



White Paper

Title: Troubleshooting the Bridge exhaust gas analyzer for air leaks-Material Handling Product Configuration

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Air leaks in general:

Due to sample gas air dilution, an air leak will cause the CO, HC, and CO₂ readings all to be low by an identical ratio. That is, if you see that CO is 5% low, (like 1.00% CO actual reading 0.95%) and also see that the HC and CO₂ readings are likewise all 5% too low - then you should suspect that there is an air leak that is diluting all of the gases the same amount.

Another even stronger indicator of an air leak is a high Oxygen reading - as an air leak contains 20.9% Oxygen. A 5% air leak as above will cause the Oxygen reading to be 1.0% higher than it should. This should be very obvious - as vehicles equipped with a CAT use up all but about 0.5% Oxygen in the natural combustion process. If you see abnormally high Oxygen values being reported by the gas analyzer, you should suspect that there is an air leak somewhere in the sample gas input system.

About the Bridge probe systems:

The Bridge probe is more complex than usual because we have the gas filters and water trap at the probe, not at the analyzer as console or portable systems do. This keeps the dirt and water condensate out of the sample line, and also allows us to have the automatic Zero and condensation purge features, increasing the practical utility of the analyzers. The downside of this arrangement is that the more complex probe/filter/water trap assembly creates an additional potential for air leaks.

There are three areas of potential leaks that should be inspected periodically: The 50mm primary filter, the fittings on the handle/water trap, and the water trap purge valve.

The primary cause of air leaks is contamination of the water trap purge valve. This is easily tested by simply placing a thumb over the bottom end of the water trap (where the purge port check valve is located) and seeing if the gas values change. If the CO, HC, and CO₂ readings go up and the O₂ reading goes down - then there probably is an air leak at this valve.

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Troubleshooting the water trap purge port check valve:

Check the water trap purge valve in the base of the water bowl by un-screwing the water bowl and filling it 1/3 way with tap water, and then reinstalling it. (The top rim of the water bowl seals against an O-ring in the housing, so you should feel a resistance as it make contact in the final ¼ turn.) Connect the probe to the analyzer sample line (the analyzer should be running at this point and pulling in sample gas) and see if the purge valve does not leak under the vacuum of the analyzer pump. Small bubbles may be seen, and if they are less than one per second, the valve is sealing correctly. If bubbles are seen rising from the base of the water trap, then the purge valve is not sealing correctly, and should be cleaned.

Cleaning the check valve of debris:

To physically clean the purge valve of debris, remove the water trap and inspect the lower end from the outside. There is a black rubber valve there (a 'duckbill' valve, which closes more if the vacuum increases. In some rare cases, there may be a small particle lodging in the valve – even though the valve is generally self-cleaning, and is protected by the input filter and this will require removal by the tip of an Exacto-knife, toothpick or similar tool. and there may be . Make sure this valve is clean and shows no light leaking through it.

Flush the water trap purge valve:

The water trap purge valve may also be cleaned of residue by filling the water bowl with tap water, and flushing the one-way valve by blowing directly in the bowl to expel the water from the bowl through the purge valve. (Be careful here - water will stream out of the valve, and you should only do this over a sink!) After completing this flushing, confirm the valve is air tight by pulling a vacuum on the water bowl or by means of the 'bubble test' above. Generally this valve creates a tight seal under vacuum, and works even better if it is slightly wet.

Periodic Checking:

The water trap purge valve should be checked periodically by looking for bubbles in the water bowl. If an excess are seen, perform the cleaning function(s) as above as required.

Leak-testing the rear filter black handled probe: (Shipped after 9/4/2001)

This probe has the 50 mm dia filter behind the long black handle – protected by a 'blast shield'. Because of this arrangement, the S-Bend goes into a brass fitting on the front of

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the handle, so this interface is more robust – although it still should be checked to see that it is not cross-threaded, etc.

Because probe disassembly no longer involves the 50 mm dia filter, it is less likely to be the source of leaks. Nevertheless it is wise to examine these plastic threads (which seal better than brass ones, by the way – but are more sensitive to cross-threading and stripping). If they look stripped, or galled, replace the filter with a new one. The 50 mm dia filter should bottom-out on the mating brass adapter on the water trap - and the other plumbing interfaces on the probe handle should be gas tight. (We have also found that Teflon paste thread sealant keeps these fittings gas tight, and this may be added as required.)

You can check the probe handle assembly for gas tightness by simply placing a finger over the entrance to the black handle, and drawing a vacuum on the fitting at the water-trap end. (Normally you can easily create about 10" of Hg vacuum, and then test to see if the handle assembly is gas-tight by simply stopping the gas flow at the quick-disconnect fitting using your tongue.) The assembly should hold a steady vacuum for at least 10 seconds. If it does not, then there is a leak in the assembly.

When complete, you can put the 'S'-bend back on the probe handle make sure it seals well, and proceed with the functional test below.

Leak-testing the front filter black handled probe assembly: (Shipped prior to 9/4/2001)

This probe has to be dis-assembled to store it in the carrying case, removing the 'S'-bend from the 50 mm dia filter. Sometimes, the 'S'bend gets cross-threaded on the 50 mm dia filter, and plastic from the 50 mm dial filter threads may remain in the 'S'-bend fitting - causing an air leak between the 'S'-bend and the filter. To check for this, remove the 'S'-bend from the 50 mm dia filter, and examine the threads on the front end of the 50 mm dia filter, P/N 10119.

If they look stripped, or galled, replace the filter with a new one. Then, look at the threads inside the brass fitting on the filter-end of the 'S'-bend. If you see plastic in them, clean the threads with a sharp instrument or a 1/8 NPT Male tap. (Standard American thread.) The S-bend internal threads should always mate up smoothly with the 50 mm dia filter and form a gas-tight seal. To facilitate this, always spin the filter end of the handle into the S-Bend, rather than the other way around.

Do not install the cleaned S-bend yet. First check to make sure that all of the other parts on the probe handle are tightly joined. The 50 mm dia filter should bottom-out on the mating brass adapter on the probe handle - and the other plumbing interfaces on the probe

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handle should be gas tight. (We have also found that Teflon paste thread sealant keeps these fittings gas tight, and this may be added as required.)

You can easily check the probe handle assembly for gas tightness by simply placing a finger over the entrance of the 50 mm dia filter, and drawing a vacuum on the quick disconnect fitting at the water-trap end. (Normally you can easily create about 10" of Hg vacuum, and then test to see if the handle assembly is gas-tight by simply stopping the gas flow at the quick-disconnect fitting using your tongue.) The assembly should hold a steady vacuum for at least 10 seconds. If it does not, then there is a leak in the assembly.

When complete, you can put the 'S'-bend back on the 50 mm dia filter, make sure it seals well, and proceed with the functional test below.

Functional Test:

Once the probe assembly has passed the tests above and you are convinced that the probe assembly is gas-tight, fill the water bowl 1/3 the way and connect the probe to a running analyzer (make sure that it has been previously turned on and Zeroed, or the test will not work - as the first thing you do after power up is to Zero the analyzer, and this will automatically empty the water bowl.) - and look for bubbles in the water bowl. If you see none, Zero the analyzer and make sure that the backflush (water trap emptying function) is operating. You should see the analyzer empty the water bowl in the first 3 seconds of the Zero command.

Then, flow calibration gas or check a known-good vehicle exhaust and observe the oxygen level for correct reading. Once you are convinced that there are no physical air leaks, nor signs of air dilution in the gas being measured, you can make exhaust gas measurements with greater confidence.

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