

Injector Flow Test 2-3-08

Like most serious hot-rodders I try to save money where I can. When I was contemplating the turbo addition to my 1994 Mustang GT I hit eBay and purchased used injectors. They were Siemens 55# units, possibly one step too large for my planned 8 psi boost but better too large than too small. A year passed, the turbo was installed and running on my proven 30# injectors. It turned out I actually was making 12 psi boost and the 30#'s were maxed out. I still hadn't installed the 55# because I was concerned with them being used, how good they were, matched, flow rating etc.

I didn't want to install these larger, unproven injectors and find out that one was not flowing the same amount as the others. I considered just holding the injectors open with 12 volts and measuring how much fuel flowed in a given period of time. I ruled this method out because part of balanced fuel flow is the opening and closing times of injectors. At low pulse widths the opening and closing time can be a HUGE portion of the total pulse width. On my car with 30# injectors, data logs show that idle pulse widths range from 1.5 to 3 ms. It takes the best part of 1.5 ms just to open these same injectors. The good part at low LOAD and RPM, slightly unbalanced injectors will not necessarily hurt the engine but it could make it rough running.

At high RPM and LOAD conditions, unbalanced injectors could lead to a lean condition on one injector and cause detonation. At 6,000 RPM there is only 20ms for a full cycle of operation. A 1.0ms difference in pulse width would give a 5% difference in fuel flow. So I felt it would be most important to test the injectors relative to each other. The closer they flow to each other in actual operating conditions, the better of my engine would be at higher boost levels, and the smoother it would operate at idle.

Previously I had worked up some circuits for driving an additional set of injectors on my car and also a signal generator to provide specific pulse widths at specific frequencies. With these circuits I could test flow at various operating conditions. For the actual test I used a stock Mustang fuel rail and fuel regulator. I used a Surflo pump from my water injection project. I originally set the whole apparatus up in my basement planning to move to the garage so I could run actual gasoline. Once I realized how involved the working setup was I did not want to move it. So I ran a mixture of 80% water, 20% methanol and some Klotz Upper Cylinder Lube to protect components against corrosion. (Photos below)

Test #1 was a bust, signal circuitry failed

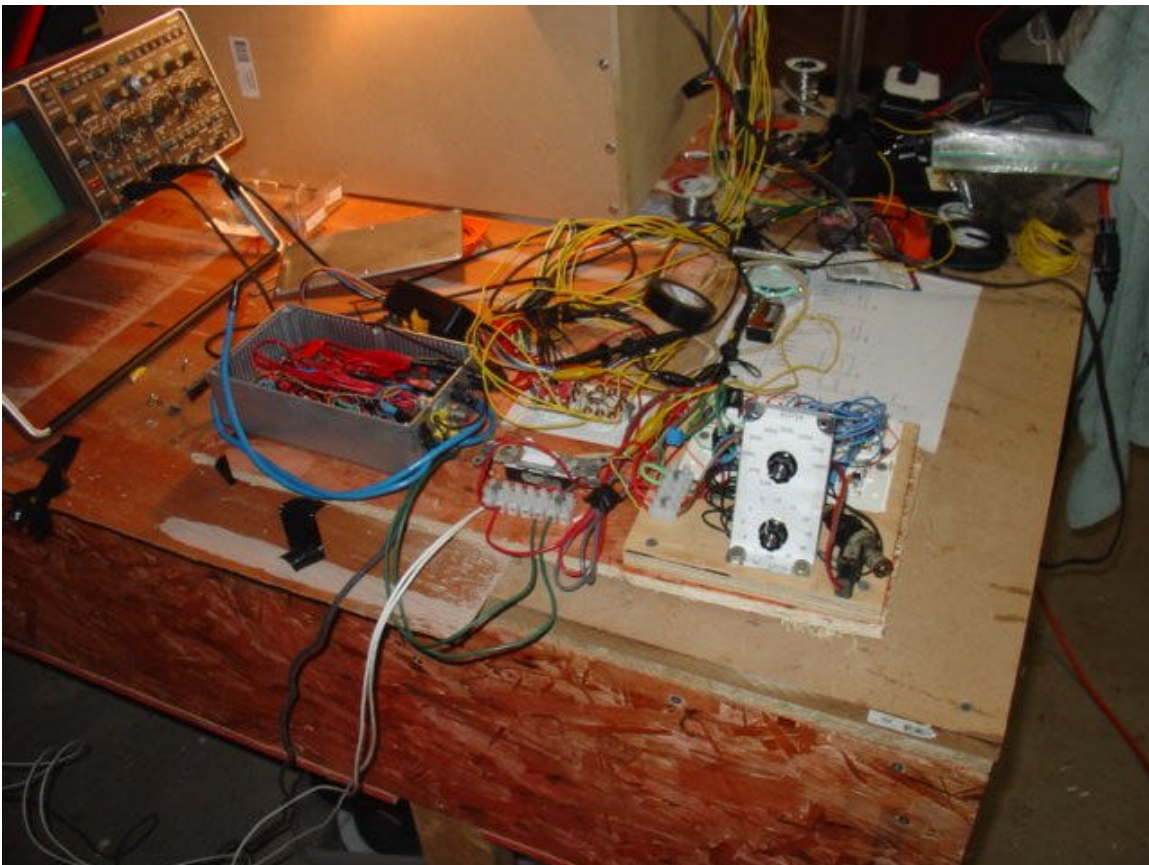
Test #2: 3.0ms PW at injector @ 1000 RPM. It took about 18 minutes to get about 90 ml of fluid through injectors.

Test #3: 13.0ms PW at injector @ 4000RPM. It took about 30 seconds to get about 90 ml of fluid through injectors.

Test #4: 8.0ms PW at injector @ 6000RPM.

Inj#	TEST #2		TEST #3		TEST #4	
	ml output	% diff	ml output	% diff	ml output	% diff
1	93	0.81%	89	-0.84%	94	-0.27%
2	91	-1.36%	90	0.28%	95	0.80%
3	92	-0.27%	89	-0.84%	93	-1.33%
4	93	0.81%	91	1.39%	95	0.80%
1-4 avg.	92.25		89.75		94.25	
5	98	1.29%	89	1.14%	92	1.10%
6	94	-2.84%	88	0.00%	91	0.00%
7	100	3.36%	87	-1.14%	90	-1.10%
8	95	-1.81%	88	0.00%	91	0.00%
5-8 avg.	96.75		88		91	

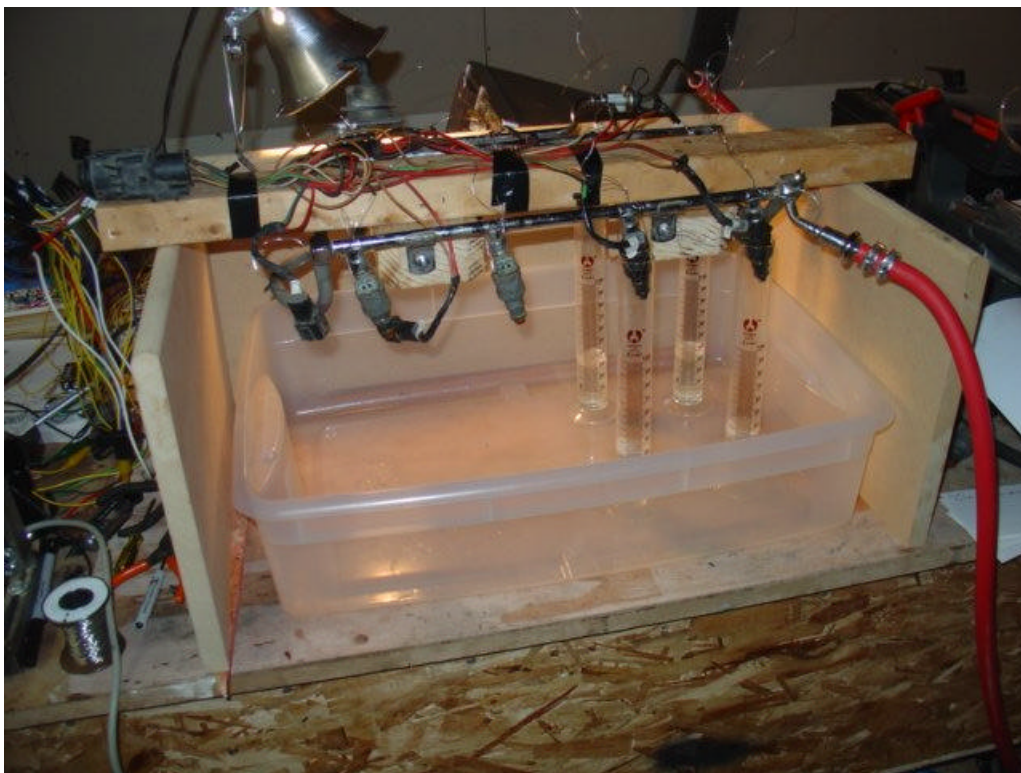
Photos:



Control Circuits



Pump and Power Source



Injector Rail and Measurement Tubes