2009 Polaris Dragon 800 upgraded to 2010 specs, at 50 degrees F

Casey Mulkins was anxious to see the dyno results of the final flash and the parts upgrades for the 2009 Dragon 800, so he brought an 09 stock D8 with 1000 very hard miles from the dealership he techs for to do the Polaris factory upgrades on the dyno. Our plan was to do this one step-at-a-time to see what each component added to or subtracted from horsepower. We also wanted to assess the latest aftermarket pipes and use the new Power Commander V fuel controller to fine tune the engine.

This latest upgrade consists of new .010" larger diameter two-ring pistons, lower compression cylinder head with redesigned chamber shape, different exhaust valve springs, a freer flowing muffler, and one more hopefully final ECU reflash.

This was the first cold weather of the fall season, touching 32 deg F overnight. This may be especially critical in assessing the new reflash, since early testers of the 2010 Dragon 800 ECU report much leaner A/F ratio as intake temperature rises toward 70 degrees F.

Casey came early, and with the customer's 09 D8 hooked up and running on the dyno by 9:30 AM dyno air temps were in the high 40 degree F range. Here is this bone stock 09 D8 with the last reflash from last season, pumping 100 lb/hr fuel flow but with power much lower than previous reflashed sleds tested here. Here is a typical test of this bone stock engine, with 120 degree F coolant temp and 1000+ degree F pipe probe temp as measured by the Digital Wrench computer software. 93 octane fuel was used with ethanol wires properly fixed. Note on the graph there is sometimes a dip in power after valve opening—this is caused by the valves opening a bit early, then engine surging a bit and accelerating quickly as the power comes on before the dyno can regain control.

2009 D8 with last season's final flash

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
5100	61.5	59.8	0.76	44.5	125	14.4	53
5200	61.9	61.2	0.71	42.4	127	14.4	53
5300	64.2	64.8	0.76	48.0	132	14.3	53
5400	65.8	67.6	0.74	49.0	136	14.3	52
5500	66.9	70.1	0.70	48.3	140	14.4	51
5600	67.8	72.3	0.70	49.7	143	14.6	50
5700	72.6	78.8	0.67	52.0	147	14.8	52
5800	74.5	82.2	0.70	56.7	151	14.7	51
5900	75.8	85.1	0.67	55.6	154	14.4	52
6000	78.1	89.2	0.62	54.1	157	14.2	53
6100	78.8	91.6	0.63	56.5	158	14.0	53
6200	78.7	92.9	0.64	57.7	158	14.0	53
6300	81.7	98.0	0.59	56.3	162	13.9	52
6400	81.3	99.1	0.60	58.2	163	13.8	51
6500	82.4	102.0	0.65	64.7	164	13.6	52
6600	82.5	103.7	0.62	63.1	164	13.2	53
6700	81.7	104.2	0.60	61.0	167	12.8	52
6800	73.2	94.8	0.74	68.6	164	12.5	53

6900	73.0	95.8	0.73	68.3	165	12.5	52
7000	72.7	97.0	0.74	69.8	167	12.6	52
7100	74.0	100.0	0.73	71.6	169	12.6	52
7200	78.3	107.3	0.68	71.6	178	12.3	52
7300	80.7	112.2	0.69	75.2	183	12.2	52
7400	80.3	113.2	0.67	74.3	184	11.8	52
7500	86.1	123.0	0.71	85.3	195	11.4	52
7600	89.5	129.5	0.77	97.5	210	10.6	53
7700	89.7	131.5	0.76	98.0	212	10.5	53
7800	91.4	135.8	0.77	101.9	220	10.5	52
7900	86.9	130.7	0.77	99.1	220	10.5	50
8000	84.7	129.0	0.77	96.8	221	10.6	51

The easiest and quickest upgrade was to reflash the customer's sled with the newest ECU programming, which Casey did in a few minutes. Fuel flow dropped a bit, but overall horsepower didn't increase by much (perhaps due to the very poor ring seal on this engine).

2009 D8 with 2010 ECU programming

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFA-B Lb/hph	FulA-B lb/hr	A/FA-B Ratio	Air1+2 scfm	LAMAF1 Ratio	AirTmp degF
5000	59.7	56.8	0.82	45.7	12.22	122	13.9	50
5100	59.1	57.4	0.82	46.0	12.33	124	13.9	50
5200	61.0	60.4	0.84	49.8	11.96	130	13.8	49
5300	63.4	64.0	0.76	48.0	12.85	135	13.8	49
5400	64.2	66.0	0.80	51.7	12.21	138	14.0	50
5500	65.3	68.4	0.76	50.9	12.69	141	14.2	50
5600	65.8	70.2	0.73	50.5	12.95	143	14.3	50
5700	69.6	75.5	0.71	52.8	12.94	149	14.6	50
5800	69.3	76.5	0.71	53.0	12.97	150	14.6	50
5900	72.5	81.5	0.70	56.1	12.48	153	14.5	50
6000	74.3	84.9	0.70	58.7	12.29	158	14.3	49
6100	75.9	88.2	0.70	60.2	12.02	158	14.0	49
6200	75.7	89.4	0.71	61.9	11.70	158	14.0	49
6300	80.5	96.5	0.68	64.3	11.63	163	13.3	50
6400	80.9	98.6	0.69	66.4	11.32	164	12.9	50
6500	81.1	100.4	0.68	66.5	11.42	166	12.6	50
6600	80.9	101.7	0.65	64.8	11.88	168	12.4	50
6700	81.2	103.6	0.62	63.6	12.23	170	12.2	47
6800	72.8	94.2	0.65	60.5	12.58	166	12.1	48
6900	71.6	94.0	0.67	61.4	12.43	167	12.1	49
7000	71.4	95.1	0.67	62.3	12.37	168	12.2	49
7100	71.9	97.2	0.66	63.1	12.29	169	12.2	49
7200	73.7	101.0	0.67	66.1	11.93	172	12.2	49
7300	74.3	103.3	0.68	68.6	11.73	176	12.1	50
7400	75.9	107.0	0.67	70.2	11.71	180	12.0	50
7500	77.5	110.6	0.68	74.2	11.47	186	11.6	49
7600	90.3	130.6	0.73	92.9	10.46	212	10.8	51
7700	91.4	134.0	0.7	92.5	10.63	215	10.7	51
7800	91.3	135.6	0.68	89.7	11.14	218	10.7	51
7900	90.0	135.3	0.7	93.1	10.77	219	10.9	51

8000	88.7	135.0	0.69	90.8	11.12	221	11.0	51
8100	82.4	127.2	0.70	86.5	11.65	220	11.5	51

Next Casey installed the new 2010 Dragon 800 muffler, which according to the part number is a Dragon 700 muffler from prior years. Now the airflow CFM was higher, which by virtue of the fixed fuel flow effectively leaned out A/F ratio. How could the old 700 muffler be freer flowing than the original 800 muffler? That tight original 800 muffler could have been at least partially responsible for the detonation that troubled last years D8's—causing light clicks that caused the ECU to pull timing and reduce HP. Tight mufflers prevent active radicals in hot combustion gases from being swept from combustion chambers, and when enough of them stay behind deto will occur. Here is the still disappointing dyno test of the 09 D8 with the higher flowing D7 muffler:

2009 D8 w/ 2010 reflash and 2010 muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	A/FA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	Ratio	scfm	Ratio	degF
7000	80.1	106.8	0.78	81.2	10.58	188	10.8	49
7100	80.2	108.4	0.76	81.2	10.58	188	10.8	50
7200	81.4	111.7	0.77	84.0	10.35	190	10.8	50
7300	84.6	117.6	0.72	82.7	10.76	194	10.8	50
7400	90.7	127.8	0.67	84.2	11.00	202	10.9	50
7500	95.7	136.7	0.70	93.1	10.48	213	10.9	50
7600	93.9	135.8	0.74	99.2	10.08	218	10.8	49
7700	93.1	136.4	0.73	97.4	10.31	219	10.8	49
7800	93.2	138.4	0.70	95.2	10.81	225	10.8	50
7900	89.0	133.9	0.73	96.0	10.84	227	10.9	49

The next logical next step was to install the new exhaust valve springs and .010" *larger diameter* 2010 pistons with two rings instead of one. We suspect that the valve springs are lighter, allowing the valves to open more instantly when the solenoids are energized. Last year the valves seemed to drop at least partially closed too early at high revs when backing off the throttle slightly causing rich 9/1 misfire which we covered with those wicked PCIII midrange negatives (Wayne Stoutner's dyno contribution to the widely appreciated CCW map) which terrified some people but worked dandily for those who experienced the dreaded off-throttle burble last season. Lighter springs should allow the valves to stay open fully as long as the ECU. Ditch the CCW map—we must remap once more.

Casey removed the head, and showed me how pistons with .016" wall clearance wobble incredibly in their bores. After he pulled the cylinder I honed each hole with my well-used Aamco rigid hone, stored in a cupboard next to a nearly used-up gallon jug of muriatic acid (I have, annoyingly, done this many hundreds of times here, mostly before we learned to watch A/F and BSFC and more recently began listening for audible knock with the detophones). The Aamco hone did a superb job of smoothing out some light but very obvious vertical piston ring gap ridges left mysteriously by single rings, apparently growing occasionally to beyond interference fit during some of those 1000 miles. Was this engine severely overheated last winter? Or, could extreme blowby be the culprit,

putting fire onto, and past the single rings, creating excessive growth of the rings? Normally during combustion a much lower volume of cool unburned air/fuel mixture is squeezed into the squish band area and then down the sides of the pistons above the rings and most of that mixture stops there. What little mixture that sneaks by well seated rings is "good stuff" according to Kevin Cameron so there's no contamination (EGR) of the crankcase intake charge. Could those wobbling single rings, overheated by severe blowby and EGR, and have been creating horrible HP robbing friction, making them even hotter? And finally, if the rings are getting so hot that they grow enough to pinch and buckle the end gaps tightly, they surely can't be doing a good job of transferring heat from the aluminum piston to the nickasil lined cylinder walls, making hot pistons even hotter! Could that be the reason last year's pistons were .010" smaller in diameter, just to keep them from sticking? I offer these scenarios in an attempt to get people and myself to understand this incredible dyno test result after installing properly clearanced two ring pistons. Prior testing here with new vs worn rings has often been disappointing, as it was a few years ago on this website when we replaced whipped moly-less rings in a SkiDoo 600 with new ones, and got almost no power improvement. As always, I welcome email comments here. Info@dynotechresearch.com. Here is the 09 D8 engine, with new 2010 pistons, different exhaust springs, and with the original 09 cylinder head left in place. One step at a time is always best.

2009 D8 w/ 2010 ECU, muffler, pistons and exhaust valve springs

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
4400	56.9	47.7	0.65	30.2	115	16.9	53
4500	56.1	48.1	0.61	28.6	115	17.0	53
4600	56.3	49.3	0.61	29.4	116	17.0	53
4700	57.1	51.1	0.66	33.0	117	16.9	53
4800	59.2	54.1	0.64	33.9	117	16.3	52
4900	62.0	57.8	0.72	40.7	119	15.4	52
5000	65.6	62.4	0.68	41.4	122	14.7	51
5100	65.3	63.4	0.67	41.3	123	14.7	51
5200	69.1	68.4	0.64	42.6	129	14.3	52
5300	72.7	73.3	0.70	49.9	134	14.2	52
5400	73.3	75.3	0.64	47.1	138	14.2	53
5500	74.9	78.4	0.60	46.1	142	14.3	53
5600	75.4	80.4	0.62	48.3	144	14.4	53
5700	76.9	83.5	0.66	53.4	147	14.5	53
5800	79.3	87.6	0.64	54.6	151	14.6	52
5900	80.7	90.7	0.66	58.3	155	14.5	52
6000	82.5	94.2	0.65	60.3	159	14.2	52
6100	83.3	96.7	0.65	61.3	163	13.9	52
6200	83.9	99.1	0.66	64.1	164	13.6	51
6300	84.0	100.8	0.68	67.0	165	13.4	52
6400	85.7	104.4	0.66	67.1	168	13.1	52
6500	86.2	106.6	0.64	66.4	168	13.0	52
6600	87.1	109.4	0.58	61.5	170	12.9	52
6700	87.0	111.0	0.63	68.7	171	12.8	52
6800	86.3	111.7	0.62	67.5	172	12.8	52
6900	82.3	108.1	0.66	69.6	174	12.7	52
7000	85.5	113.9	0.74	82.3	182	12.6	52

7100	85.2	115.1	0.72	81.2	184	12.5	52
7200	88.6	121.5	0.71	83.8	190	12.2	53
7300	88.6	123.2	0.68	81.5	192	11.7	53
7400	94.8	133.5	0.67	87.4	205	11.5	53
7500	98.5	140.7	0.68	94.0	215	11.3	53
7600	97.8	141.6	0.71	98.3	218	11.2	53
7700	98.4	144.2	0.70	99.0	220	11.1	54
7800	98.9	146.8	0.66	95.2	224	11.0	53
7900	98.1	147.6	0.68	98.1	227	11.1	52
8000	96.9	147.6	0.65	94.1	230	11.2	52
8100	96.0	148.1	0.63	91.6	231	11.3	52
8200	93.7	146.3	0.62	88.5	231	11.6	52

With the engine seemingly back to normal and before we went to the final 2010 head, we installed an 09 cylinder head modified to lower compression top-hat combustion chamber by Sean Ray (seanmray@yahoo.com). Sean has developed and tuned here the Polaris 800 and 600 SnoX race engines for my old dyno pal Tim Bender and Hentges Racing, and has used that experience and his own CNC equipment and combustion chamber machining programs to make more HP with less compression in this application with no clicks of deto that cause the protective ECU to reduce timing.

2009 D8 with 2010 ECU, muffler, pistons and Sean Ray modified 09 head

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	A/FA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	Ratio	scfm	Ratio	degF
4600	56.2	49.2	0.67	32.0	17.04	119	16.6	51
4700	55.4	49.5	0.64	31.2	17.65	120	16.5	51
4800	59.0	53.9	0.71	37.4	14.74	120	15.7	52
4900	59.3	55.3	0.74	40.2	13.61	119	15.4	52
5000	62.4	59.4	0.77	44.8	12.36	121	14.5	52
5100	62.5	60.7	0.77	45.7	12.33	123	14.4	51
5200	67.4	66.8	0.77	50.1	11.82	129	13.9	51
5300	69.2	69.9	0.70	48.1	12.69	133	13.6	51
5400	71.6	73.6	0.73	52.3	12.03	137	13.6	52
5500	72.4	75.8	0.70	51.7	12.50	141	13.7	51
5600	74.5	79.4	0.66	51.2	12.89	144	13.9	51
5700	76.3	82.8	0.65	52.6	12.81	147	14.2	50
5800	78.0	86.2	0.64	54.2	12.68	150	14.3	51
5900	79.5	89.3	0.70	60.9	11.66	155	14.2	51
6000	78.7	90.0	0.68	60.1	11.89	156	14.1	51
6100	81.5	94.6	0.65	60.5	12.21	161	13.7	49
6200	81.9	96.7	0.65	61.5	12.16	163	13.5	49
6300	83.5	100.1	0.62	60.5	12.36	163	13.2	50
6400	84.2	102.6	0.62	62.4	12.15	166	13.1	50
6500	85.2	105.4	0.59	61.1	12.53	167	13.0	51
6600	85.9	107.9	0.62	65.2	11.85	169	12.9	51
6700	85.8	109.5	0.63	67.9	11.46	170	12.8	51
6800	79.0	102.2	0.65	64.8	11.97	169	12.7	51
6900	78.7	103.4	0.70	70.6	11.08	171	12.7	51
7000	80.4	107.2	0.69	72.2	11.29	178	12.5	51
7100	80.7	109.1	0.72	76.3	10.88	181	12.3	51

7200	82.3	112.9	0.72	79.7	10.56	184	12.2	52
7300	84.4	117.3	0.68	77.8	11.00	187	11.8	52
7400	90.2	127.1	0.69	85.3	10.55	196	11.5	52
7500	95.5	136.4	0.67	89.0	10.71	208	11.3	52
7600	96.6	139.8	0.67	92.1	10.83	218	11.0	52
7700	96.8	142.0	0.67	92.5	10.85	219	10.9	52
7800	97.6	144.9	0.64	90.6	11.25	223	10.9	51
7900	98.6	148.3	0.64	93.3	11.04	225	10.9	51
8000	98.6	150.2	0.61	89.0	11.72	228	11.1	51
8100	97.8	150.8	0.60	88.1	11.89	229	11.4	50
8200	94.8	148.0	0.60	87.3	12.07	230	11.7	50
8300	91.2	144.1	0.62	87.7	11.92	228	11.8	51

Here is the same engine now with the new Polaris head, which is lower compression than Sean's by a whisker (about one point lower than the stock 09 head) and has unusual tall trapezoidal shaped chambers—more like a Pilgrim's hat than a top hat with the spark plug seated seemingly deep into the combustion chamber, but probably exactly where it was in relation to the piston dome in the 09 head. Less compression with more power is good.

2009 D8 completely updated to 2010 specs including head at 50 degrees F

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFA-B lb/hph	FulA-B lb/hr	Air1+2 scfm	LAMAF1 Ratio	AirTmp degF
4500	56.2	48.1	0.61	28.5	121	16.0	51
4600	55.2	48.3	0.55	25.8	122	16.0	51
4700	54.4	48.7	0.73	34.5	122	16.0	52
4800	57.1	52.2	0.67	34.0	121	15.3	53
4900	56.9	53.1	0.69	35.5	120	15.1	52
5000	59.6	56.7	0.74	40.8	120	13.7	53
5100	59.6	57.9	0.72	40.5	121	13.7	53
5200	62.7	62.1	0.74	45.1	127	13.6	52
5300	63.5	64.1	0.75	46.9	128	13.5	52
5400	70.4	72.4	0.73	51.8	138	13.4	52
5500	70.7	74.0	0.73	53.0	140	13.5	52
5600	72.0	76.8	0.67	50.3	143	13.5	52
5700	73.9	80.2	0.65	51.1	147	13.4	52
5800	76.5	84.5	0.67	55.4	152	13.8	52
5900	77.3	86.8	0.64	54.6	153	13.8	52
6000	79.2	90.5	0.64	56.4	157	14.7	52
6100	79.9	92.8	0.61	55.5	162	14.3	52
6200	80.7	95.2	0.64	59.2	163	13.8	50
6300	80.9	97.0	0.63	59.8	164	13.6	50
6400	82.0	99.9	0.63	61.7	165	13.4	51
6500	82.9	102.6	0.62	61.9	166	13.3	52
6600	83.7	105.2	0.61	62.2	168	13.0	52
6700	83.4	106.4	0.61	63.3	171	12.8	52
6800	78.8	102.0	0.62	61.9	172	12.7	52
6900	77.9	102.3	0.62	62.3	173	12.7	52
7000	80.5	107.2	0.66	68.8	177	13.6	52
7100	81.3	109.9	0.59	63.4	179	13.1	52

7200	81.6	111.8	0.60	65.0	181	13.0	52
7300	84.6	117.5	0.63	72.6	186	12.5	52
7400	91.0	128.2	0.62	77.1	199	12.0	53
7500	94.1	134.3	0.66	86.7	205	11.7	53
7600	94.4	136.6	0.69	92.1	215	11.2	52
7700	94.0	137.8	0.68	90.9	218	11.1	52
7800	96.6	143.5	0.64	89.4	222	10.9	52
7900	97.6	146.9	0.61	87.9	225	11.0	52
8000	97.1	147.9	0.62	89.4	228	11.2	49
8100	97.3	150.1	0.58	85.3	228	11.5	51
8200	94.5	147.5	0.59	85.4	227	11.8	53
8300	91.5	144.7	0.63	88.4	227	11.6	53
8400	86.1	137.7	0.64	85.3	225	11.6	53

Next, leaving the ECU alone with stock fuel flow we installed aftermarket exhausts. Without the additional cost of a Boondocker or Power Commander what would bolt-on pipes do for us? First we tried a DynoPort pipewith the stock 2010 muffler but it was way too rich causing misfire in the fat midrange. The BMP pipe is very similar to the DynoPort pipe but has an internal stinger which *increases* airflow CFM thus leaning out the 2010 D8 A/F ratio to a burnable midrange level with the stock quiet muffler. The BMP pipe mod achieves a similar result, but we didn't have one to test this day. We might think that an internal stinger would act as a choke, slowing and reducing airflow CFM and increasing backpressure inordinately. But it is believed that the internal stinger acts like a cookie cutter, punching a clean hole in the sound wave and returning more energy to the exhaust port instead of making noise out the muffler, creating better (and sometimes too good) supercharging. Also the BMP pipe is tuned to create max HP at higher RPM, where fuel flow is lower resulting in leaner more powerful A/F ratio at that RPM with no fuel tuners needed. Adding the BMP can could lean out mixture more and add more HP, but it isn't shown in this test.

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2010 spec D8 with BMP pipe and stock 2010 muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
4900	61.6	57.5	0.72	40.3	116	14.4	57
5000	64.0	60.9	0.77	45.2	120	14.2	57
5100	64.0	62.1	0.73	43.9	121	14.2	58
5200	67.0	66.3	0.76	48.5	125	14.2	58
5300	70.3	70.9	0.70	47.7	130	14.2	59
5400	72.0	74.1	0.63	45.5	134	14.2	58
5500	72.8	76.3	0.67	49.3	138	14.3	58
5600	74.6	79.5	0.68	52.3	142	14.4	57
5700	77.6	84.2	0.66	54.0	146	14.5	58
5800	77.7	85.8	0.69	57.4	147	14.4	58
5900	80.4	90.3	0.65	56.7	152	14.3	58
6000	81.8	93.4	0.71	64.0	155	14.1	59
6100	83.3	96.8	0.66	62.0	157	13.8	59
6200	83.9	99.0	0.68	64.9	159	13.5	57
6300	84.5	101.4	0.71	69.8	163	12.9	54

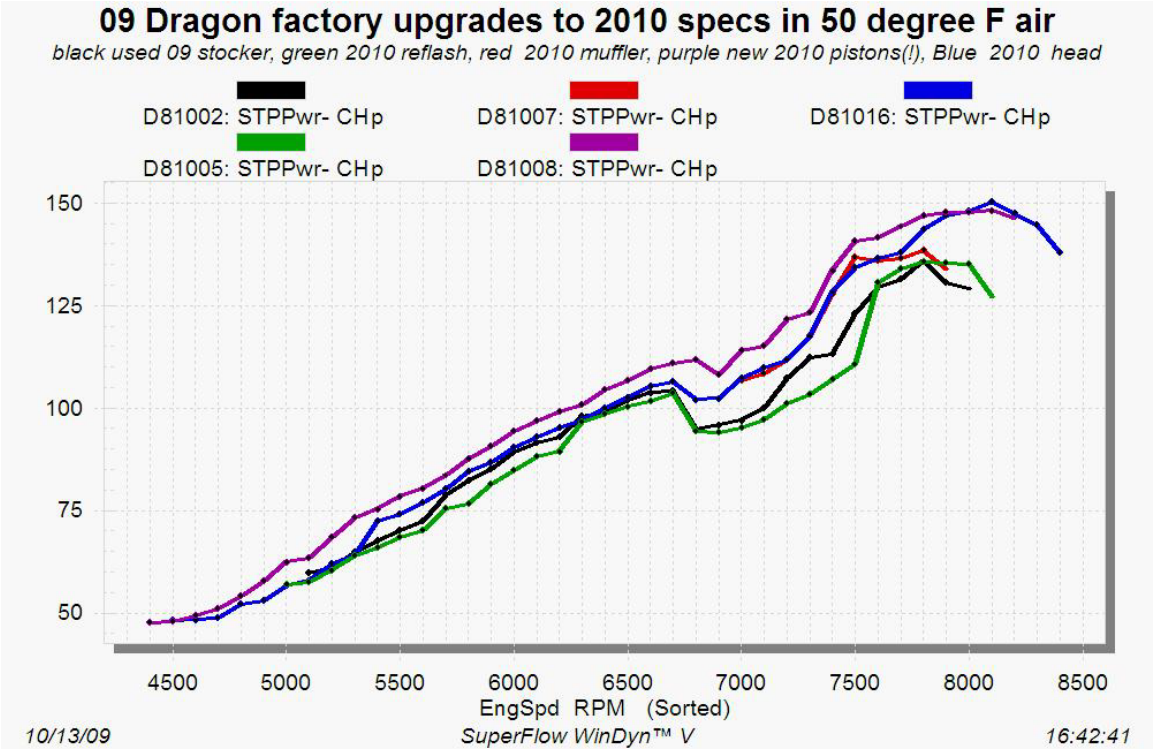
6400	84.3	102.8	0.70	69.8	162	12.7	55
6500	85.5	105.9	0.69	70.9	164	12.4	56
6600	85.6	107.6	0.67	69.6	164	12.3	57
6700	85.4	109.0	0.63	66.9	166	12.3	58
6800	80.9	104.8	0.66	66.5	166	12.3	58
6900	80.3	105.5	0.66	67.4	167	12.3	58
7000	84.2	112.2	0.72	78.3	174	12.3	58
7100	85.4	115.5	0.72	80.0	180	11.7	58
7200	87.6	120.1	0.72	83.7	188	11.3	58
7300	87.3	121.4	0.72	85.0	192	11.3	58
7400	88.6	124.9	0.75	90.5	197	11.1	59
7500	90.2	128.8	0.75	93.5	206	10.9	58
7600	89.6	129.6	0.79	99.1	210	10.7	57
7700	89.6	131.4	0.77	98.6	212	10.6	56
7800	92.1	136.7	0.72	95.6	216	10.5	57
7900	96.7	145.4	0.67	94.1	222	10.8	56
8000	96.7	147.3	0.65	92.2	223	10.9	56
8100	97.5	150.4	0.65	94.3	225	11.1	56
8200	97.1	151.6	0.61	89.6	225	11.2	57
8300	97.1	153.5	0.59	87.5	226	11.0	57
8400	97.3	155.7	0.59	88.7	228	11.3	57
8500	95.1	153.9	0.57	85.4	227	11.5	57
8600	92.9	152.2	0.58	85.3	226	11.6	57

Finally we fitted the SLP pipe/ muffler combo (the SLP single is sold only as a package of Ypipe, pipe and muffler) that is tuned very well for the fuel curve of the D8 with 2010 ECU calibration. The higher flowing SLP can muffler is just a bit louder than stock, especially after valve opening. Unlike some ear bleeder glasspacks the SLP can muffler is probably tolerable cruising on some trail systems where noise is policed. The added airflow leans out fixed fuel flow, and A/F ratio is leaned close to max HP. The added airflow should help further reduce active radicals as well.

2010 spec D8, SLP exhaust

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFA-B lb/hph	FulA-B lb/hr	Air1+2 scfm	LAMAF1 Ratio	AirTmp degF
6100	85.6	99.4	0.78	74.9	162	12.1	56
6200	86.2	101.8	0.67	66.2	163	12.1	56
6300	85.7	102.8	0.64	63.3	164	12.6	56
6400	86.6	105.6	0.66	67.8	165	12.9	56
6500	86.5	107.1	0.67	68.9	167	13.0	57
6600	86.7	109.0	0.69	72.9	169	12.7	56
6700	86.9	110.8	0.69	74.5	172	12.4	54
6800	85.5	110.7	0.67	72.4	173	12.3	54
6900	85.0	111.7	0.68	73.3	173	12.3	55
7000	88.0	117.3	0.69	77.9	180	12.5	55
7100	87.8	118.7	0.68	77.8	181	12.5	55
7200	94.8	130.0	0.66	82.4	193	12.3	57
7300	97.1	134.9	0.64	84.1	199	12.3	57

7400	100.2	141.2	0.67	92.0	209	12.1	55
7500	100.7	143.7	0.67	93.9	214	11.8	54
7600	101.9	147.5	0.69	98.2	220	11.5	55
7700	102.1	149.7	0.66	95.4	223	11.4	55
7800	104.6	155.3	0.61	91.7	227	11.4	56
7900	105.2	158.3	0.60	91.2	230	11.8	56
8000	104.6	159.3	0.59	91.6	232	11.9	56
8100	103.9	160.2	0.58	89.7	235	11.9	56
8200	103.1	160.9	0.59	91.5	236	12.0	56
8300	101.1	159.8	0.59	91.0	236	12.1	55
8400	99.3	158.8	0.57	87.0	235	12.2	56
8500	97.2	157.4	0.54	82.0	235	12.5	56
8600	92.2	151.0	0.56	82.7	233	12.7	54



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TUNING WITH PARTS AND FUEL MANAGEMENT

Back to our baseline, with all 2010 Dragon 800 upgrades at 50 degrees F, with stock exhaust and stock fuel flow:

2010 spec stock Dragon 800

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFA-B lb/hph	FulA-B lb/hr	Air1+2 scfm	LAMAF1 Ratio	AirTmp degF
4500	56.2	48.1	0.61	28.5	121	16	51
4600	55.2	48.3	0.55	25.8	122	16	51
4700	54.4	48.7	0.73	34.5	122	16	52

4800	57.1	52.2	0.67	34.0	121	15.3	53
4900	56.9	53.1	0.69	35.5	120	15.1	52
5000	59.6	56.7	0.74	40.8	120	13.7	53
5100	59.6	57.9	0.72	40.5	121	13.7	53
5200	62.7	62.1	0.74	45.1	127	13.6	52
5300	63.5	64.1	0.75	46.9	128	13.5	52
5400	70.4	72.4	0.73	51.8	138	13.4	52
5500	70.7	74.0	0.73	53.0	140	13.5	52
5600	72.0	76.8	0.67	50.3	143	13.5	52
5700	73.9	80.2	0.65	51.1	147	13.4	52
5800	76.5	84.5	0.67	55.4	152	13.8	52
5900	77.3	86.8	0.64	54.6	153	13.8	52
6000	79.2	90.5	0.64	56.4	157	14.7	52
6100	79.9	92.8	0.61	55.5	162	14.3	52
6200	80.7	95.2	0.64	59.2	163	13.8	50
6300	80.9	97.0	0.63	59.8	164	13.6	50
6400	82.0	99.9	0.63	61.7	165	13.4	51
6500	82.9	102.6	0.62	61.9	166	13.3	52
6600	83.7	105.2	0.61	62.2	168	13.0	52
6700	83.4	106.4	0.61	63.3	171	12.8	52
6800	78.8	102.0	0.62	61.9	172	12.7	52
6900	77.9	102.3	0.62	62.3	173	12.7	52
7000	80.5	107.2	0.66	68.8	177	13.6	52
7100	81.3	109.9	0.59	63.4	179	13.1	52
7200	81.6	111.8	0.60	65.0	181	13.0	52
7300	84.6	117.5	0.63	72.6	186	12.5	52
7400	91.0	128.2	0.62	77.1	199	12.0	53
7500	94.1	134.3	0.66	86.7	205	11.7	53
7600	94.4	136.6	0.69	92.1	215	11.2	52
7700	94.0	137.8	0.68	90.9	218	11.1	52
7800	96.6	143.5	0.64	89.4	222	10.9	52
7900	97.6	146.9	0.61	87.9	225	11.0	52
8000	97.1	147.9	0.62	89.4	228	11.2	49
8100	97.3	150.1	0.58	85.3	228	11.5	51
8200	94.5	147.5	0.59	85.4	227	11.8	53
8300	91.5	144.7	0.63	88.4	227	11.6	53
8400	86.1	137.7	0.64	85.3	225	11.6	53

We must keep in mind that this is 50 degree F air and if, as some independent 2010 Dragon 800 testers are suggesting, A/F leans out at 70 degrees F, and enrichens considerably at 30 degrees F we may need different Power Commander maps than shown here in winter air. So the tuning we are doing here might be very conservative once winter arrives. If that is the case, then if we create more aggressive maps for winter air, then those maps may be too lean for the few who dragrace in the summer on grass or asphalt. Over the years, we have found that Arctic Cat EFI calibration exhibits similar inconsistency from summer to winter—so much so that I can't tune Cat EFI engines accurately during warm weather for good winter power and vice-versa.

This is where the new Power Commander V should be ideal for those who desire to be at max power regardless of density altitude. The PCV alone is $369 and can be loaded with generic tuning maps just like a PCIII. The "Auto Tune" option is another $249 and includes a wide band O2 sensor threaded into a welded-in bung that feeds info to the PCV. It "tunes" as you drive—it makes nearly immediate adjustments to injector pulsewidth to try to achieve the A/F ratio that you have commanded for each RPM and throttle position. Those on-the-fly tweaks to the maps can be viewed, accepted and the Power Commander map updated with your PC. At that time, the supplied Bosch wideband O2 sensor can be removed and replaced in the bung with a supplied stainless plug. The O2 sensor can be utilized later if different pipes/ porting etc are added.

On the dyno, we experimented with the PCV and after commanding 12.5/1 at 100% throttle at all RPM, and it took only two or three 10 second acceleration tests and PCV adjustments to create a perfect fuel curve. The norm has been more like six-ten dyno runs, each with calculators used to estimate fuel % added or subtracted. This is perceived by some to be dyno operator skill but it was just math and lots of dyno runs. Now it's all done for us much more quickly which is not good for those who operate dynamometers and charge by the hour! But technical progress is being made, and this is a huge improvement over the tiny main jets we used to put in EFI fuel lines to restrict fuel pressure and lean out mixture just a few years ago. Dyno Jet says they should begin shipping PCVs for Polaris sleds to SLP and DynoTech the week of 10/26/09.

Here is the 2010 spec stock D8 with Power Commander leaned out WOT 10% at 7000 and 7250 and 15% at 7500 and 7750 then 10% at 8000 and 8250.

2010 Dragon 800, totally stock w/ fuel leaned out

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
4800	61.1	55.8	0.78	42.2	117	15.0	56
4900	63.3	59.0	0.76	43.7	119	14.8	55
5000	65.1	62.0	0.79	47.5	122	14.7	56
5100	66.5	64.6	0.72	45.2	123	14.5	56
5200	69.4	68.7	0.70	46.9	127	14.3	57
5300	71.4	72.0	0.66	46.3	132	14.3	56
5400	72.8	74.9	0.65	47.6	135	14.4	55
5500	73.4	76.9	0.68	51.0	138	14.5	56
5600	75.9	80.9	0.68	53.5	142	14.6	56
5700	77.8	84.4	0.68	56.0	145	14.7	56
5800	79.1	87.3	0.65	55.0	149	14.6	57
5900	79.6	89.4	0.67	58.0	151	14.5	57
6000	81.6	93.3	0.68	61.7	154	14.2	58
6100	83.3	96.8	0.67	62.8	157	13.8	58
6200	83.6	98.7	0.66	62.9	159	13.3	57
6300	83.1	99.7	0.67	65.2	160	13.2	57
6400	84.0	102.3	0.71	70.7	163	12.7	56
6500	84.6	104.7	0.66	66.9	165	12.5	55
6600	85.8	107.9	0.65	68.3	167	12.4	56
6700	85.5	109.1	0.69	72.9	168	12.4	56
6800	82.9	107.3	0.70	72.4	170	12.3	56

6900	82.8	108.7	0.68	71.6	171	12.3	56
7000	85.8	114.4	0.63	70.4	177	12.4	56
7100	87.3	118.0	0.61	70.4	181	12.5	55
7200	89.6	122.9	0.60	72.2	186	12.6	55
7300	90.9	126.3	0.58	70.9	190	12.6	55
7400	96.1	135.4	0.58	76.2	198	12.7	56
7500	99.6	142.3	0.58	80.3	207	12.6	56
7600	101.2	146.5	0.58	82.9	214	12.3	56
7700	101.4	148.7	0.57	82.5	216	12.2	56
7800	102.9	152.8	0.51	75.9	220	12.3	56
7900	103.3	155.4	0.50	75.1	223	12.5	56
8000	103.3	157.3	0.51	78.0	226	12.8	56
8100	101.9	157.1	0.54	81.7	226	12.7	57
8200	99.2	154.9	0.53	79.3	226	12.6	57
8300	96.9	153.2	0.55	81.1	226	12.5	56

Here's the D8 with stock exhaust with Power Commander V tuning and Sean's low compression stock head, with slightly richer A/F than the prior test:

2010 spec D8, leaned out fuel flow w/ Sean Ray low compression 09 head

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
5900	83.7	94.0	0.74	67.3	153	11.9	53
6000	83.5	95.4	0.76	69.9	154	12.0	53
6100	82.9	96.3	0.76	70.9	156	11.9	53
6200	84.7	100.0	0.68	65.8	158	11.6	53
6300	86.2	103.4	0.63	63.1	158	11.9	53
6400	86.6	105.5	0.66	67.3	159	12.2	53
6500	86.6	107.2	0.69	71.3	160	12.2	53
6600	87.7	110.2	0.67	71.5	164	12.0	53
6700	87.7	111.9	0.67	72.6	166	11.9	52
6800	80.8	104.6	0.69	69.5	164	11.8	52
6900	80.2	105.4	0.70	71.6	165	11.9	52
7000	82.7	110.2	0.74	79.3	171	12.1	53
7100	85.5	115.5	0.73	81.2	177	11.8	54
7200	86.3	118.3	0.71	81.3	179	11.8	54
7300	87.1	121.1	0.71	82.7	182	11.5	54
7400	87.3	123.1	0.69	82.0	183	11.5	54
7500	87.9	125.5	0.68	82.2	184	11.5	54
7600	102.3	148.0	0.60	85.5	207	11.8	53
7700	104.0	152.5	0.58	85.0	214	11.8	53
7800	105.7	156.9	0.56	84.5	219	11.8	53
7900	106.2	159.7	0.54	83.1	222	11.9	53
8000	104.5	159.2	0.56	86.3	225	12.0	53
8100	102.2	157.6	0.57	87.2	225	11.8	53
8200	99.5	155.4	0.58	87.2	225	11.7	53
8300	96.7	152.7	0.58	85.6	224	11.7	54
8400	94.0	150.3	0.57	83.1	223	11.8	53

With the stock head in place, we tuned the PC III for max deto-free HP with the SLP, BMP and Dynoport single pipes all with freer flowing can mufflers. Remember the lower midrange airflow of the DynoPort pipe caused it to burble from rich misfire from midrange to top end with the stock ECU, so leaning out the mixture with the Power Commander rectified that problem and created good power. Interestingly the SLP combo made it's best power at 12/1 indicated by our LM1 dyno readout (LAMAF1). Leaning out beyond that resulted in to more power.

DynoPort pipe and can and PC tuning

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
6200	83.7	98.8	0.55	53.0	157	15.8	56
6300	83.8	100.5	0.53	51.3	157	15.8	55
6400	83.7	102.0	0.55	54.2	158	15.6	56
6500	83.9	103.8	0.50	49.9	158	15.0	56
6600	83.7	105.2	0.55	56.5	157	14.6	56
6700	82.5	105.2	0.59	60.2	160	14.2	57
6800	77.1	99.9	0.60	57.7	152	13.5	56
6900	75.8	99.6	0.62	59.8	152	13.3	56
7000	77.6	103.4	0.58	58.1	154	12.9	55
7100	78.0	105.4	0.55	56.2	157	12.8	56
7200	79.4	108.9	0.58	61.5	161	12.6	56
7300	83.8	116.4	0.54	61.3	167	12.5	56
7400	83.3	117.4	0.55	62.2	168	12.5	56
7500	85.7	122.4	0.56	66.6	173	12.4	56
7600	87.0	125.9	0.55	66.7	178	12.2	56
7700	93.8	137.5	0.60	79.4	192	11.9	56
7800	98.6	146.5	0.49	69.3	202	12.0	55
7900	99.3	149.3	0.48	69.9	205	12.3	56
8000	100.1	152.5	0.47	69.4	209	12.5	56
8100	100.1	154.4	0.48	71.4	211	12.6	56
8200	101.3	158.2	0.46	70.4	216	12.9	56
8300	101.7	160.7	0.49	75.9	219	12.9	56
8400	100.0	160.0	0.51	78.9	219	12.8	55
8500	98.8	159.9	0.52	81.1	220	12.5	56
8600	97.7	159.9	0.53	82.6	221	12.4	56
8700	95.7	158.6	0.55	84.5	219	12.3	56

Bikeman Performance pipe and can muffler and PC tuning

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
5000	63.8	60.8	0.73	42.7	121	14.5	59
5100	64.9	63.0	0.71	43.4	122	14.4	59
5200	68.2	67.5	0.70	45.9	127	14.4	59
5300	68.6	69.2	0.68	45.8	128	14.4	59
5400	71.5	73.5	0.66	46.9	134	14.5	58
5500	72.6	76.1	0.64	47.3	138	14.5	59
5600	74.1	79.0	0.63	47.9	140	14.7	59
5700	74.4	80.7	0.59	46.0	143	14.8	59
5800	76.7	84.7	0.65	52.9	147	14.8	60

5900	79.5	89.3	0.66	56.8	151	14.6	59
6000	81.2	92.7	0.67	59.7	154	14.3	59
6100	82.6	96.0	0.65	60.3	157	14.0	59
6200	84.0	99.1	0.69	65.9	156	13.6	60
6300	85.0	101.9	0.69	68.1	161	12.9	60
6400	84.3	102.7	0.69	68.5	161	12.7	60
6500	85.1	105.3	0.64	65.1	162	12.4	60
6600	85.4	107.3	0.67	69.8	163	12.3	60
6700	85.2	108.7	0.64	66.9	164	12.3	59
6800	78.6	101.8	0.62	61.2	163	12.7	59
6900	78.0	102.5	0.62	61.1	164	12.7	59
7000	77.8	103.7	0.60	60.3	165	12.7	59
7100	84.7	114.5	0.58	64.3	174	13.4	59
7200	88.0	120.7	0.56	65.2	180	13.3	59
7300	91.4	127.1	0.55	67.8	189	13.1	60
7400	91.6	129.1	0.60	74.6	192	13.0	60
7500	93.9	134.1	0.60	77.1	201	12.8	60
7600	94.1	136.2	0.59	78.2	205	12.7	60
7700	97.2	142.5	0.56	77.6	210	12.2	60
7800	98.9	146.8	0.54	76.0	213	12.3	60
7900	101.3	152.4	0.51	74.8	218	12.5	60
8000	101.1	154.1	0.50	74.2	219	12.6	60
8100	101.7	156.8	0.53	76.8	223	12.8	59
8200	101.0	157.8	0.54	77.3	225	12.9	59
8300	100.2	158.4	0.53	81.3	225	12.6	59
8400	98.9	158.2	0.54	82.8	226	12.3	60
8500	98.2	158.9	0.49	75.7	226	12.3	59
8600	96.8	158.6	0.48	72.9	226	12.5	59

SLP pipe and muffler with PC tuning

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	LAMAF1	AirTmp
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio	degF
6100	85.1	98.9	0.78	75.1	163	12.0	55
6200	84.5	99.8	0.74	71.9	163	12.0	55
6300	85.3	102.4	0.65	64.8	164	12.2	55
6400	85.6	104.3	0.67	67.3	165	12.6	54
6500	85.9	106.3	0.71	73.0	167	12.6	54
6600	86.3	108.4	0.71	75.1	170	12.3	52
6700	87.3	111.4	0.72	78.0	171	12.1	54
6800	86.8	112.4	0.70	76.7	173	12.1	54
6900	85.9	112.8	0.69	75.4	173	12.1	54
7000	90.6	120.8	0.66	77.7	183	12.3	54
7100	91.9	124.3	0.67	80.8	187	12.4	55
7200	95.0	130.3	0.66	83.1	193	12.2	55
7300	98.4	136.8	0.62	82.5	203	12.5	55
7400	98.4	138.7	0.64	85.5	205	12.5	55
7500	101.7	145.3	0.65	91.2	214	12.0	54
7600	103.0	149.0	0.66	95.6	220	11.6	54
7700	103.3	151.4	0.64	94.4	223	11.5	53
7800	105.7	157.0	0.57	86.5	227	11.7	53
7900	106.1	159.5	0.57	87.5	230	12.1	54
8000	105.4	160.6	0.60	94.2	233	12.1	53

8100	104.6	161.3	0.58	91.5	235	12.0	52
8200	103.2	161.1	0.58	91.2	237	12.0	52
8300	101.4	160.3	0.59	91.7	238	12.0	53
8400	98.3	157.2	0.60	91.2	237	12.1	53
8500	94.7	153.2	0.58	86.7	236	12.2	52