

# Simplified K&N Air Filter Project for the Piaggio MP3 500

## Introduction.

I looked through several of the threads on the Modern Vespa MP3 forum to see how people have approached replacing the original MP3 air filter assembly. K&N filters have a solid reputation, and present probably the most comprehensive range of filter configurations, along with supporting parts and accessories. Based on my research, I decided to go into the project with a few precepts:

- Take the design and engineering, and fabrication approach that depended *least* upon metalworking.
- Use Piaggio original parts/concepts when they are unlikely to seriously degrade the final result.
- Leverage the parts and accessories K&N offers when they make sense.

With those precepts in mind, I came up with my set of guidelines:

-- No Tin Cans. I decided I wasn't going to fabricate or adapt some kind of metalwork to shield the filter from rain and flung gunk. K&N has a couple of slip-over nylon mesh products that either repel water (Drycharger) or snow and water (Snowcharger). The Dry/Snowchargers are easy to inspect or replace, and they don't increase the size of the overall assembly.

-- Use the Original Intake Pipe. Some might find this heretical, but I decided to use the original intake pipe (40mm ID) in its original length. In my mind the main culprit in the stock Piaggio air filter is the smaller intake pipe (22mm ID) down in the air filter box. (I guess someone could put two versions of a K&N mod on the dyno and compare stock vs. larger diameter intakes -- but I'm not bothering with that.) One advantage of retaining the stock hose is that this approach doesn't introduce any joints, adapters, or other interference to the intake air flow.

-- Crankcase Vents into Air Filter/Intake. I didn't feel it was appropriate to vent the crankcase to the atmosphere. It is certainly easy enough pipe the crankcase breather into the K&N filter without interfering with the airflow in the intake pipe.

## Selecting the Filter.

My precepts and initial guidelines actually helped me narrow down the filter choices. At first glance the K&N listings are a little intimidating. It didn't matter to me if the filter shape was straight or tapered, round or oval. But tapered round or oval would offer some fitting advantages.

I decided the best mounting approach was to fit the filter's flange over the outer flange of the intake pipe. It appeared that a 62mm ID K&N filter flange would be best. I rejected 64mm ID flanges (though you could shim out the intake pipe outer diameter with gasket material) and 44mm ID flanges (attach the filter to the smaller part of the intake pipe behind the flared bell end).

The search was made easier by eliminating all the filters that do not have **Drychargers** or **Snowchargers** fitted for them. Whilst working through the list I also discovered that the filters with an angled flange

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also had longer flanges. Installing a hose nipple on that flange would allow the crankcase to vent to the inside of the filter without interfering with the air flow inside the intake pipe. The angled flange also gets the filter a little bit farther away from the rear tire.

For my project I selected the **SN-2540** -- a tapered oval filter with a body length of 127mm (5 inches), and a 20-degree flange that is 32mm (1 ¼ inches) long. The runners up were the round tapered **SN-2530**, **SN-2520**, and **SN-2510**. These all have a longer (51mm) flange angled at 20 degrees. The difference between the three is the filter body length: 102mm (4-inch), 127mm (5-inch), and 162mm (6-inch) respectively.

### Modifications to the Filter (Nothing Major).

The first mod is the installation of a ½-inch steel flange (K&N 85-1050) into the filter's rubber flange wall. This is to accept the crankcase breather hose. The K&N steel flange is not inexpensive, but it works, and takes up less space than plastic fittings.

Use a 5/8-inch wood boring bit (i.e. Irwin Speedbor) if you have one -- and go slow. Use Loctite to secure the flange nut. In one of the photos following, note the orientation of the hex head's faces to allow the most room possible for the Piaggio intake pipe to fit in.



½-inch hose flange installed.



Bolt and washers on filter end.

The second mod is the installation of a bolt in the filter's "top" so that you can mount a support to stabilize the installed filter. With the filter is on the scooter's swing arm, you can't have it bouncing and waving around -- and eventually falling off. There is a raised rectangle of rubber in the top cover of the filter that can be removed easily with a sharp wood chisel. Using a sharp pocket knife works too.

Bore a hole in the end of the filter for attaching the support bolt. I used a 6mm x 35mm bolt secured with a couple of fender washers and a nut secured with Loctite. That secures the support bolt to the filter (once installed, you never take this apart). A pair of fender washers and a rubber/neoprene washer will secure the end of the filter cover, held in place by a lock washer. I cut a slot in the end of the bolt so that I can use a flat blade screwdriver keep the bolt from rotating while I secure the lock nut on the end.

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### Modifications to the Piaggio Intake Pipe (Very Minor).

There are a couple of ears on the tire side the mounting flange that align the intake pipe with the air filter box. Cut those off.

To allow the rubber flange of the air filter to clamp more firmly to the mounting flange of the intake pipe, a little stiffening is in order. Cut a 12mm section off the end of a 1 ½-inch PVC pipe coupler. Then make a right angle cut to split that ring. Carefully continue filing the cut a little wider so that you can fit the PVC ring under the intake pipe mounting flange and around the actual air intake. It should fit snugly, without stretching the outer rubber of the intake pipe. When you attach the filter to the intake pipe with the supplied hose clamp, this plastic ring will provide a more secure fitting than soft rubber over soft rubber.



PVC insert to support clamping. You can see the split at 11 o'clock in the installed picture.



Align the flat of the hex head.



Intake pipe attached to filter.

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### Mating the Crankcase Breather Hose.

The stock breather hose has flared ends to fit over 3/4-inch nipples, but the main part of the hose is 1/2-inch ID.

When you remove the stock air cleaner box, it's easiest to uninstall the breather hose and its 90-degree fitting from the crankcase and leave the breather hose attached to the box. Then cut off the hose clamp at the air box and remove the hose. Attach a very short length of 1/2-inch ID heater hose to the metal hose flange you installed on the K&N air filter. This piece of hose only needs to be an inch or so, and shouldn't go over the flared end of the metal hose flange -- you're just using the hose as a collar to "neck up" the metal flange OD. Press the air filter end of the breather hose over that stub of heater hose and clamp in place. The 90-degree plastic fitting on the other end of the breather hose should be able to fit nicely back into the crankcase.

Unanswered at this time is whether or not that oil-laden air will foul the intake or throttle body. The stock air filter box has what amounts to an oil separator. If this turns out to be a problem, I'll look at installing some kind of separator inline.



Filter, pipe, and breather hose assembled.

### Filter Support.

Although the K&N filter clamps securely onto the Piaggio intake pipe, that's still a lot of mass attached to the suspension and bouncing around: Recipe for failure.

I considered several options for this over a month or two and initially decided on a strip of stainless steel (K&S 1/2 inch x 0.028"). Two 1/4-inch holes were drilled 4 inches apart and the strip trimmed and the ends rounded freehand with a MotoTool cut-off wheel.

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I mounted this to the swing arm with two ½-inch x 1-inch brass corner brackets. The brackets were cleaned and blackened with “Blacken-It”. You can see in the photo that one attaches to one of the air box mounting points and the other is used as an extra support. A piece of rubber gasket material is glued to the bottom of the support angle.



Side view of filter, support, and bracket.



End view (rear) of filter, support, and bracket.

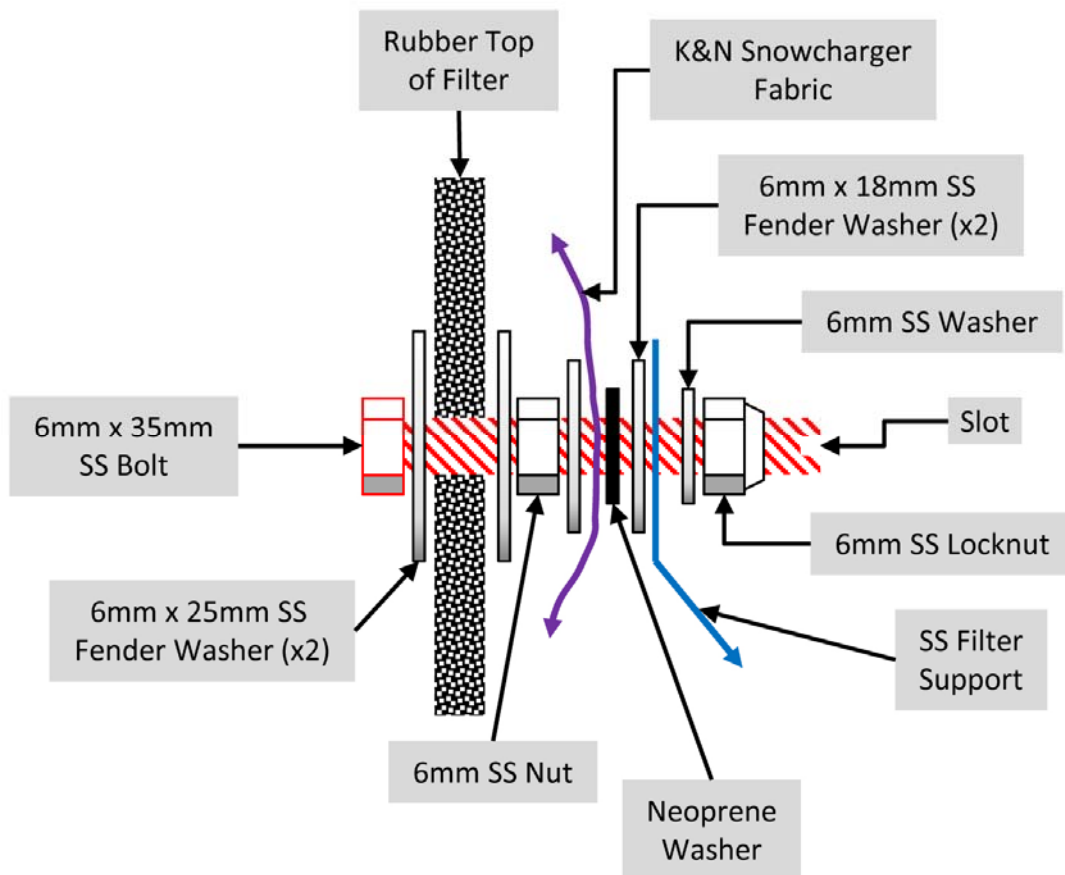
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Naturally, once I mounted everything up, I began to have doubts about the single strip of steel. However, this is the thickest strip that I could easily find. I'm going to fabricate a second version of the support using two strips of stainless steel with gasket material sandwiched between. This approach would make a little bit of a dampened box structure and keep the two metal strips flexing together.

I'm going to be keeping an eye on the brass brackets and will replace them with painted steel if they show signs of failing.

### Snowcharger Cover.

Once I was sure all the hardware and parts fit, the only task remaining was to install the cover. This only required melting a hole in the middle of the end so the filter support bolt would pass through. The way the filter came folded in its retail package, the creases made an "X" right in the middle of the nylon panel. Make a hole with a soldering iron.



Hardware for the filter support. The head of the bolt is inside the filter.

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Close-up, wide-angle view (typical workshop shot) of the installed filter and filter cover. The scooter's side plastic is just gravity-hung. When I get the bike outside in a month or so, I'll take a better photo. This *does*, however, show how much more compact the filter is compared to stock.

### Relections.

-- If I was to do it again, I'd consider using the SN-2530 (filter 4 inches long on a 2 inch long flange). The overall length would be about the same, but the longer flange would allow more options for placing the flange for the breathing hose. My guess is that the filter is more than sufficient for a 500 engine and there would be less mass bouncing around.

-- I'm not sure what will happen with the new crankcase breather. The stock configuration has the breather hose connected to the filtered side of the air box, into a small box-like chamber on the filtered side. There is a clear plastic drain hose on the forward end of the air filter box which collects oil. On my MP3, with 2400 miles, there was about 10mm of oil in the tube, as compared with no oil showing in the little clear rear bulb (which collects oil from the unfiltered side). Will the oil from the breather tube collect at the bottom of the K&N and eventually drip through the filter's cotton mesh? Will there be fouling in the intake from that oil-rich air?

-- An alternative to my metal brackets for the filter support would be to use a single piece of 1-inch aluminum angle stock about 1 ¼ inches long. Stand the piece flat against the stock filter box support, and sculpt the bottom, as needed, for a snug fit. Paint or polish.