements took over.

A filter engineer gave us some background on oil filter evolution. "Years ago, we asked ourselves, 'What's important?' So, we did radioactive isotope and wear testing," he tells us. "We say that particles in the 10-20 micron range cause the most wear in the shortest time. They're smaller than dust — more like talcum powder but they cause scratches because they bridge the oil film, especially on top of the con rod bearing on the power stroke.

"So, we concentrated on building filter papers that could achieve a high first-pass efficiency for these particles. If you look at media under a microscope, this is like stacking up sticks or brush. We make a mix of big and little sticks. One fiber only a micron in diameter can cross a 40-micron gap and cut it in half."

Using this philosophy, high-quality filters score 96% or more SPE (Single Pass Efficiency) in the SAE test procedure J806 that's been around for years. The relatively new SAE standard J1858 takes analysis to a new level of measuring capacity and efficiency. Particles are counted by size both upstream and downstream of the filter, then a filtration ratio is determined for each size. For example, a filter may be rated as capable of catching 40% of 10-micron particles and 97% of 40-micron particles.

Years ago, we heard that one of the big-volume aftermarket manufacturers was going to a lighter gauge of steel for its oil filter housings, but we didn't think much about it until a car showed up in our shop with a glowing oil pressure light. Sure enough, no oil. When we got underneath to find the root of the problem, it was obvious. Somebody had tightened this flimsy filter with a wrench, and in the process had crimped and punctured the housing. Ever since, we buy the highest quality oil filters available, such as the original equipment items from SOA. After all, the difference in cost between the best and what's essentially unknown is very little indeed when you consider that a motor job today costs many thousands of dollars.

# Filters: Excluding Undesireables



Don't make the mistake we've heard many quick-lubes commonly make. That is, removing the ATF filter instead of the engine oil filter during a regular oil change. They look the same, but are clearly marked. Besides, why would an oil filter be screwed onto the transaxle? The ATF filter is a life-of-car item, but we would still replace it during a trans flush, which maintenance is recommended every 15,000 miles if the vehicle tows a trailer frequently.

One filtration expert we interviewed mentioned a related point: "Never let a filter go out with a dent or crimp. That will cause a stress riser that focuses the movement from pulses and start/stop cycles to one point, so you'll get a crack."

### **Every Other?**

Then there's the perennial question: Since filters are better than ever, and decades ago some carmakers recommended replacing the filter every other oil change, isn't that still valid? Well, we understand the attraction — speed and no messy oil spills from unscrewing that can. We know technicians who do this routinely on their own cars. Oil is cheap, after all. They do the deed faithfully every 3,000 miles, though, and trust that the filter was designed to live for the recommended 7,500-mile oil change interval.

But, is this any way to run an airline? Isn't customer communication difficult enough without introducing this complication? Who knows how long it'll be before he or she shows up again? And, that 7.5K-mile interval, remember, is for "mild" or "normal" service, and we don't know many motorists who are that normal. To some people, SOA's Maintenance Schedule 2 is more real-world realistic, and it says every 3,750 miles.

No, we just can't see it from a policy point of view for the professional repair shop. It's just too risky. As one filter authority tells us, "I have a strong opinion on this. I think it's a bad idea. The technical reason for this is that filters pick up water, and water is bad for filters. Your oil filter is the cheapest insurance you'll ever buy. If you change the oil and filter every 3,000 miles, your engine will last just about forever."

## Fair Air?

Air filters exhibit a strange characteristic in that they do a better job after they get dirty. And that's the danger with cheap ones: They often have open media that lets some pretty big particles through. In other words, they may flow plenty of air, but they have dangerously poor initial filtering efficiency.

According to a comparison done in fleet testing, buying an off-brand filter is about the same as pouring a tablespoon of dust down the engine's intake. We remember reading somewhere that ingesting a volume of dirt the equivalent of two aspirin tablets will cause more wear in an engine than 75,000 miles of normal driving. That certainly stretches credulity, but you can see the possible problems if you realize that, while stoichiometric combustion only requires 14.7:1 air to fuel by weight, that translates into about 9,000 gallons of air per gallon of gasoline by volume. Ever notice all the dust in the air as made visible by a shaft of sunlight coming through a window? And that's indoors. Just think of the amount that must be in the thousands of cubic feet an engine takes in just to propel you for a few miles and you'll stick with quality air filters.



This cutaway should give you an idea of the quality of an original equipment Subaru air filter element. The best media tightly packed means better filtration and less engine wear. Cheap insurance, certainly.



Where air filters are concerned, Subaru gives you choices to offer your customers. Left to right, the standard element, an upgraded version that breathes better, and the STI type, the ultimate in performance.

# Filters: Excluding Undesireables



While fuel filter replacement is not a required service per se, Subaru recommends that it be replaced every 30,000 miles "for safe vehicle operation."

Unlike the micron rating of oil filters, air filters are evaluated for life and efficiency using ISO standard 5011. A dust concentration of 0.028-grams/cubic foot is used for single stage elements and twice that for multistage. What the test does is measure how long in hours it takes the filter to become restricted. The capacity of the filter is the amount of dust it's able to hold.

Efficiency is determined in an interesting way. A second filter is placed downstream of the one being tested, and it captures any particles that get past the first. At the end of the tests the downstream filter (referred to as the "absolute filter") is weighed to see how much it has gained, and this result is compared to the total weight of the particles used in the test.

Engine wear can happen with particles as small as 10-20 microns (a human hair is about 50 microns in diameter). Just as it does for oil filters, the SAE sets standards for air filters. Standard J726 looks at efficiencies with particles in the range of 5.5 to 176 microns, from which it assigns a rating. Typical efficiency ratings are in the high 90 percentile (96-98%).

Air filters trap dirt three ways. Interception is just what it sounds like. Dirt particles in the air stream are forced to flow through and around the media and become trapped on the surface. Impaction deals with the inertia of larger particles that don't typically stay in the air stream. They run right into the element and are captured. Finally, diffusion is a strategy used to trap very small particles. The idea is to get them to bounce so that they don't follow the air flow straight through the element, and this sideways movement causes them to get caught even though they may be smaller than the openings in the media.

The replacement interval Subaru gives for the air filter elements in its vehicles is every 30,000 miles, which is convenient since it can be bundled with many other service duties that fall due at that mileage. That doesn't relieve you of the responsibility of checking the element at every oil change, however. If it looks bad even though the recommended interval hasn't yet been reached, you've got another sales opportunity. Be sure to save the old one to show the customer.

## **Fuel Filter Failure Facts**

It's especially unfortunate that fuel filter replacement is frequently neglected. You may have noticed that the ones you remove are sometimes so plugged up you can't blow through them. They may still be doing their job of keeping contaminants out of the injectors, but what's that restriction doing to the fuel pump?

Engineers tell us that the fuel pumps are supposed to last for the life of the car (whatever huge number of miles that translates into today). Late-model pumps have lower amperage draw, better-balanced armatures, and more compatible materials in the brushes and commutator than previous versions did, all done to achieve that goal.

That's fine in theory, but in the real world they often don't last that long. Why? Three reasons: dirt, dirt, and dirt. If you had checked the pump's amperage draw before removing an old, clogged filter, you might have seen up to twice what's normal — say, eight or ten instead of four to six. The simple fact is that a plugged fuel filter will make a pump work harder, and all that extra juice will burn up the brushes and groove the commutator, resulting in a premature failure. An engineer puts it succinctly, saying, "Any time you add backpressure to the system, there's going to be more arcing, heat, and wear."

The idea that clogged filters ruin pumps may not come as a revelation to you, but a related statement from a pump specialist came as one to us: "Remember, whatever you find inside the fuel filter, the pump's already had to eat." Of course! But we'd just never thought of it that way.

After you've replaced a fuel filter, it's a good idea to open it up with a pipe cutter (a hacksaw will throw too many filings into the equation) and take a look at what's inside. If you find lots of rust or other contamination, you can protect your relationship with the customer by showing him or her the evidence, then recommending that the tank be removed and cleaned and the lines blown out. If he or she declines, make a big note on the R.O., and caution that filter replacement should be done more often than the specified interval, which in the case of SOA is a reasonable 30,000 miles (not an actual requirement, but "recommended service for safe vehicle operation").



here's an organization called the Filter Manufacturers Council. Established in 1971, it represents manufacturers of vehicular and industrial filtration products. It was initially developed to monitor regulatory and technological developments that affect the industry. The Council has undertaken several environmental initiatives including partnering with states to promote the proper disposal of used oil filters. With the ongoing support of the Council, the rate of used oil filter recycling has climbed over 50% nationally from near zero just ten years ago.

This is perhaps the most pressing issue regarding oil filters today. Here's what the Filter Manufacturers Council has to say about it:

"The U.S. Environmental Protection Agency (EPA) requires used oil filters to be drained of all free-flowing oil before they are discarded or recycled. Most states follow federal requirements for used oil filter disposal. Currently, U.S. manufactured oil filters are exempt from hazardous waste regulation if the oil filter is:

- punctured through the dome end or anti-drain back valve and hot-drained; or
- hot-drained and crushed; or
- hot-drained and dismantled; or

hot-drained using an equivalent method to remove used oil"

The next logical question is, What is hot-draining?

"Hot-draining is defined as draining the oil filter at or nearengine operating temperature, but above 60 degrees Fahrenheit. In other words, remove the filter from the engine while it is still warm, then puncture or crush and drain the filter. The EPA recommends hotdraining for a minimum of 12-hours, although specific state requirements may vary. Most of the oil is removed from the filter during hotdraining."

"WARNING: Use caution when hot-draining filters to avoid being burned. Protective equipment such as safety glasses and gloves should be worn to prevent injury.

To find out the specific requirements for generators, collectors and processors for your state, call the **Used Filter Recycling Hotline at 1-800-993-4583**. The Used Filter Recycling Hotline is sponsored by the Filter Manufacturers Council and administered by the Motor & Equipment Manufacturers Association (MEMA) Environmental Institute. Callers to the hotline receive an easy-toread summary of their state's filter management requirements; a list of companies in their area that transport, process and recycle used oil filters; and a brochure entitled 'How to Choose a Filter Management Service.'" The site goes on to recommend procedures for recycling oil filters:

"Steps to Recycling Oil Filters

The three steps to recycling used oil filters are:

collection and transporation

processing

recycling by a steel mill into a new steel

If your business changes oil commercially, it is a good idea to voluntarily collect used oil filters from Do-It-Youselfers (DIYers). Businesses currently collecting used oil filters include auto parts stores, quick lubes, and other service outlets. As state agencies see businesses voluntarily collecting filters, there will be less need for mandatory regulations.

In addition, accepting used oil filters from DIYers can be used as a tool to market your business. Studies have shown consumers are more likely to patronize businesses that offer sound environmental management practices.

Before collecting used oil filters, you should arrange for a special waste collection company to pick them up from your shop. Alternatively, if you crush them with your own on-site equipment, you can take them to a ferrous scrap processor.

Once the filters are processed, they are sent to a steel mill or foundry. Some steel mills produce flat rolled steel products by combining scrap products and hot metal from iron ore to make products such as steel cans, cars, and appliances, while others use virtually 100 percent scrap to make products such as rebar and I-beams.

For a list of filter management companies that serve your area for used oil filters, call the Used Filter Recycling Hotline at 1-800-993-4583."

