Table of Contents

Go To Technical Menu

REF: Engine Mechanicals - Sub-04E

Building Your Own Slack Tube (Manometer)

See also in the Sportsterpedia:

- Manometer (slack tube) for Measuring Air Pressure
- Using / Diagnosing with a Slack Tube (Manometer)
- Slack Tube Testing on a 1998 1250S Sportster
- Testing with a Slack Tube (Manometer) by bustert

Building the Unit

Article by Hippysmack of the XLFORUM [1]

The backing plate is a 2×4 with an aluminum 36“ ruler attached with drywall screws. The base is a 12” long piece of 1×6.
The two rulers below (right pic below) show the measurements on the wooden ruler to be 1/8“ longer than the steel one in a 36” run.
Ambient temps can also shrink or expand the ruler whether wooden or aluminum so that has to be taken into account of subsequent tests.


2)

3)

The drywall screws were also used to bind the hose between the ruler and the shank using the screw head to hold the hose down. [4]

The black connector at the top is a cut down spark plug boot used as a sleeve for the hose connections. (technically if you buy enough length of hose, you don't need the connector)
Just make sure all connections are sealed good.
The engine will suck on the hose for the most part in varying degrees so there's not enough pressure to blow off the hose.
A small piece of plywood screwed to the bottom of the 2×4 makes a nice stand for the unit but it can also be screwed to your shop wall.
Then all you have to do is remove the timing plug, install the new fitting and hook the hose end to it.


5)


6)


7)


8)


9)

[10)]

Selecting the Tubing

The slack tube above is fitted with 1/8“ clear Tygon vinyl tubing and a 2×4 app 3 feet long. [11)] However, any clear vinyl tubing will work (1/4”-1/8“).
You'll need at least twice the length of the tube plus six inches or so for a fudge factor just to fit the tool.
If you plan on making the tube a one piece deal, you'll need the tool length plus the length you plan to have it away from the engine.
The tool needs to sit higher than the outlet at the engine so account for that in length as well.
The clear hose has to be routed away from the pipes and other heat sources.
If need be, you can account for tool length, set the tool where you want it and run a string from the engine source to the the tool to measure length of hose needed.
The tool should be as close to the engine as possible but exact length isn't a huge issue.
The hose from the above tool was fitted with a sleeve (cut portion of a spark plug boot) to connect the tool length of hose to the engine.

Selecting a liquid media

The best liquid to use depends on how much pressure you'll be measuring is the short answer.
Typically, mercury or water is suggested but for use on a Sportster, water is perfectly fine.
The liquid used for the one above is plain ole tap water with food coloring added to it. Green coloring was used as it shows up well in the tube.

Mercury has a density of 13,600 kg/m3 whereas water only has a density of 1,000 kg/m3.
Mercury manometers are typically used in high heat applications such as exhaust manifolds.

Liquid manometers measure differential pressure by balancing the weight of a liquid between two pressures.
Light liquids such as water can measure small pressure differences.
Mercury or other heavy liquids are used for large pressure differences.
For an indicating fluid 3 times heavier than water, the pressure measurement range is 3 times greater, but the resolution is reduced.

Typically, there isn't a large amount of crankcase pressure generated in a Sportster engine.
So slight changes that may be important in diagnosing ongoing wear would not be detected with heavier liquids.

Indicating fluids can be colored water (green or red food coloring works good), oil, benzenes, bromides, and pure mercury.
When selecting an indicating fluid, check the specifications for specific gravity, operating temperature range, vapor pressure, and flash point.
Corrosive properties, solubility, and toxicity are also considerations.

Liquid characteristics in a U-tube Manometer: [12)]

1. Viscosity should be low.
2. Low surface tension is required.
3. The liquid should stick on the walls.
4. Should not get vaporized.

How tall should the U-tube be?

Generally, whichever liquid media you are using, you want the meter to be tall enough so the liquid doesn't suck back into the engine.
The length of the tubes needs to be longer than the expected pressure you'll be measuring. Make sure to account for spikes in considering the tube lengths.
The standard conversion from PSI to Inches of Water: 1 PSI is equal to 28” of water column (overall vertical movement).
Accounting for pressure spikes makes that a 36“ tall slack tube.
A three foot tube allows you to set the water level centered at 18” and gives 18“ of push or pull either way (18” rise in one leg is 36“ of water column).
If you are measuring more than 36” of water, the tool has to be taller or you may need a mechanical or digital gauge instead.
When using a U-tube type manometer, divide the total inches of water travel (in both legs) by 2 as the water in each leg of the instrument are moving.
I.E., 1“ down on one leg and 1” up on the other equals a total of 2“ of total movement.
Therefore, 1 PSI = 28” of water divided by 2 = 14“ of movement per leg per pound of pressure.

- **Example: To convert 4 PSI to total inches of water**:
  - 1 PSI = 28” of water
  - 2 psi = 56“ of water (2 x 28 = 56)
- **Likewise: To convert total inches of water to PSI**:
  - 56” of total water = 2 PSI (56 / 28)

So, technically, a 30“ tall U-Tube instrument (each leg 30” tall) would do for testing from 2 PSI and below readings.
However, a 36“ tall instrument may account for pressure spikes better without dumping water out the end or sucking water into the engine.
Caution:
Once the water reaches the top of the tube or drops below the top of the “U” (crossover) the water will

dump out the end of the tube.
(in testing on a Sportster engine, generally this means the water getting sucked into the engine)

If need be, you can get away with using a shorter tube by using a valve to throttle back the source pressure.

In measuring crankcase pressure;
You want the vertical leg to be able to the hold the actual pressure differential of water plus an airspace above that.
Else, you could suck the liquid into the engine (don't let the end of liquid cross the “U” in the bottom of the tool).
We know of two Sportsters on the XLForum that have been tested for crankcase pressure using a slack tube.
At idle, 15” of water column has been logged on one leg.
However, the variables are specific to each individual rig.
The water level is usually filled to the center of the tubes to allow equal sway up and down the range, but especially the vacuum leg.
Depending on the individual engine, your readings may be higher or lower but a 36“ meter is a good starting point for testing crankcase pressure.

With the engine at operating temp and at idle, the vacuum will be the highest.
The reason you need it to be fairly long is because a very slight difference in vacuum can easily cause the fluid to skyrocket especially when using water.
You may need the larger adjustment range.
When the bike is in perfect tune, you may get away with a shorter manometer.
But if your bike is well tuned, you really don't need the manometer.

Go To Technical Menu

1)
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
2) , 4) , 11)
photo by Hippysmack of the XLFORUM
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
3) , 5) , 6) , 7) , 8) , 9) , 10)
photo by Hippysmack
12)
https://www.fierceelectronics.com/components/manometer-basics