

TECHNICAL TOPICS

TDR OIL FILTER BUYER'S GUIDE By Arden Kysely

Oil filters! Who cares? Just grab one from the auto supply store or Wal-Mart and put it on when you change the oil. That rugged diesel under the hood of your Ram won't notice the difference, right?

Maybe so, maybe not. Are you willing to bet the service life of your diesel on just any oil filter, or do you want the best protection for your internal combustion investment? Going with the lowest bidder makes sense if all the suppliers sell the same item, like copier paper. But when quality counts, as it does for a critical item like an oil filter, a couple of extra bucks is just cheap insurance against unnecessary engine wear and premature failure. The question becomes, can you afford *not* to care which filter you fit to your truck? I'll try to help you sort this out.

Every brand of truck has their own line of parts, accessories, and filters (if you can't spell Mopar by now, maybe you're reading the wrong journal), and there are plenty of aftermarket suppliers as well. What you may not know, and what seems to be guarded as Top Secret in the automotive industry, is that there are far fewer oil filter manufacturers than there are suppliers. Just because it says ABC on the label doesn't mean that it wasn't made by XYZ. Some folks in the industry don't make a secret of their relationship, such as Wix making NAPA filters, but getting at the truth in other cases can border on industrial espionage, as some manufacturers may have to sign non-disclosure agreements with OEMs and others for whom they build filters. I'll tell you what I think is going on based on our close examination of a group of filters for the 12-valve Turbo Diesel—inside and out.

Who Is This Guy?

First let me introduce myself. My passion is two-wheeled transport and I usually write for motorcycle magazines, which is what Editor Patton reads when he's not boning up on diesel engine part numbers or busy getting out the next issue of TDR. He saw my article on motorcycle oil filters, "Filtering Out the Truth," in the September, 2000 issue of Rider magazine and asked me to do a similar piece for the readers of TDR. The idea was to open up several brands of oil filter, take some measurements, make an educated assessment of quality, and determine as best I could which filters were made by the same manufacturer. Then, with the information my observations and analysis provided, we could help diesel drivers buy a filter they feel confident in, whatever the brand or wherever it's sold.

The Usual Suspects

The Editor chose the 12-valve Cummins 5.9 liter engine application as my target so we'd have a wide variety of brands to choose from. Suppliers have had plenty of time to spec their own filter for that application since that engine/oil filter combo debuted in 1983. Here's our Lucky 13:

- Deutsch D651
- K&N HP 4003
- Mobil M1-403
- Fleetguard 3349
- Fleetguard 3552
- Mopar 5016547AB
- Motorcraft FL896
- Napa 1607
- Penske PN 3976
- Wix 51607
- Hastings LF408
- Purolator L 44422
- Fram PH3976

Is that enough? Too many? We had to limit the number to something I could conveniently work with and report on while still getting a good cross section. So many original equipment manufacturers have an oil filter built to their specification for use with the B series engine use in construction/on-highway equipment that the complete listing was 54 models long. Consider these: OEM's that offer a filter made to their specifications by Fleetguard, Agco, Aveling Barford, Borati, Blaw Knox, Blount, Claas, Clark, Coopers, Crassland, Daewoo, DAF... all the way through Vapormatic, and Volvo. Now consider that Wix, Purolator and other filter manufacturers also private label for OEMs and mass merchandisers and the part number proliferation is likely close to 100!

The Editor did the shopping, plucking filters off the shelves of several auto parts and discount stores, then tried his hand at e-commerce on the Internet. Beneath the fancy paint, packaging, and marketing hype we deduced that our 13 filters probably represent only five manufacturers. Of course that doesn't mean that all filters made in one plant are the same. As our data show, each different brand of the "same" filter may well have different specs for its various components.

Now here's a question that would stump most of the hopefuls on *Who Wants to Be a Millionaire*, "Does the oil flow into a spin-on oil filter via the little holes around the center or the big hole in the middle?" Let's work into the answer by talking about just how a filter operates. After all, a spin-on oil filter is really a disposable machine that keeps your oil from becoming the equivalent of valve grinding paste as it courses through your engine. As soon as a bit of metal is worn off a moving part, it becomes an enemy agent, ready to do damage as it circulates with the oil. The filter's job is to neutralize the threat as soon as possible by removing it from the oil stream.

Oil Filter Anatomy

The open end of an oil filter is the base, a heavy steel disk with a large threaded hole for attaching to the block. Surrounding the big hole are usually six or eight smaller ones, and all together they provide the input/output system for the filter. Sitting in a groove in the base is a rubber gasket, the one you're accustomed to lubing with clean oil before installing the filter. A sheet steel shell or canister, the main body of the filter, is crimped to the base.

Inside the canister may be up to five more components: the filter element or cartridge, a gasket or adapter that fits between the cartridge and the base, a bypass valve, an anti-drainback diaphragm, and a spring. The cartridge is a cylinder of a few dozen pleats of filter media (usually a cellulose-based paper-type product) surrounding a perforated metal core. The filter media is glued to end caps, which are usually metal, to keep it in place. The metal core inside the filter cartridge prevents the element from collapsing under the pressure of the oil passing through. One of the cartridge's end caps has a large hole that matches the threaded hole in the base, and the other may include a bypass valve. Surrounding the center hole in the base and covering the inflow holes may be a anti-drainback diaphragm made of rubber or a similar flexible material. The spring, which can be a coil or a leaf-type unit, fits between the top of the canister and the filter cartridge to hold the cartridge in place. No rocket science here, just a modest little mechanism.

How does it work to protect your engine? Pretty simply, but with lots of leeway for design differences, component qualities, and engineering trade-offs. I've already given away the final answer to the question I posed earlier, but here it is again: during normal operation, oil enters the filter under pressure through the small holes in the base, passes through the filter media, and exits via the large center hole. All the bad stuff stays on the outside of the media, and the oil comes out ready to pick up another load of grunge on its next trip about the block. How much cleaner the oil is when it exits than when it entered depends on the filter media. The most damaging particles have been determined to be in the range of 10-30 microns. Compare that to the typical 70 micron thickness of a human hair and you can see that we're talking about some pretty small stuff.

A bypass valve comes into play whenever the motor needs more oil than can pass through the filter media quickly. It opens when there's a pressure differential between the inside and outside of the filter—a typical value might be 10 psi. When the valve is open, oil bypasses the filter media and shoots straight back to the engine, just like the filter wasn't there. A couple of things can make this happen. The first is cold engine start-up, when the oil is too thick to pass easily through the filter media. The pressure rises because of the restricted flow, the bypass opens, and your cold engine gets the lubrication it needs at a critical time (normal pressure in the 12-valve Cummins is about 40 psi, but may rise to 60-65 psi during cold cranking). The second condition that will cause bypass is hard throttle operations, when oil pressure climbs and the engine needs oil *now*. Oil can also take the short trip through the filter because the filter element is clogged, meaning that *someone* (we won't name names to protect the guilty) waited too long for an oil change. Now with all that behind us, I have to tell you that you won't be seeing any bypass valves in this group of filters for the

simple reason that the bypass mechanism is part of the engine for the Turbo Diesel. I've included a photo of a motorcycle filter's bypass valve (page 29) just to give you an idea of what this spring-loaded button might look like.

Once you get where you're going and shut 'er down, oil pressure drops to zero and the anti-drainback diaphragm, if the filter has one, flops into place to seal off the inlet holes. This keeps a pool of oil in the filter so there's no lag in oil delivery for the next start-up, and prevents unfiltered oil from draining back into the sump. Sure, it would get filtered on its next trip through, but why not clean it while you've got it? The anti-drainback diaphragm is one reason an oil and filter change can use more oil than changing just the oil, and why it's hard to completely drain used filters that are equipped with one before you recycle it (used oil is nasty stuff, so please don't skip the recycling step). As a Cummins diesel owner, you won't have to worry about this. Your filter hangs from the bottom of the motor, so there's no need for an anti-drainback valve on your filter, and none of our test filters sport one. By the way, if you do your own oil changes on another vehicle which uses anti-drainback equipped filters, the best way to drain them before recycling is to punch a hole in the top and set them upside down in a drain pan (just be sure to sign the release in the back of the magazine before you reach for something sharp).

Part is Parts, Or Are They?

Just like your truck, an oil filter is the sum of its parts. If any component is deficient, the whole machine is diminished—but that doesn't mean some parts aren't more important than others. Although it needs all the supporting players to do its job properly, the critical part of an oil filter is the filter media. Different media will not only trap different sized particles, but they can also have different flow rates. The ideal media has two opposite qualities: high flow from large passages, and small particle entrapment by small passages. Energy that's not used to pump oil can go to (albeit, minimal) drive the wheels, so free flowing filters can have a performance impact, too.

Every filter here except the Fleetguard 3552 uses the cellulose-based filter media. The 3552 features Fleetguard's Microglass (patented StrataPore on the LF3894 24-valve filter) media, which is a multi-layer synthetic material. I couldn't tell much difference between the two with my Grandad's old 10-power field lens (except for the Microglass being bright white as opposed to the brownish-yellow color of most cellulose-based media), but Russell Smith at Fleetguard was kind enough to give me some numbers on the filtering efficiency and flow rates of their cellulose media versus the Microglass/StrataPore. According to Smith, the cellulose media removes 30% of 10 micron oil contaminants and 95% of 30 micron contaminants of per pass, whereas Microglass/StrataPore bumps those numbers to 60% at 10 microns and 100% at 30 microns. The best part is that there's no flow rate difference between the two types of media.

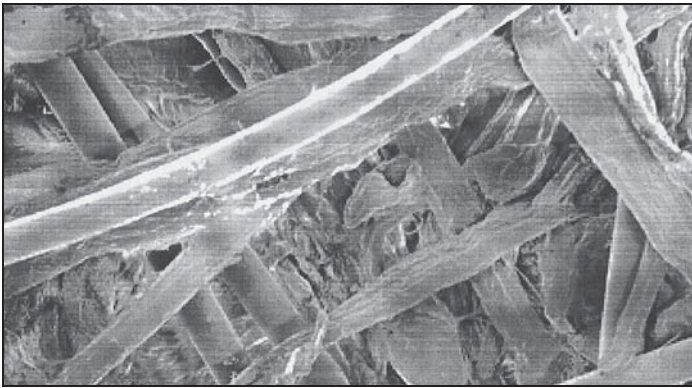
Technically speaking, in the LF3349 (and other paper cellulose filters), the cellulose fiber is covered with a phenolic resin which, when heat cured, gives the media its wet strength. This resin, combined with the irregular size of the fibers, takes up a lot of flow area. This results in fewer paths through which the oil can flow as compared to the Microglass/StrataPore filter media. Also, the

TECHNICAL TOPICS Continued

cellulose paths are irregular (some larger, some smaller), resulting in lower efficiency.

In contrast to the irregular size of the paper/cellulose fibers, the manufacturer of the Microglass/StrataPore filter media can be better controlled. In the case of the Microglass media, the smaller and extremely consistent Microglass fiber creates very small pores for the oil to flow through.

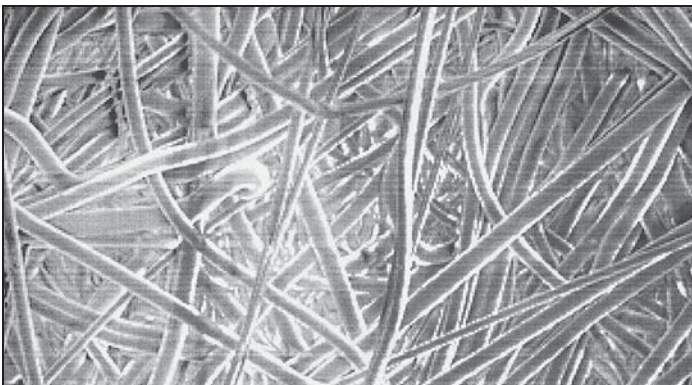
The StrataPore filter media goes a step further. StrataPore is a multi-layer polymeric filter media. Using a Melt Blowing process designed by Exxon, molten polymers are extruded through a spinneret that forms multiple fibers. High temperature, high velocity air is used to draw the fibers to small diameters which are collected on a screen forming a fine-fibered non-woven media. The benefit to the customer: Consistent fiber control in a three-stage (coarse, medium and fine) filter design.



Cellulose filter media.



Microglass filter media.



StrataPore filter media.

A Peek Inside

I performed the surgery with a an oil filter cutter (a big step up from the band saw I used for the motorcycle filters), slicing the nut off each canister just above the crimp, so the recorded weight of the nut includes just a tad of the canister. Likewise, the canister comes up light by the few grams of it that are still with the nut. I weighed everything on a digital scale and measured the filter cartridge exterior and pleat depth with a steel ruler. Pleat depths were taken at three or more places since they tend to vary a bit. My formula for estimating filter media area is length times width, where width is the height of the filter cartridge and length is the number of pleats times the pleat depth, times two because there are two sides to each pleat. Microsoft Excel performed the calculations; any errors in data logging can be attributed to my new bifocals.



Parts is parts? Tools of the trade.

As you can see from the data table (on page 30), the weights of filter components vary somewhat across our samples. For example, the Fleetguard 3349 has one of the lightest bases, but by virtue of its Cummins part number it meets the necessary specs for the 12-valve motor. Honors for the heaviest base belong to Deutsch and K&N, who may have decided to make one base for both the 12-valve motor *and* the 24-valve, for which Dodge has required a heavier base and canister to handle spikes in the oil pressure. (For the latest update on the 24-valve engine's correct oil filter see the "Final Notes" at the end of the article.) For Deutsch and K&N, who also have some of the heaviest canisters, it must make economic sense to build just one sturdy filter to handle all comers, while Fleetguard appears to build to a separate spec for each application.

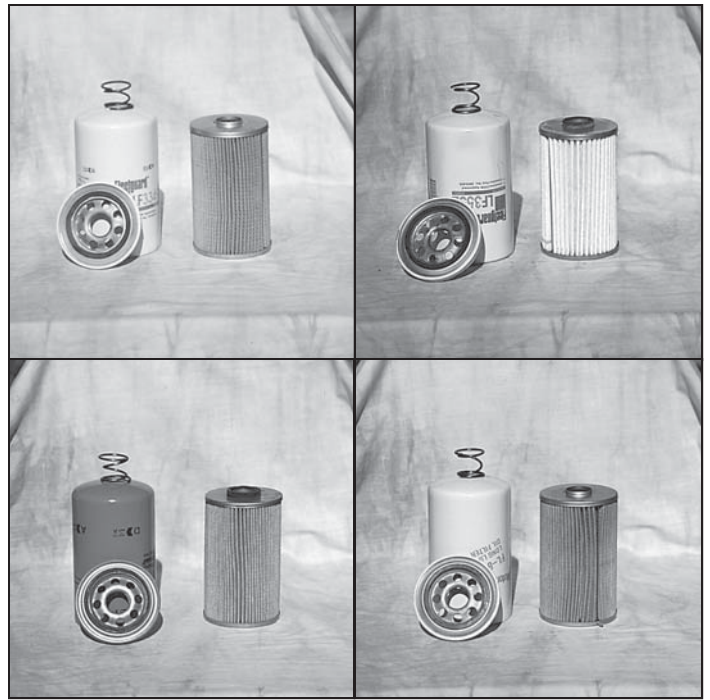
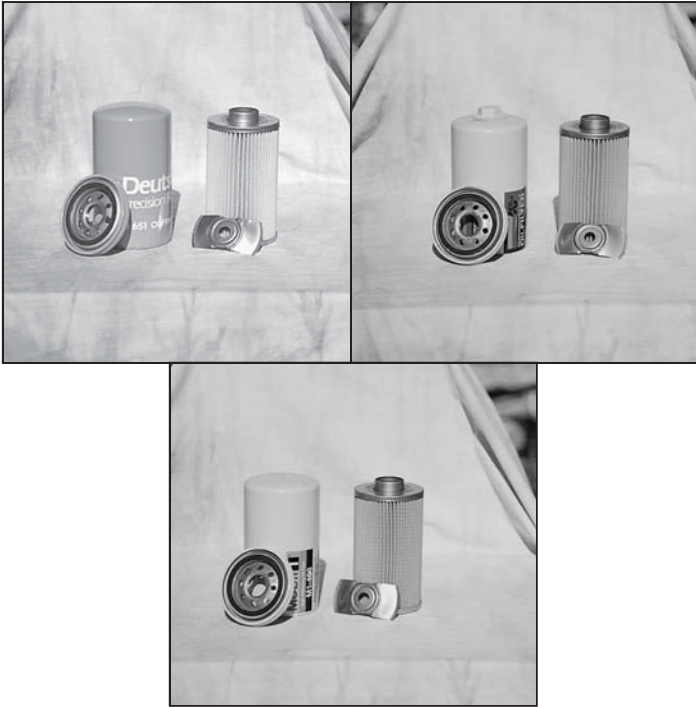
A good example of two filters that appear to be similar enough to have come from the same factory (right down to their squat coil springs) but that are obviously built to different specifications are the Purolator and Hastings samples. There are significant differences in both their base and shell weights. On the other hand, the Wix/NAPA filters are basically identical, with their kissing-cousin Penske differing only slightly. Since it's so easy to tell which filters are related by having a common manufacturer, we've grouped them that way for a discussion of our observations.

TECHNICAL TOPICS Continued

The Filters

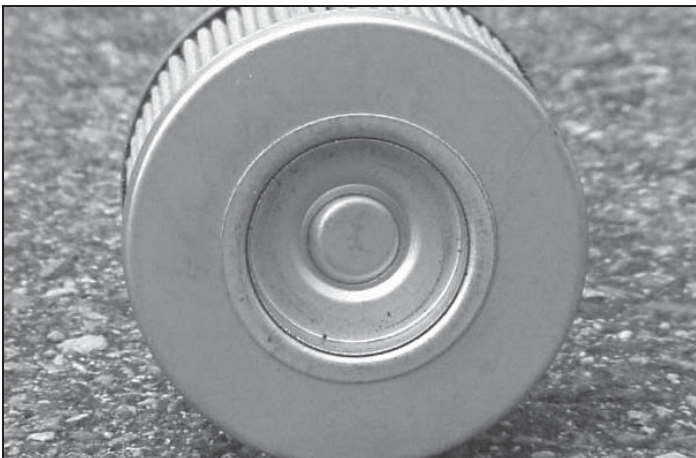
Deutsch D651	\$4.49 AutoZone, Atlanta, GA
K&N HP 4300	\$7.68 Mailorder
Mobil 1 M1-403	\$9.97 AutoZone, Atlanta, GA

Fleetguard 3349	\$4.95 Geno's Garage (mailorder)
Fleetguard 3552	\$8.45 Geno's Garage (mailorder)
Mopar 5016547AB	\$11.35 Dodge dealership, Buford, GA
Motorcraft FL-896	\$10.98 Ford dealership, Atlanta, GA



On the outside, this group is characterized by a heavy base with eight intakes holes, one that's slightly larger than the rest, and the gaskets are pinned to prevent bunching when you torque them down. Inside, the canisters have a long metal protrusion on the open end that mates to the base. In most of the other brands, the cartridge top is flat and a plastic or rubber adapter makes the seal. The filter cartridges have a light colored cellulose media and are held in place by a leaf style spring. The Mobil 1 filter's box claims a synthetic fiber content that removes 98% of the pesky 10-20 micron particles in a single pass. It's not clear if the other filters, which look the same, use the same media. Whatever the case, all of these are stout, well-made filters that should be up to the task of protecting your engine.

The dead giveaway on this group is the "5661" stamped on each base, except for the Mopar, which has "9900". All of the bases have the same hole and weld pattern, but the Motorcraft and Fleetguard 3349 have loose gaskets, while the other two are pinned. Each filter cartridge has a small protrusion on the mating end that's sealed with a rubber gasket and a recess in the closed end for the coil spring. Besides the Microglass-equipped Fleetguard 3552, all of the filter media appears to be identical cellulose and is closed with a metal crimp. The 3552 cartridge weighs a lot more because of a wire mesh backing inside each pleat. Editor Patton tells me the Mopar filter has been superseded by an 'AC' suffix, so if you can't find 'AB' that's why. Since both Fleetguard filters are Cummins OEM replacements and the Mopar unit is built to Dodge's specs, it would be hard to go wrong with any of these filters. I guess the only bad news here is that you could buy your Ram a decent filter (Motorcraft FL-896) at the Brand F shop.



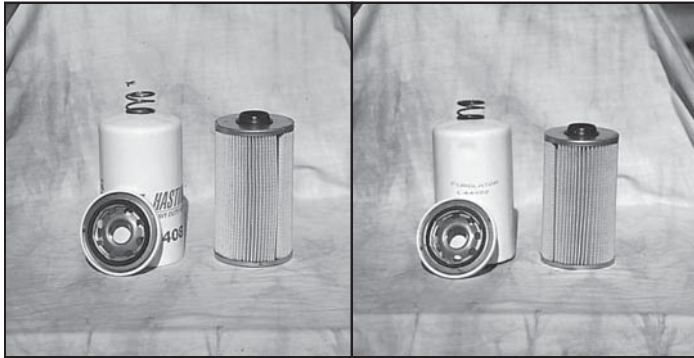
Wondering what a bypass valve looks like?

Picture compliments of Arden's previous article for the motorcycle magazine.

TECHNICAL TOPICS Continued

Hastings LF408
Purolator L44422

\$7.00 Smith's Auto, Derry, NH
\$7.00 Pep Boys, Atlanta, GA



I've mentioned that this pair share an identical coil spring already, but all of the other components are indistinguishable as well—the eight larger intake holes in the base, the plastic adapter between the cartridge and the base, and the unpinned external gaskets. But once you study the component weights, the differences pop out: the Purolator parts are heavier in both base and canister than the Hastings, but the Hastings has a few more pleats of filter media, giving it the most filter area of the bunch. Is one better? We can't say from this level of analysis, but if the Hastings does the job, there's no reason to think so. In fact, its larger filter area should handle a higher load of contaminants before clogging (though I hope you change your filters long before that becomes an issue), and provide better flow-through in the meantime.

Fram PH3976

\$3.97 Wal-Mart, Cumming, GA

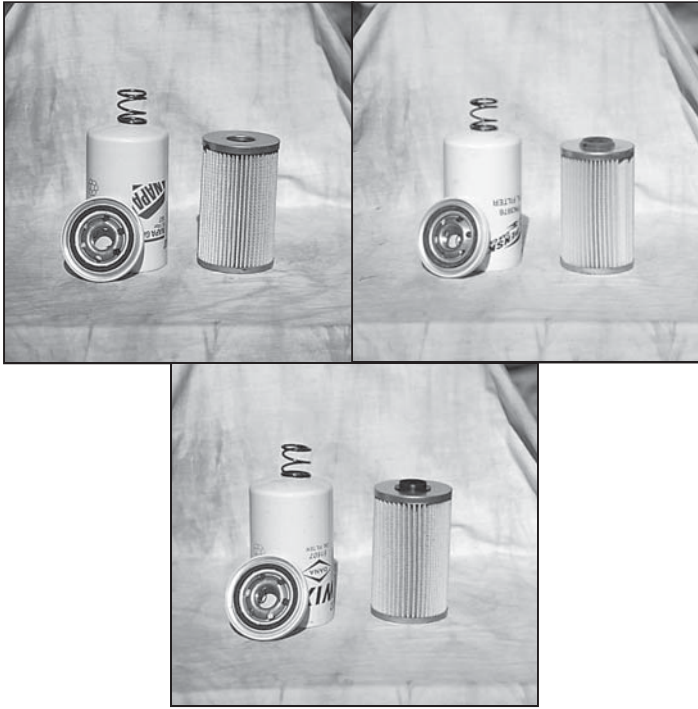


The bright orange Fram filter is the loner of the bunch, so different inside that it's unique within our survey. For starters, the filter cartridge is open on both ends instead of being sealed at the top by the end cap like the others. The leaf spring that holds the cartridge in place does double duty by plugging one end, while another metal piece makes the connection to the oil outlet hole on the other. Also different is the cartridge end cap material—cardboard instead of metal. It may work OK, but doesn't give this evaluator the same feeling of quality construction found in the rest of the filters. The Fram also has the least amount of filter media inside of the filters with a cellulose-based media. Externally, it has a medium-heavy canister and heavy base with eight large intake holes and a pinned gasket. The Fram may do the job, but I didn't get a warm fuzzy feeling after examining it.

Make	Part Number	Nut Weight (oz)	Shell Weight (oz)	Filter Weight (oz)	Filter Area	Height	Pleat Depth	Number of Pleats	Diameter	Shell Thickness (inches)
Deutsch	D651	7.8	6.4	6.2	478.13	5.3125	0.7500	60	3.3750	0.0185
K&N	HP 4003	7.8	7.0	6.2	416.37	5.3125	0.6875	57	3.3750	0.0188
Mobil 1	M1-403	7.6	6.4	6.6	487.27	5.6250	0.6875	63	3.3125	0.0179
Fleetguard	3349	6.0	4.8	6.4	517.97	5.3125	0.7500	65	3.3750	0.0138
Fleetguard	3552	6.0	5.0	11.4	382.50	5.3125	0.7500	48	3.3750	0.0155
Mopar	5016547AB	7.6	6.6	6.6	548.44	5.6250	0.7500	65	3.3750	0.0180
Motorcraft	FL896	6.0	4.8	6.2	510.00	5.3125	0.7500	64	3.3750	0.0139
NAPA	1607	7.0	5.0	5.8	435.09	5.6875	0.7500	51	3.4375	0.0165
Penske	PN3976	7.0	5.2	5.6	471.35	5.6875	0.8125	51	3.3750	0.0160
Wix	51607	7.0	5.0	5.8	469.22	5.6875	0.7500	55	3.4375	0.0163
Hastings	LF408	5.6	4.8	7.4	594.00	6.0000	0.7500	66	3.4375	0.0125
Purolator	L44422	6.2	5.6	7.4	576.00	6.0000	0.7500	64	3.3750	0.0160
Fram	PH3976	7.4	5.2	5.2	388.13	5.7500	0.6250	54	3.1250	0.0159

TECHNICAL TOPICS Continued

NAPA Gold 1607	\$7.00 napaon-line.com
Penske PN3976	\$5.89 K-Mart, Atlanta, GA
Wix 51607	\$6.07 Fleet Pride, Conley, GA



Six big intake holes feed dirty oil into this group of filters, where it is cleaned by filter cartridges that appear identical. One small difference is that the Penske uses a rubber gasket mating piece between the base and filter cartridge where the Wix and NAPA use plastic. As the data show, the Penske also has a slightly heavier canister, but the base components are identical, right down to the number "63926" stamped on the inside of each one. Wix, which patented the first spin-on oil filter in 1954, knows how to make a good filter and it shows in each of these examples.

In the End

We can't even start to pretend that what you've read about these filters is pure science, and we certainly aren't equipped to put them through their paces in a controlled filtering environment, such as the SAE's J806 Multi Pass test, but after getting inside those metal skins we can come to the conclusion that it's not hard to find a good oil filter for your Turbo Diesel. And it's nice to note that they're all made here in the USA. Basically, if it fits your truck, doesn't leak or blow off, and cleans the oil without degrading the oil circulation through your engine, a filter does its job. The only thing that stands out here is the improved filter media of the Fleetguard 3552. Sure, with enough passes the cellulose will capture all the bad guys, but when you consider they could be making another rampage or two through the your engine's bearings and valve gear than they would with Microglass/StrataPore on board, it's kind of like picking off Frank James while leaving Jesse and the rest of the gang to terrorize the countryside. A good sheriff will round them all up as soon as possible to limit the damage they do.

Arden Kysely
Santa Barbara, CA

CAN'T JUDGE A BOOK BY IT'S COVER?

Editor's notes: I hope you found Arden's general overview of filter construction, tear-down, visual analysis and weight measurements somewhat helpful. You say you want more? Consider the following point/counter-point posted by a TDR member on the web site. Gary-KJ6Q was responding to an oil filter expose at www.members.xoom.com/minimopar/oilfilterstudy.html. A quick review of the site sets the scene for Gary-KJ6Q's response. The site features a view of the filter's internal components similar to the work that Arden has done for us.

And the counter-point response from Gary:

That old "oil filter study" is so old it has whiskers – and equally worthless!

It isn't an actual study at all – merely cutting up of various brands/models of filters, and assumptions as to what was seen.

In actual testing, you must actually use the filters under test, and measure the various parameters associated with filter operation – does it actually pass the proper volume of hot/cold oil, or immediately go into bypass mode – does it filter down to a specific contaminant size – does the bypass/drainback perform its job – regardless of materials used...

It's entirely possible for a well designed "cardboard" valve to function better than a poor metal or plastic one in actual use – just as it is for less volume of a good filter medium to filter more effectively than a larger volume of a poor one!

Attempting to somehow judge effectiveness of various filters by visual inspection alone is pretty much like trying to select the difference between a Cummins and International using the same methods – looks alone can be very deceiving!

Arden and I discussed the counter-point comments.

We're in agreement with Gary, you can't tell a book by its cover. However, I do trust Arden's judgement in assessing overall quality by visual inspection of the fit, finish, seams, pleats and materials used in the filter.

We're also in agreement that filter testing results would be the ultimate in investigative research. We don't have the resources for such a test. Additionally, consider we would test for only one model of a filter – the test results could not be used as a carte blanche assumptive for a manufacturer's entire product line.

Where does that leave us? Do you trust the technical engineering staff at Fleetguard and, thus, the discussion covering the Microglass and StrataPore filter media? Again, a quote from the web site discussion sums up the Editor's feelings, "I stick with the Fleetguard (or Mopar as made by Fleetguard) filter. It works and it gives you peace of mind. The filters can be purchased locally or by mail-order at a competitive price."

TECHNICAL TOPICS Continued

FINAL NOTES: 24-VALVE PART NUMBERS

For 24-valve owners the story is a bit complicated. To start, we documented back in Issue 18 that the Dodge 24-valve engine has a different oil filter than does the Cummins 24-valve engine in other on-highway motorcoach applications. As many have learned the hard way, if you request a 24-valve ISB-type filter at a Cummins shop you'll receive a filter with a larger diameter threaded nut assembly. Like screwing a 1/2" nut onto a 3/8" bolt, the filter does not fit.

To avoid parts conflict in the field, Dodge wisely requested "their" Cummins engine keep the same diameter threaded nut assembly as the previous 12-valve generation vehicles. The Mopar filter for 24-valve applications is 5016547AC, corresponding to Fleetguard LF3959. As you can tell from the "AC" Mopar designation, the filter has been superseded three times! Previous TDR magazines (Issue 26, page 28; Issue 28, page 44, Issue 30, page 55) documented the changes to the oil filters.

To save you from thumbing through the old magazines (and for new members) the following is a summary of the changes.

The first change to the 501647AA/Fleetguard LF3885 involved Mopar specifying that the filter have a thicker filter shell, a heavier thread nut assembly, and a thicker rubber sealing gasket. The changes were to prevent oil leaks due to cold weather oil pressure spikes inherent with the 24-valve engine's oiling system.

Then came a change in the composition of the rubber sealing gasket. Again, the Mopar and Fleetguard part numbers were superseded; new number was 501647AB/LF3935.

The latest change to the oil filter is applicable for all 24-valve

engines and affects the rubber sealing gasket retainer. The revised gasket retainer will lower the torque necessary to remove the filter.

The gasket was previously wedged into its retainer. When the filter was installed, the gasket would rub against the filter head as it was turned into place. This caused excess removal torque. The revised retainer allows the gasket to float in the retainer and thus lowers the removal torque. The revised part numbers are 5016547AC/LF3959.


To be up-to-date, and "technically correct," the part number you should use for all Cummins engines in Dodge applications is Mopar 5016547AC.

If a customer wants the benefit of the internal StrataPore filter media, the LF3959's crossover equivalent continues to be the LF3894 StrataPore.

Note that unlike the supersession of Mopar numbers 501647AA/AB/AC and Fleetguard numbers LF3885/3935/3959, the part number for the Fleetguard StrataPore LF3894 has not changed as time has passed. Rather than change the part number, Fleetguard made the effective rubber seal composition and seal retainer revision without changing the part number of the LF3894. Thus, unless Fleetguard makes an unexpected part number supersession, LF3894 is the correct StrataPore filter for your 24-valve engine, 24-valve HO engine, or older 12-valve engine.

To be "technically correct," however, the LF3894 is not the right filter. Mopar 5016547AC is the correct filter.


Clear as mud?
Robert Patton
TDR Staff



GENO'S GARAGE

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CUP HOLDER IMPROVES FUEL MILEAGE BY 5%



The audience comments, "Now I've heard it all." While the mileage savings may be fictitious, the Cup-Smoothie (for five- and six-speed owners) will reinforce smooth gear shift changes. And smooth gear changes with a smooth right throttle foot will net better mileage. Hence, the "Smoothie" title for our product. For automatic owners there is not a gearshift lever/cup holder close fit, thus no outlandish mileage comments. The console mounted cup holder is form fitted to the inside diameters of the console. Using a 1"x6" Velcro strip, the cup holder attaches to the inside of the console. With the Cup Smoothie, you've instantly increased storage and cup holding capacity of your truck.

Cup-Smoothie
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