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REF: Engine Mechanicals - Sub-04G

See also in the Sportsterpedia:

- [Manometer \(slack tube\) for Measuring Air Pressure](#)
- [Building Your Own Slack Tube](#)
- [Using / Diagnosing with a Slack Tube \(Manometer\)](#)
- [Evo Crankcase Pressure and Engine Breathing](#)
- [Testing with a Slack Tube \(Manometer\) by bustert](#)
- [Using / Diagnosing with a Slack Tube \(Manometer\)](#)
- [Engine and Primary Oil System Modifications](#)
- [Wet Sumping](#)
- [Breather Venting / Relocation](#)

Slack tube testing on a 1998 1250S model

This testing was done to see the changes in crankcase pressure using a homemade slack tube while changing some variables.

Note: Testing was done while the bike was sitting still (no load) The stock 1200 engine has been upgraded to 1250cc with the stock S model ignition (not tweak-able) with the double blip timing cup. It also has a Buell crankshaft assembly with the cupped flywheel ends. The oil pump is the 2007 Sportster gerotor pump.

The first test was on a cold startup with used umbrella valves. Just testing the waters using black coffee as a liquid media.

The second and future tests were done at operating temp (200F), technically the way it should be and with green food coloring and water in the tube.

In reading the numbers, you'll see the readings in the left and right legs change.

However, the measurement change in each leg is only actually half of the affected height of liquid moved.

To be accurate, take the reading from the left leg between zero reference and the height of the liquid and multiply it by 2 to get total increase/decrease in vacuum.

Likewise you can add zero to the liquid height on both tubes and get the same result.

In the drawing below (left);

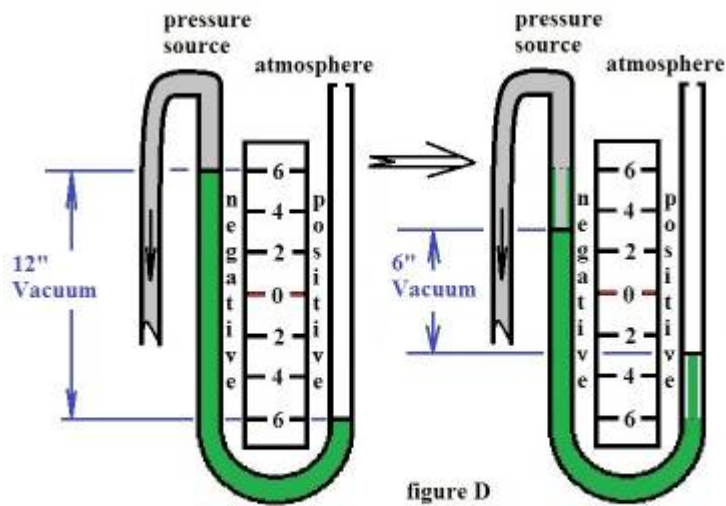
A rise in vacuum pressure of 6" of water (left leg) has a total of 12" in rise as the water has traveled in both legs.

Then, on the right;

An addition of 3" of positive pressure exerted (6" in actual height) on downstroke still yields a balance of

6" of total vacuum from the engine (showing 3" on left leg).

In this example, the total pressure in the crankcase is still negative but with not as much pressure as it was at the last upstroke.



12" of vacuum with 6" of positive added to it results in 6" of vacuum

www.sportsterpedia.com

For this testing, a slack tube was made using an 1/8" hose barb fitting plugged into the timing plug hole with a length of 1/8" clear hose to the instrument.

The [build article](#) is [here](#) for it's construction.

Anti-seize was not used on the hose fitting initially and later it was used with no difference in the results. Using a ruler instead of graduations each direction from reference zero will work fine. You just have to do some math to get the readings.

All testing done with green coloring below was done with 36" ruler with reference zero at 18-1/8" on the ruler as shown below.



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Summaries from Slack Tube Testing

Before changing to new umbrellas; ⁴⁾

1. The rear umbrella was more stiff than the front one which was 'like new'.
2. The oil cap could be removed at hot idle and the engine stumbled or died.
 - There was oil frothing in the oil tank with the cap off at idle. The frothing got less when the cap was 'slightly' off.It didn't have any affect pulling the cap at cold idle.
3. There are app. 1/4" fluctuations in the pressure readings at 1000 and 2000 RPM. The fluctuations are relatively quick changing.

After changing to new umbrellas;

1. The engine loped a little better.
2. There was no noticeable change in RPM with the oil cap removed.
3. There was no frothing of oil in the tank with the cap removed.
4. Residual vacuum was decreased with new umbrellas across the RPM range.
5. The engine flipped over to positive pressure at a lower RPM.
6. There was less gap between the pressure changes from 1000 and 2000 RPM and have a slower reaction rate.

After restricting both breather bolts to 1/8" openings;

1. The smaller bolt holes actually reduced vacuum.
2. They also offer more control of CC pressure throughout the RPM range by creating lower pressure swings.

Other testing:

1. The air/fuel mixture did not have an affect on CC pressure.
2. There was no difference in pressure with the air cleaner on or off during testing.
3. Timing changes did not have an affect on CC pressure.

Tests using the head breathing system

Other Notes:

Testing from cold startup

1. There was no oil spraying /puking out the A/C before or after changing the umbrellas or during any of the testing.

2. There was no extra drag on the motor before or after changing the umbrellas.

An initial test was done at cold startup just to see where the measurements would fall.

The engine was warmed just enough to shut the enrichener off and testing began.

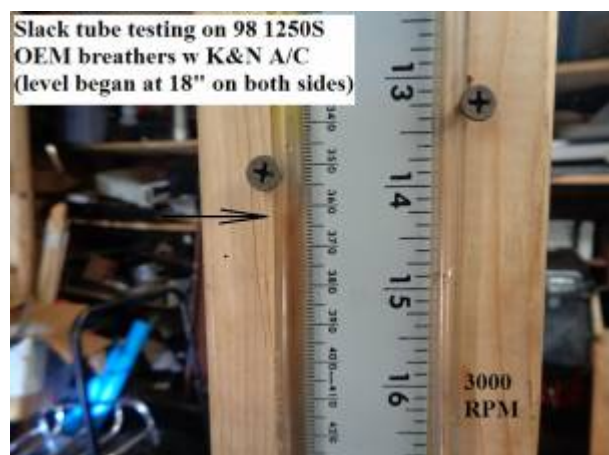
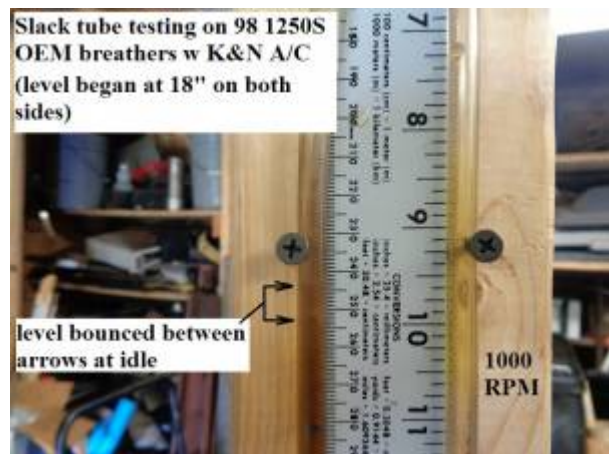
Ideal testing, of course, is a full operating temperature so this portion of testing is just for reference only.

The rings will seal better on a hot test and the results will change from these readings.

The level began at 18" on the ruler on both legs. There was about a 3/8" fluctuation at idle but was stable thru the rest of the testing.

Below are the results from 1000-5000 RPM.

As you can see, the coffee doesn't show up well in the pics which is why green food coloring in water was used in later testing.





All future testing was done with the engine up to operating temperature with oil temp at 200°F.

Initial Test (engine at operating temp)

This is the first official test that was done with the engine up to temp.

Green food coloring in tap water was used as the liquid media.

The umbrella valves were in used state. The front umbrella had about 6 months use.





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Test after replacing the umbrellas

Upon removal of the old umbrellas, the rear one was a little stiffer than the front but still would bend over (just not as much as the front would).

The front was just as flimsy as a new one.

The results show about a 3-1/4" reduction in vacuum at idle in the left leg (6-1/2" of water column) with a new umbrella in each rocker box.

The engine seemed to lope a little better at idle although there wasn't a seat of the pants difference on the road.

And the engine is now going to positive pressure around 4200 rpm.

At both 1000 and 2000 RPM, there was not a fast changing variance in the measurement (as was in the previous test mostly at idle).

The variant level is still about a 1/4" up and down but it rises and falls slower now.

There was no noticeable sign of wetsumping or oil puking out the breathers even before any of this testing began.



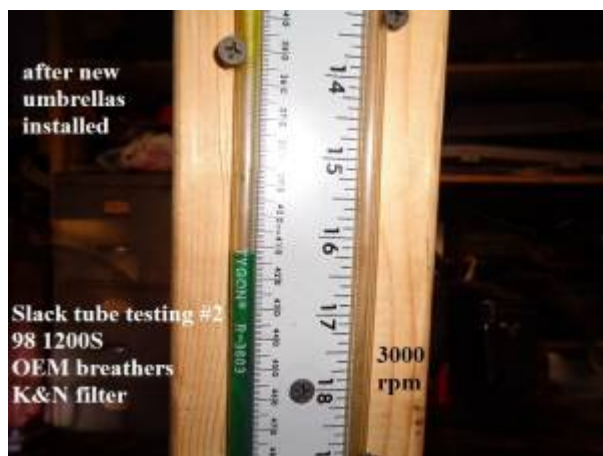
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Test with reduced breather bolt orifices

This was done to see what the affects were of the restricted breather bolts in 04-up engines.
(to see if the restricted hole itself has an affect on pressure on the inside and if so how much)

The [mod for these bolts is here](#) in the Sportsterpedia.

Although the restricted hole is on the inside end of the newer bolts, this was just easier to make.

The smaller bolt holes actually reduced vacuum and they also offered more control of crankcase pressure throughout the RPM range by creating lower pressure swings.

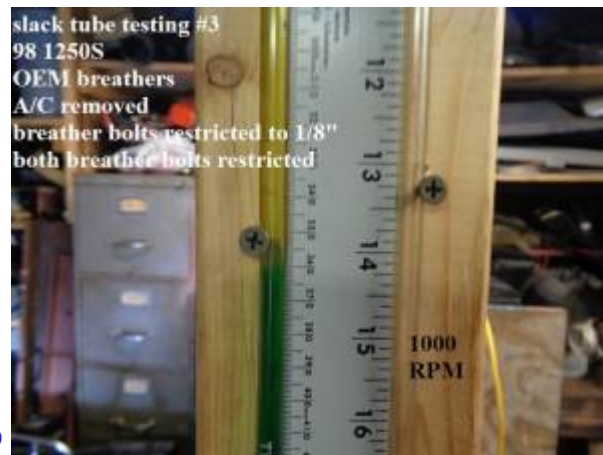
The air cleaner was left off since it didn't change the crankcase pressure readings.

And it was easier to spot for oil mist from the bolts which there wasn't any.





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Test for oil cap issue when removed at idle

Before the umbrellas were replaced it was noticed that, at hot idle and the oil cap removed, the engine speed would stumble and sometimes shut down.

The slack tube was hooked up to help diagnose the problem.



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Before the new umbrellas, 3-3/4" (7-1/2" WC) of vacuum was lost while removing the oil cap and the engine died when removing the cap.

The idle changed with slight movements of the cap being closer to or farther away from the oil tank neck opening.

There was oil frothing in the oil tank with the cap off at idle. The frothing got less when the cap was 'slightly' off.

It didn't have any affect pulling the cap at cold idle.



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The umbrellas were replaced with new ones and the test performed again.

The overall vacuum decreased at idle with the new umbrellas.

When the oil cap was removed, only 2-1/4" (4-1/2" WC) was lost and there was only a slight pitch change in the engine with no noticeable amount on the tach.

No frothing in the oil tank now with the cap removed at idle. So it appears the problem was a stiff umbrella valve (rear).



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Test with air cleaner removed

The A/C was removed to see if it had any impact on crankcase pressure testing.

There was no noticeable difference with it off through the RPM range tested up to 5000.

There was also no noticeable oil mist during this period.

Condensation and light oil mist accumulation at the bolts was from original testing before replacing the umbrellas.

But none of this was in the filter and no oil puking.



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1) 2)

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<https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-motor-engine/sportster-motorcycle-bottom-end/197307-sportster-crankcase-pressure-engine-breathing-wetsumping-and-mods/page52#post4349847>

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Last update: **2023/12/26 23:09**

