

CARBON MONOXIDE TESTER

I had been tuning my Bora carburetors by adjusting each mixture screw to obtain highest RPM, driving to inspect the color of spark plugs and then fine tuning. It ran fine this way but I could not adjust precisely enough to pass the emission test.

Anticipating that an exhaust analyzer would solve my problems, I purchased a carbon monoxide (CO) tester manufactured by Gunson, Ltd. England. (They also make the Colortune see-thru spark plug that some of you may use to adjust mixture) Gunson distributor Auto Expert also provided several articles about emission tuning that are quite valuable and not furnished by other vendors.

An eight minute warm-up was suggested in the literature, but I found that it took 45 minutes to stabilize the instrument. Calibration only required setting the digital readout to 2.0% in fresh air. Accuracy is stated to be within 0.6%-

Placing the probe of the carbon monoxide tester into an exhaust pipe and trying to adjust eight mixture screws did not work well. Since the air fuel mixture varied between the eight cylinders, it was impossible to determine which were too rich or too lean. Calibrating for correct CO at the exhaust outlet insured that some cylinders were too lean.

This meant that sampling the individual cylinders was required, The Bora was fitted, at the factory, with test ports in the exhaust header tubes. They are 45=BO flare fittings with 10 mm threads and are fitted with brass caps. I searched diligently to find adapters without success - so I fabricated them.

I purchased eight appliance gas hoses and fitting. One type of fitting required machining to connect to the test port. When attached, the eight hoses were all accessible under the rear bumper.

My Ghibli had no factory header fittings, so I decided to match those in the Bora. I drilled holes in the header tubes so that all fitting were accessible from under the car, machined fittings and had them welded in place. I also fabricated brass caps.

Testing the Bora with 42 DCNF/1 1 carburetors:

The tester was stabilized and the engine was warmed up completely, until both of the cooling fans were on. Since the literature states that the engine should be very warm, I covered the front of the car with the car cover to somewhat restrict air intake. R worked quite well.

Air flow was balanced first. The UniSyn balancer, that samples some of the air flow with the bouncing ball, has been in use for years but is sometimes difficult to read accurately. Another unit, providing a steady indicator reading, is the STE Synchronometer, which has a rotating drum through which all of the air flows. I use the Synchronometer.

The literature, provided with the instrument, relates that stoichiometric (perfect bum) air/fuel ratio is 14.7:1, which equals 0% CO. Typical air fuel ratio at idle is between a leaner 14.3:1 and richer 13:1. This correlates with a CO percentage of 0.4% and 4.0%.

I set idle at 800 RPM. The instrument hose was attached to one of the header sample hoses and I adjusted the carburetor mixture screw to 2.0% CO. Engine speed was raised and allowed to settle for a check and readjustment. This was repeated for each cylinder. I revved the engine, sampled and recorded each cylinder. Some had changed and the procedure was repeated until the readings were close. The tailpipe slowly turned a light gray because combustion was too lean at this setting.

Emissions testing recorded 2.3% CO and 1130 parts per million of hydrocarbons (ppm, HC, unburned fuel). Specifications for my 1913 Bora are 5.5% CO and 400ppm HC. The mechanic suggested lean misfire as the cause and the idle had become somewhat rough while driving to the service facility.

The next goal was to set CO at 3%. Following the same procedure, most of the settings had changed after first adjustment. Some were close, several were too lean at 0.99 1.7 and some were too rich at 4.6 and 6.2. I repeated the process with similar but closer results. Again. And again. And again. Cylinders 5 and 6 were especially troublesome. Number 5 was at 3.01 #6 was 1.7. Number

6 was readjusted to 3.1, cylinder 5 became 7.2. Adjusted #5 to 3.0, #6 changed to 1.1 etc.

The best tuning method that I found was to sample and record all eight hoses before making any adjustments. I adjusted two or three cylinders with the greatest deviation from the goal, revved the engine and repeated the procedure.

Testing the Ghibli with 40 DCNU5 carburetors:

Last week I started to set the Ghibli carburetors. This early Ghibli has always fouled spark plugs at idle. It recently had a rough idle and was idling too fast. If I lowered the idle speed, it would stall. I first set the mixture screws on one bank between 3% and 4%- Likewise the other side. Some cylinders had been too lean, some too rich. The idle became smooth. I reduced the idle speed to 800 and set mixtures again, to between 3.3% and 3.8%.

At one point I thought that a cylinder was leaking gas, either from progression holes or from the accelerator circuit. CO was about 7% and I could not reduce it. I checked the other cylinders on that bank and found two others that were also that high. I found the cylinder that was actually too rich and then reset the others. This demonstrated that exhaust from other cylinders does effects the one being tested.

As I was readjusting CO at lower idle speeds, I continually had to lean the mixture by turning the screws in. This meant that when idle mixture was correct the mixture became lean when speed increased. Per the Weber technical manuals, this indicates that the low speed gas jet is too small or the low speed air jet is too large. I have machined some new gas jets since they are no longer available. I'll now purchase a reamer, add a hole .002 larger (Weber jets are available in 0.05mm increments) and test again.

Conclusion

I could only think of two possible causes for the difficulty in tuning the cars. First, exhaust pulsations are greatest at low engine speed due to suction back into the combustion chambers during valve overlap. Exhaust from other cylinders is being sucked into the header tube being tested and changing the exhaust mixture. Note, though, that this problem was simple to rectify in the Ghibli. Second, the possibility exists that when mixture is changed in one cylinder, RPM changes enough to modify air flow *with* resultant mixture changes elsewhere.

I not only wanted to pass the emission test but also to learn more about fine tuning and carburetor balancing. I did learn. Now *I* know that with this tester I *will* be able to correctly jet the Ghibli carburetors. Purchasing the instrument was well worth it.

Suppliers

Gastester Digital Exhaust CO Analyzer \$125 Gastester Professional with Tachometer \$225

Manufacturer Gunson Ltd.

Distributor Auto Expert Products Co., FL 800-795-6958

STE Synchronometer Flow Meter Type SK 1-30/1 Super Shop.805-49&7749 or a Weber distributor

I have an almost new UniSyn available for \$15.

Hoses are stainless steel Flexible Gas Connectors, 1/2" x 4811, about \$55 at a building supply store.
(Discard fittings and use the ones listed below or purchase other fittings to adapt to them)