RK TEK REV 2 “Drop in” KIT FOR POLARIS CFI2 800
Jim Czekala

After hearing about the higher HP we made with the 2015 Polaris Axys with new 800HO engine, WNY trail riders Norm Ahrons and Todd DeWind upgraded their Polaris CFI2 800 engines with RKT Rev 2 piston/ shim/ billet head kit. Norm and Todd already had the higher flowing VF3R rubber dampened reed sets in their engines (Norm’s was the sled we used for Moto Tassinari’s test session on this website), and Power Commander V fuel tuners.

Norm and Todd are true trail riders—no picks in their tracks and log many thousands of miles each winter. They just wanted more power to have fun with the Axys, Etec and Cat riders they hang out with. They had asked me about the RKT drop-in kit, and though I’d never tested an engine with the Rev 2 kit, my experience with RKT owner Kelsey has always been positive. Like most of us, he always answers the phone, is very opinionated (who isn’t?), likes to share ideas and experiences, and enjoys spending too many hours talking about things related to HP. Unlike some engine people who still like to proclaim that “you don’t race dynos”, Kelsey appreciates the information that we obtain from this excellent SuperFlow equipment. And most importantly to me, I’ve had many RKT engines tuned here over the years, and owners have invariably been pleased with their results. So when Norm and Todd opted to buy the Rev 2 kit, Kelsey wanted to get involved with some R&D at DTR—compare reeds, domes, timing, pipes, and tuning for max HP on pump gas. I’d been bugging Kelsey to come out east and be involved with some dyno testing (I’m only 30 minutes from the Buffalo NY airport on the same street) for the flatlanders, and he would finally come for Todd’s session.

Norm [remember Norm’s sled was *141 HP* bone stock before we began tweaking on it] installed his Rev 2 dropin kit, which includes a thick spacer to accommodate proprietary forged replacement pistons—said to be much more durable than OEM—and to improve port timing, and a billet cylinder head with textured domes (and fashionably tight, high velocity squish bands that drop down into the bores). Norm decided to reinstall his stock reed cages and then switch to the VF3R reeds on the dyno to see the difference in airflow/ HP with the Rev 2 kit. Boyesen was in the process of retooling to create aluminum Rage Cage bodies with dampening/ sealing Viton Oring material inserted into inverted Vgrooves (to trap the material), but when Norm was ready to test and tune in December, the Boyesens were not. So Norm’s session was to test his 13/1 Rev 2 kit with stock and Vforce 3R reeds, ignition timing and very importantly fuel tuning to make optimal HP without detonation. Remember, it was Norm’s stocker we used to test the new VF3R reeds (stock on the new 2015 800 HO engine) against the stocker reeds.

Then, our plan would be as soon as Boyesen had the new Viton-dampened 68A Rage Cages, Todd would come with his sled with his 12.5/1 Rev 2 kit and VF3Rs for baseline then try the Boyesen 68Rs, timing, and some other domes that Kelsey would bring with him for dyno testing.

Norm's original dyno test results with bone stock engine/ tuning were a disappointing 141 HP which was improved greatly with Power Commander V tuning and those higher flowing Vforce 3R reeds. The new rubber dampened reeds had a similar airflow/ HP improvement with the Rev 2 kit, and we would optimize HP on the 13/1 Rev 2 kit with a 2 degree timing key (at test time, DynoJet hadn't released the 19-030 PCV with ignition control). Airflow was enhanced a bit by removing the shelf from the airbox, too. During the test session, the copper tube bolted to the cylinder head let us listen for, and react to clicks of detonation. All testing was done with @120F coolant temp, and we were able to run click-free with A/F ratio as lean as, or even leaner than stock. Norm's fuel measured at 92.2 R+M/2 octane, zero ethanol on our Zeltex octane tester with ECU set for non-ethanol fuel.

Here's Norm's final, most optimal setup to make max HP w/o deto. Rev 2 kit, VF3R reeds, 2 degree key, gutted airbox, and stock exhaust. Following is an overlay graph of Norm's CFI2 engine from bone stock to 158+ HP with 120 F coolant and 1000 F+ pipe center section temp. My dyno notes were uncharacteristically vague but the final dyno test is with a fuel map that we have for PCV tuning Rev 2 fitted engines. LM1 Air is the airflow CFM determined by the dyno computer based upon measured fuel flow lb/hr and the wideband LamAF1 A/F ratio.

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	DenAlt Feet	AirInT degF	ElpsTm Secnds
6500	103.8	83.8	0.507	51.1	15.09	108	38.8	0.21
6600	104.6	83.2	0.528	53.6	15.08	100	38.7	1.13
6700	106.1	83.2	0.562	58.0	14.89	98	38.6	1.42
6800	108.8	84.0	0.606	64.1	14.27	96	38.6	1.77
6900	114.4	87.1	0.626	69.6	13.22	92	38.6	2.33
7000	118.2	88.7	0.622	71.5	13.05	89	38.5	2.66
7100	121.9	90.1	0.613	72.6	13.05	87	38.5	2.99
7200	126.7	92.5	0.602	74.1	13.14	85	38.5	3.41
7300	131.3	94.5	0.587	75.0	13.18	84	38.5	3.72
7400	138.4	98.3	0.560	75.4	13.13	85	38.5	4.26
7500	143.4	100.5	0.544	75.9	13.05	85	38.5	4.67
7600	147.2	101.7	0.540	77.2	12.97	85	38.5	5.12
7700	150.2	102.4	0.538	78.6	12.96	86	38.5	5.51
7800	152.9	103.0	0.524	77.9	13.04	87	38.5	5.91
7900	155.5	103.4	0.509	76.9	13.23	88	38.5	6.39
8000	157.4	103.3	0.503	76.9	13.31	88	38.5	6.76
8100	158.4	102.7	0.499	76.8	13.29	89	38.5	7.12
8200	158.1	101.3	0.505	77.6	13.14	91	38.5	7.62
8300	155.9	98.7	0.522	79.1	12.93	93	38.6	8.14
8400	149.4	93.4	0.541	78.5	12.73	94	38.6	8.60

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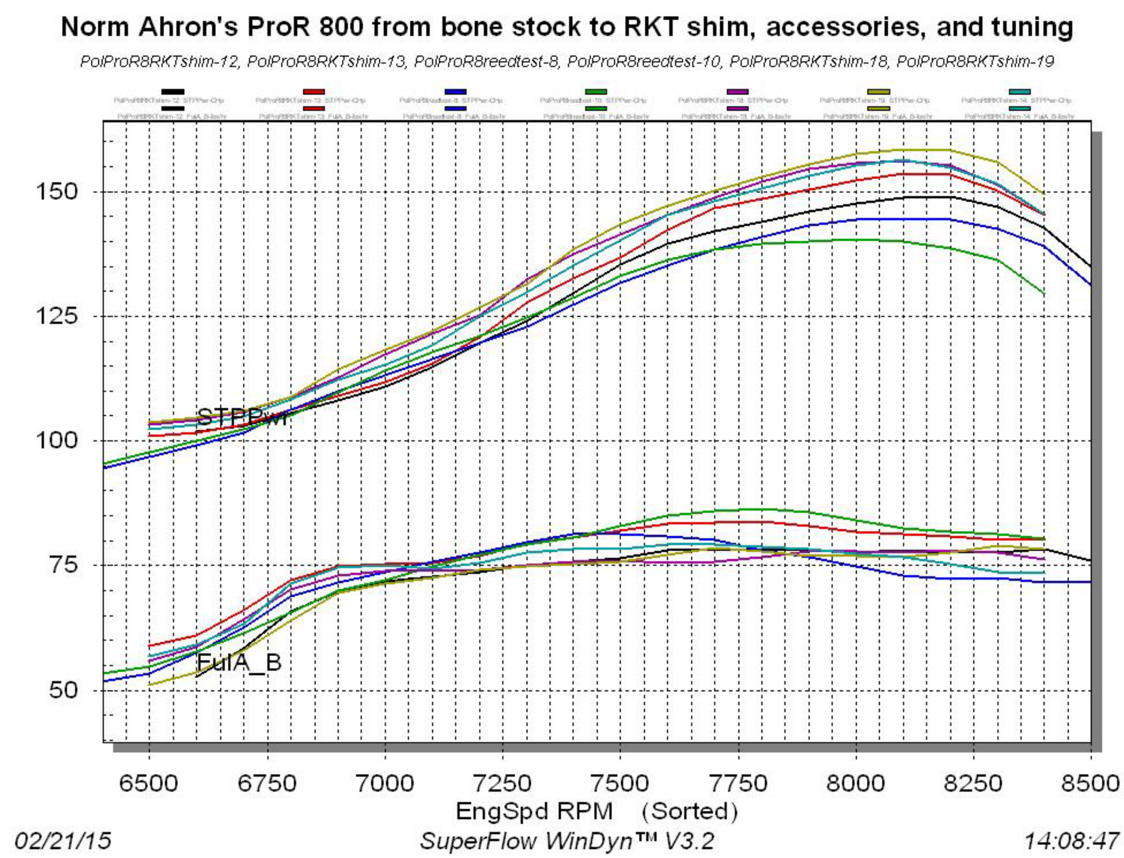
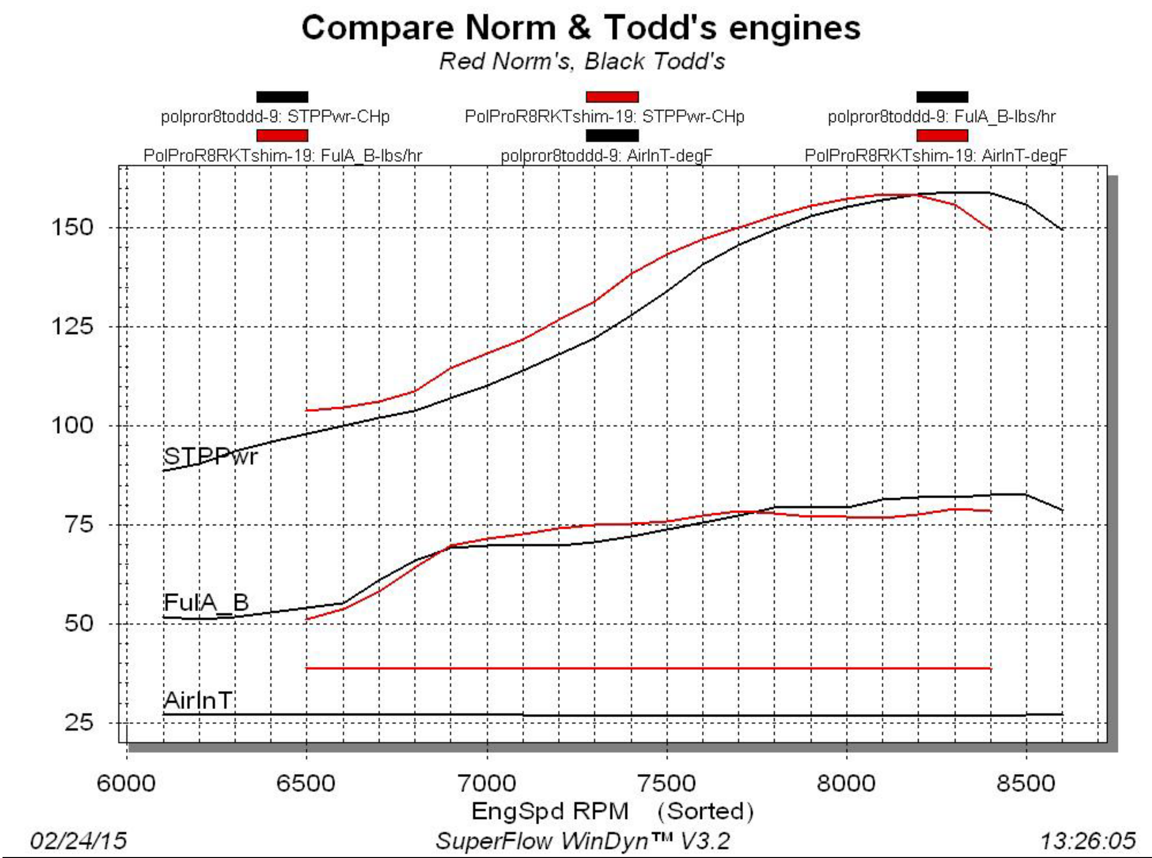
We should note that, as we often recommend, both Norm and Todd are running their sleds with no Tstats—just the rubber gasket is all that's needed to seal the housing on the head. With higher coolant velocity scouring heat from the combustion chambers and eliminating it through the heat exchangers (higher velocity = higher turbulence and maximum exchange of heat into and out of coolant), both guys report that their coolant temp runs lower—typically 100-110f, which is much better for avoiding detonation, and will make more HP at lower coolant temps! And they are both careful to warm their sleds up to 80f before driving off. Also, it should be noted here that the second 800 HO Axys tested here with 1200 miles and a true production ECU made much less HP than Norm's engine. Stay tuned for more on that—Heath Link is coming back on 2/27/15 to retest his Axys, now with over 1000 miles to see how much HP he has now with a production ECU. Results should be posted by 3/3/15.

Here's Norm's engine tuned up from 141 to 159 HP with stock exhaust.



It was Feb 8, we finally had a set of Boyesen 68A Rage Cages, Kelsey showed up with domes and donuts, and Norm and Todd brought Todd's ProR 800 already fitted with the Rev 2 kit at 12.5/1, VF3R reeds and shelfless airbox. Todd had the same fuel as Norm did, with sled set in non-ethanol mode. Today we could experiment with timing easily because we had a 19-030 PCV for fuel and spark tuning. Kelsey also came up with Aaen and SLP exhausts to see if those could improve things, too.

Starting off with Todd's sled we created a knock-free PCV map along with two degrees of timing. This made a bit less torque (midrange HP) than did Norm's 13/1 Rev 2, but a bit more top end and overrev HP. Note that Todd's February session benefited from colder temps that would create much better Density Altitude, and deto is always more of an issue at great DA when tuning for max HP…



Todd's Rev 2, 12.5/1, VF3R, 2 deg timing

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	AFRA_B	AirInT	LM1Air	Air_1c
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	degF	SCFM	CFM
6100	88.7	76.4	0.596	51.8	12.98	26.8	152	144.1
6200	90.6	76.7	0.577	51.2	13.36	26.9	152	146.6
6300	93.5	77.9	0.565	51.7	13.49	26.9	155	149.5
6400	95.8	78.7	0.562	52.8	13.43	26.9	158	151.9
6500	97.8	79.1	0.563	53.9	13.33	26.9	160	154.1
6600	100.0	79.6	0.565	55.3	13.24	26.9	163	156.9
6700	102.0	80.0	0.612	61.1	12.36	26.9	177	161.9
6800	103.9	80.2	0.649	66.0	11.76	26.9	185	166.4
6900	107.0	81.4	0.660	69.2	11.69	26.9	183	173.3
7000	110.3	82.8	0.644	69.7	11.88	26.9	183	177.3
7100	113.8	84.2	0.625	69.7	12.12	26.8	186	180.9
7200	118.0	86.0	0.604	69.8	12.36	26.8	190	184.8
7300	122.2	87.9	0.589	70.6	12.46	26.7	193	188.3

7400	128.0	90.9	0.575	72.1	12.47	26.7	199	192.7
7500	134.1	93.9	0.561	73.8	12.40	26.6	204	196.0
7600	140.7	97.2	0.549	75.7	12.27	26.7	208	198.8
7700	145.6	99.3	0.542	77.3	12.13	26.7	212	200.9
7800	149.6	100.7	0.542	79.4	12.01	26.7	217	204.4
7900	152.9	101.6	0.531	79.5	12.17	26.7	216	207.3
8000	155.3	101.9	0.522	79.5	12.31	26.6	214	209.5
8100	157.0	101.8	0.529	81.4	12.13	26.6	216	211.5
8200	158.4	101.4	0.529	82.1	12.11	26.7	215	212.8
8300	159.2	100.8	0.525	81.9	12.20	26.7	213	213.9
8400	158.7	99.2	0.531	82.6	12.10	26.8	214	214.1
8500	155.9	96.3	0.541	82.6	12.06	26.9	214	213.3
8600	149.5	91.3	0.538	78.8	12.27	27.0	205	207.2

Here's the engine fitted with new design RKT domes replacing the original 12.5/1 domes. We had to back off to 1 degree timing added for this combo. Zero timing is also fine with this—only a few tenths of a HP was lost with stock timing. Stock pipe and muffler is used for all tests.

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	AFRA_B	LamAF1	LM1Air	Air_1c
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	Ratio	SCFM	CFM
6100	90.5	78.0	0.555	49.0	13.49	14.06	149	143.0
6200	92.3	78.2	0.557	50.1	13.36	14.16	154	144.9
6300	94.8	79.0	0.550	50.8	13.40	14.28	157	147.2
6400	97.3	79.9	0.548	52.0	13.31	14.31	161	149.7
6500	99.4	80.3	0.558	54.1	12.99	14.25	167	152.1
6600	101.3	80.6	0.573	56.6	12.70	14.20	174	155.5
6700	103.1	80.8	0.612	61.5	12.09	13.87	185	161.0
6800	105.2	81.2	0.629	64.4	11.89	13.36	186	165.8
6900	108.8	82.8	0.607	64.4	12.31	12.93	180	171.5
7000	113.1	84.8	0.589	64.9	12.51	13.14	184	175.7
7100	116.2	86.0	0.580	65.7	12.60	13.31	189	179.2
7200	119.2	87.0	0.568	66.0	12.78	13.46	192	182.5
7300	124.7	89.7	0.544	66.1	13.10	13.73	196	187.5
7400	129.7	92.1	0.523	66.1	13.34	13.84	198	191.0
7500	134.4	94.1	0.510	66.8	13.45	13.87	201	194.5
7600	140.7	97.2	0.503	68.9	13.29	13.73	205	198.3
7700	145.8	99.4	0.493	70.1	13.23	13.53	205	200.7
7800	149.5	100.7	0.500	72.8	12.90	13.29	209	203.3
7900	152.7	101.5	0.509	75.8	12.59	12.95	212	206.4
8000	155.0	101.7	0.511	77.1	12.54	12.70	212	209.3
8100	156.9	101.7	0.515	78.7	12.41	12.56	214	211.4
8200	159.0	101.9	0.515	79.8	12.34	12.45	215	213.3
8300	161.3	102.0	0.514	80.7	12.26	12.37	216	214.4
8400	161.3	100.9	0.518	81.4	12.18	12.32	217	214.8
8500	158.8	98.1	0.521	80.7	12.28	12.28	215	214.5

8600	152.4	93.1	0.525	77.8	12.64	12.19	205	213.1
8700	141.7	85.5	0.512	70.7	12.80	12.09	185	195.9

Norm and Todd spent several hours swapping reed cages—the new Boyesen 68A Rad Valves would add significant airflow—up to 10% higher in the midrange and 4% at peak revs, some % of which was probably short circuited. But the extra air that *was* trapped in the combustion chamber seemed to increase the operating compression ratio—and required added fuel and reduced timing to prevent knock—offsetting the benefit of the added trapped airflow on the incredibly good Density Altitude day. The flowing graph shows what we tried to do to get knock-free operation with the Boyesen 68A's. The short tests were aborted—clicks heard on the copper tube would set the engine into protect-me mode—gradually reducing timing (where you can see HP tail off). Then after more clicks would go into failsafe mode. It would be good to try even lower compression "new design" domes to take full advantage of the added airflow with the 68As for flatland riders—high altitudes and reduced density altitude can use all the added airflow they can get, so compression ratio is not as much of an issue. But for today, the reeds were equal in HP output

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Kelsey had gotten us Aaen and SLP pipes to try. The Aaen was tested here with stock muffler and the SLP was fitted with its own muffler, configured so that the stock muffler could not be used.

AAEN PIPE/ STOCK MUFFLER

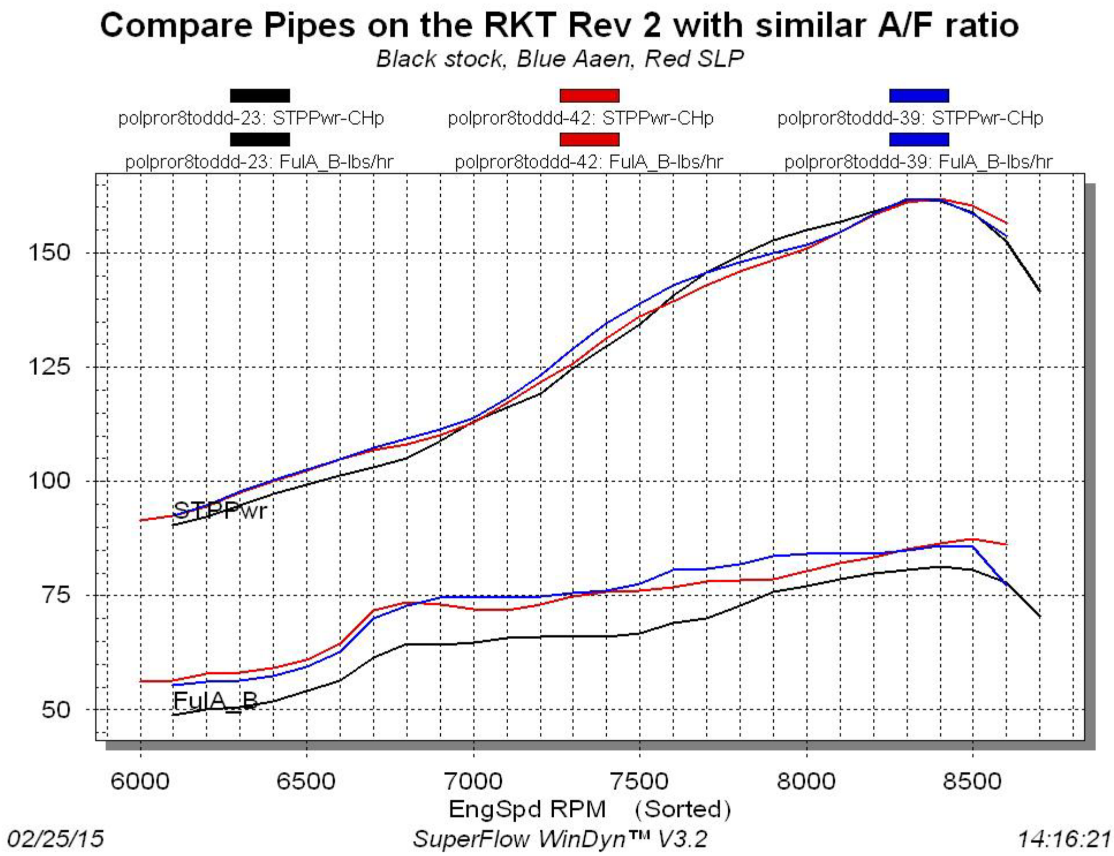
EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	AFRA_B Ratio	LamAF1 Ratio	LM1Air SCFM	Air_1c CFM
6100	92.4	79.6	0.603	55.6	13.14	13.13	153	152.8
6200	94.7	80.2	0.594	56.1	13.29	13.34	156	156.0
6300	97.8	81.5	0.580	56.6	13.39	13.52	160	158.4
6400	100.3	82.3	0.573	57.4	13.39	13.50	162	160.7
6500	102.5	82.8	0.581	59.4	13.13	13.43	167	163.1
6600	104.8	83.4	0.601	62.8	12.73	13.45	177	167.2
6700	107.4	84.2	0.653	69.9	12.00	13.19	193	175.6
6800	109.4	84.5	0.668	72.9	11.82	12.82	196	180.2
6900	111.4	84.8	0.671	74.5	11.89	12.61	197	185.3
7000	114.0	85.5	0.656	74.6	12.08	12.76	199	188.5
7100	118.3	87.5	0.632	74.6	12.35	13.07	204	192.7
7200	123.2	89.9	0.610	74.9	12.50	13.26	208	195.9
7300	129.2	92.9	0.588	75.7	12.59	13.26	210	199.3
7400	134.6	95.5	0.567	76.2	12.72	13.12	209	202.6
7500	138.9	97.2	0.561	77.7	12.60	12.93	210	204.8
7600	142.8	98.7	0.565	80.5	12.28	12.70	214	207.0
7700	145.7	99.4	0.556	80.8	12.32	12.58	213	208.4
7800	148.1	99.7	0.555	82.0	12.23	12.39	213	209.8

7900	150.1	99.8	0.560	83.8	12.07	12.23	214	211.5
8000	151.8	99.7	0.556	84.2	12.14	12.13	214	213.9
8100	154.5	100.1	0.548	84.4	12.27	12.08	213	216.6
8200	158.7	101.6	0.532	84.1	12.46	12.17	214	219.3
8300	161.9	102.4	0.526	84.9	12.45	12.26	218	221.1
8400	161.5	101.0	0.534	86.1	12.31	12.19	220	221.6
8500	158.6	98.0	0.542	85.7	12.37	12.05	216	221.7
8600	153.9	94.0	0.505	77.5	12.61	11.92	193	204.3

SLP PIPE/ MUFFLER COMBO

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	AFRA_B Ratio	LamAF1 Ratio	LM1Air SCFM	Air_1c CFM
6000	91.5	80.1	0.616	56.1	12.85	13.28	156	151.1
6100	92.6	79.7	0.613	56.6	12.91	13.28	157	153.0
6200	94.6	80.1	0.614	57.9	12.91	13.42	163	156.6
6300	97.7	81.4	0.597	58.1	13.14	13.62	166	159.9
6400	100.0	82.0	0.594	59.2	13.05	13.70	170	161.7
6500	102.4	82.7	0.599	61.0	12.88	13.74	176	164.7
6600	104.8	83.4	0.617	64.4	12.42	13.76	186	167.7
6700	107.0	83.9	0.674	71.9	11.47	13.49	203	172.6
6800	108.3	83.6	0.683	73.6	11.35	13.02	201	175.0
6900	110.0	83.8	0.667	73.1	11.64	12.48	191	178.4
7000	113.0	84.8	0.640	72.0	12.00	12.51	189	181.1
7100	117.2	86.7	0.614	71.7	12.34	12.70	191	185.3
7200	121.7	88.8	0.603	73.1	12.34	12.91	198	188.9
7300	125.8	90.5	0.596	74.8	12.29	13.04	204	192.4
7400	131.3	93.2	0.580	75.8	12.39	13.08	208	196.7
7500	136.2	95.4	0.561	76.0	12.56	12.95	206	200.0
7600	139.5	96.4	0.553	76.9	12.63	12.82	206	203.4
7700	142.9	97.4	0.550	78.2	12.61	12.76	209	206.7
7800	146.0	98.3	0.539	78.4	12.73	12.73	209	209.2
7900	148.5	98.8	0.532	78.7	12.86	12.65	209	211.9
8000	150.9	99.1	0.535	80.5	12.75	12.54	211	215.0
8100	154.5	100.2	0.535	82.3	12.70	12.42	214	218.9
8200	158.4	101.5	0.529	83.5	12.64	12.37	216	220.9
8300	161.0	101.9	0.531	85.1	12.51	12.33	220	223.0
8400	161.9	101.2	0.537	86.5	12.37	12.24	222	224.1
8500	160.3	99.0	0.548	87.5	12.23	12.09	222	224.1
8600	156.5	95.6	0.553	86.2	12.14	11.97	216	219.1

The final graph shows the stock pipe matching the aftermarket pipes with fuel flow adjusted properly to match the higher airflow of the pipes w/ Boyesen 68A's.



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