I'll present this third session on the new Cat 800s in chronological order. We started with the Crossfire, then retested the F8. Our baseline stock test with the F8 today would be two HP less than last week! But on this day, we were cursed with nearly 100% humidity, foggy and rainy all day. Plus the barometer was a bit lower. Sled EFI systems have no need to adjust for water vapor or the more modern reference to water grains per pound of air, since cold winter air contains almost no water vapor which takes up space and displaces O2. So on this day, the stock ECU delivered fuel flow nearly identical to my previous two sessions with the same sled, but the combination of high water grains per pound of air and slightly reduced baro gave us about 1% less corrected HP. So when you look at the Crossfire 800's 157 HP, don't compare it to the last F8 session where we tested at 163. Instead, compare it to the 161 HP we made with the new F8 on this awful weather day.

We need for a supply of dry, very cold air for tuning/ testing EFI sleds in less than optimal conditions. With carbed sleds, we can tweak jetting to exactly compensate for humidity and vapor pressure, but I'm not quite comfortable doing that for bone stock comparison with either Boondocker or Power Commander. So I'm collaborating with DTR pal refrigeration guru Wayne Stoutner to create a cold dry air delivery system for this sort of situation. Tuning modified EFI sleds with Boondockers and PCIIIs and Vs makes up the bulk of the sled tuning done here, and I have learned that it is nearly useless to tune EFI sleds for winter use in warm summer weather. So if Wayne can help us come up with winter air in August, this will eliminate the logjam of EFI tuners in early winter.

Dale Roes from D&D Powersports had been surprised by the lack of a huge power increase with the D&D Ypipe on the new F8 tested here a few days earlier. They had dyno tested their Y pipe on their new Crossfire 800, and had gotten way more power increase than we did on the new F8. So Dale loaded up their Crossfire 800 and brought it to DTR to demonstrate, and try to figure out what was happening with the F8.

On the first dyno test the Crossfire 800 seemed like a completely different engine—the exhaust valves open in stages, but very differently than the F8, giving us smooth, controllable power from low revs to high! In the field, both sleds open the Ex valves instantly as the throttle is whacked but on a gradual slow acceleration test on the dyno, the valves are held closed, then open in several stages. The Crossfire seems more gradual, and the dyno tests are smooth, free of surging. But the F8 has the most violent and later valve opening causing the surge line on our dyno tests. While both sleds have nearly identical fuel flow, the F8 has two degrees more timing throughout the RPM range as we observed while watching the Arctic Cat EFI software that shows timing, engine temps, knock protection timing retard etc.. For comparison, we tested the Crossfire 800 with the F8 ECU and that is shown here. The added two degrees of timing with the stock exhaust = a couple of HP, which is a good deal for $20 if you're running stock. But that reduced timing on the Crossfire 800 ECU would be helpful in creating max power with no detonation when the higher flowing D&D Ypipe and single pipe were used.

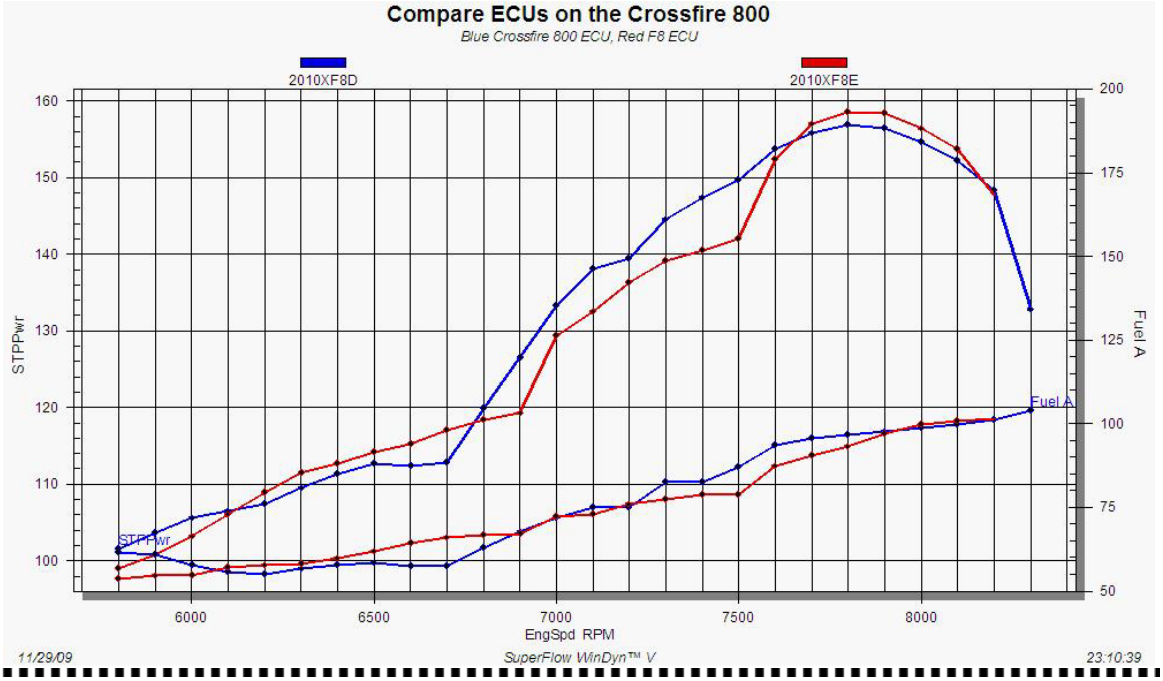
Here is the bone stock Crossfire 800, with stock exhaust on our bad air day.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5800	91.9	101.5	0.63	61.5	13.21	42.9	177
5900	92.3	103.6	0.61	61.0	13.61	42.9	181
6000	92.4	105.5	0.57	57.9	14.63	43.0	185
6100	91.7	106.4	0.54	55.7	15.37	43.0	187
6200	91.0	107.5	0.53	55.1	15.81	43.0	190
6300	91.2	109.5	0.53	56.6	15.55	43.0	192
6400	91.4	111.3	0.54	57.8	15.27	42.9	193
6500	91.0	112.7	0.53	58.3	15.13	42.9	193
6600	89.4	112.4	0.53	57.5	15.21	43.0	191
6700	88.5	112.9	0.53	57.4	15.34	43.0	192
6800	92.6	119.9	0.54	63.1	14.61	42.8	201
6900	96.3	126.5	0.55	67.6	13.98	42.8	206
7000	100.0	133.3	0.56	71.7	13.45	42.7	211
7100	102.2	138.2	0.56	74.9	13.09	42.6	214
7200	101.7	139.4	0.56	74.9	13.19	42.6	216
7300	104.0	144.5	0.59	82.7	12.31	42.6	222
7400	104.6	147.4	0.58	82.7	12.42	42.5	224
7500	104.8	149.6	0.60	87.1	11.95	42.4	227
7600	106.2	153.7	0.63	93.5	11.47	42.4	234
7700	106.2	155.8	0.63	95.6	11.24	42.4	235
7800	105.6	156.9	0.64	96.6	11.17	42.3	236
7900	104.0	156.4	0.65	97.6	11.23	42.2	239
8000	101.5	154.6	0.66	98.9	11.15	42.2	241
8100	98.7	152.3	0.68	99.9	11.03	42.2	241
8200	95.0	148.4	0.71	101.1	10.73	42.1	237
8300	84.0	132.8	0.81	104	10.28	42.1	233

Next, we installed the F8 ECU basically to see what the extra 2 degrees of timing would do for us. Now the Crossfire 800 surged at the first partial valve opening, then surged even harder at 7500. But for practical purposes this shows the difference in two maore degrees of timing on top end. After this, we would revert to the stock ECU for the rest of this test session.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	LAMAF1 Ratio	FuelP psig	Air 2 scfm
6000	87.3	99.8	0.60	59.1	12.72	15.0	43.0	164
6100	86.8	100.8	0.60	59.1	12.82	15.0	43.0	165
6200	88.7	104.7	0.59	60.3	13.04	15.1	43.0	172
6300	88.8	106.5	0.58	60.5	13.14	15.2	43.0	174
6400	89.7	109.3	0.57	60.9	13.36	15.4	43.0	178
6500	90.9	112.5	0.59	65.3	12.84	15.3	43.0	183
6600	90.7	114.0	0.59	65.9	12.89	15.0	42.9	186
6700	90.1	114.9	0.59	66.9	12.93	14.8	42.9	189

6800	89.5	115.8	0.60	68.1	12.85	14.5	42.9	191
6900	88.9	116.8	0.59	67.8	13.00	14.4	42.9	192
7000	91.9	122.5	0.60	72.6	12.67	14.3	42.8	201
7100	92.3	124.8	0.62	75.6	12.24	14.0	42.8	202
7200	92.1	126.3	0.62	76.9	12.16	13.8	42.7	204
7300	93.4	129.9	0.63	80.2	12.00	13.4	42.6	210
7400	93.8	132.1	0.62	80.7	12.04	13.3	42.6	212
7500	93.5	133.5	0.62	81.2	12.07	13.3	42.6	214
7600	100.7	145.7	0.64	91.1	11.39	13.0	42.4	227
7700	102.2	149.8	0.64	93.8	11.19	12.8	42.4	229
7800	103.1	153.1	0.64	97.0	10.91	12.4	42.3	231
7900	104.9	157.8	0.65	101.2	10.60	11.9	42.2	234
8000	105.0	159.9	0.65	102.5	10.60	11.6	42.2	237
8100	104.0	160.4	0.65	103.0	10.55	11.5	42.1	237
8200	101.7	158.7	0.67	104.0	10.38	11.3	42.1	236
8300	97.8	154.6	0.69	105.0	10.22	11.2	42.1	234
8400	91.9	146.9	0.73	104.8	10.12	11.1	42.1	232



Back to the stock Crossfire 800 ECU, we installed the D&D single pipe on the stock Y pipe. For all testing this day, the stock quiet muffler was used for a three HP gain.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5700	95.9	104.1	0.61	61.8	13.07	43.0	176
5800	94.7	104.6	0.61	61.3	13.17	42.9	176
5900	94.9	106.6	0.59	60.8	13.61	43.0	181
6000	95.1	108.7	0.57	59.6	14.21	43.0	185
6100	95.1	110.5	0.55	58.3	14.76	43.0	188
6200	93.2	110.0	0.52	55.7	15.65	43.0	190

6300	92.6	111.0	0.52	55.6	15.84	43.0	192
6400	93.2	113.5	0.52	57.4	15.46	43.0	194
6500	93.2	115.3	0.52	58.3	15.09	43.1	192
6600	91.3	114.8	0.52	57.9	15.12	43.0	191
6700	91.9	117.3	0.52	58.6	15.12	42.9	193
6800	95.2	123.2	0.53	62.9	14.57	42.9	200
6900	99.7	131.0	0.54	68.3	13.81	42.9	206
7000	101.5	135.2	0.54	71.1	13.49	42.9	209
7100	103.3	139.7	0.55	74.0	13.29	42.8	215
7200	103.9	142.5	0.57	78.3	12.85	42.7	220
7300	103.6	144.0	0.58	80.7	12.67	42.7	223
7400	104.2	146.7	0.59	84.0	12.37	42.7	227
7500	104.1	148.6	0.58	83.5	12.52	42.6	228
7600	107.9	156.1	0.62	94.2	11.51	42.5	237
7700	107.2	157.1	0.63	95.2	11.45	42.5	238
7800	107.4	159.5	0.63	96.5	11.44	42.4	241
7900	106.3	159.8	0.63	97.8	11.30	42.3	241
8000	103.6	157.8	0.64	97.8	11.30	42.3	241
8100	99.0	152.7	0.67	99.4	11.15	42.3	242
8200	84.5	131.9	0.79	100.2	10.97	42.3	240

Next we installed the D&D Ypipe with the stock pipe, and as Dale had suggested we got big power—a 7 HP gain over the stock Ypipe with the stock single pipe.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5800	92.1	101.7	0.64	62.3	12.90	43.1	176
5900	92.5	103.9	0.61	60.7	13.47	43.0	179
6000	93.8	107.1	0.58	59.7	13.99	43.1	182
6100	93.8	108.9	0.55	57.4	14.85	43.2	186
6200	93.4	110.2	0.53	56.0	15.44	43.2	189
6300	93.2	111.8	0.52	56.2	15.63	43.2	192
6400	93.4	113.8	0.53	57.9	15.35	43.1	194
6500	92.9	114.9	0.53	58.3	15.21	43.2	194
6600	91.4	114.9	0.52	57.8	15.25	43.2	192
6700	93.2	118.9	0.53	61.3	15.00	43.1	201
6800	92.5	119.7	0.54	62.4	14.86	43.0	202
6900	95.8	125.8	0.53	64.8	14.53	43.0	206
7000	99.2	132.2	0.55	69.4	13.78	43.0	209
7100	102.0	137.9	0.54	71.8	13.63	42.8	214
7200	107.1	146.8	0.57	80.1	12.68	42.8	222
7300	107.6	149.5	0.57	82.0	12.53	42.8	224
7400	107.5	151.5	0.57	82.8	12.56	42.8	227
7500	108.0	154.3	0.57	84.1	12.48	42.7	229
7600	108.7	157.4	0.61	93.0	11.55	42.5	235
7700	110.4	161.9	0.62	96.4	11.32	42.5	238
7800	109.8	163.1	0.62	96.9	11.37	42.4	241
7900	109.1	164.1	0.62	97.4	11.41	42.4	243
8000	105.7	161.0	0.63	97.8	11.39	42.4	243

8100	102.4	157.9	0.66	99.6	11.21	42.4	244
8200	95.4	149.0	0.71	102.2	10.84	42.4	242
8300	87.0	137.4	0.77	102.2	10.63	42.4	237

Now we went to the complete combo, D&D Ypipe and D&D single pipe with the stock muffler. Here with the D&D Y pipe the D&D single pipe added more HP than it did with the stock Y pipe. Today, with 93 octane gas in the sled, there was zero knock and zero detonation protection from the ECU.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5700	95.5	103.7	0.61	60.7	13.22	43.0	175
5800	95.1	105.0	0.60	61.1	13.25	43.0	177
5900	95.5	107.3	0.58	60.0	13.80	43.0	181
6000	95.7	109.4	0.56	59.1	14.22	43.0	184
6100	95.6	111.1	0.55	59.2	14.45	43.1	187
6200	95.3	112.5	0.55	60.0	14.38	43.0	188
6300	95.1	114.1	0.52	57.2	15.38	43.1	192
6400	94.7	115.4	0.52	57.9	15.37	43.1	194
6500	93.9	116.2	0.52	58.0	15.23	43.1	193
6600	93.2	117.1	0.51	57.9	15.13	43.0	191
6700	91.8	117.2	0.51	57.2	15.32	43.1	191
6800	96.0	124.3	0.52	62.6	14.77	43.0	202
6900	97.4	128.0	0.52	64.5	14.57	42.9	205
7000	104.0	138.7	0.52	69.9	13.84	42.5	211
7100	106.3	143.7	0.53	73.8	13.33	42.8	215
7200	108.2	148.3	0.54	76.8	13.12	42.8	220
7300	108.8	151.2	0.56	81.9	12.72	42.8	227
7400	109.1	153.8	0.56	82.6	12.77	42.7	230
7500	108.8	155.4	0.55	82.7	12.87	42.6	232
7600	111.7	161.7	0.60	92.9	11.80	42.5	239
7700	112.3	164.6	0.59	93.9	11.85	42.4	243
7800	113.2	168.1	0.59	96.2	11.66	42.1	245
7900	112.3	168.9	0.59	96.4	11.69	42.3	246
8000	110.8	168.8	0.60	97.3	11.72	42.4	249
8100	105.8	163.1	0.64	100.3	11.44	42.3	251

After we completed this test session, we decided to put the F8 back on the dyno for a fourth time, to see if this exact same Y pipe would give us different results today. This is where we discovered just how bad the 100% humidity air would hurt our HP—a little over one percent worse air density = one percent HP reduction. Also note that while the Airflow SCFM is lower as indicated here, it is likely that the air flow between the throttle bodies is compromised perhaps by an airbox misfit somewhere. It is shown for reference only. Here is the 2010 F8 today, bone stock.

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	AirDen lb/cFt	FuelP psig	Air 2 scfm
5800	86.1	95.1	0.61	55.4	12.67	0.074	43.9	153
5900	86.8	97.5	0.59	55.6	12.77	0.073	43.9	155
6000	87.6	100.0	0.58	56.1	12.97	0.073	44.0	159
6100	90.5	105.1	0.58	58.4	13.00	0.073	44.0	166
6200	89.7	105.9	0.58	58.5	13.08	0.073	44.0	167
6300	93.0	111.5	0.55	58.8	13.62	0.073	44.0	175
6400	92.9	113.2	0.55	59.5	13.62	0.073	44.0	177
6500	93.0	115.1	0.53	58.9	14.01	0.073	44.0	180
6600	92.5	116.2	0.56	62.9	13.44	0.073	43.9	185
6700	91.6	116.9	0.59	65.8	13.01	0.073	43.9	187
6800	90.6	117.3	0.58	65.8	13.07	0.073	43.9	188
6900	94.0	123.5	0.59	69.8	12.81	0.074	43.8	195
7000	94.2	125.6	0.59	71.1	12.83	0.074	43.8	199
7100	94.2	127.4	0.58	71.5	12.97	0.074	43.9	202
7200	94.8	129.9	0.59	73.3	12.80	0.074	43.8	205
7300	97.2	135.0	0.59	76.8	12.52	0.074	43.7	210
7400	97.8	137.8	0.59	78.0	12.51	0.073	43.8	213
7500	97.3	138.9	0.59	78.0	12.51	0.073	43.8	213
7600	96.8	140.0	0.58	78.3	12.55	0.073	43.7	215
7700	105.0	153.9	0.62	92.0	11.30	0.074	43.5	227
7800	106.6	158.4	0.63	95.8	10.95	0.073	43.6	229
7900	106.1	159.6	0.64	98.1	10.84	0.074	43.6	232
8000	105.6	160.8	0.65	100.9	10.55	0.074	43.4	232
8100	103.4	159.5	0.66	101.8	10.45	0.074	43.3	232
8200	100.4	156.8	0.69	103.1	10.33	0.074	43.4	233
8300	94.3	149.1	0.72	102.7	10.29	0.074	43.4	231

Since in the previous F8 test I had neglected to test the D&D single tuned pipe on the F8 with stock Ypipe, we did that today. Here is the F8, stock Y pipe and D&D single pipe:

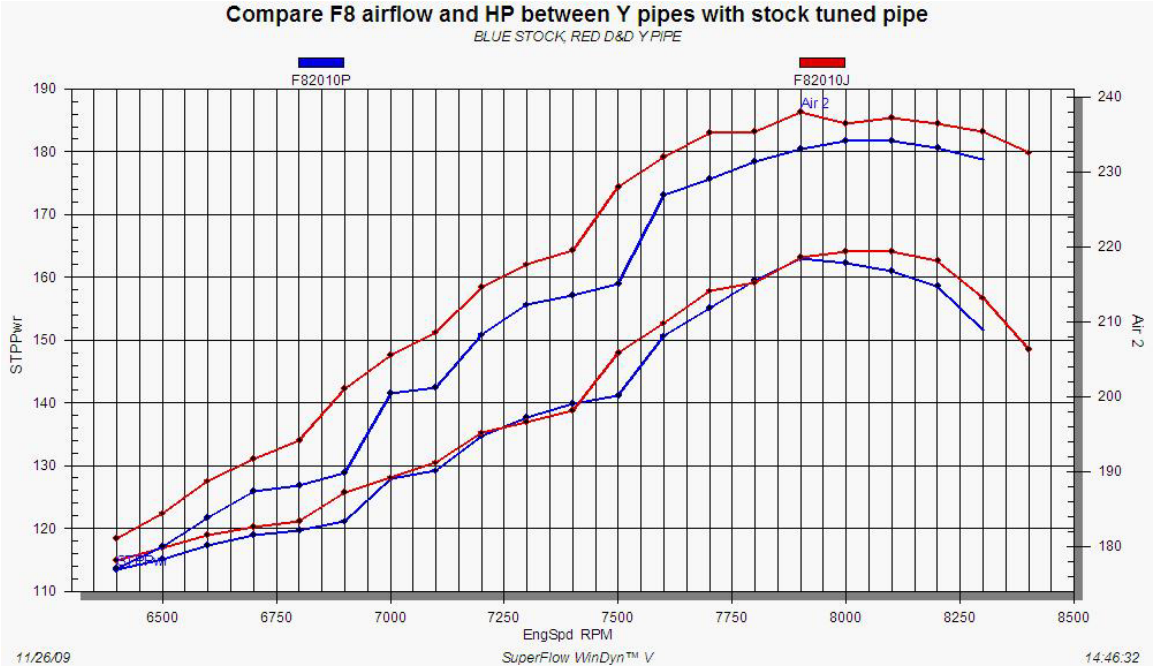
EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5800	92.4	102.0	0.56	55.4	13.13	44.0	159
5900	92.1	103.4	0.56	56.0	13.10	44.0	160
6000	92.2	105.3	0.56	56.7	13.02	44.0	161
6100	93.1	108.1	0.56	57.8	13.05	44.0	165
6200	93.8	110.8	0.55	58.7	13.09	43.9	168
6300	94.2	113.0	0.54	58.8	13.31	43.9	171
6400	93.7	114.2	0.54	59.1	13.46	44.0	174
6500	92.7	114.7	0.55	60.1	13.37	44.0	175
6600	91.4	114.8	0.56	61.8	13.18	44.0	178
6700	89.5	114.2	0.58	63.0	13.04	43.9	179
6800	88.4	114.4	0.60	65.4	12.82	43.9	183
6900	87.6	115.1	0.59	65.3	12.87	43.9	184

7000	88.5	117.9	0.58	65.5	13.00	43.9	186
7100	96.7	130.7	0.57	71.3	12.99	43.7	202
7200	97.5	133.7	0.58	74.1	12.71	43.8	206
7300	98.9	137.4	0.58	76.5	12.54	43.8	209
7400	99.8	140.6	0.57	76.5	12.63	43.9	211
7500	99.8	142.5	0.56	76.7	12.67	43.9	212
7600	109.5	158.5	0.58	88.6	11.57	43.6	224
7700	110.3	161.7	0.59	91.0	11.36	43.6	226
7800	110.9	164.7	0.60	94.6	11.02	43.5	228
7900	109.5	164.6	0.62	97.7	10.77	43.4	230
8000	105.5	160.7	0.65	100.3	10.54	43.4	231
8100	99.1	152.9	0.69	101.2	10.35	43.3	229

Next we installed the D&D Ypipe with the stock tuned pipe. Once again, results were dramatically different than the Crossfire 800 we tested today. Even though relative airflow SCFM is increased greatly over the seemingly similar looking Ypipe, peak HP increase is not as significant. Two HP added with the Y pipe today, as opposed to 1.5 HP added in the last session. Here it is, about like we get with the Best Y pipes on Polaris and SkiDoo 800 twins:

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
5700	86.0	93.4	0.61	54.4	12.68	44.0	151
5800	85.2	94.1	0.61	54.9	12.53	44.1	150
5900	86.3	96.9	0.60	55.4	12.73	44.0	154
6000	88.0	100.6	0.58	56.0	13.02	44.0	159
6100	89.7	104.2	0.58	57.6	13.14	43.9	165
6200	91.0	107.4	0.56	58.0	13.39	44.0	170
6300	92.8	111.4	0.55	58.8	13.60	44.0	175
6400	93.1	113.5	0.54	58.6	13.97	43.8	179
6500	93.6	115.8	0.54	59.7	13.89	44.0	181
6600	93.4	117.3	0.55	62.1	13.63	43.9	185
6700	92.7	118.3	0.56	63.7	13.45	43.9	187
6800	91.7	118.7	0.56	64.3	13.44	43.9	189
6900	95.5	125.4	0.57	68.8	13.06	43.8	196
7000	96.7	128.9	0.58	71.1	12.95	43.8	201
7100	96.8	130.9	0.58	72.2	12.95	43.8	204
7200	97.5	133.7	0.58	74.6	12.75	43.8	208
7300	98.3	136.6	0.58	76.4	12.69	43.9	212
7400	97.8	137.7	0.58	76.9	12.77	43.8	214
7500	98.1	140.0	0.57	76.9	12.83	43.8	215
7600	104.5	151.2	0.60	87.0	11.88	43.6	226
7700	107.4	157.5	0.61	92.3	11.42	43.5	230
7800	108.1	160.5	0.61	94.4	11.26	43.5	232
7900	108.3	163.0	0.62	97.5	11.00	43.5	234
8000	106.5	162.2	0.64	99.6	10.82	43.4	235
8100	104.8	161.6	0.66	101.7	10.68	43.3	237
8200	102.5	160.0	0.67	102.3	10.48	43.4	234

8300	96.9	153.1	0.70	102.6	10.32	43.4	231
8400	89.7	143.5	0.75	102.5	10.28	43.4	230



Combining the higher flowing D&D Y pipe with the D&D single pipe caused us some issues with midrange detonation that caused us to lose HP as timing was reduced by the ECU in response to two or three clicks of detonation. Today I had our copper tube deto-sensor bolted to the cylinder head. Accelerating through the midrange, I listened for clicks with headphones like Sean Ray and I have done, saving 100s of pistons by recognizing and reacting to the audible sounds of deto we hear clearly now. Sean and I allow two, maybe three clicks on a dyno test then abort and retune. Remember, last year I boneheadedly allowed Casy Mulkins' Dragon 800, with factory knock sensor disabled, to make about 10 audible clicks of deto before a piston was hurt. Today, I was able to compare audible detophone clicks to what Dale Roes was seeing on the Arctic Cat EFI monitoring software. Today this was what I consider perfect protection—one or two clicks, then two degrees of timing was pulled, HP dropped and clicks went away! Three or more clicks, then timing is pulled then the engine is drowned in fuel (shown in our previous F8 test) and a low (7800) RPM rev limiter cuts in. This is great protection for those who opt for airflow and power adding parts, then buy low octane gas. If you suddenly hit a wall at 7800 then you probably got boned at the last place you bought high test gas.

We got the initial clicks before valve opening at 7500, which caused the ECU to protect and goof us up at peak HP. With valves artificially closed (remember, in the field they whack open as soon as you hit the throttle!), it creates much higher than normal compression ratio, aggravating the situation. So we began our final tests at 7500 RPM,

where valves are open, allowing freer breathing, and here is the power we got with the combo D&D Ypipe and D&D single pipe again with the stock muffler:

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFC A lb/hph	Fuel A lb/hr	A/F A Ratio	FuelP psig	Air 2 scfm
7300	102.7	142.8	0.55	75.5	12.99	43.8	214
7400	102.2	144.0	0.55	75.8	12.98	43.8	215
7500	102.2	146.0	0.54	75.5	13.12	43.7	216
7600	109.6	158.6	0.56	85.4	12.23	43.6	228
7700	112.5	164.9	0.58	91.4	11.65	43.5	233
7800	113.0	167.8	0.59	95.3	11.26	43.5	234
7900	111.4	167.5	0.61	98.2	10.89	43.4	234
8000	106.1	161.6	0.65	100.8	10.63	43.3	234

We should have tried this final combination with the Crossfire 800 ECU to see if it's the retarded timing, or just the Crossfire single pipe that made the slight difference in bad-air HP today. Remember, this identical combo gave us 171 HP in good air with the same F8 tested just a few days earlier, but this is more of a relative test comparison.

Additionally, I was delighted that Dale Roes could hear the loud clicks of detonation on the copper tube bolted to the cylinder head, and plumbed into the relatively quiet control room. With a quiet muffler, clicks of deto can be heard by everyone in the control room rattling off the tube—unmistakable sounds of knock that suggests that a test be aborted before damage occurs. Many, many 100's of pistons have been saved by this $20 length of copper tubing that was brought to Sean Ray's Delphi dyno cel by Hyundai engineers who didn't trust their own deto sensors while Sean was calibrating a Hyundai engine there. Today, all of Delphi's million dollar dyno cels are fitted with crude copper tubing, so engineers can listen to engines, like farmers with their ears pressed against screwdriver handles with the flat blades touching the problem areas of the engines . I'm betting that the D&D dyno room has copper tubing plumbed into it today.