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Saturday, February 18, 2012

K and N/ High Flow Air Filters: Test #3

High Flow Automotive Air Filters Part 3: AnthonyS tests

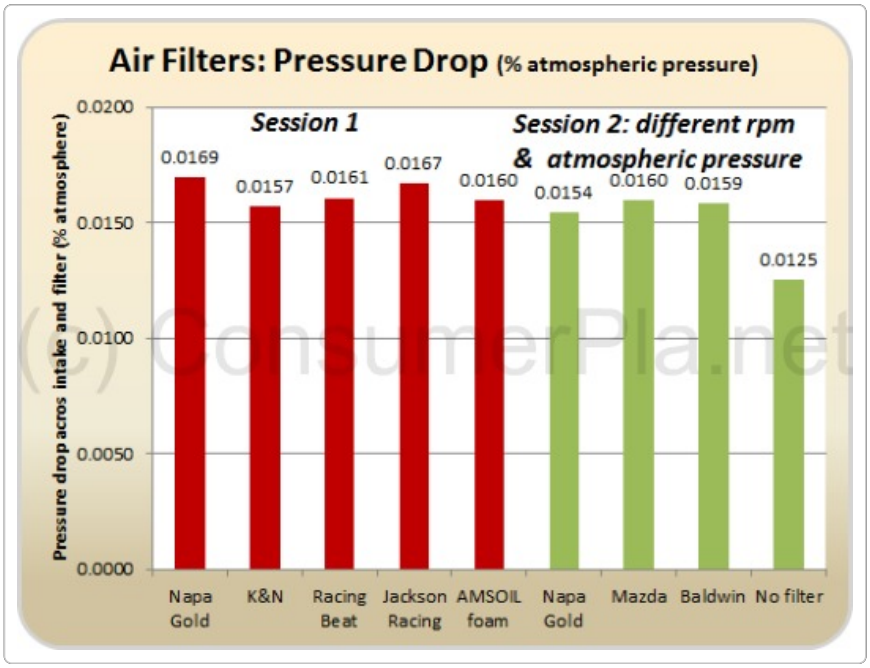
ton bobistheoilguy, probably the best forum site for lubrication issues on net forums.

The **results** of the Spicer/TESTAND standardized 5011 tests for air filters pointed at a very clear pattern: K&N (cotton gauze) and AMSOIL (foam) filters had less flow restriction when clean, but more flow restriction when dirty than the standard AC Delco OEM air filter replacement, and there was a dramatic difference in filtration efficiency, to the advantage of the AC Delco filter. We wanted to get some corroborative evidence, to avoid the possibility of commercial collusion or test errors. We found AnthonyS' tests on bobistheoilguy, run in 2003. AnthonyS, a user of K&N filters, decided to conduct a low budget test on air filter efficiency.

AnthonyS is a forum member of the bobistheoilguy site, which archived a discussion thread on his tests. According to what he writes, he is deeply familiar with automotive technology, and has a BS in Mechanical Engineering. AnthonyS conducted both flow and filtration tests on a set of filters, including oiled cotton filters (K&N), foam (Jackson Racing, Racing Beat, AMSOIL previous generation), and paper or similar fiber-based media (Napa Gold, Baldwin, Mazda).

Air flow

For the flow tests, AnthonyS mounted a Dwyer water manometer on the intake, to measure the pressure drop from the atmosphere across the intake and filter, and took 4 successive measurements for each filter, which he compared to intake pressure drop only.



Because there are two different sessions where car rpms are different (6,000 rpms vs. 6.500 rpms) as is atmospheric pressure, it is not possible to compare all brands to each other, but the test clear shows that:

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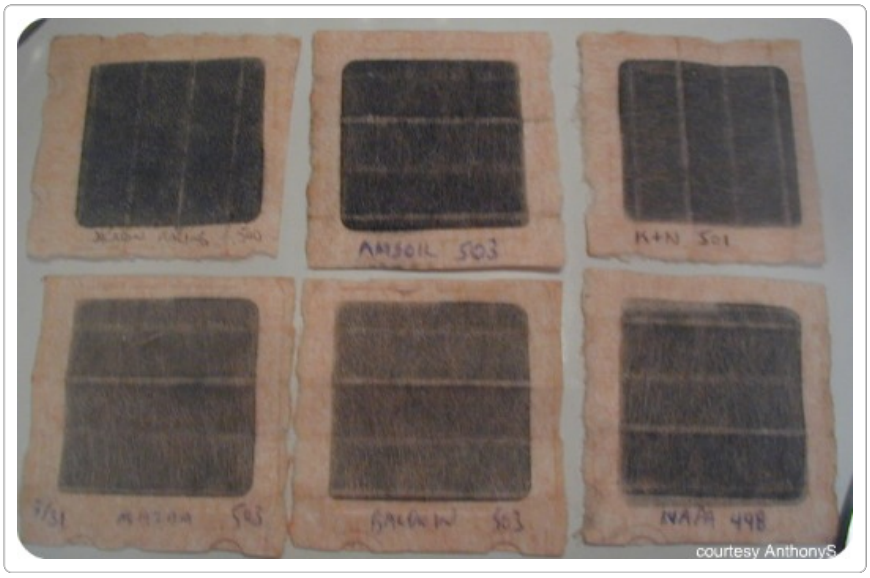
- all paper filters are roughly equivalent in flow
- the K&N filter flows better than the other filters, although the difference is only 1.4% of atmospheric pressure, probably only noticeable in a racing environment.

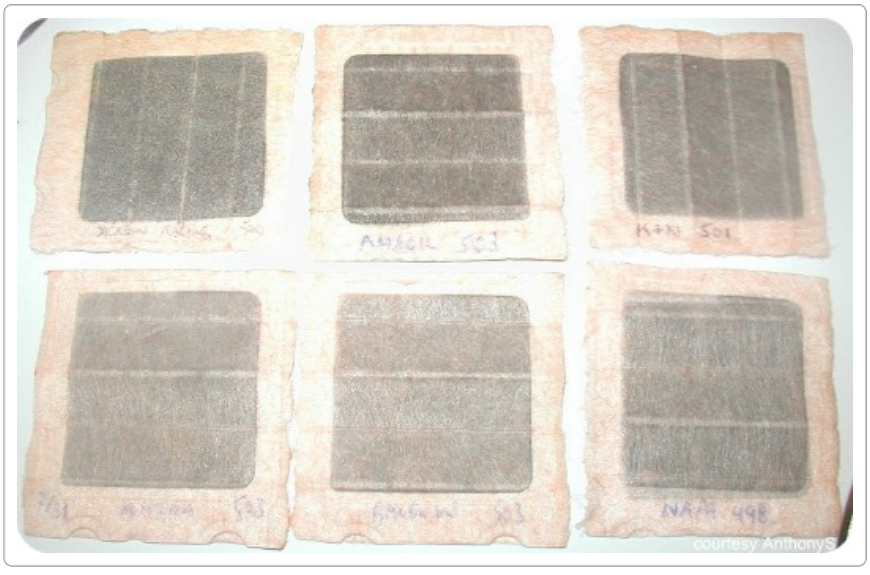
Our conclusion on flow tests is that we have corroborating evidence from two tests on the relative superiority of K&N filters as far as air flow is concerned - although it is appears to us that, for regular driving use, the difference may not be noticeable.

Filtration Efficiency

In order to measure filtration efficiency, AnthonyS inserted a secondary air filter downstream of the primary air filter, and run 500 mile tests with each filter, after which he had a third party (his wife:-) evaluate filter color.The darker secondary filters indicated the filters with worse filtration efficiency.



No flash



Flash

The color judge evaluated all paper filters as roughly the same, and definitely lighter than the foam and cotton filters. She rated AMSOIL and K&N filters roughly at the same level, with a possible advantage to K&N. The pictures tell the same tale.

We conclude from AnthonyS' filtration tests that paper filter filtration is more effective than cotton or foam, a result which corroborates the filtration findings of the previously reviewed ISO 5011 test. While we do not believe that it ranks at the level of incontrovertible evidence because of weaknesses in experience design, we feel that AnthonyS' air filter test is appropriate as

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corroborating evidence.

Next we discuss the conclusions to draw from the data we uncovered on high flow automotive air filters... So come back soon!

Posted by George Gear at 10:21 AM 1 comments Links to this post

Labels: Automotive, cars

Reactions: funny (0) interesting (0) cool (0)

Friday, February 17, 2012

Best Air Filters: SwRI/AEM 2007 Tests

Best Air Filters Review Part 7: SwRI/AEM 2007 air filter tests

Air filters: how do you prove that your product is superior? In a field where technical performance is critical, you can ask a prestigious third party to test the competitive field for you. This is what AEM did in 2007, when they commissioned a prestigious third party research lab, the Southwest Research Institute (SwRI), to compare drop-in filter performance across all its competition. SwRI produced, as expected, an outstanding research report, whose only -minor- weakness is that the samples to test were actually provided by AEM. AEM does not provide the link any more, and it took us a lot of research to actually locate it.

Is AEM's sponsorship of these tests a credibility issue? We spent a good amount of time debating this question at ConsumerPla.net. Our conclusion is that it does not significantly impact the credibility of the report, expect, possibly, in one respect. The test procedure is standard, and was led by SwRI in isolation with no participation from AEM personnel. The samples were provided by AEM, which is the sole significant weakness of the test. From SwRI comments, it appears that competitive samples were not, in general, damaged or skewed, with one minor exception which we discount, where dust spots appeared on one competitive filter. At worst, the only skew in this regard would be that AEM would have made sure to provide a non-faulty sample of its own filter. AEM has a good reputation as a provider of quality hardware, and we do not believe that this introduces a significant restriction to the validity of the tests. As for the possibility of selective quoting form the report, it is non-existent, as SwRI requires that the totality of its reports be quoted when some of it is. Indeed, we had access (as you can too) to the totality of the SwRI report. Our conclusion, then, is that the report can be considered a valid third part comparison report.

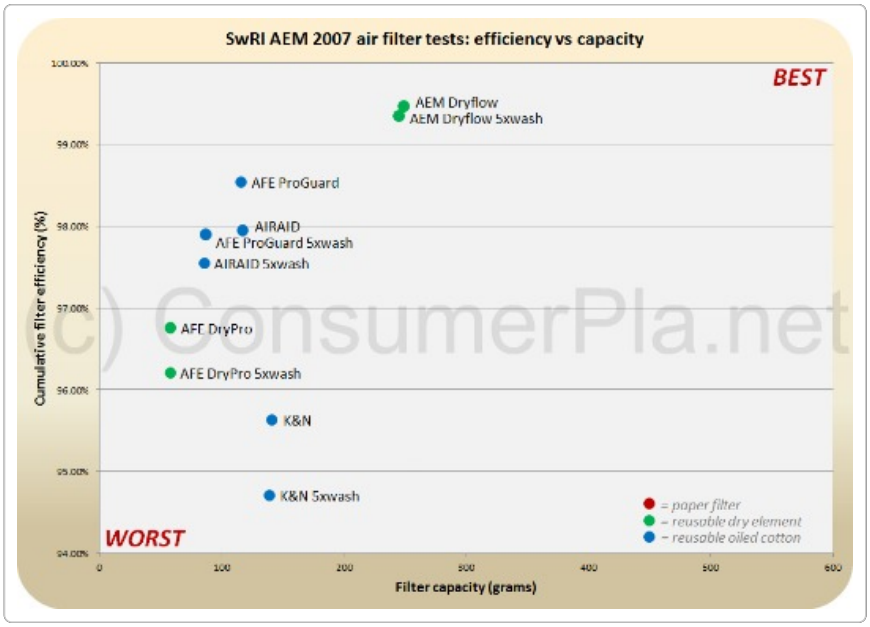
SwRI tested the air filters requested by AEM through the whole regular procedure outlined by ISO 5011, using ISO 12103-1, A2 fine test dust (0-80 microns) as a test medium. The choice of the dust is an interesting one. Manufacturers typically ISO 12103-1, A4 coarse test dust (0-180 micron size), because the results are better (coarse particles get filtered more easily). Since AEM paid for the tests, they must have requested fine test dust, which indicates to us that the AEM filter probably tests better against its competitors with fine test dust than with coarse test dust. We find this a very positive attribute for AEM, as fine test dust is more likely to approximate real use patterns. Since both the *Jeep Magazine* study and the present one use fine dust (as opposed to the Spicer/Testand study), their results can be compared with more validity.

The selected air filters represented a majority of the high end air filters available in North America, which, unfortunately, does not include good quality throw-away paper filters in AEM's eyes: we would have liked to see some included, as they were in the Spicer/Testand study. The list:

- AEM Dryflow filters are dry element filters that are reusable and washable
- AFE Dry Pro S filters are dry element filters that are reusable and washable
- AFE ProGuard filters are oiled cotton filters with an additional synthetics barrier to enhance filtration - they are reusable and washable, and need to be re-oiled before use
- AIRAID filters are oiled cotton filters, also with an additional synthetic barrier ("Synthaflow") to enhance filtration - they are reusable and washable, and need to be re-oiled before use
- K&N filters, the most common premium filters on the market, are oiled cotton filters - they are reusable and washable, and need to be re-oiled before use.

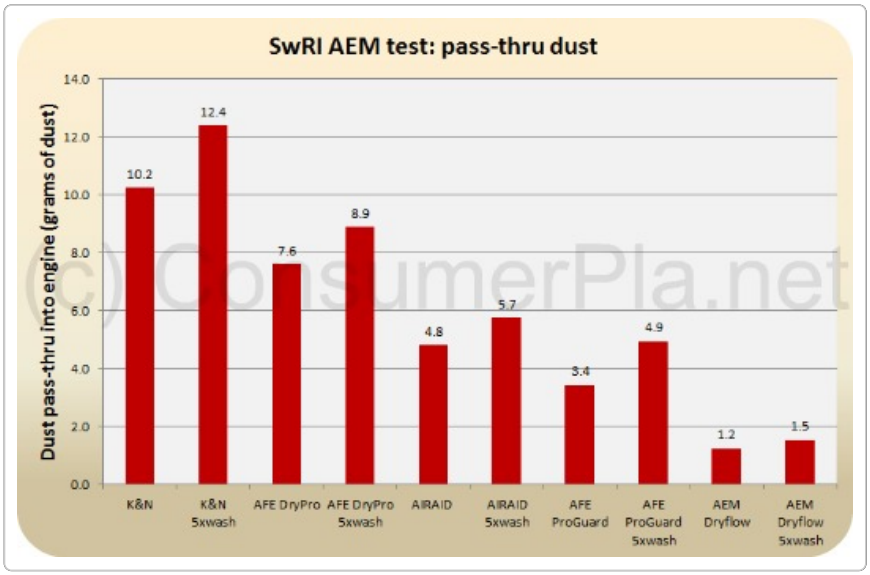
We already saw performance analysis of K&N and AFE Proguard filters in the Spicer/Testand study, and of AEM and Airaid in the *Jeep Magazine* study. It is interesting to note that the results we found for AEM, K&N, AFE and Airaid filters are basically reinforced by the present one, which confirms our analysis that the present study is not damaged by AEM's sponsorship. There are two types of AFE filters in the SwRI study: while the Dry Pro S series consists of dry elements, the ProGuard product line requires oiling. AFE sales people typically recommends AFE ProGuard filters as the best filtration elements their company provides. The results of this study confirm their statements.

An interesting aspect of this study, which was not performed by any other, is that SwRI also studied the performance of the filters it tested after multiple washes. It is particularly interesting, as these reusable filters are all sold with the expectation that they will last the lifetime of the vehicle - true for all reusable filters we know of expect for AMSOIL filters, which are sold for 100,000 miles or 4 years, whatever comes first. The present study tested clean filters, then used and washed them five times, then tested them again after the fifth wash. The results are interesting:

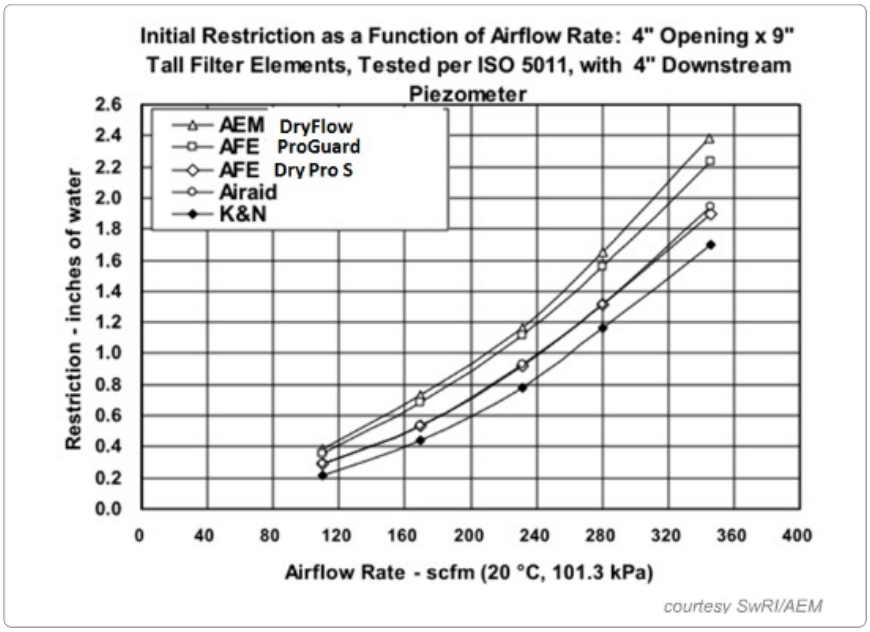


As already noted in the *Jeep Magazine* study, the present test highlights the fact that high end filters actually show less capacity than throwaway paper filters as shown in the Spicer/ Testand study. As in the Jeep Magazine study, AEM scores highest in filtration efficiency. Its capacity appears to have improved since 2006, and tops other filters as well. There is no degradation of either efficiency or performance with the number of washes. As usual, K&N scores lowest in filtration efficiency, but comparatively well in capacity. The AFE ProGuard and AIRAID filters show somewhat comparable performance, with a little edge for the ProGuard. They both lose a small amount of efficiency and capacity with reuse. The AFE Dry Pro filters scores behind all brands except K&N in filtration, and behind all others in capacity. It loses some efficiency with reuse, as does the K&N. Overall, the AEM filter does extremely well in this study so far.

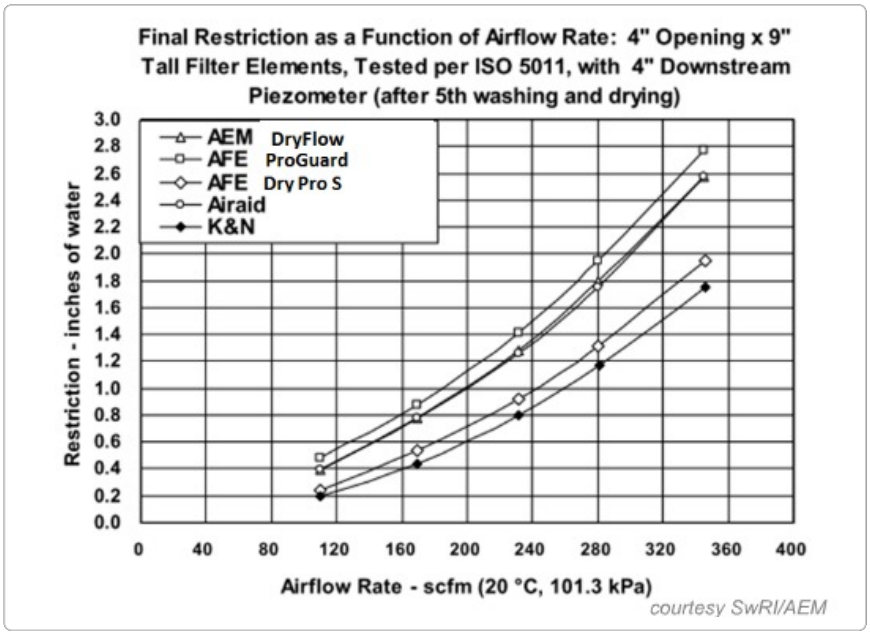
How much impact does efficiency have on how much dust passes through into your engine? The average filter capacity for all filters surveyed across the present series is 234 grams.Taking this amount as the average quantity necessary to clogging your filter, this is how much pass-through dust would make it into your engine combustion chamber:



The difference between some of these filters is shocking, given how engine wear directly correlates with the amount of dust particles in the combustion chamber. So far the AEM filter has scored significantly above the others, while the K&N and the AFE Dry Pro S have trailed. For the sake of giving a complete picture, we will also cover what the tests have to say about air flow performance, although we consider it a minor criterion.

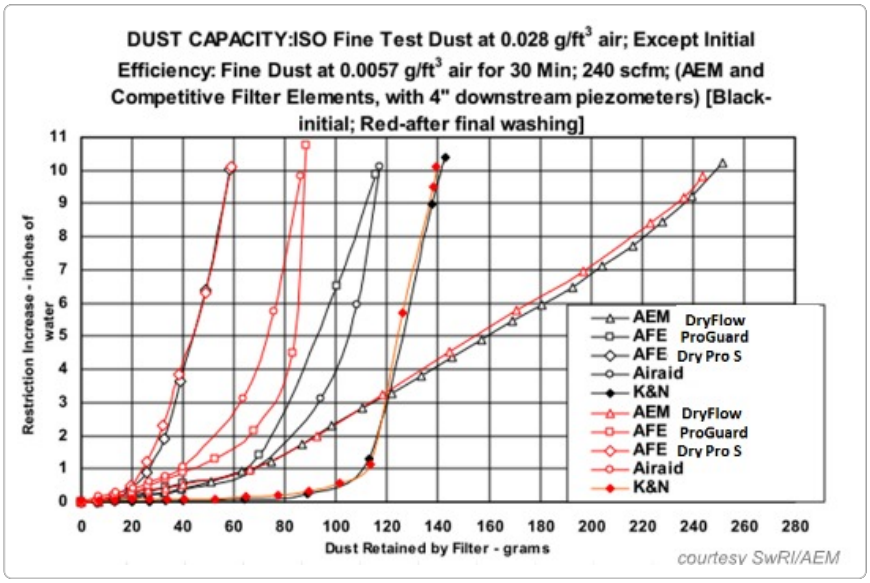


When looking at initial air flow performance, with a new filter and no dust in the filter, we find the K&N filter significantly ahead in performance, followed by the AFE Dry Pro and the Airaid. It is probably no coincidence that the K&N and the Dry Pro filters also account for the worst filtration performance of the lot - the Airaid performance is all the more meritorious. The AFE Proguard follows, and the AEM Dryllow brings out the rear. The situation changes somewhat when we look at the filters after 5 washes:



After 5 washes, the K&N still handsomely leads the field, followed closely by the AFE Dry Pro. The Airaid's performance has somewhat receded, while the AEM Dryflow's has improved, and they now perform equally well. The AFE ProGuard now trails the others.

The curves we looked at above assume a clean filter. Another dimension that is worthwhile looking at is airflow vs. clogging: what happens as more dust settles on the filter: what happens as the filter is actually being used? The results are, once again, interesting and surprising:



This diagram is particularly interesting, as it explains why the AEM filter has the better capacity. The K&N shows by far the better air flow as dust increases, until it reaches close to capacity, at which time it suddenly clogs quickly. The behavior is duplicated by all other filters except for the Dryflow, with the difference that these other filters have a lower capacity than the K&N (and lower airflow as well). The AEM Dryflow starts somewhat high, but it airflow performance worsens only slowly and linearly with dust deposit, while all other filters degrade drastically in performance significantly before approaching capacity.

Let's face it: the SwRI/ AEM study is a victory for AEM, even if the test format was chosen by that company. The AEM filter showed itself excellent at filtration and with good capacity, while its airflow performance was middling, although improving with use relatively to other filters. The K&N filter, on the other hand, did poorly in filtration, had decent capacity, and showed excellent performance in airflow. The other filters did not excel in either field. There is more discussion on these and other SwRI tests commissioned by AEM on automotive.com, sporttruck.com, NASIOC, Don McBride's Air Filter Notes and VW Vortex (although the links to the SwRI tests are not active

any more, following the 2010 acquisition of AEM by K&N).

Next we discuss the ISO 5011 S&B tests published by S&B... So come back soon!

Note: accidentally published out of sequence

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Posted by George Gear at 8:01 PM 0 comments Links to this post

Labels: Automotive, cars

Reactions: funny (0) interesting (0) cool (0)

Thursday, February 16, 2012

Best Air Filters: Jeep Magazine 2006 Tests

Best Air Filters Review Part 3: *Jeep Magazine* air filter tests

In November 2006, *Jeep Magazine* published a series of air filter tests comparing leading high-end drop-in air filters. Because they dealt with off-road vehicles, they decided not to test paper-based filters, which can collapse with water, and focused on reusable dry elements and oiled cotton filters. We feel that this was a mistake on their part, probably due to the fact that they underestimated the performance of standard paper-based filters.

Many auto mags spend a lot of time with dynamometer ("dyno") testing to evaluate torque and HP gains from stock modifications. Interestingly, *Jeep Magazine* discounts such testing for air filters: "if you've got a stock engine, basically any filter will flow enough air to keep it happy. And you aren't going to pick up any power from a filter swap alone. The restriction in the stock Jeep is the stock air-intake system, not the filter." Instead, like us, they focus on cumulated efficiency and dust capacity.

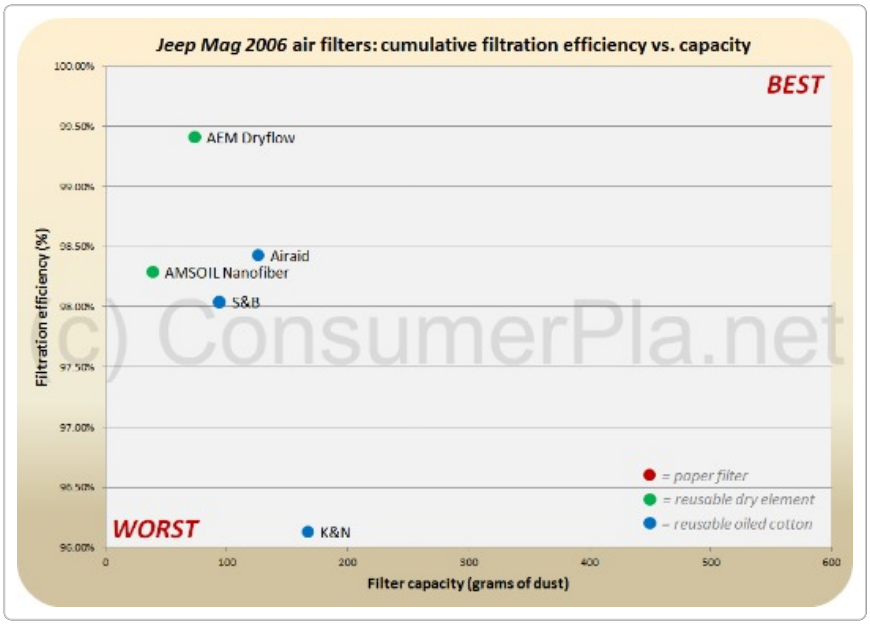
Like the Spicer/ Testand study, the *Jeep Magazine* team ran ISO 5011 tests. However, they used ISO 12103-1, A2 fine test dust (0-80 microns) in their tests rather than ISO 12103-1, A4 coarse test dust(0-180 micron size), which was used in the Testand tests, because they felt that fine dust matches standard vehicle use better than coarse dust. We agree with them - but we need to note that, as a result, the *Jeep Magazine* tests cannot be directly compared with the Spicer/Testand tests. Manufacturers typically use coarse test dust because the are allowed by the standard and the results are better.

Jeep Magazine selected five filters for its tests (the FRAM AirHog is also listed but is not evaluated). All of them are considered premium filters, reusable, and are significantly more expensive than regular paper filters.The list:

- The AEM DryFlow is a dry element filter, made of polyester with a nylon cage. Its nominal filtration efficiency is quoted as 99.4%. It is reusable and can be washed.
- The Airaid is an oiled cotton filter than uses an additional synthetic fiber barrier to enhance filtration. *Jeep Magazine* quotes its nominal efficiency at 99.997% down to 10 micron. It is reusable and can be washed, although it also needs to be re-oiled prior to reuse.
- The AMSOIL EaA filter is a dry element filter, which mixes cellulose (paper fiber) with synthetic nanofibers (Donaldson technology). It is reusable and can be vacuumed/ air-blown for up to 100,000 miles or 4 years (whatever is less). This AMSOIL nanofiber filter is the present generation of AMSOIL filters, whereas the one reviewed here was from the previous AMSOIL product generation.
- The K&N was already described here. *Jeep Magazine* reports its efficiency as 97-99%.
- The S&B is an oiled cotton filter similar to the K&N filter. Its efficiency is claimed to be 99% for coarse dust.

Once again, the results are enlightening, although a bit less surprising to us, since we had already reviewed the Spicer/ Testand tests. The results mostly do not match manufacturers claims, but we should again bring attention to the fact that manufacturers' tests typically use coarse test dust.

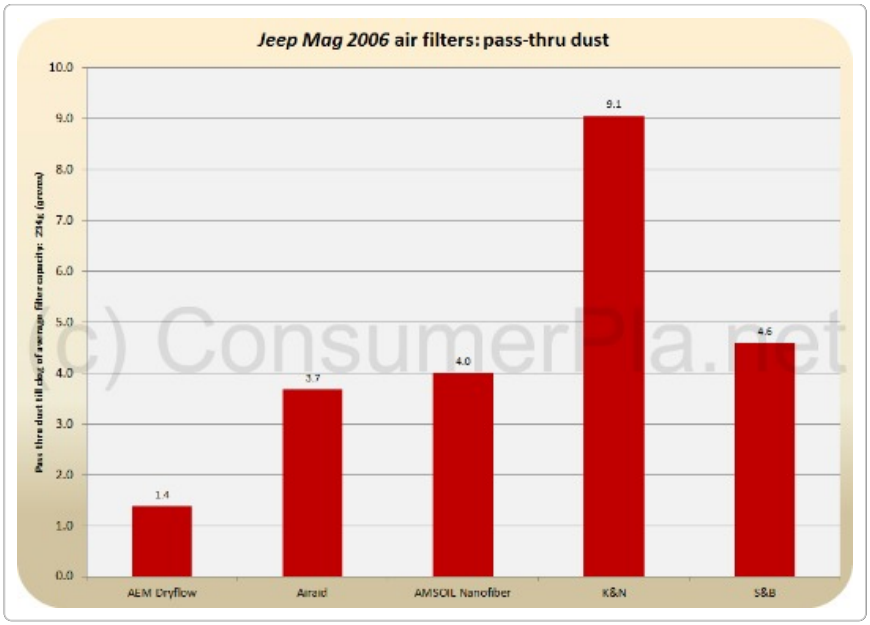
Coarse test dust leads to better test results, but probably does not match real life use as well as the fine test dust used in the *Jeep Magazine* tests.



The capacity of all these filters is significantly lower to that of many surveyed in the Spicer/Testand study. Some of it is due to the choice of filters in both studies: *Jeep Magazine* did not select any paper filters, which have significantly higher capacity. We suspect, however, that the other reason is the difference in dust: fine test dust probably ends up clogging filters faster than coarse test dust.

In this test again, K&N ends up last in filtration. It would probably end up first in flow - but the magazine did not conduct flow measurements. Airaid and S&B appear to have similar performance. The AMSOIL nanofiber filter appears to have a shockingly low capacity compared to the others. The AEM filter shows up superior filtration performance, along with low capacity.

The difference in filtration performance between a filter at 98.5% cumulative efficiency and one at 99.5% might appear small. But each fraction of a percent means more dust showing up in the combustion chamber of your engine and leaving more wear scar in it. We calculated the average capacity of all the air filters we surveyed in this series at 234 grams. If we run 234 grams of dust through these filters (i.e. enough to clog the average air filter in this study), this is how much dust will end up in your engine:



There is a shocking difference between some of these filters in terms of pass-through dust.

Next we review the 2007 air filter study and ISO 5011 tests by Southwest Research Institute... So come back soon!

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Posted by George Gear at 8:40 AM 0 comments Links to this post

Labels: Automotive, cars

Reactions: funny (0) interesting (0) cool (0)

Wednesday, February 15, 2012

K&N Air Filters: Testand Tests

Best Air Filters Review Part 6: Spicer/ Testand filtration tests

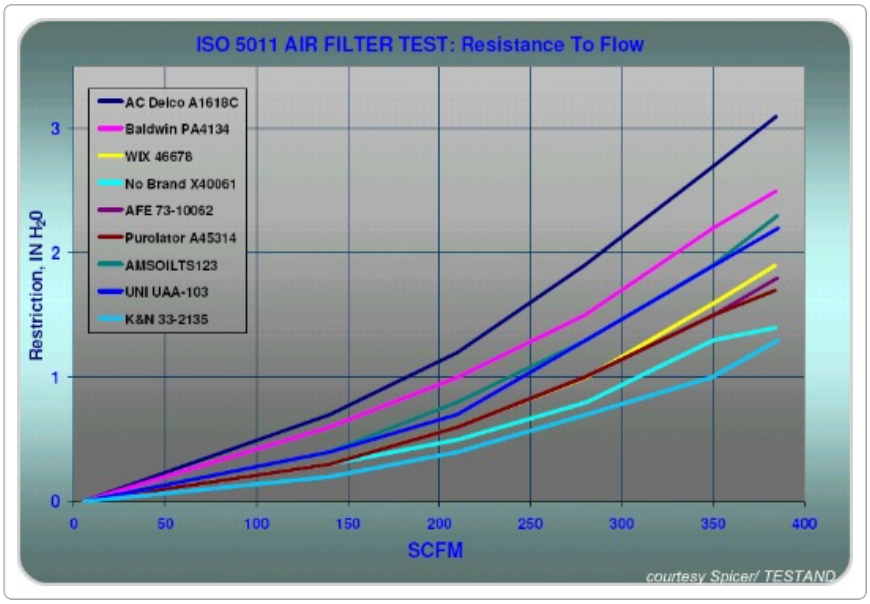
Amazingly, high flow manufacturers have not published third party tests showing the superiority their filtration technology, even for those, such as AMSOIL, who use such tests as a standard marketing strategy for their other products.

We were still able to find relevant and interesting automotive air filtration tests. In 2004, the company Testand, a manufacturer of filter test equipment, collaborated with Arlen Spicer, a Duramax enthusiast, to run a series of standardized ISO 5011 tests (equivalent to the obsoleted SAE J726) test on air filters, using one of their expensive $285,000 test machines. The results were shocking to us, and probably to many high flow air filter users. The test compared K&H (reusable cotton gauze filter), the previous generation of AMSOIL filters (foam filter), and multiple other products made of paper or other fiber combinations, the leading OEM brand being AC Delco. The original thread for this test runs very over 40 pages (another discussion thread), and the only location where we could actually find the original data is on DieselBombers.

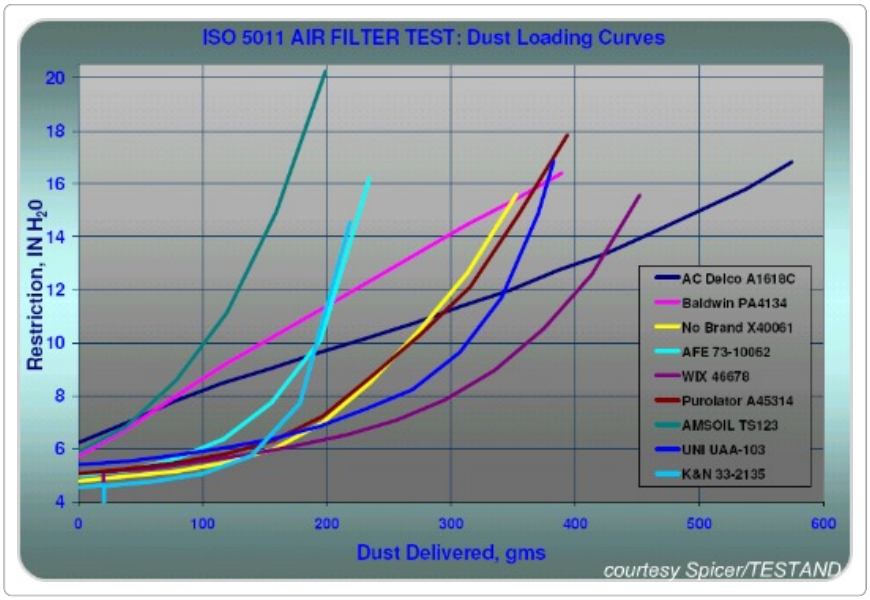
A primary goal of the study was to evaluate if high performance, high flow filters (in particular the K&N filter brand) were worth purchasing. The authors of the study selected a broad swath of filters. Several filters were regular OEM/ aftermarket throwaway paper filters (AC Delco, Baldwin, Wix, and a no-name model, which ended up doing pretty well in the tests). The other filters were all premium filters in different flavors:

- Purolator is a premium non-reusable paper filter
- AMSOIL foam and UNI are premium, washable and reusable foam filters (the AMSOIL model belongs to a previous product generation, and has been superseded by nanofiber filters)
- K&N is an oiled cotton filter, that is reusable: it can be washed and re-oiled
- AFE, another oiled cotton filter that can be washed and re-oiled, adds an additional synthetic barrier to the cotton gauze layers to improve filtration efficiency.

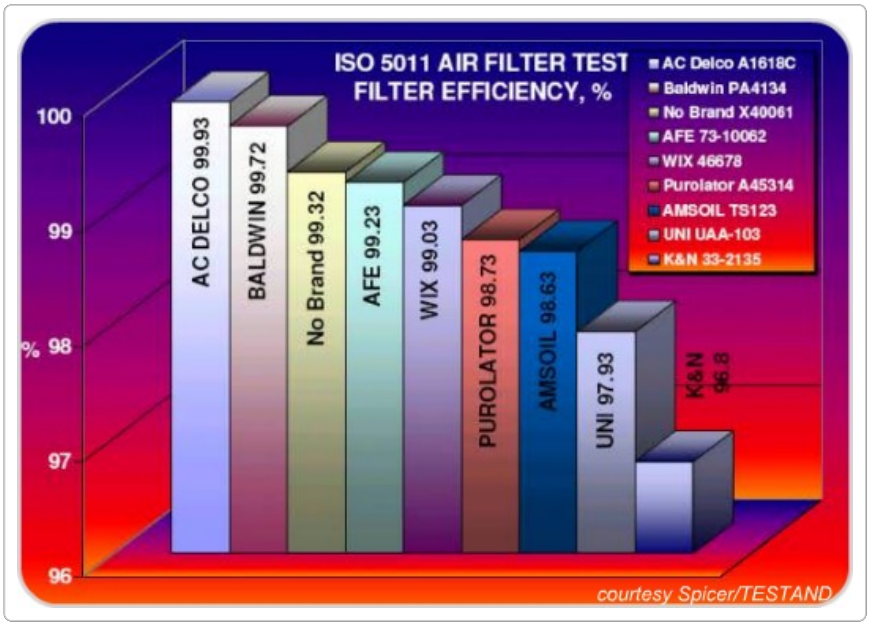
The first part of the test measured flow restriction in each filter, while clean, and progressively increased the volume of air being pushed through: which filter introduced the least resistance to air being brought into the engine? While the differences were not enormous, the winner was the premium-priced K&N filter, as shown in the graph below:



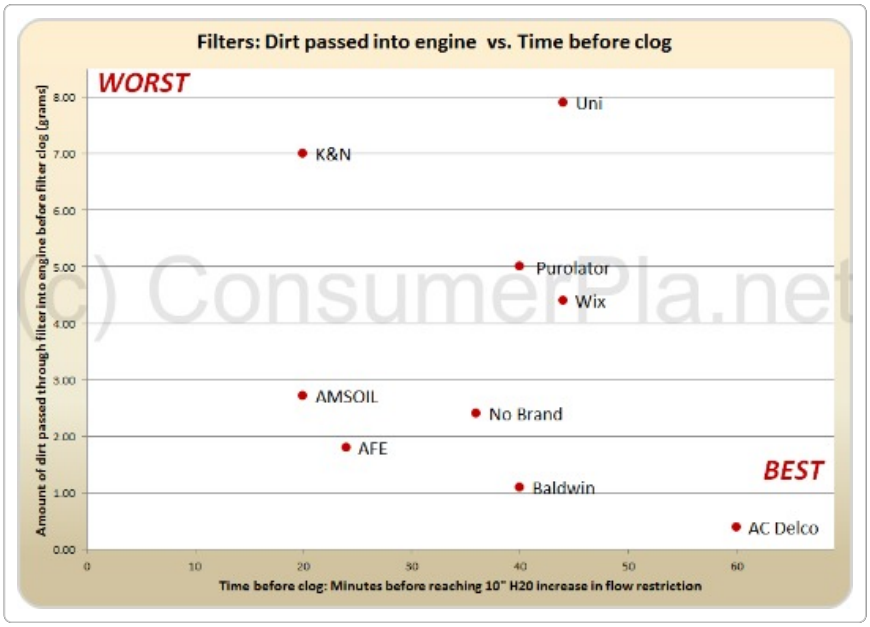
This result augured well of the success of the K&N filter. The next question was to find out how the filter behaves as it gets progressively clogged by dust, as happens during actual use. The test used a constant 9.8grams/ minute dust flow, using standardized ISO 12103-1, A4 coarse test dust, 0-180 micron size. The outcome of this test was the first real shocker -there are several to come. The test below shows that, as dust progressively clogs the filter, many filters, including the K&N and the AMSOIL filters, see the flow restriction (i.e. the resistance to air flow) growing exponentially, to very largely exceed the restriction seen on the standard OEM paper filter made by AC Delco:



The result of this test was a big surprise: the flow restriction advantage for the K&N (or other alternative filters) only existed when the filter was largely clean! Hopefully, this meant that the alternative filters were particularly efficient at removing dust, and, as a result, might have clogged faster. The next step was then to evaluate filtration efficiency, which is when we encountered the next shocker: the most efficient filtration was provided by the AC Delco filter, why the high-end K&N provided the worst filtration of all filters, and the AMSOIL filter mediocre filtration at best, as demonstrated by the test below, using the same standardized dust:

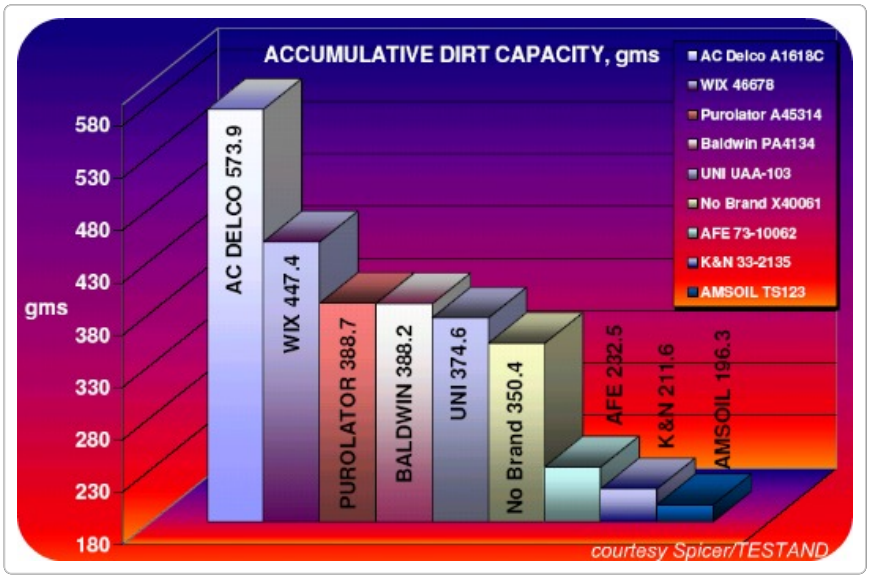


Given the proof provided by SAE, more than 15 years before this test, of how critical dust was to engine wear (we discussed it here), we could not understand how it was possible for alternative filter manufacturers to actually market a premium product when its efficiency was significantly below that of the standard, regular price product. We felt that, possibly, other filtration tests would show superiority for the premium priced, alternative filters. The ultimate test would compare the different filters, according to the amount of dust that was being passed up to a specific restriction of air flow, which, in the ISO 5011 test, was set at an increase of 10" of H20 from the original flow restriction as measured with a clean filter. The result was another shocker. The best performing filter, both in terms of time to clog and amount of dust passed, was the standard paper-made AC Delco filter, while the worst was, again, the K&N filter, the AMSOIL filter not being far behind:



In the test, the standard OEM replacement made by AC Delco took 60 minutes to increase flow restriction by 10" H2O, and passed 0.4 grams of dust to the engine in the process, while the premium K&N filter took 20 minutes to get to the same stage, passing 7.0 grams of dust (!!!) in the process, the AMSOIL filter clogging as fast but passing less dust through in the process. The amount of pass-through dust can be illustrated by the pictures in this article.

Finally, we could not help wondering how much dust overall could accumulate into the filter before causing a clog (measured in ISO 5011 tests as 10" H2O restriction, not quite equivalent to clog):



Again, AC Delco was the runaway winner, AMSOIL running last in the tests, and K&N second to last.

To say that we were shocked by the results of this test would be a strong understatement. We were also surprised by the poor availability of this test, which, while somewhat known on the forums, was not broadly available, as the original archives for the test, along with several replacements, had disappeared off the web. Could there be a problem with the credibility of the test? We did not think so, but felt that corroborating test results would be needed to truly feel comfortable with the outcome.

Next we review the results of Jeep Magazine's 2006 ISO 5011 air filter study and tests... So come back soon!

Note: accidentally published out of sequence

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Posted by George Gear at 8:52 AM 0 comments Links to this post

Labels: Automotive, cars

Reactions: funny (0) interesting (0) cool (0)

Friday, February 10, 2012

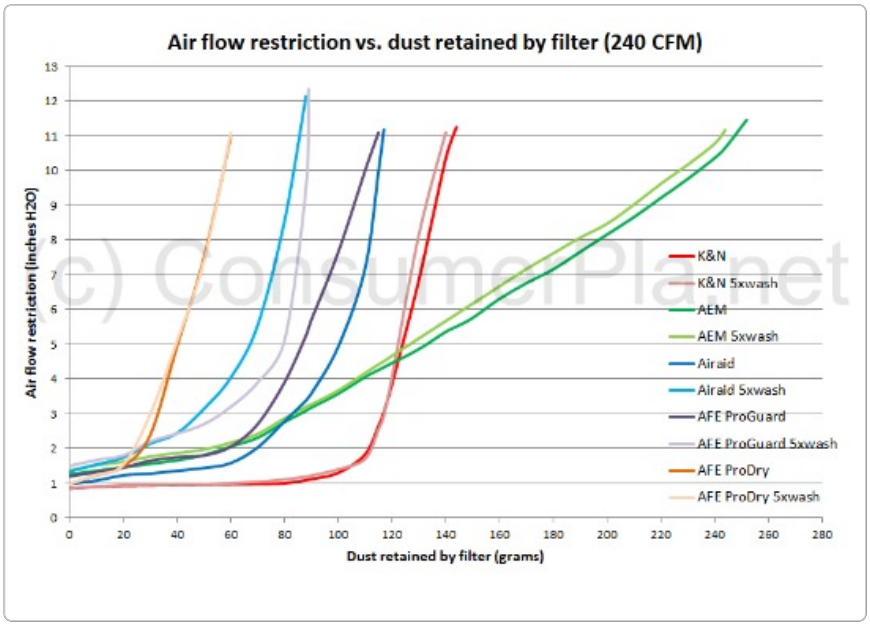
Dirty Filters May Impact Performance

Best Air Filters Review: Air Filter Facts

Air Filter Facts Part 10: Dirty air filters and performance

In our last post on air filters, we reviewed dirty filter air flow and concluded that there was possibly a range of air flow restriction which could impact engine performance. The air flow curves were characteristically shaped, most of them being exponential with dust accumulation, with the exception of a small number being linear. Can we corroborate this data?

The Southwest Research Institute published a research report commissioned by AEM on similar tests:



Regrettably, the SwRI restriction tests occurred at a low flow level of 240 CFM, while the Oak Ridge National Lab tests occurred on the vehicle itself at wide open throttle, and the Spicer/Testand ISO 5011 tests occurred at 350 CFM, a better level to approximate true/ wide open throttle conditions. As a result, the initial restriction shown on the SwTI tests above is significantly lower than in other tests, and restriction under dust load is also affected. The SwRI tests also include filters that have been washed and dried five times: the changes in air flow between new filters and washed filters are interesting to note.

Nevertheless, the same curves show up in both graphs: similarly to the data in the Spicer/Testand study, there is relatively little spread in the change in air flow between filters until the clogging elbow, except, in this study, for K&N, which remains at very low restriction, increasing its advantage in air flow against the other filters until it hits its own clogging elbow. The AEM filter in this study appears to behave similarly to the AC Delco in the Spicer test, having a very linear curve on air flow vs. capacity. As the two tests use different reference dust (coarse test dust for the Spicer/Testand study., fine test dust for the DwRI study) and vehicles, it is not possible to directly compare them quantitatively.

Since we know that, when they reach clogging, filters definitely impact engine performance, it is fair to say, at some point as we move towards the right in these curves, we will start seeing some performance impact. It it is possible that a small number of filters might do worse than others. No filter, however, appears to significantly improve performance as dust accumulates compared to the majority average. it is worth noting that capacity impact on performance appears very significant when you get close to clogging.

Conclusion

- There is no difference in vehicle performance between most dirty air filters
- There may be some differences in vehicle performance between some specific dirty - but not clogged- air filters
- There is no proof that there is a difference in vehicle performance between any two dirty - but not clogged- air filters
- Filter Capacity may have more impact on performance than air flow over the life cycle of an air filter

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Posted by George Gear at 2:36 PM 0 comments Links to this post

Labels: Automotive, cars

Reactions:

funny (0) interesting (0) cool (0)

Thursday, February 9, 2012

Dirty Air Filters And Performance DRAFT

Best Air Filters Review: Air Filter Facts

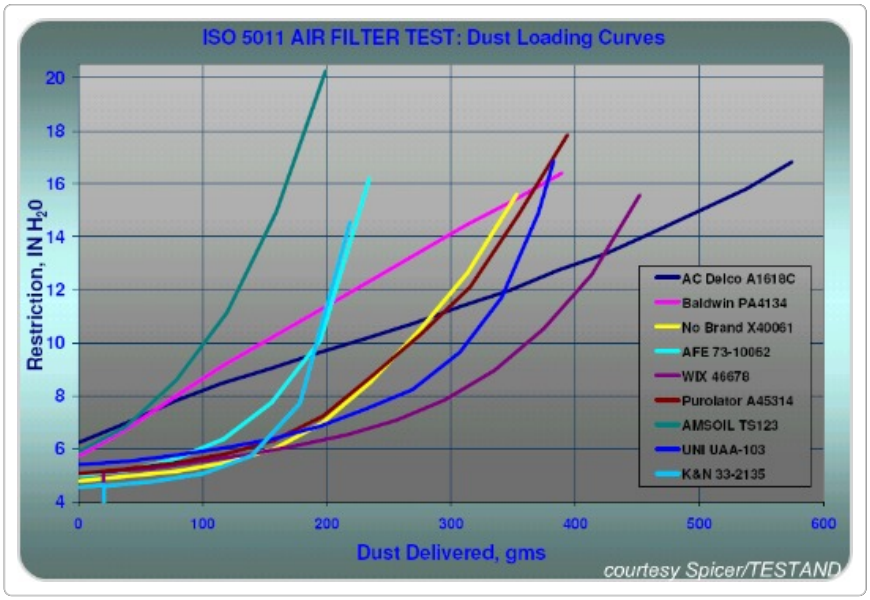
Air Filter Facts Part 9: Dirty air filters and performance

We proved conclusively that there is no measurable difference in vehicle performance (i.e. acceleration, horsepower, torque) between clean air filters. Is it possible that there could be more significant differences in vehicle performance between dirty (but not clogged) air filters?

As filters progressively accumulate dirt, their efficiency improves but their air flow worsens. In fact, Perrin Performance's pitch is that their filters boost performance after 10,000 miles: "We sell our filters by saying all filters when new flow about the same. But when dirty, foam continues to flow more air. In an example of an OEM filter being replaced with a PERRIN foam filter (on an STI), we see about a 3 wheel Horse Power gain. This is not much at all and not something you can generally notice. So its not that your stock filter when clean is super restrictive, but throw 10,000 miles at it, and the story changes."

We have already seen that, close to clogging, there is impact to performance. There clearly is a great difference between filters when close to clogging, as the capacity of air filters varies widely (later in this series of articles we will show conclusive proof of the widely varying capacity between filters). When one filter starts clogging when another isn't close to it, the clogging filter will certainly worsen engine performance, while the other one should be still able to ensure good air flow. In this case, the advantage will go to filters with higher capacity, assuming that they do not get swapped too early in their life cycle.

What happens when air filters are not clean any more, but not yet clogged, i.e. for most of their working life? Thankfully, we can look at the results from some comparative tests that we review extensively further in our series. The Spicer/Testand study compared multiple different air filters in a series of ISO 5011 tests, using coarse test dust. This is how the tested air filters compare in air flow restriction when accumulating dust:



If we look at the change in air flow restriction between filters, we find out that, among those tested, as long as we remain below the clogging threshold, the difference between filters remains roughly constant, except for the AMSOIL foam filter and the Baldwin filter, where restriction increases significantly faster than other filters.

We know that, around 2-5" H2O of restriction or 0.5-1.25 kPa - that is, for clean air filters-, **XXX** there is no difference between air filters **XXX**. We also know that, as you get to 16" H2O or 4 kPa,

you may start seeing significant performance impact. Therefore, somewhere between 6" and 16" we should see the first signs of performance degradation - where exactly we don't know.

Initial restriction for a clean air filter at wide open throttle (here measured at 350 CFM) typically varies from roughly 2" to 6" H20. If we were to encounter performance impact, we would expect a given engine to see performance impact from all filters at the same restriction level, regardless of their initial restriction, but higher than 2-6" H2O. Let's take, for instance, 12" H2O as a hypothetical restriction level where we might start seeing performance impact. For this example, we see that the AMSOIL filter will get in trouble first, at 125 grams of dust, followed by the K&N and the AFE at 205 grams, the Baldwin at 220 grams, the generic (no-brand) filter at 300 grams, the Purolator at 315 grams, the UNI and the AC Delco at 340 grams, and finally by the WIX, performing very well dirty at 400 grams. But - the order in which we see these filters could be different if performance impact started at a different level of air flow restriction.

At what level do you see performance impact?

K&N filter minder calibration most gasoline engine powered automobiles 20 inches maximum.
pic shows 10" H20 85-2444.jpg (JPEG Image, 382x550 pixels)

As the air filter gets dirty, the yellow position indicator moves in the clear window of the service indicator and locks at the highest point. It can be read even after the engine is turned off. The air filter should not be cleaned until the yellow position indicator reaches the red zone. Reset the position of the indicator to zero by pushing the yellow reset at the end of the service indicator.

K&N Air filters become more efficient at stopping dirt as they build a dust film. It is recommended that the air filter be cleaned only when the air filter service indicator reaches the red zone.

Donaldson filter service indicator PDF call?

AEM filter minder PDF : 10"H20...
designed to show a red indication at a pressure of approximately 10 inches of water

We should expect each engine to have a different level of air flow restriction at which it starts showing performance degradation. This level will depend upon the sizing and design of the air intake, and the engine displacement. Unfortunately, we have no data to tell us at which restriction level engines start seeing performance impact. As can be seen from the graph, the set of filters performing well at a given restriction level varies widely with the restriction level: the filters starting with low initial restrictions typically seem to have low capacity, which results in their showing high flow restriction at low with relatively lower dust weight. As a result, without knowing at which level of flow restriction we see performance impact, it is difficult to rate filters on "dirty performance" - although we will try later in this series.

These results were all drawn from one single study. Can we find corroborating proof? Next we review supporting evidence on vehicle performance with dirty air filters... So come back soon!

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Posted by George Gear at 6:43 PM 0 comments Links to this post

Labels: Automotive, cars

Reactions: funny (0) interesting (0) cool (0)

Wednesday, February 8, 2012

Clean Air Filters and Performance

Best Air Filters Review: Air Filter Facts

Air Filter Facts Part 8: Clean air filters and performance- more evidence

In our last post we reviewed *Diesel Power Magazine* air filter tests, which conclude that swapping air filters alone does not impact performance (for clean filters). Can we confirm this test's results across other tests? We were not able to find other credible tests. But we did find information provided within the industry which corroborates, in our opinion, *Diesel Power Magazine*'s results:

- Castrol, of motor oil fame, also sells air filters. Its expert advice section, in a Q&A page ("More Air, More Horsepower) states: "When it comes to modern engines with electronic ignition and fuel control, an air filter upgrade in conjunction with a cold air intake can yield horsepower gains." This statement clearly implies that an air filter upgrade alone, without a cold air intake, is unlikely to yield horsepower gains.

- Comptech, a manufacturer of performance parts for Japanese cars, writes to one of its customers: "Your ECU [Engine Control Unit] shouldn't be affected by changing the filter only." This implies, of course, that a drop-in air filter change will not affect performance.

- Perrin Performance, a manufacturer of performance high flow filters, writes in its Filters Q&A: "We sell our filters by saying all filters when new flow about the same [...] In an example of an OEM filter being replaced with a PERRIN foam filter (on an STI), we see about a 3 wheel Horse Power gain. This is not much at all and not something you can generally notice." In fact, we are no even sure that their measurement (certainly from a dyno) would be statistically significant, as dyno experiments are typically not accurate within 3 hp. What is significant is that the manufacturer recognizes the gain as minor, if any.

- While many filter manufacturers claim that their filter will improve performance, none actually publish any third party tests proving such increase in performance. We find it unlikely that such would be the case if an improvement in performance could actually be documented.

While we find none of these facts sufficient by themselves, we consider that, together, along with *Diesel Power Magazine*'s tests, they prove conclusively that no notable gain of performance can be obtained from swapping air filters alone. Our conclusion is that changing drop-in air filters does not affect vehicle performance in a measurable way.

Conclusion

- **Swapping drop-in air filters alone does not improve vehicle performance for a clean filter**

But could this conclusion be different when applied to the same filters when dirty? Next we discuss difference in performance between drop-in air filters when dirty... So come back soon!

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Posted by George Gear at 6:45 PM 0 comments Links to this post

Labels: Automotive, cars

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