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# REF: Engine Mechanicals

## Breather Venting / Relocation

### Sub Documents

In the sub documents below, you'll find several different mods.

Some of which are ways of obtaining better engine breathing or controlling oil carry-over out the vent(s). It is important to note that these are a compilation of mods from XLForum members and that each individual engine is different.

So one mod may work for some but not for others.

Listing these here does not equate to an endorsement of any mod but rather examples of the extent others have went to accomplish their goals.

Use them at your own risk and if any of them are not clear to you, ask someone before installing them.

- [Converting to Vent Line Extensions](#)
- [Converting to Filtered Vents out of the Air Cleaner](#)
- [Installing a Catch Can on the Breather Vent Line](#)
- [Converting Head Breathers to Cam Chest Breather](#) The Deimus Mod.
- [Adding a Vent Between the Oil Tank and the Cam Chest](#)
- [Installing a Buell Rocker Box / Breather System on an Evo Sportster](#)
- [86-90 Engine Breather Mod Using #4 Cam as an Oil Slinger](#)
- [Fitting a Breather Horseshoe Tube to a Stock Ham Cam A/C](#)
- [79-85 Breather Vent Mod - Adding a Secondary Vent Hose at 6:00 Position](#)
- [Aftermarket Breather Valves](#)
- [Installing "Slobber Stoppers" \(1991-1993 Models\)](#)
- **Related articles in the Sportsterpedia.**
  - [Breather Valves \(1957-Up\)](#) (list of breather valve changes)
  - [Breather Venting / Relocation](#) (list of breathing mods and aftermarket breathers)
  - [Head Vents vs Cam Chest Vent](#)
  - [Wet Sumping](#)
  - [Why Oil Pukes Out the Breather](#)

### Aftermarket engine breathers and breathing mods in general

**Maintaining your OEM breather umbrella valve(s) is not something you do every five years or so.**

Harley considers them a normal replacement item. <sup>1)</sup>

The biggest problem occurs when the stock umbrella valves blow out or get hard and quit working as one way valves.

The purpose of one way valves is to allow the air in the crank case to be pushed out as the pistons go down.

Then the valve closes to prevent air from being sucked back in as the pistons go back up.

If the valve doesn't flex properly (or keep in time with piston action), the crankcase cannot pressurize/depressurize as it was designed to do.

### **General statements on modifications of OEM components:**

If you're discussing engine breathing mods, you're also discussing changing crankcase pressure.

Revised crankcase breathing is an area where you have huge potential to create unintended consequences. <sup>2)</sup>

Few really understand the ifs, ands and buts of all the factors the factory took into consideration when they designed the system.

The MoCo somehow balanced the engine design factors to come up with a compromise that worked.

Once you change CC pressure / compression ratio and etc, that equilibrium is disturbed.

Generally speaking, all modifications to the factory oiling / engine breathing system should be done at your own risk.

Companies are everywhere trying to sell us venting mods and breather valves and advertise theirs as the best on the market.

However;

Stock breathing systems are generally fine for stock engine configurations. There shouldn't be a problem with OEM breathers if they are maintained properly.

Stock rubber umbrella valves will harden over time and need to be replaced.

However, performance upgrades may produce higher pressure swings in the bottom end and that needs to be accounted for.

Bigger pistons than stock or aftermarket parts (breather valves, venting mods, venting restrictions etc.) can easily change overall crankcase pressure.

Just keep in mind that sometimes mods are necessary due to other non-factory changes made to the engine.

Sometimes they are not, however, and prove to be more harm than good,

Best advice is to check with your supplier / engine builder for any side affects of and / or accommodations needed due to any performance upgrades.

To be clear, if you're not experiencing issues with your breathing system, there is no reason to install aftermarket parts.

Being proactive here means monitoring your individual issues and reacting accordingly.

### **There are generally several reasons why some need or want a different breather venting system.**

Several are listed below although there are probably others as well.

#### **1. The 1990-older factory breather valve is now obsolete.**

- This happens with older bikers but there are still options available.  
You don't have to just let it go because you can't find a factory valve.
- Failing breather valves can cause too much vacuum in the crankcase or not enough.

That can also lead to weeping / leaking gaskets, blowing out seals and / or robbing horsepower.

- 1991-up breather valves are currently in circulation as of this writing.
- 1990-prior breather valves (although obsoleted at the MoCo) are available online at times. Sometimes you just have to wait and search to find them.  
NOS valves can sometimes be found at dealerships but you'll have to contact them and ask. (sometimes a phone call or in person will get better responses than emails).
- 1977-up engines all use one way breather valves although exact construction and venting changed over the years.  
1977-1990 engines all vented from the cam cover.  
So an external motorcycle one way breather valve (that can be plumbed sufficiently) can be installed externally in the same place.  
1977-up engines also all begin making full vacuum starting from when the second piston begins it's upstroke motion.  
So any external motorcycle one way breather valve (that can be plumbed sufficiently) will work on 1977-up Sportsters.  
It is important to note that while using an external breather valve, the internal valve should be removed.  
Leaving the old valve inside will only create more restriction to the air moving out of the engine.

**2. There is no sensible reason to change air cleaners or engine breathing just because that's someone else did.**

- If your goal is simply to change the overall appearance, by all means, make it your own. But understand that sometimes you can help or hurt the breathing system by what changes you make and all engines are different.  
You can test the crankcase pressure to find out what your engine is doing or needs so you'll know where to go from there.

**3. One advantage of venting to atmosphere is cleaner combustion (and cleaner pistons).**

- There is also a case against improper installation of external vent(s).  
There are many aftermarket and homemade breather vent relocation mods available to move the vents out of the air cleaner.  
However, depending on how you route the vent lines, you can cause emulsified oil accumulation in them.  
Emulsified oil will just build up in the tubes until it all comes out. And it could also alter engine breathing if it doesn't come out.

**4. An external breather will get rid of oil leaks or drips from the breather vent hose.**

- This is wrong.
  - All Harleys drip a little oil from the breather vent(s) every now and then by nature. Some say no but it is inevitable.  
And truthfully, the MoCo still hasn't repaired that flaw. They just hid it in the air cleaner.  
Maintaining the correct pressure in the crankcase and minimizing oil leaks from the breather hose is always a trade off.
  - If the OEM umbrella valves are in good condition, there should be very little oil coming out the vents.  
However, condensation will happen and so will a certain amount of oil mist.
- Sharp bends and elevation changes in external vent lines will allow this mixture to sit and build instead of flowing the end of the vent line.

- A filter on the end of the vent does the same as the bends and elevations. It allows the mist to sit and build.

There is no need to install a filter on the end of the vent line. It's just a potential puddle later.

#### 5. **Commercial hype from aftermarket manufacturers.**

- OUR breather valve ads X amount of horsepower to your engine.  
The reality is there is no data from aftermarket breathers manufacturers showing any horsepower gains from testing done on their breather valves.
- Hayden makes that claim, maybe others also, but they offer no evidence as to how their valve adds horsepower.
- Testing was done however to prove whether any breather vent in particular could make extra horsepower.

See comments by aswricing below on venting mods to obtain more horsepower: <sup>3)</sup>

- I've induced scavenging issues mostly from using gapless rings. But not from venting mods.

However, I've dyno tested venting mods until I'm blue in the face and never found a single horsepower there.

(except for pulling the blow by out of the intake tract, which is good for a small across the board improvement)

S&S cases have no scavenging issues due to the strategic placement of the reed valve (in the sump).

The scavenge inlet sees pressure but is isolated from the vacuum when the pistons go back up.

In addition to the above, I also did a bunch of testing of the aftermarket breather check valves from Spyke and Hayden. <sup>4)</sup>

(and even did some experiments with vacuum pumps and the like) Did some magazine articles here and there at the time.

The motor was remarkably insensitive to anything I did with the breathers.

Like I said, the only thing I could get to show up on the Dyno sheet at all was the removing of the blow-by from the intake tract.

#### 6. **Stage 1 or higher air cleaner changes makes OEM breather venting impossible.**

- It is still possible to keep the venting into the air cleaner when upgrading OEM air cleaners. You may have to get creative with plumbing or fabrication in some instances however.
- You may also want to take advantage of some of the mods listed in the sub documents at the top of this page.

Again changing the breathing system can have it's downfalls and should only be done to improve the breathing system.

Testing the internal air pressure after performing breather mods will tell you if the mods helped or hurt the system.

## Vent Outlet Above vs Below the Head Vents

There has been debatable ways to route the vent lines off the heads when doing air cleaner mods. However, exact line routing comes down to function over fashion.

While it may look better or cleaner for the lines to be routed above the air cleaner; Doing so doesn't necessarily make for good functioning of the breather system.

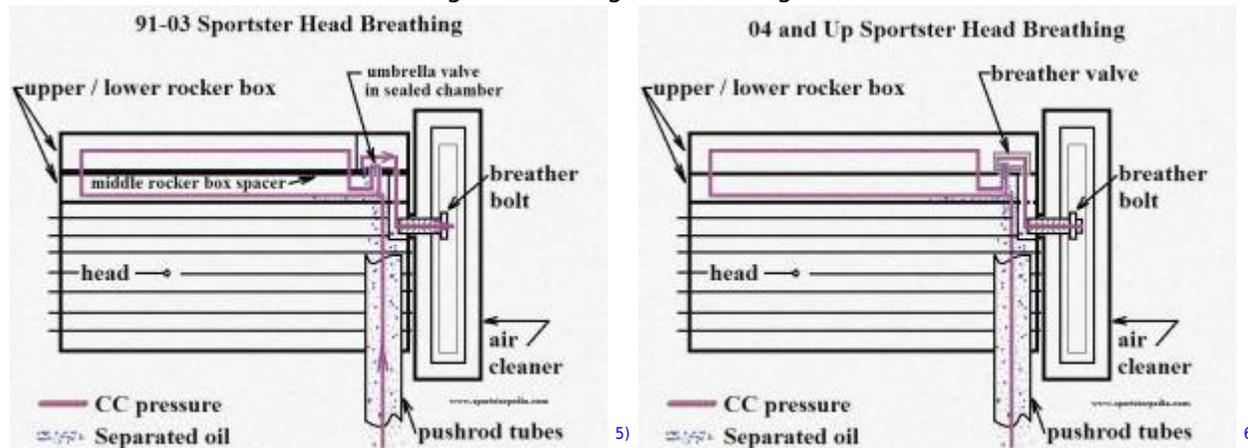
That also can be debated.

The air / oil that gets blown out is a combination of crankcase pressure and engine blowby. The argument is blowby gasses produce a corrosive vapor which doesn't need to go back into the engine. It'll simply pool in the heads / vent lines and become an emulsified goop. Mounting vent lines higher than the head vents is counterproductive to quick air/oil/condensate removal. It's the quick removal that helps prevent sludge buildup.

As you can see from the drawings below, expelled air leaves the rocker boxes by running downhill to get out the vent holes in the heads.

If the vent lines are piped above the exit point in the heads, oil out of suspension will not drain back into the engine.

The oil would have to run uphill to get from the heads to the rocker boxes and into the lower end. So there is no functional advantage to running the lines higher than the head vents.



The air coming from the head vents has fine water condensation and oil mist particles in suspension with it.

When that air cools, the oil mist falls out of suspension and collects in the vent lines and mixing with unsuspended oil droplets.

Pointing the vent lines straight into the A/C (OEM) or down into a catch can allows the oil out of suspension to leave the vent lines.

### **Kuryakyn or Other High Mount Breather Bolts:**

However, pointing the vent lines upward of the head vents allows oil out of suspension to collect in them. Once there is enough liquid oil in the upward breather tubes it will act just like the trap under your sink. It may restrict or block air from getting out until the engine (on startup) builds enough pressure to push the liquid and bubble up to the top.

So it may affect crankcase pressure slightly until the lines are cleared.

Or the trapped oil may simply be blown out the vent lines in globs.

Vent lines mounted high tend to promote a mixture of oil and condensation settling near the head connection of the hose.



### **Horseshoe Tube:**

The horseshoe breathers that take the outlet from the breather bolts upwards tend to clog with foamy oily gunk.<sup>9)</sup>

It's a low pressure output with not enough to push the sludge upwards and around the bend.

This means the breather bolts are swimming in this gunk and if there is a small leak there is plenty to leak.

Fitting a breather where the outlet from the bolts goes downwards alleviates this.

Nylon, copper or brass washers will deform slightly under pressure and seal things better also.

With the horseshoe tube mounted high and only one end with a vent line at the banjo bolt, condensation and oil can emulsify in the non-vented end.

In the pic below, the air in the rear head has to travel up to the front.

When the engine is shut off, condensation / unsuspected oil falls back to the low spot (in this case the tube connection at the rear head).

Goop collects there which either has to re-suspend after startup, heat up and move out into the vent.

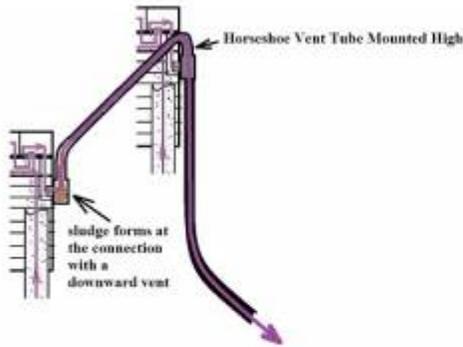
It can also come back down the horseshoe towards the engine, and collect at the breather valve.

If there is a filter on the end of the vent line, this collected goop can be sent to and clog the filter as well.

Some appear to be OK with this as it is seen as better to be outside than inside the engine.

However, the goop (emulsified oil) is a restriction to crankcase pressure leaving the engine until it is cleared.

### On Piston Downstroke

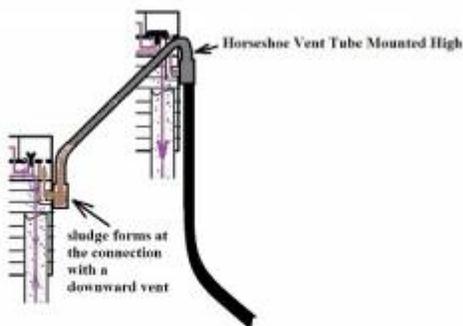


**On piston downstroke, crankcase pressure has to dodge the sludge buildup to get out of the engine. This can back up CC pressure until the sludge is cleared out by suspension or by force.**

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### On Piston Upstroke

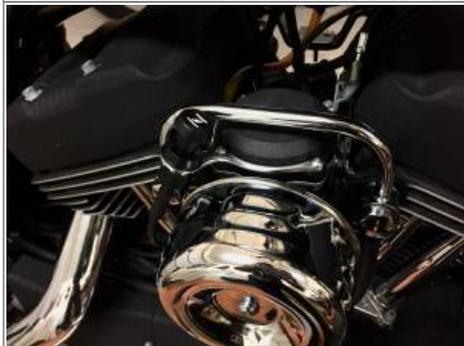


**If the umbrella doesn't close fully, sludge is drawn back toward the head on downstroke until the next upstroke**

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11)

Horseshoe tube, high mount / vent line in front. <sup>12)</sup>



Rear bolt covered in sludge. <sup>13)</sup>



Filter mounted high will receive built up sludge. <sup>14)</sup>



Vent lines mounted lower than the head vents allow oil / condensation to leave the heads.



The sludge doesn't get there at once.

To begin with, it's just a slight mist. The restrictions to the vent line (including a filter on the end) allow the mist to glob.

Also, the healthier your engine breathing, the less problems you'll have with the sludge.

But sludge will form even in the healthiest conditions depending on how the vents are routed.

## Breather Bolts

### OEM Breathe Bolts

Crankcase pressure was increased in 2004 by several means.

One of which was the reduction of the hole size in the breather bolts on the engine side (more restriction).

The smaller hole creates higher (positive) pressure in the crankcase on piston downstroke which aides in oil scavenging.

They also allow the air to leave the vents at a faster (pressure) rate.

The threads in these bolts are cut wider for a tighter fit into the heads.



17)



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## Aftermarket Banjo Bolts

Aftermarket breather bolts have a larger hole in the bolts than the 04+ bolts. The banjo bolt must be indexed to have the small side hole on top.<sup>20)</sup> If not, they will drip more. You can adjust them with copper washers.

Careful when tightening the bolts with the holes in the sides, the hole does weaken the bolt. The threads may be cut to standard width which allows a looser thread fit into the heads. To stop a leak, you may be tempted to tighten the bolts even more. This could result in breaking the bolt.

On 04-up heads, changing to aftermarket breather bolts means using bolts with the bigger I.D. (91-03) style bolts.

The results of using the bigger holed bolt would be a slower rate of outflow and less positive crankcase pressure on a stock motor.<sup>21)</sup>

But the timing of the upstroke is the same which then pulls a vacuum.

The umbrella valve will close down only when inside air pressure is lower than outside air pressure.

If the inside pressure can't get out fast enough before piston upstroke happens the umbrella may 'float' or not close all the way.

If the umbrella floats, X amount of extra air is pulled in until it does close.

(on top of what didn't get completely out on the last downstroke = more air in the engine on the next

downstroke = oil puking out the breather).

How much slower the bigger bolt hole yields will vary with different engines.

However, the smaller holed bolts were designed to OEM specs internally.

If you've upgraded to bigger pistons, there will be more positive pressure displaced out the breathers on downstroke.

This may negate the need for higher pressure generated by the smaller holed bolts.

This may be something you'd want to watch since there isn't sufficient data to prove one way or the other.



22)



23)



24)

## Filter on End of the Vent Line

Lots of folks like to install a small filter on the end of the vent hose. <sup>25)</sup>

It's not at all necessary as there is no vacuum on the outside of the breather valve (just a slight escape of crankcase gasses).

The filter adds resistance to the vent pressure coming out of the engine.

This resistance can add to goop in the line / filter later.

A stopped up filter can also increase the vacuum inside the engine, which on a street bike, translates to weeping gaskets.

The filter does not keep debris from coming back into the engine. <sup>26)</sup> That's the job of the breather valves inside the engine.

If anything can get back in, it means your umbrella valves are shot. There will be quite a bit of oil coming out the breathers, and all sorts of stuff going back in. Unfortunately, it's not just condensed oil. It's emulsified oil, as the oil mixes with water which condenses out of the crankcase breather gasses.

If your breather valves are in good order, nothing can get back through them. The exception to this would be small oil drainback hole that keeps oil from building up between the umbrella and the outlet. The tiny holes next to (and slightly lower than) the umbrella valves are for draining the separated oil back into the rocker box. However, there isn't large enough suction back on the vent line to pull debris up and into the engine.

It's also safe to say that if you have an external vent line(s) attached and it never leaks even a drop, you may want to keep an eye out for worn out breather valves. When the umbrellas get old and hard, they don't flex enough to allow proper air flow around them. More vacuum is formed in the engine. The increased pressure, if vent line filter is stopped up, may overcome the engine gasket seals with oil seepage to follow.

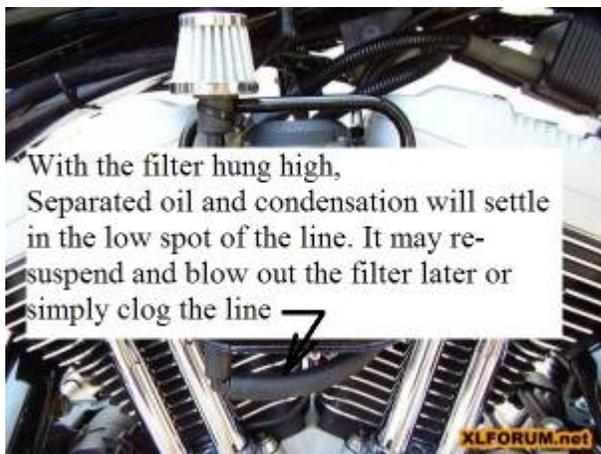
Ring flutter is normally attributed to happen around 5000-5500. Ring flutter equates to blowby which produces more positive pressure in the crankcase from above. Excess blowby can also pull oil up into the chambers on upstroke as the rings flutter. Excess blowby creates a higher density oil splash in the bottom. This equals more oil hitting the breather valves(s) to be separated and some may splash out the breather vent at high RPM when the crankcase mean pressure goes positive. Oil seepage out the vent at sustained high RPM could be enough to saturate the filter and hinder the breathability of the engine to atmosphere. Repeated runs can stop up the now saturated filter if it is left unchecked. Condensation and separated oil can also attach to the filter element and clog it up.

## **Filter Placement / Maintenance**

Adding a filter on the end of the line and hanging the filter lower than the vent can cause filter blockage. No matter what breathing system you are using, a certain amount of oil / air mist still makes it past the breather. That and vapor condensation will fall out of air suspension when it hits the filter element and cools down. Even if it's just a small non-visual amount, it will eventually clog in the filter material or in the line before the filter. Condensation and separated oil and attach to the filter element and clog it up. If you feel you need a filter on the end, check the the filter routinely to make sure you can blow air through it easily. Anytime the filter element is not clean looking, there is some amount of debris in it. The more debris in the filter element, the higher the resistance back to the engine and crankcase pressure will be higher. Too high and it can blow out the seals / gaskets in the engine. So blocking the breather(s) simply bottles up pressure inside the engine.

Check the filter regularly. How soon can't be stated properly since there are so many different variables. Filter change intervals should be based on riding style, environment (think high humidity), health of the engine etc.

The filter in the first pic below was full of junk contributing to weeping rocker box gaskets.



## Homemade Breather Valves

This was made by norseXL of the XLFORUM and is a direct derivative of the 86-90 breather valve setup.<sup>29)</sup>

A male threaded cap was made to screw into the female threaded body of the breather valve container as shown below.

The center of the cap was drilled and tapped for a hollow (5.5mm) M10 bolt.

The cam cover was also drilled and tapped for M10 threads.

The brass adapter for the banjo also has M10 internal threads.

The umbrella inside the body is the stock 91-03 umbrella.

A 1.5mm hole was drilled into the bottom side of the body to drain any oil that makes it past the umbrella.





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5) , 10) , 11)

drawing by Hippysmack

6) 17)

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7) 8)

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18) 19)

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photo by socal1200r of the XLFORUM, annotated by Hippysmack

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<https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-motor-engine/sportster-motorcycle-bottom-end/36799-installing-the-ultimate-crankcase-vent-%C2%93how-to%C2%94/page23#post4383140>

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