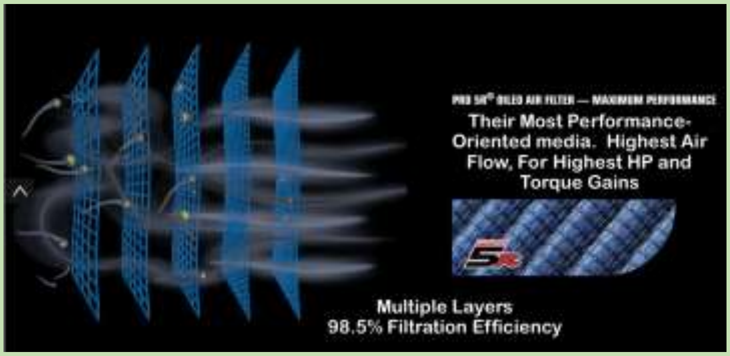
WA Technology

"*Why*" & "*How To*" Install ***aFe*** Oiled Cotton Air Filter in a C8

We'll start with *"Why"* and follow with our many pic/caption *"Install."* A detailed *"Appendix" is included.*

If only interested in installing, skip to page 4.



There are skeptics of the benefits of oiled cotton or aftermarket air filters of any type. This document will present facts versus their subjective opinions!

***"Why Bother to Use One"* is more of an issue then the install detail so it's covered first.**

Comments From Corvette Chief Engineer:

We'll counter the often heard, *"If aftermarket type filters were so good GM would use them"* with first, a forum post from the Chief Corvette Engineer Tadge Juechter. This is a short summary of what he said, with full details in the Appendix:

"Aside from the exhaust, there is no greater noise source on a performance vehicle than the intake system. Induction systems generally have many tuning elements that ensure the quality of the sound emanating from it are pleasing and harmonious with the exhaust note. These tuning elements also dampen the sound energy to help with pass-by legal noise requirements. Aftermarket companies don't have to worry about it, but as the OEM, we must guarantee that our products are quiet enough to be driven at full throttle by a microphone by the side of the road and meet certain decibel levels. There are pass-by laws in many states and pretty universal around the world.

As with many of the questions on this forum, all vehicle design is a balance of trade-offs. We do what is legal and right for the vast majority of customers. Aftermarket companies offer products that strike a different balance that might appeal to some folks."

History of Oil Assisted Air Filters:

Long before people started using cotton gauze air filters coated with oil, the oil bath air filter was the dominant filter in the market. I recalled the "oil bath filter" I had on my 1950 Ford V8, pic below. The filter removes debris in the air by passing it over oil and a mesh element. Those filters worked great when most roads were dirty. The oil bath air filter pulls in outside air and makes it turn 90 degrees over a pool of oil. This helps to remove the large, heavy particles. The air then travels over a filter element, often steel mesh as it was in my 1950 Ford. The bottom of the mesh is in the oil and wicks up on the surface.

The filter element could be cleaned with kerosene. It used typically engine oil that had to be filled to a specific level for the filter to be able to catch debris. The element could last the life of the vehicle.

As roads improved in the 1950s, the need faded, and cheap disposable pleated paper filters were used.

Comments: Japanese Supplier of Race Car Parts

Oiled filter material relies on the tackiness of the oil to catch contaminants while the more open cotton media allows a higher flow rate. The oil acts as a sticky trap for incoming air contaminants, providing an important layer of protection to keep the air free of debris. These filters typically come pre-oiled with a specific amount so they can drop right in without the user having to do anything. Oiled filters are what you see in most race applications. Many are a classic cone shape, but companies offer a direct drop-in replacement for the OEM filters, and often, there is a slight bump in performance.

Another benefit is that these filters can last a lot longer than their dry counterparts. Oiled filters have the advantage of being completely washable and reusable but must be regularly cleaned, maintained and properly oiled. You may have also heard that oiled filters can damage your mass airflow sensor (MAF). Let's nip this right in the bud. The only way for something like this to happen is if you over-oil the filter when re-applying the oil. If there is too much oil on the filter, some of it can get sucked in through the cotton gauze and might damage the MAF sensor.

Increased "Sucking Sound"

As Tadge mentioned, after the exhaust, intake air flow produces the next loudest sound. That can be a good sound to hear at WOT! I have two examples of *"good noise."* In fact, Tadge said for the C8 they routed the intake air to accomplish that objective! One is my ProStreet Rod with an 8.2 Liter, 525 hp Big Block Chevy where the large 14-inch diameter by 5-inch-high oiled cotton filter makes almost as much "Sucking Sound" as the long tube headers passing exhaust though 3-inch pipes and straight through Borla mufflers.

The other is the ***aFe*** oiled cotton filter installed on my C7 Z51 then removed when sold and installed on my 2017 Grand Sport. The "Sucking Sound" at WOT was much louder than with the OEM air filter and close to the NPP exhaust on both C7s. Details in Appendix.

Plant Tour WIX Filters

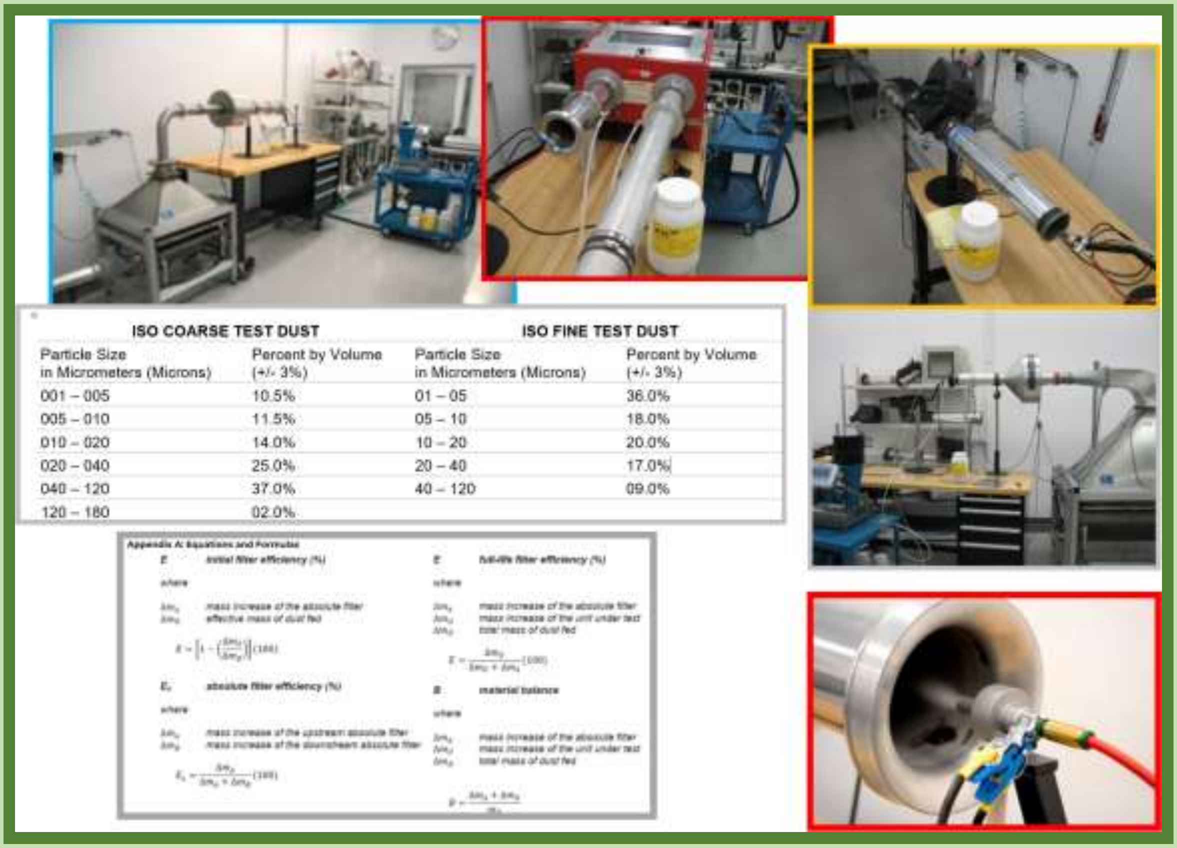
Our local ASME Section toured the ~380,000 square foot WIX filter plant in SC. We saw and discussed the high speed, automated operation of both oil and air filters. They made and labeled filters of NAPA and many others. A key advantage to paper filters is they are cheap! Particularly for the dealers and shops installing them who can make a high margin with frequent replacement!

Design Research and Testing of Oiled Cotton Filters

Some folks may be interested in the technology involved with filter design and testing. There is a 6-page article in the Appendix.

I found the ISO 5011 test used to measure filter effectiveness most interesting. It provides a method of testing BUT >10 different dust sizes can be selected! That explains how you can see test data that always has the filter being promoted on top! Pick the right dust size or filter holder and results change dramatically! The auto air filter industry uses the ISO 5011 testing protocol when testing filtration efficiency and dust capacity. The test protocol calls for the introduction of a measured amount of "test dust" into the air filter at a selected airflow rate. The test is then terminated after the filter reaches a selected level of restriction (terminal test pressure). The test protocol then measures the percentage of dust retained by the filter (efficiency) and the total amount of dust held by the filter (capacity).

Note, the article has many pics and some math. Here is a composite of some:

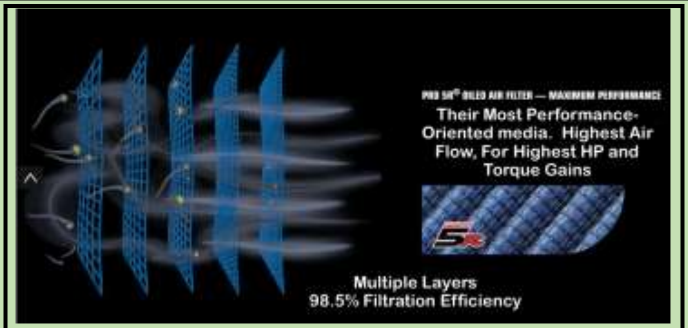


ISO COARSE TEST DUST		ISO FINE TEST DUST	
Particle Size in Micrometers (Microns)	Percent by Volume (+/- 3%)	Particle Size in Micrometers (Microns)	Percent by Volume (+/- 3%)
001 – 005	10.5%	01 – 05	36.0%
005 – 010	11.5%	05 – 10	18.0%
010 – 020	14.0%	10 – 20	20.0%
020 – 040	25.0%	20 – 40	17.0%
040 – 120	37.0%	40 – 120	09.0%
120 – 180	02.0%		

Photo Sequence of *aFe* Oiled Cotton Filter Selected and the How To Install

aFe Offers 2 Filter Medias for the C8

The highest "performance" with the most percentage increased airflow of 27% over the OEM filter is their PRO 5R (which we purchased.) It has 5 layers of oiled cotton filter material while retaining 98.5% Filtration Efficiency (amount of dust captured.)

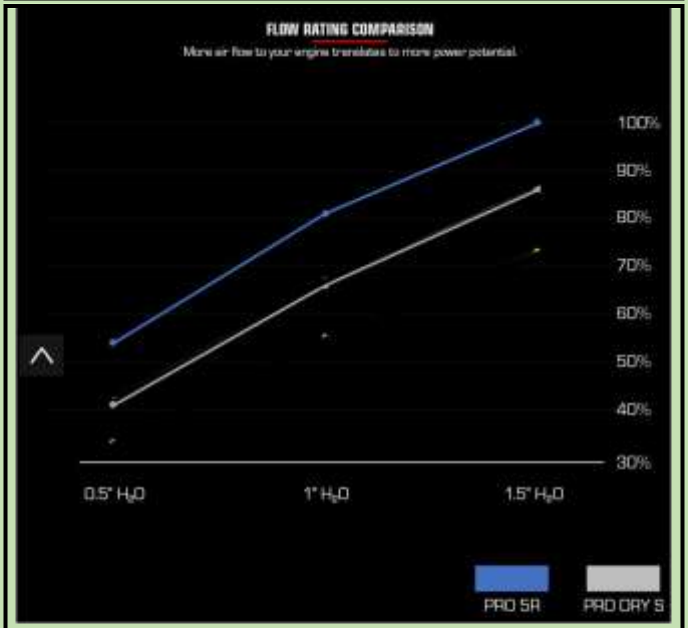


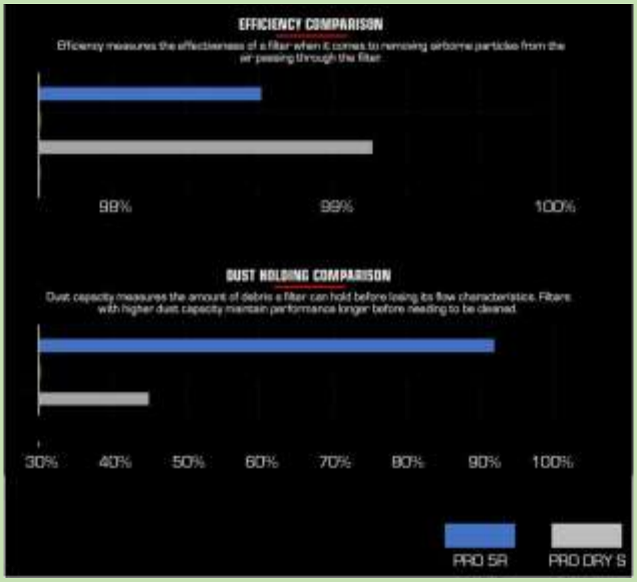
Their non-oiled filter is called PRO DRY S. It has three layers of synthetic media that can also be washed for reuse. They don't provide a value of increased flow with this model. They show a 99.2% filtration Efficiency, 0.7% better than their oiled cotton PRO 5R.

Why pick Oiled Cotton? It flows air with less restriction than the PRO DRY S. It flows 27% more than the OEM filter.

This graph shows the flow rating with various pressure drops as the filter accumulates "dirt and dust."

Note at all pressure drops the PRO 5R flows about the same amount of additional air.





Then why is there a dry filter? It flows less than the PRO 5R BUT it is somewhat more effective of removing small dust particles.

However, the PRO DRY S filter also holds less dust so will have to be cleaned more often to maintain max performance.

Also, some folks are concerned the oil may affect the MAF sensor. That is NOT AN ISSUE IF REOILED PROPERLY. I chuckle at the concern as a number of C7 dry sump owners had forum posts of oil overfills with some oil went into the air intake tube and dripped from the air filter on the floor. Dealers didn't replace those MAF's which had far more oil enter the sensor than any could from even moderately overoiled filters! LOL

NOW THE INSTALL

Although there are a lot of fasteners to remove and reinstall, it's straight forward. The tools you'll need include a T15 Torx wrench, an 8mm socket and a trim tool with forked end. I like to use a hand ratchet versus a powered tool. Can't over torque, which is easy to do with power tools.

If you have a Z51, as I do, need something to protect the spoiler. I use what I had for my two C7's that folds neatly at the bottom of the trunk. It's a fender pad that has a high friction backing so it stays put. It's also inexpensive. If you have a high wing and are less that 6' 4" you'll need a step stool!

Wing/Rear Protector in place.

Next remove the net from the 4 hooks.	
	**Remove the hooks from the threaded studs by unscrewing by hand.**
Next, in my case, had to remove the Optional Jake Trunk Mat. It just pulls out.	
	**Pic of the Truck Mat.**

There are 4 plastic Scrivets that support the bottom of the OEM trunk liner. Remove those with a forked trim tool. Suggest holding your hand over and capture as they can pop out with a lot of force. Easier to catch than find!

Note, also moved the wing “protector” to either side when needed.

Had the GM sold rear protection pad for for my C6. However, it was a PIA to unroll and roll back up.

Wound up lifting my golf clubs in and out (~twice a week) over the rear spoiler! Hit it a few times. Now, no excuse it’s easy to use and store the fender pad.

There are 4 screws per side that hold the top roof clips. They have to be removed to get the trunk liner out.

Once those screws and the Scrivets are out the Trunk Liner just pulls out. Will have to pull the bottom from the lower hook studs.

Next to be removed are the screws holding the composite trunk panel. **By using the simple hand ratchet, it was very quick. You could feel they were not tightened with much force. Don't use more force when reinstalling.**	
	**With the trunk panel out, the air filter housing is now visible.**
	**After removing the six 8mm hex head screws that hold the cover in place it comes off easily. This is a pic of the back.**

This is the OEM filter. Several videos showed trouble getting it out. One showed pulling the bottom out first, which I did and with a good tug it came out. Good time to mention the gasket. It slips into a groove and has two notches on top, so it only goes in one way. Check the fit.

The difficulty is getting the new filter to stay in place while the cover is put back on. **One video mentioned "hold the new filter in with your finger as you install the cover." Easier said than done as your finger is in the way!**

Took several tries but was able to quickly remove my finger while the cover was slipped in place. Held the cover and installed the top screw snug so it was holding the filter in place. Be careful installing the screws as don't want to drop them and the bottom three are hard to see.

Biggest Issue is Holding the New Filter in Place While the Cover is Slipped Over to Keep it in Place. It Falls Out! Used a Finger to Hold the Filter as the Cover Was Slide in Place to Retain.

Looking back, could have used a thin paint stir stick and pulled out quickly before the cover was put fully in place.

These are the two filters side by side. It was an 80-degree day so no issue with the rubber being flexible. Several videos mentioned if cold to use a hair dryer and warm up the rubber. The filter fits in groves in the holder on both back and front.

I used a fiber optic camera to see if I could identify the air flow passage. Tadge Juechter said in an Autoline After Hours 1 hr. interview that the very quiet C8 passenger compartment made it hard to hear the "good noise." He was referring to the air intake "sucking sound" and the exhaust. He said they purposely routed air high in the side air vent to get it closer to your ear. He said unlike the very thick 9mm back passenger compartment glass the side glass is very thin!

All I found was this bright line by shinning a flashlight into the side vent!

However, could see the air passage that Tadge referenced clearly looking in the side vent opening. In the interview, Tadge said it was on the top 1/3 of the side vent. It certainly is "closer" to you ear when sitting in the cabin. However, hear less "sucking sound" compared to my 2014 Z51 and my 2017 Grand Sport where it was louder as was tire and road noise. Also, both my C7s had NPP and the exhaust was also louder than in my C8 coupe from the passenger compartment. In fact, the C8 is the quietest of all the 6 Vettes I have owned.

Even the exhaust sound is not as "good" as my C7s. Tadge said the short exhaust pipes and single high flow CAT contribute to the different, quieter C8 exhaust sound compared to FE Vettes.

Finishing is straight forward. When putting the trunk composite panels back, install all screws by hand before tightening. Then install the trunk liner. Be sure the upper rubber molding is over the liner. Then install the 4 removed Scrivets on the bottom.

Once issue to watch for is installing the roof latches. Be sure to start the screws by hand.

The net hooks are installed by hand, threading over the studs.

THE RESULTS!

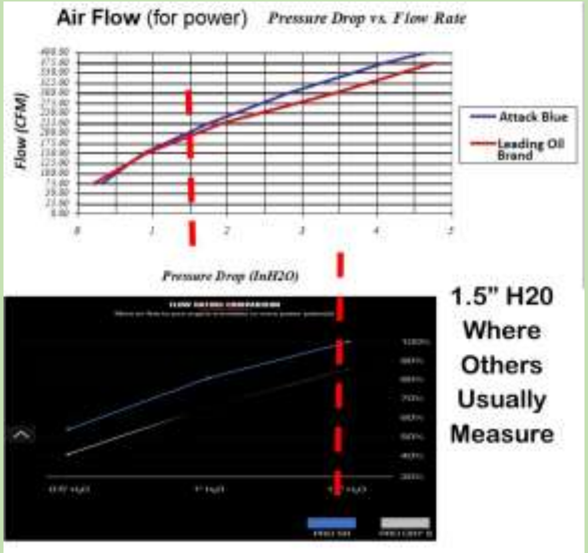
No CEL, car ran fine. With only a 27% reduced flow restriction expect the ECM will soon learn any air/fuel ratio changes to optimize performance. Tested the "sucking sound" increase with the window opened and closed at WOT. It was louder at higher rpm. Not as much as my C7s with *aFe* filter systems and didn't match the NPP exhaust but louder!

Didn't expect it would be as loud as the C7 system that had a 41% increase in flow with its larger than OEM oiled cotton filter.

The question of how much hp was gained, if any, is still not known.

The closest type of filter available is Attack Blue, a direct replacement for the OEM filter. They show a comparison with "Leading Brand" and since K&N doesn't have one for the C8, it may be the *aFe*. At 1.5" H_2O they show the same reduced flow restriction. Attack Blue dyno data shows 11 hp gain. All I would be looking for is 5 hp to say- my LT2 has 500 hp. LOL

Did not expect the 17 hp *aFe* showed dyno data for on the C7 LT1. Its larger filter also has 41% less restriction than the OEM filter. A forum poster dyno'd his C7 non-oiled filter *aFe* system before and after the install and got 10 hp. Expect even with oiled cotton that was probably closer to the true increase I was getting.



***BOTTOM LINE:* Have More Sucking Sound and a Filter I Can Clean To Maintain Max Performance. My Goals.**

If you are Tracking and extra hp is useful, then this more expensive *aFe* Track Series system provides ~65% more area with its two cone filters compared to the PRO 5R OEM filter replacement.

The ~65% is based on my calculations of surface area compared to the OEM or PRO 5R. Currently *aFe* does not provide flow or hp gains for the Track Series.

Appendix

Tadge's Corvette Forum Post on Air Filters:

We engineer all Corvette intake systems for minimum restriction and to meet many other requirements ***that aftermarket companies do not.***

We do not routinely test aftermarket induction systems or any other aftermarket parts for that matter. We have our hands full designing, building and testing our production hardware. Although simple in concept, induction systems play an important role in many vehicle performance areas. ***Aside from the exhaust, there is no greater noise source on a performance vehicle.*** *Induction systems generally have many tuning elements that ensure the quality of the sound emanating from it are pleasing and harmonious with the exhaust note.* ***These tuning elements also dampen the sound energy to help with pass-by requirements. Aftermarket companies don't have to worry about it,*** *but as the OEM, we must guarantee that our products are quiet enough to be driven at full throttle by a microphone by the side of the road and meet certain decibel levels. There are pass-by laws in many states and pretty universal around the world.*

Although most people think of air flow into an engine as fairly continuous, it really is not. The opening and closing of valves and reciprocating nature of internal combustion engines means the air flow is really a series of pulses which make measuring the exact flow challenging. Intake engineers spend a lot of time optimizing the system to get excellent signal quality out of the MAF. In addition to efficiency, or fuel economy, the precise metering of air and fuel is directly correlated with tail pipe emissions, an area of extreme scrutiny by government agencies for we manufacturers.

The air filter itself is the focus of many discussions on low restriction. Its job is to keep foreign material out of the engine. Here again, there are many trade-off decisions balancing restriction with filter life (service interval) and filtration quality. Sacrificing either of the latter two improve the former. ***We tend to be conservative to make sure that our engines are very durable, so that does open up an opportunity for aftermarket system.***

As with many of the questions on this forum, all vehicle design is a balance of trade-offs. ***We do what is legal and right for the vast majority of customers. Aftermarket companies offer products that strike a different balance that might appeal to some folks.***

Louder Sucking Sound

My ProStreet Rod has an 8.2 Liter ~525 hp Big Block Chevy engine. Air and fuel enter through an 850 Holley Double Pumper carburetor. Exhaust leaves via long tube headers with 3-inch exhaust pipes flowing into straight through Borla mufflers.

There was no room to have the exhaust pipes go over the narrowed rear axle with coilover springs/shocks located where the exhaust pipes would have to go. The adjustable 4 bar link suspension managing the rear axle movement also limits the available area. I fabricated the exhaust to exit behind the door just before the rear tires. Meets NSRA safety rules. Had room in the 1934 Ford sedan to have the engine set back about 6 inches. It provides 53% of the cars 3000 lbs on the wide rear Micky Thompson tires. There was also height room in the engine compartment to utilize a large 14-inch diameter X 5-inch-high oiled cotton air filter. I added a black K&N polyester "Prefilter" for looks. (See pic upper left.)

With the window open at WOT the intake "Sucking Sound" is as loud as the exhaust through the long tube headers and straight though Borla mufflers.

I installed an ***aFe*** oiled cotton filter system on my C7s. First installed on a 2014 Z51 then when I sold it, removed the system, reinstalled the OEM system. Put that ***aFe*** system on my 2017 Grand Sport. Just cleaned and reoil the filter and it was like new!

For the C7 they quote that Pro 5R oiled cotton filter as having 41% higher flow (*compared to 27% for the C8 replacement filter*) and showing an 18 hp gain with dyno results. Even if it's half that, 9 hp is significant. For the C8 all it needs to accomplish is 5hp to push the 495 to a "better sounding" 500! LOL

REOILING A FILTER- MY EXPERIENCE

I installed oil cotton air filters on most of my 6 Vettes. Reoiling is done so you never feel the oil! When the filter is new it comes preoiled - you don't feel oil! First clean, with the cleaning products sold by the filter manufacturer.

Let it soak in for ~30 minutes and wash with a low velocity stream of water from a faucet. Then let the filter dry thoroughly, I usually wait overnight. Then put a small amount of the oil supplied by the manufacturer on the top of each outer rib pleat. Let it wick down into the pleats. In <30 minutes it will wick and cover most of the cotton fabric. The oil will have the manufacturers dye color added for that purpose. At the bottom of some pleats, it will not have oil and a drop of two in those areas is all that is needed to have it oiled properly WITH NO EXCESS OIL.

R&D and Design of Oil Cotton Filters

This is a technical Article written by K&N. The company was started in 1957 by Ken Johnson and Norm McDonald, avid dirt track racers in the early 1950's. Their designs are based on stringent dyno and real-world performance testing. Some may be interested to see what air filter design and testing involves.

The Air filter industry use ISO 5011 standard testing protocol to measure filtration efficiency and dust capacity. The test protocol calls for the introduction of a measured amount of "test dust" into the air filter at a selected airflow rate. The test is then terminated after the filter reaches a selected level of restriction (terminal test pressure). The test protocol then measures the percentage of dust retained by the filter (efficiency) and the total amount of dust held by the filter (capacity).

The ISO 5011 protocol allows for flexibility in test design and choice in the variables selected for the test. This means that you can change the grade of test dust, the airflow rate, the beginning and end points of the test, and other factors while still being in conformity with the protocol. For example, the filter can be tested in a special "test housing" or in the factory air box.

As you can see, the ISO 5011 test protocol it is not an absolute test or standard; it is meant to help engineers design air filters by holding conditions constant while one variable is changed to measure the change impact.

If all the variables are consistent between two tests, the results can be used to compare the filtration capabilities of two air filters in a laboratory setting under specific controlled conditions. However, any filtration measurement will only be meaningful if it includes disclosure of the test variables that were selected, such as grade of test dust, airflow rate and terminal test pressure.

Because the ISO 5011 protocol uses fixed airflow and is often conducted with the air filter in "test housing," it is not intended to develop a filtration number you will experience in actual use. While in a vehicle, an air filter will experience a range of operating conditions, airflow and dust feed rates, etc.

Under the parameters of the ISO test, the user may select the grade of test dust used. The content of the two most commonly used types of ISO test dust for air filters are as follows:

ISO COARSE TEST DUST		ISO FINE TEST DUST	
Particle Size in Micrometers (Microns)	Percent by Volume (+/- 3%)	Particle Size in Micrometers (Microns)	Percent by Volume (+/- 3%)
001 – 005	10.5%	01 – 05	36.0%
005 – 010	11.5%	05 – 10	18.0%
010 – 020	14.0%	10 – 20	20.0%
020 – 040	25.0%	20 – 40	17.0%
040 – 120	37.0%	40 – 120	09.0%
120 – 180	02.0%		

K&N operates an in-house filtration test lab with two different testing machines built in consultation with Southwest Research Institute, one of the pre-eminent testing companies in the world. Most of the filtration testing we perform on our air filters is performed in our lab that operates on a year-round basis. Occasionally, we send air filters out for testing with an independent lab, either to confirm our in-house testing or to reduce the capacity requirements on our lab.

We perform tests of filters both in the factory air box and in SAE/ISO recommended test housing fixtures. Our goal is to design filters with the maximum possible airflow achievable while providing guaranteed engine protection.

Our actual air filters when tested generally demonstrate a cumulative filtration efficiency of between 96% and 99%. All this testing we do allows us to guarantee our air filters provide all the protection your vehicle will ever need.

For a more technical explanation of our filtration test stand procedures see our Efficiency Testing Procedure.

K&N Engineering Air Filtration Efficiency Testing Protocol

Scope and Application

K&N Filters performs air filter tests for efficiency and capacity in compliance with the ISO-5011 Standard for Performance Testing of Inlet Air cleaning equipment for internal combustion engines and compressors. Previous to the adoption of the ISO-5011, testing was performed in compliance with the SAE J-726 - Air Cleaner Test Code. The ISO standard states that the basic performance characteristics of greatest interest are air flow restriction, dust collection efficiency, and dust capacity. K&N adheres to the ISO standard in the measurement of these test parameters.

Lab Environmental Conditions

K&N maintains the ISO Filtration Lab at 70° F and 50% RH within the limits of the ISO standard for normal testing.

Calibration and Equipment Checks

Check Lab conditions each morning to verify they are stable and within the prescribed limits. Verify that the dampers are open and operate the system air blowers at a predetermined rate. Monitor computer data channels to ensure that all instruments are working properly. Verify that the digital cameras are charged and operational.

Allow test dust to acclimate to lab conditions for 24 hours and load the necessary amount into the dust feeder hoppers for the first test to be performed.

Set the weighing oven to 105°C (221°F) and allow it to come up to operating temperature.

Periodically - Validate the efficiency of absolute filter media as required by the ISO standard. Calibrate instrumentation periodically as required by the calibration schedule.

Test Fixtures

K&N uses three types of fixtures to enable testing of the broad types, shapes and sizes of the filter we manufacture. For OEM replacement filters we have found that using the OEM air box or filter housing allow the best comparison and repeatability when testing these filters. Another type of fixture used is a filter housing conforming to the design specifications spelled out in the ISO 5011 protocol. This ISO Fixture is used for specific testing as specified by the engineering staff as well as for most round filters. Lastly, K&N has developed a cabinet type of fixture, modeled after the ISO fixture for testing universal clamp-on type filters. This cabinet allows repeatable consistent dust loading of these open element type filters.

Once the test fixture has been specified, the Dust Test procedures are the same for all filter types except for some minor differences in mounting, orientation and placement of the dust nozzle and pressure taps which become apparent when finalizing the setup of the test apparatus.

Lab Test Procedures

Condition and Restriction Test - Verify that the dust feeder has been loaded with the proper amount and type of dust for the test to be performed.

Install a new absolute filter into the test stand filter tray. Condition the absolute filter at 110% of the rated flow of ambient air for 15 minutes to reduce any subsequent errors in measurements caused by losses of fibers or materials. The conditioning of the absolute filter can be performed in the Manual Test Mode.

While performing absolute filter conditioning, prepare test data sheets and other required documentation, mark test articles with appropriate task number, photograph test articles and create test folder on the appropriate server as required. Record the test information into the control computer and create the necessary data file in the appropriate folder.

Install the test article (fixture) onto the test stand specified in the test request. The connections for the upstream and downstream pressure measurements are made using the two tubes marked Test Filter Restriction and Test Filter Delta-P. The tubes are connected depending on the fixture to be used as follows:

ISO Housing or Dust Cabinet - Install the tube marked Test Filter Restriction to the dust cabinet outlet tube pressure port (clean side of the filter). Install the tube marked Test Filter Delta-P to the dust feed tube pressure port (dirty side of the filter). Attach grounding cables to test fixture and test article as recommended by the ISO test standard.

OEM Air box - Install the tube marked Test Filter Restriction to the upstream absolute filter pressure port of the test stand plenum. Leave the tube marked Test Filter Delta-P open to atmosphere. Attach grounding cables to test stand and test article as recommended by the ISO test standard.

Perform the Condition and Restriction Test using test filter and absolute filter at the air flow rate specified by the test request. Condition the test apparatus for 15 minutes as required by the ISO standard. Measure and record the restriction and differential pressure versus flow rate at 50%, 75%, 100%, 125%, and 150% of the requested air flow rate.

Measure and record the mass of the test article and dust chamber (fixture). Stabilize an absolute filter using the ventilated oven at the required temperature. Measure and record the mass of the absolute filter.

Reinstall the absolute filter and test article with fixture into the appropriate test stand. Re-attach grounding cables to test fixture and test article as recommended by the ISO test standard.

Initial Efficiency Test

The purpose of the Initial Efficiency Test is to determine the dust retention capability of the test article when loaded with an initial amount of test dust.

The initial efficiency will be determined after the addition of 20g of dust or the number of grams numerically equivalent to 6 times the air flow in m3/min (cubic meters / minute), whichever is greater. Using the appropriate worksheet, determine the actual number of grams to be applied in the initial efficiency test based on requested flow rates and enter the appropriate amounts including the termination criteria into the control computer. Enable the control computer to record all necessary data parameters for the duration of the test.

At the Lab computer interface, lock in the scale reading by checking the appropriate dialog box. Switch on the blower and verify that it reaches the required test air flow rate and allow the system to stabilize. Turn on the dust feeder using the dialog box control button and record the initial restriction (delta-p).

Monitor the system parameters until the termination point has been reached. The control computer will automatically shut down the blower and dust feeder at the termination point. Record screen data on the appropriate data sheet and file it in the test folder.

Remove the test filter, fixtures and the absolute filter from the test stand. Photograph the test article and fixtures and note any anomalies in the comments section of the datasheet. Place the absolute filter in the ventilated oven and periodically check for the weight to stabilize. Record the final absolute filter weight on the data sheet.

Weigh the test filter and fixture. Record the weight(s) on the appropriate data sheet. If the test filter reached its full-life termination pressure during the initial test phase, record that fact in the data sheet and archive the test filter, otherwise prepare the test filter and fixtures for the full-life/capacity test.

Full-Life/Capacity Test

The purpose of the Full-Life/Capacity Test is to determine the total mass of dust retained by the test filter by recording the incremental weight of the dust fed until the test filter reaches a terminating pressure restriction as specified by the test request.

The full-life efficiency will be determined after adding a quantity of dust at the rate of 1 g/m3 (grams per cubic meter) until the test filter reaches a predetermined pressure restriction. Enter the air flow rate, dust feed rate, and termination pressure into the control computer dialog box. Set the control computer to record all necessary data parameters for the duration of the test.

Reinstall the absolute filter, test filter and appropriate fixture onto the test stand. At the Lab computer interface, lock in the scale reading by checking the appropriate dialog box. Switch on the blower and verify that it reaches the required test air flow rate and allow the system to stabilize. Turn on the dust feeder using the dialog box control button and record the initial restriction (delta-p).

Monitor the system parameters until the termination point has been reached. The control computer will automatically shut down the blower and dust feeder at the termination point. Record screen data on the appropriate data sheet and file it in the test folder.

Remove the test filter, fixtures and the absolute filter from the test stand. Photograph the test article and fixtures and note any anomalies in the comments section of the datasheet. Place the absolute filter in the ventilated oven and periodically check for the weight to stabilize. Record the final absolute filter weight on the data sheet.

Weigh the test filter and fixture. Record the weight(s) on the appropriate data sheet and archive the test filter.

Equations and Formulas

E *initial filter efficiency (%)*

where

Δm_A *mass increase of the absolute filter*
Δm_D *effective mass of dust fed*

$$E = \left[1 - \left(\frac{\Delta m_A}{\Delta m_D}\right)\right](100)$$

E_a *absolute filter efficiency (%)*

where

Δm_A *mass increase of the upstream absolute filter*
Δm_B *mass increase of the downstream absolute filter*

$$E_a = \frac{\Delta m_A}{\Delta m_A + \Delta m_B}(100)$$

E *full-life filter efficiency (%)*

where

Δm_A *mass increase of the absolute filter*
Δm_U *mass increase of the unit under test*
Δm_D *total mass of dust fed*

$$E = \frac{\Delta m_U}{\Delta m_U + \Delta m_A}(100)$$

B *material balance*

where

Δm_A *mass increase of the absolute filter*
Δm_U *mass increase of the unit under test*
Δm_D *total mass of dust fed*

$$B = \frac{\Delta m_A + \Delta m_U}{m_D}$$

Video Added To The Thread I Started By Forum Poster

A forum poster added three videos re filter performance tests to the Thread I started. Of the three, I found the one posted by Jason Fenske most compelling. Jason is a Mechanical Engineer and a YouTuber (*so have to consider a possible bias.*) He has many car related videos on his Engineering Explained website. Note, this video was NOT paid for by K&N the oiled cotton filter tested.

He tested the K&N, AN OEM dirty filter, OEM new filter and another paper filter. He includes not only dyno tests but also actual 20 to 60 mph and 20 to 45 mph runs with interesting significant differences. Since I have ME degrees and formal training and practical use of statistically sound testing methods, appreciated his comment about performing his tests in a random sequence to avoid time and inevitable background change bias! He also repeated each test to provide a "feel" for repeatability measurement error.

The bottom-line result is similar to what Oiled Cotton Filter Manufacturers publish.

This is a link:

Do Performance Air Filters Actually Work? - YouTube