SkiDoo Etec 800 Ypipe testing, phase 2 Jim Czekala

If this is “phase 2” where is “phase 1”?

Phase 1 was a full day test session here in November with great guy Branco Dickhut of HotRod Sled Shop in PA last November. We had all of this stuff to test—and a 1000 mile, broken in 2015 stocker, but no BUDS to monitor actual engine and exhaust temperatures and actual exhaust valve opening %. Because of the Etec’s protect-me mode that begins to close exhaust valves when muffler temp climbs, our testing on this day, all day, was not consistent—so our data was useless in comparing component HP. Could we compare Y pipe A to Y pipe B without knowing that engine temps were similar, and that exhaust valves were similarly wide open? Nope.

For phase 2, we came up with another 2015 stock Etec 800 with 1000 miles on it, owned by Chad Giesler who works in an industrial facility within earshot of DTR. Chad was always intrigued by the sound of howling sled engines at DTR, and being a hotrodder was eager to offer up his machine for testing. Our BUDS go-to guy Jim Cooper, owner and CTO of Coopers' Sales and Service SkiDoo in Waterport, NY, sold this Etec 800 to Chad, and had programmed the ECU for +2 degrees. Jim's presence with his BUDS system would enable us to closely monitor Etec engine operating conditions to ensure perfect repeatability. Coolant temperature and exhaust temps affect airflow and HP, and where peak HP occurs. Remember—the speed of sound increases as gas temperature climbs, but is unaffected by gas pressure. The Etec system appears to control high exhaust system temperatures by gradually closing exhaust valves based upon the gas temperature in the muffler, reducing exhaust airflow (and HP). It appears that, based on early testing, the 2016 Etec 800 may be even more sensitive to high exhaust temps. One 2016 we had here appeared to begin closing valves at temps as low as 800F, whereas this 2015 model held the valves open to 1000F! When exhaust valves begin to close, airflow and HP drops so when trying to assess the value of exhaust components, we must know that exhaust valves are fully open!

Why worry about exhaust temperature? Aren't "hot pipes" the "hot deal"? If you scroll down on this website to the scanned printed DynoTech issues, you'll find a treasure trove of meaningful technical info (including 30+ tech articles by Cycle World tech ed Kevin Cameron) that many of us re-read periodically. In the 9/1/93 issue (Volume 5 number 4) on page 15 at Kevin's suggestion we did a test session, where we fitted an 80 HP Yamaha Exciter single pipe with five thermocouples from the Ypipe to the tailpipe. Then we did a series of back-to-back acceleration tests along with extended steady-state WOT operation. Based upon that data, it's easy to see how the Etec 800—with, say, 1200F+ average exhaust temp coming out the ports and double the CFM of exhaust gas compared to the Exciter—can turn the complete exhaust system a dull red hot from Y pipe to muffler outlet if run at 160+ HP long enough—hence the need to cool things off! Red-hot exhaust in the proximity of plastic body panels is obviously a bad thing, so Etec owners complaining about HP "fade" really shouldn't. And, back in November when we were testing Branco's Etec 800, at one point we did pick up some HP by adding fuel with his intake air temp probe fooling device—perhaps cooling the exhaust gas just a bit, and keeping the valves fully open? And besides the HP advantage, running an extra two degrees of timing surely helps by reducing exhaust temperature—let more of that valuable heat energy push the pistons down their bores instead of overheating the exhaust!

Notice that all of the Ypipes (except the prototype stainless one second from the right tested privately) are tapered in various angles. DTR member Michigan roadracer/ race car/ engine builder Paul Gentilozzi commented: "the tapered or step pipe is a great idea. I spent a day recently at Yamaha's small engine racing build shop in Japan. They are very big on managing exhaust gas expansion rates to maintain velocity. It makes power in every model".

Our strategy on this day was to have Jim Cooper monitor his BUDS and call out coolant and exhaust temperatures to Chad and me as we warmed up the engine then loaded to full throttle and ran our dyno acceleration tests. Chad would act as dyno stenographer, manually recording beginning and ending coolant and exhaust temps in each of the three back-to-back dyno tests of each component. Meanwhile, Jim Cooper would also monitor exhaust valve % to make sure no protect-me-mode was employed as exhaust temps approached 1000F. Today, on this broken-in 2015, even at ex temps of 1000F and even slightly higher, exhaust valves stayed open.

After “heat soaking” the engines with five 250 RPM/ second dyno sweep tests, we would run three back-to-back full throttle dyno tests on each component—beginning at about 110F coolant temp and 500F exhaust temp. A typical coolant temp rise for each acceleration test would be 110-116F, then 120-130F, and 135-145+ on the last test. Exhaust temp rise would approximate 500-700F, then 700-800F, and finally 800-900+F on the final dyno test. The first test of each series might represent how the engine responds initially at WOT either from a dead stop, or from light throttle cruising. The third test of each series might match field temperatures experienced after about 30 seconds at WOT. Today, Chad had 91 octane non ethanol fuel in the tank.

CARTOONS ARE KING

An overlay graph is easier to assess/ compare than are rows of numbers. It’s human nature to just gravitate to the highest torque or HP number in a row. But midrange power can be meaningful, and seeing the actual HP curve is best. So we show each component tested as an overlay graph, and actual numbers from the hottest, third test of each series.

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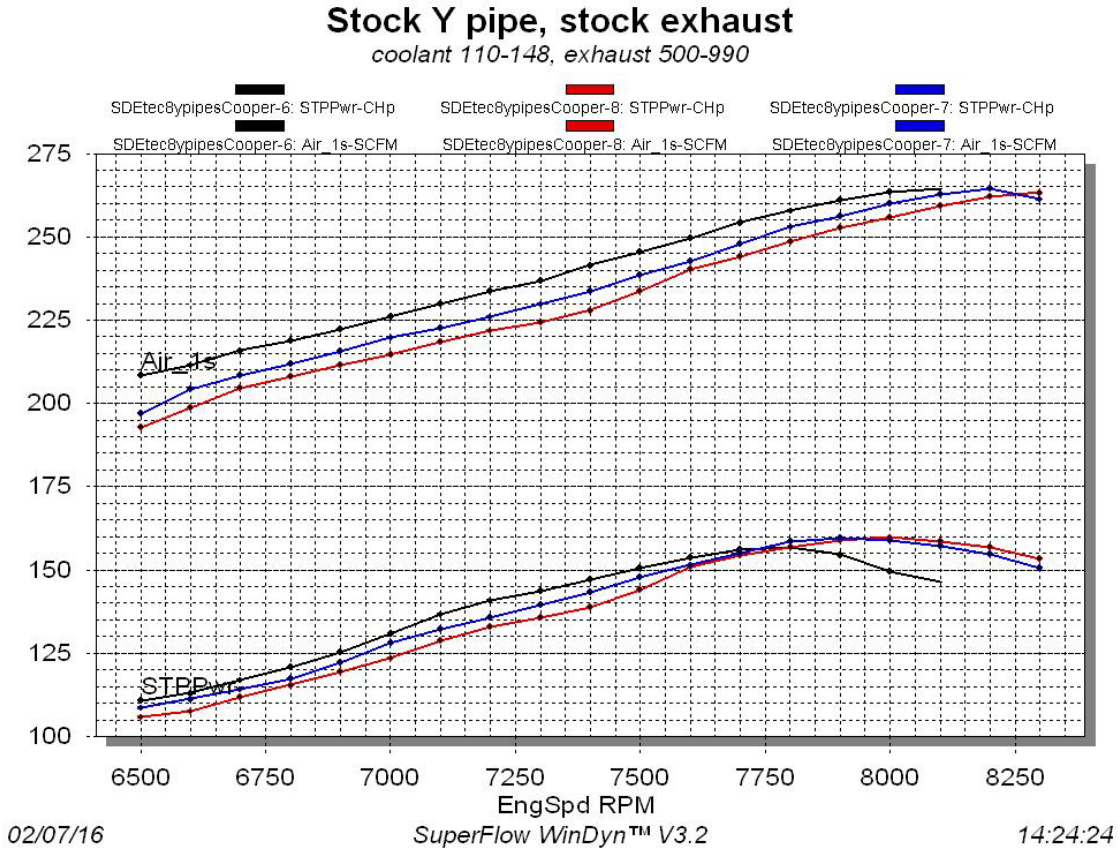
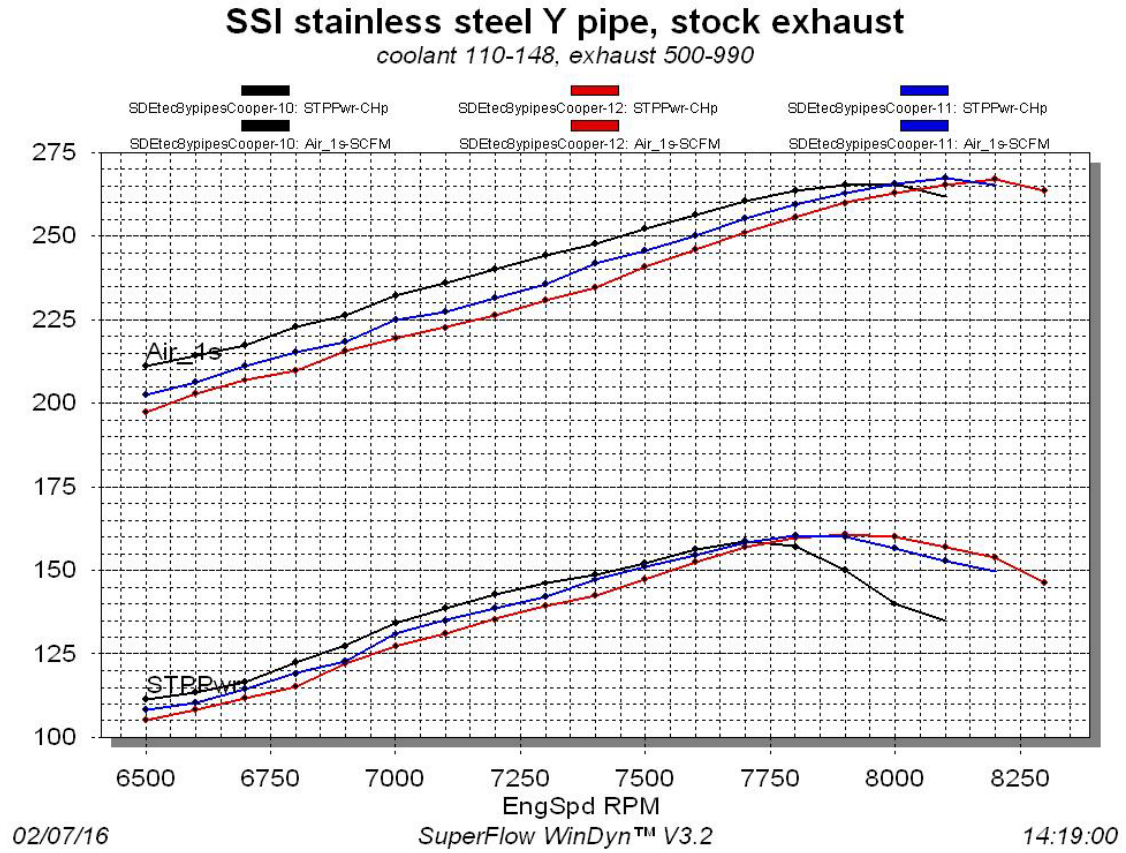
All stock, airflow CFM and HP



test three of the stock Ypipe—coolant 140-152, exhaust 840-1000f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	105.7	85.4	0.676	66.6	13.81	212	192.9
6600	107.5	85.5	0.675	67.7	13.77	214	198.7
6700	111.7	87.6	0.666	69.4	13.61	217	204.5
6800	115.4	89.1	0.666	71.6	13.41	221	208.0
6900	119.3	90.8	0.667	74.2	13.11	224	211.6
7000	123.4	92.6	0.663	76.3	12.81	225	214.6
7100	128.7	95.2	0.643	77.2	12.54	223	218.4
7200	132.9	96.9	0.627	77.7	12.51	224	221.8
7300	135.6	97.5	0.620	78.4	12.55	227	224.4
7400	138.7	98.5	0.613	79.3	12.65	231	227.9
7500	143.9	100.7	0.600	80.5	12.81	237	233.7
7600	150.8	104.2	0.579	81.4	12.80	240	240.2
7700	154.3	105.2	0.577	82.9	12.70	243	244.0
7800	156.7	105.5	0.577	84.3	12.63	245	248.6
7900	158.8	105.6	0.573	84.8	12.70	248	252.7

8000	159.7	104.9	0.566	84.3	12.85	249	255.7
8100	158.4	102.7	0.560	82.7	13.05	248	259.5
8200	156.7	100.4	0.550	80.3	13.15	243	262.0
8300	153.4	97.0	0.542	77.4	13.31	237	263.3



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SSI stainless steel Y pipe, coolant 139-148, exhaust 810-990

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	LamAF1	LM1Air	Air_1s
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	SCFM	SCFM
6500	105.1	84.9	0.683	66.9	13.97	216	197.3
6600	108.2	86.1	0.682	68.7	13.94	221	203.0
6700	111.7	87.6	0.674	70.1	13.83	224	206.9
6800	115.2	88.9	0.664	71.2	13.66	224	209.8
6900	121.9	92.8	0.647	73.6	13.29	225	215.6
7000	127.2	95.4	0.644	76.3	13.09	230	219.5
7100	131.2	97.1	0.635	77.7	12.96	232	222.7
7200	135.4	98.8	0.614	77.5	12.97	232	226.4
7300	139.4	100.3	0.600	77.9	13.07	235	230.9
7400	142.6	101.2	0.594	78.9	13.14	239	234.7
7500	147.3	103.1	0.581	79.7	13.24	243	240.9
7600	152.6	105.4	0.569	80.9	13.25	247	246.0
7700	157.0	107.1	0.572	83.6	13.18	254	251.0
7800	159.8	107.6	0.572	85.1	13.10	257	255.7
7900	160.8	106.9	0.567	84.9	13.20	259	260.0
8000	160.1	105.1	0.567	84.4	13.37	260	262.9
8100	157.0	101.8	0.565	82.5	13.52	257	265.5
8200	153.8	98.5	0.560	80.1	13.62	252	267.2
8300	146.3	92.6	0.561	76.2	13.61	239	263.7

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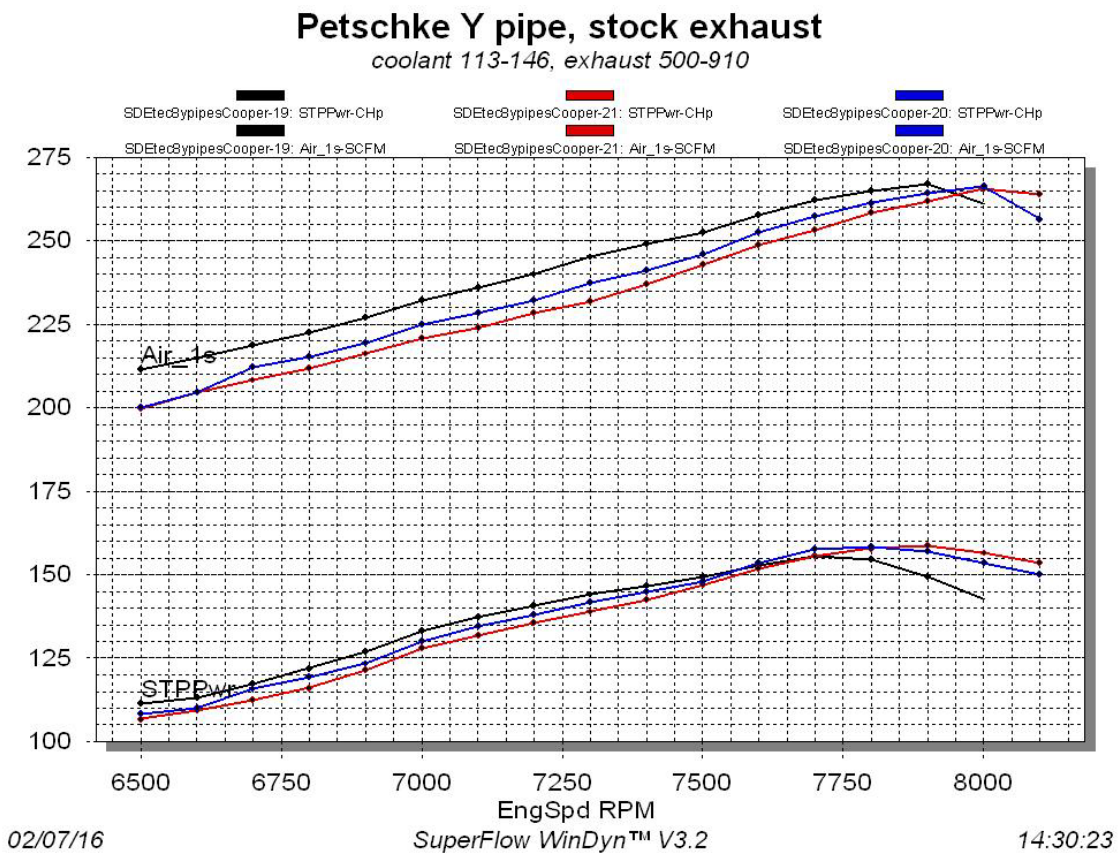
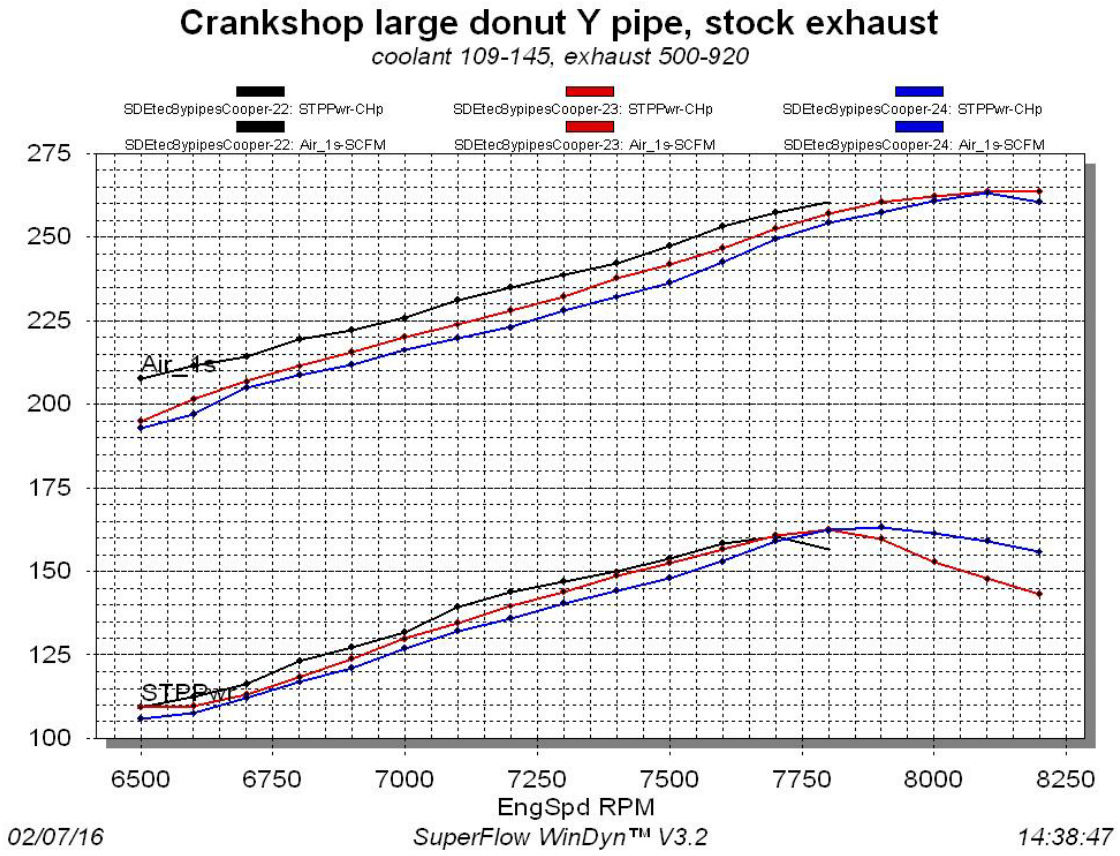


This was an early Petschke Ypipe left here years ago for testing by Billy Howard—a design that's since been taken over by D&D. I showed this one to Dale Roes and it's noticeably lower on HP compared to the first Petschke Etec 800 Ypipe tested by Chuck Hamarah and Steve Petschke back in 2011 (posted on this website). Dale sent me one of their production Y pipes, which is noticeably smoother internally. We'll test that one in Phase 3.

Early Petschke Y pipe, coolant 138-146f, exhaust 800-910f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	106.7	86.2	0.686	68.0	14.20	223	199.7
6600	109.3	87.0	0.671	68.2	14.10	222	204.4
6700	112.4	88.1	0.671	70.1	13.92	225	208.3
6800	116.0	89.6	0.670	72.3	13.70	229	211.7
6900	121.5	92.5	0.662	74.8	13.39	232	216.2
7000	128.0	96.0	0.654	77.9	13.13	236	220.9
7100	131.7	97.5	0.643	78.7	13.05	237	223.8
7200	135.6	98.9	0.617	77.8	13.05	235	228.3
7300	138.9	99.9	0.601	77.5	13.15	236	231.9
7400	142.4	101.1	0.593	78.4	13.32	242	237.0
7500	146.8	102.8	0.581	79.4	13.47	247	242.8

7600	151.7	104.9	0.571	80.5	13.52	251	248.7
7700	155.4	106.0	0.567	81.9	13.47	255	253.2
7800	157.8	106.3	0.567	83.2	13.39	257	258.4
7900	158.6	105.4	0.562	82.9	13.44	258	261.8
8000	156.4	102.7	0.562	81.7	13.72	259	265.5
8100	153.7	99.6	0.541	77.2	13.82	247	264.0

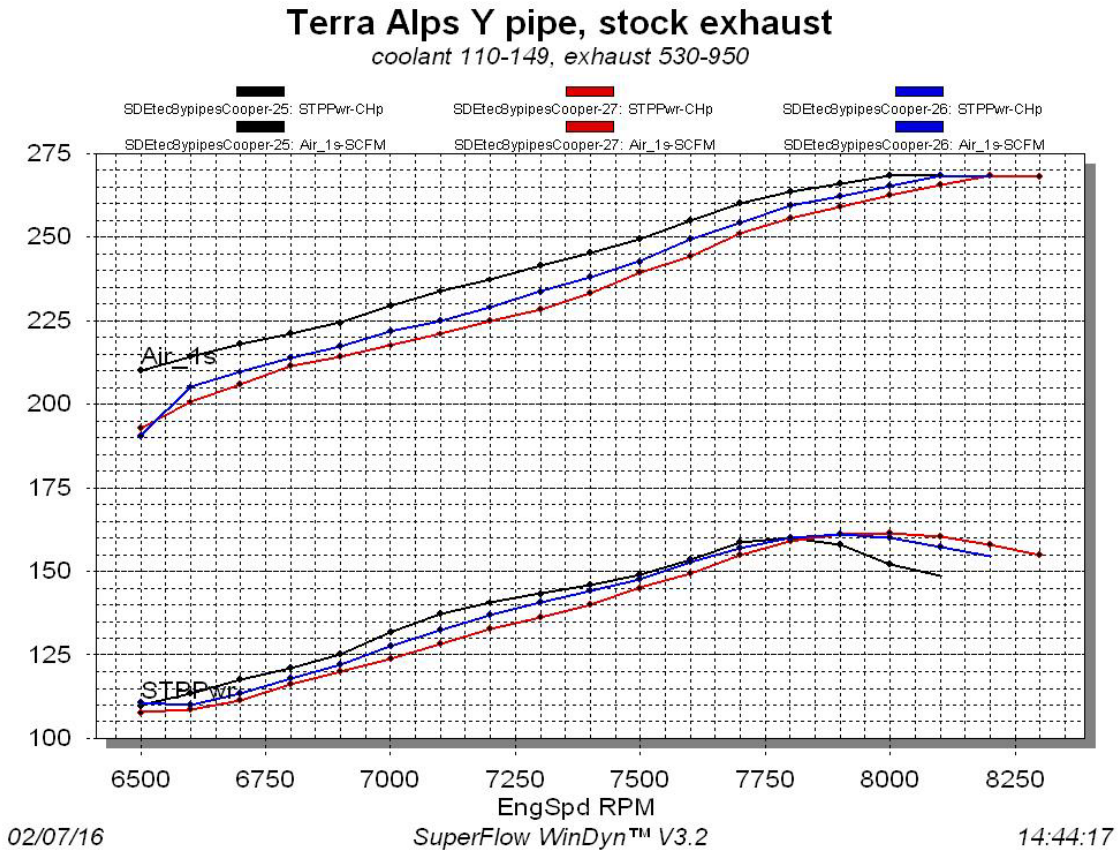


This Crankshop Y pipe has a slightly larger than stock outlet, requiring one size larger donut seal. The larger dounut helps extend the length of the stock tuned pipe, increasing midrange power and sliding the HP peak to a lower RPM. HP was the highest of all Y's. This is the same stamping used by DynoPort for their Ypipes, but DynoPort's Y pipe uses the stock donut. Rich Daly forgot to send us one of his, but we'll try to get one for Phase 3. Larry Audette also sent us a stock donut version that we'll try during Phase 3.

Crankshop large donut Y pipe, coolant 137-145f, exhaust 790-920f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	105.9	85.6	0.681	67	13.99	217	192.9
6600	107.4	85.5	0.682	68.1	13.93	219	197
6700	112.2	87.9	0.685	71.4	13.77	227	204.9

6800	116.8	90.2	0.682	74.0	13.59	233	208.7
6900	121.0	92.1	0.680	76.5	13.33	236	211.9
7000	126.8	95.2	0.663	78.2	12.97	234	216.2
7100	132.0	97.7	0.638	78.3	12.83	232	219.8
7200	135.8	99.0	0.624	78.7	12.83	234	223.0
7300	140.5	101.1	0.605	79.0	12.95	237	228.2
7400	144.3	102.4	0.595	79.8	13.02	240	232.1
7500	148.0	103.6	0.588	80.9	13.04	244	236.2
7600	153.0	105.7	0.582	82.8	13.02	249	242.6
7700	159.1	108.5	0.569	84.2	12.95	252	249.4
7800	162.3	109.3	0.564	85.0	12.93	254	254.3
7900	163.0	108.4	0.560	84.8	13.03	256	257.3
8000	161.3	105.9	0.554	83.0	13.30	255	260.8
8100	159.1	103.1	0.554	81.8	13.46	255	263.4
8200	155.8	99.8	0.528	76.3	13.55	239	260.4



The Terra Alps Y pipe made a couple of extra HP at peak, and interestingly as the final comparo graphs would show, had the best over-rev HP.

Terra Alps (Canada) Y pipe, coolant 140-149f, exhaust 800-950f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	107.8	87.1	0.664	66.5	14.20	219	192.9
6600	108.7	86.5	0.670	67.6	14.09	220	200.6
6700	111.5	87.4	0.669	69.3	13.91	223	206.0
6800	116.3	89.8	0.666	72.0	13.61	227	211.4
6900	120.0	91.4	0.668	74.5	13.39	231	214.4
7000	123.9	92.9	0.667	76.7	13.12	233	217.5
7100	128.4	95.0	0.654	78.0	12.91	233	221.0
7200	132.9	96.9	0.636	78.4	12.90	234	224.9
7300	136.2	98.0	0.620	78.4	12.99	236	228.4
7400	140.0	99.3	0.605	78.7	13.15	239	233.2
7500	145.0	101.6	0.592	79.8	13.28	245	239.3
7600	149.5	103.3	0.585	81.2	13.27	250	244.2
7700	155.0	105.7	0.580	83.4	13.16	254	251.0
7800	158.9	107.0	0.575	84.9	13.08	257	255.5
7900	161.0	107.0	0.568	84.9	13.12	258	259.2
8000	161.5	106.0	0.560	83.9	13.33	259	262.5
8100	160.4	104.0	0.555	82.7	13.55	259	265.7
8200	158.1	101.2	0.550	80.6	13.65	255	268.3
8300	155.0	98.1	0.553	79.4	13.81	254	268.0

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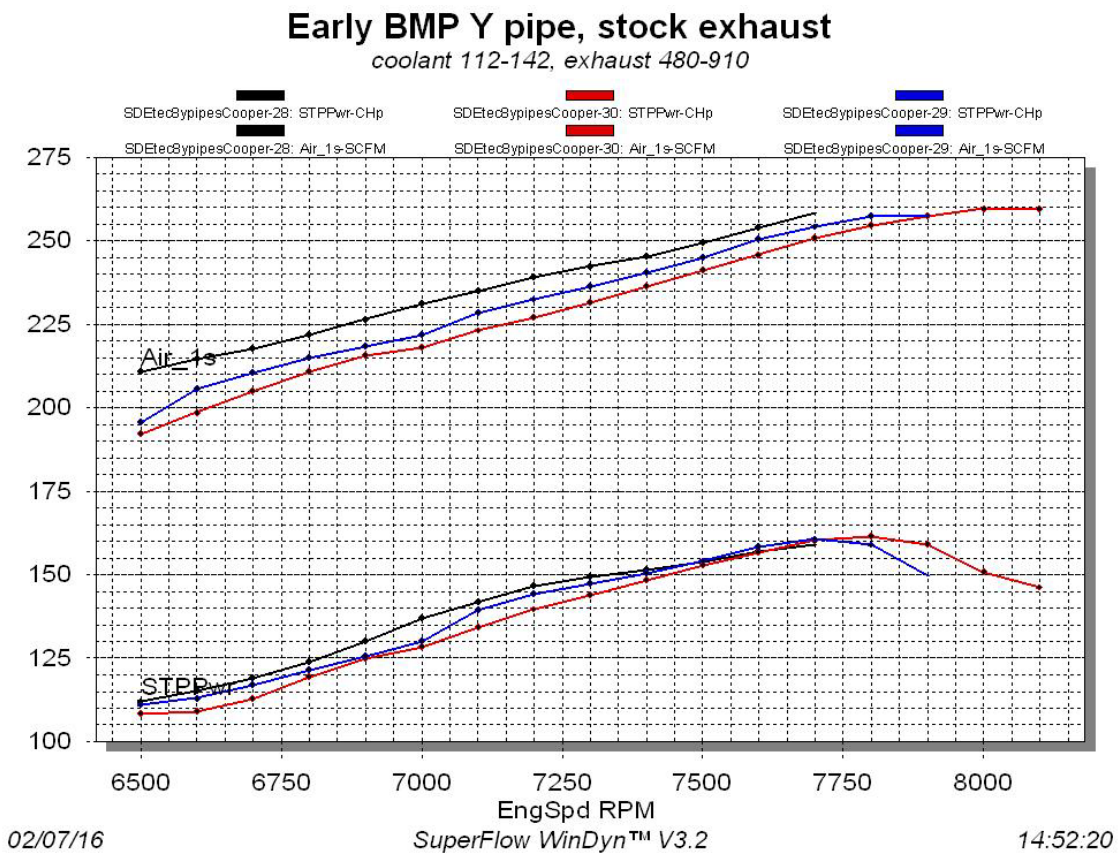
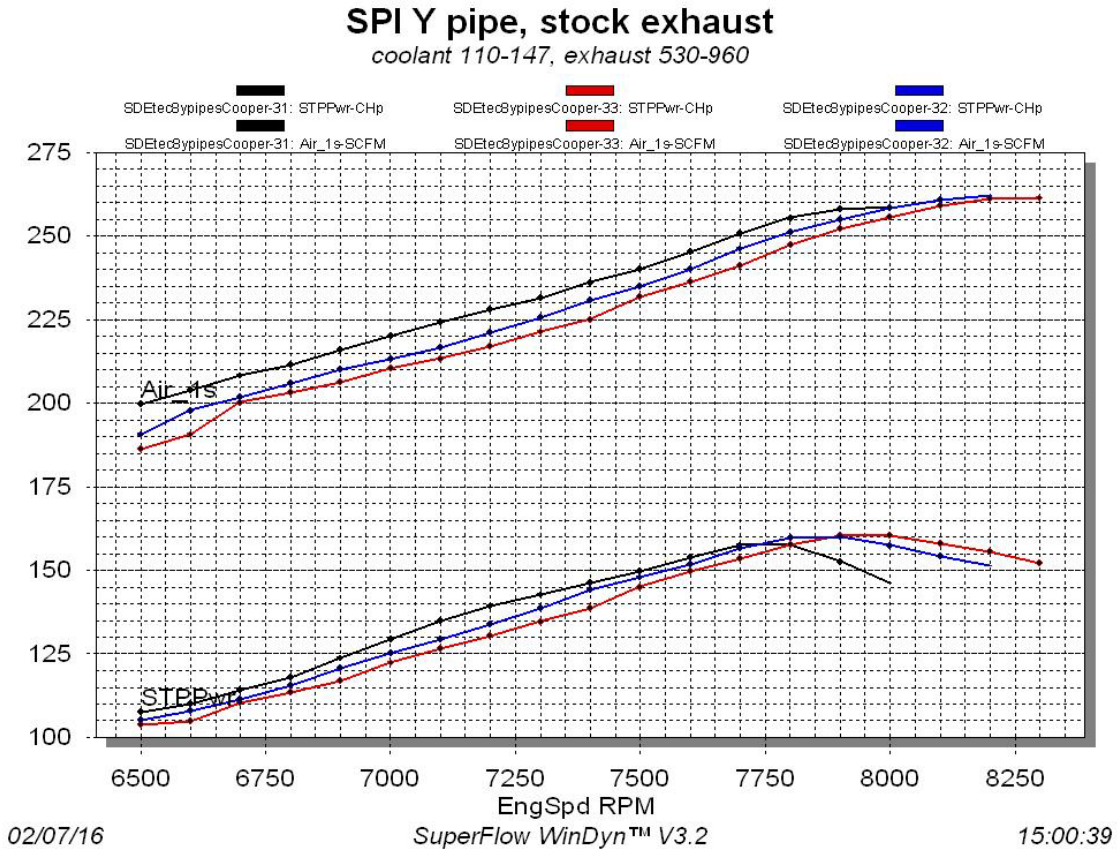


This BMP Y pipe has round, sanded exhaust port inlets. The newer BMP are said to have tapered tubes that are more oval shaped, and we'll try to obtain one of those for Phase 3 as well. As the final graphs show, this one was longest and had the best midrange HP improvement of all the Y pipes.

Early BMP Y pipe, coolant 136-142f, exhaust 770-910f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	108.4	87.6	0.664	66.8	14.03	217	192.3
6600	108.9	86.7	0.682	69.0	14.01	223	198.5
6700	112.9	88.5	0.676	70.9	13.91	228	204.9
6800	119.5	92.3	0.655	72.7	13.63	229	210.9
6900	124.9	95.0	0.644	74.7	13.39	231	215.5
7000	128.3	96.3	0.639	76.1	13.26	233	218.1
7100	134.1	99.2	0.629	78.4	13.05	237	223.1
7200	139.5	101.8	0.611	79.2	13.02	238	227.1
7300	144.0	103.6	0.587	78.5	13.13	238	231.4
7400	148.4	105.3	0.567	78.2	13.33	241	236.4
7500	152.9	107.0	0.565	80.3	13.39	249	241.3
7600	156.8	108.3	0.568	82.7	13.34	255	245.8
7700	160.2	109.3	0.570	84.8	13.19	259	250.9
7800	161.5	108.7	0.567	85.1	13.06	257	254.7
7900	159.1	105.8	0.571	84.4	13.10	256	257.5

8000	150.8	99.0	0.597	83.5	13.26	256	259.6
8100	146.1	94.7	0.602	81.5	13.29	251	259.6

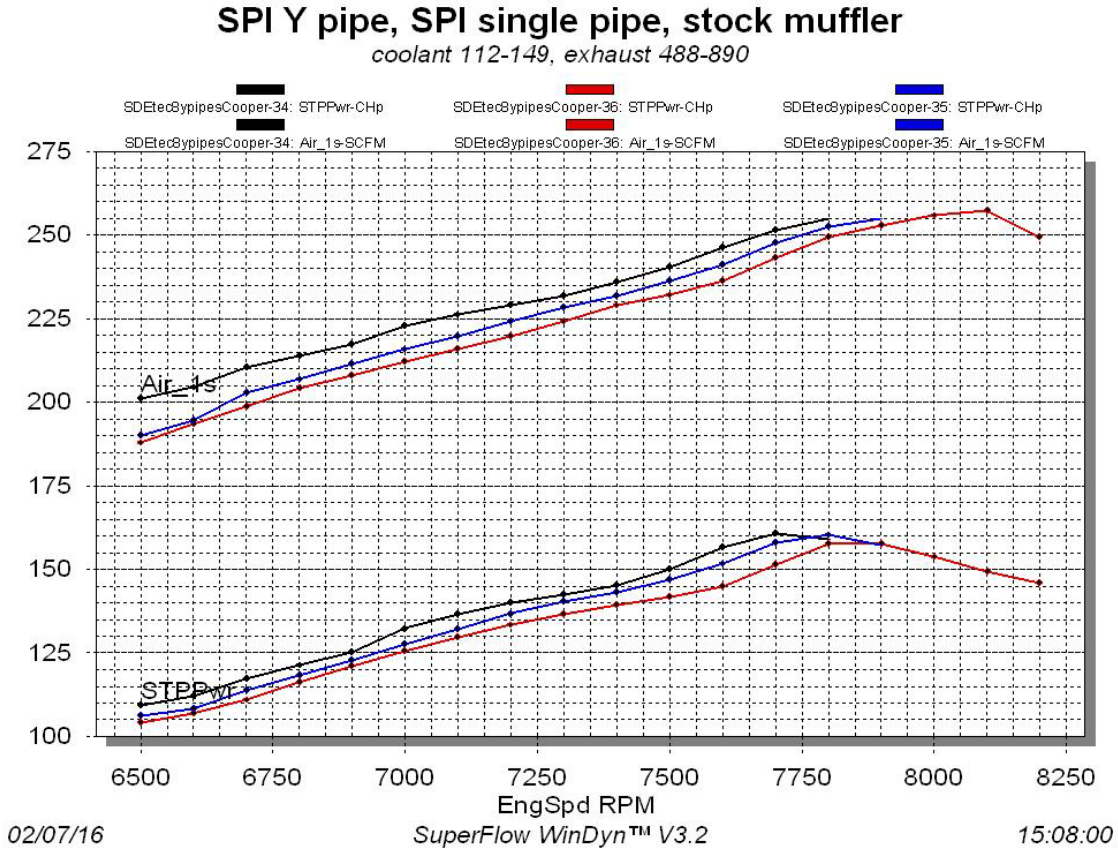


SPI ceramic coated Y pipe 134160, coolant 138-147f, exhaust 800-960f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	103.7	83.8	0.697	67.1	13.64	212	186.4
6600	104.8	83.4	0.707	68.7	13.59	216	190.6
6700	110.3	86.5	0.697	71.4	13.49	223	200.2
6800	113.6	87.7	0.696	73.3	13.38	227	203.2
6900	117.0	89.0	0.699	75.8	13.05	229	206.4
7000	122.3	91.8	0.680	77.2	12.63	226	210.4
7100	126.6	93.6	0.655	76.9	12.51	223	213.4
7200	130.4	95.1	0.637	77.1	12.49	223	216.9
7300	134.7	96.9	0.624	78.0	12.59	227	221.4
7400	138.6	98.4	0.613	78.8	12.70	232	225.1
7500	145.0	101.6	0.593	79.8	12.81	237	232.0
7600	149.7	103.4	0.587	81.5	12.80	242	236.4
7700	153.4	104.6	0.590	84.0	12.75	248	241.1
7800	157.7	106.2	0.583	85.3	12.70	251	247.5

7900	160.5	106.7	0.563	83.8	12.80	248	252.3
8000	160.5	105.4	0.554	82.5	13.01	248	255.7
8100	158.1	102.5	0.563	82.5	13.19	252	259.0
8200	155.7	99.7	0.565	81.5	13.28	251	261.2
8300	152.2	96.3	0.557	78.5	13.51	246	261.4

We also had a ceramic coated SPI single pipe that we added to the SPI Ypipe and stock muffler. This pipe made best HP on it's first test, and is likely a better high altitude pipe.

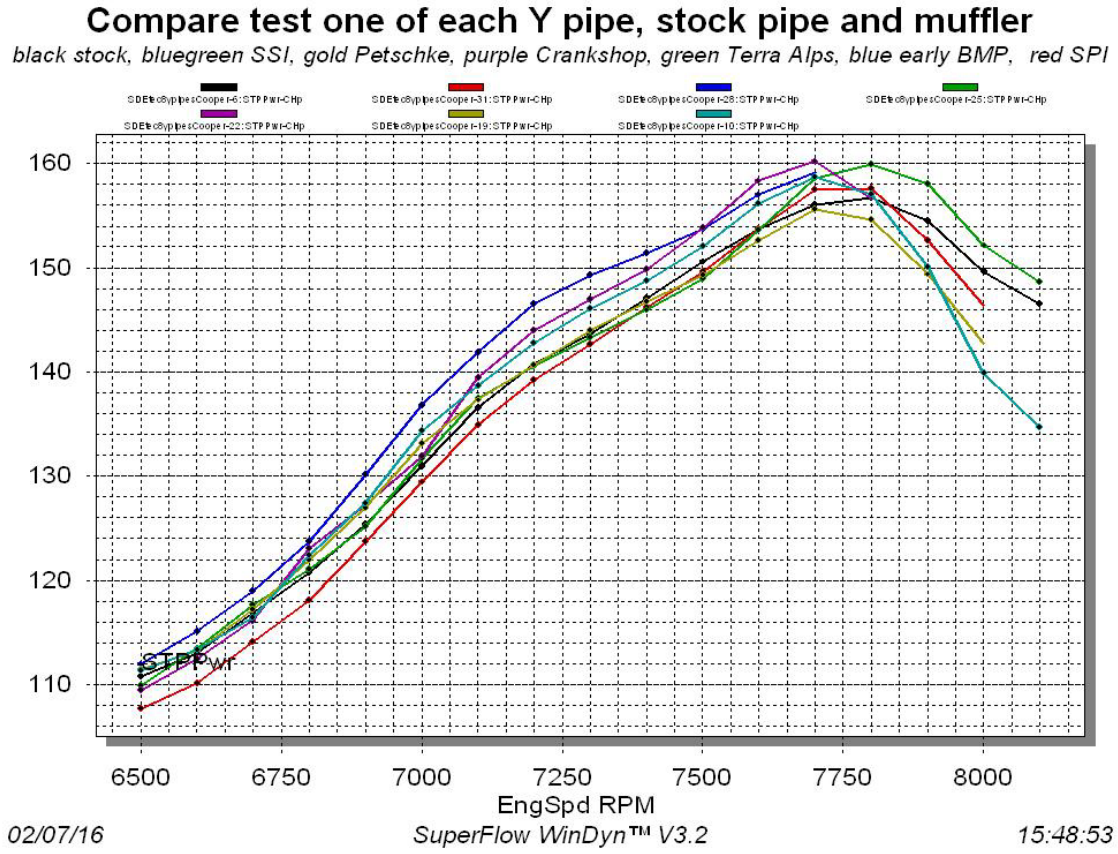


SPI single pipe and Y pipe, coolant 112-118f, exhaust 530-704f

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	LamAF1 Ratio	LM1Air SCFM	Air_1s SCFM
6500	109.3	88.3	0.670	67.9	14.49	228	201.2
6600	112.0	89.1	0.658	68.4	14.46	229	204.4
6700	117.2	91.9	0.638	69.4	14.29	230	210.4
6800	121.3	93.7	0.636	71.6	14.16	235	213.8
6900	125.3	95.4	0.640	74.4	13.97	241	217.2
7000	132.3	99.2	0.625	76.8	13.58	241	222.9

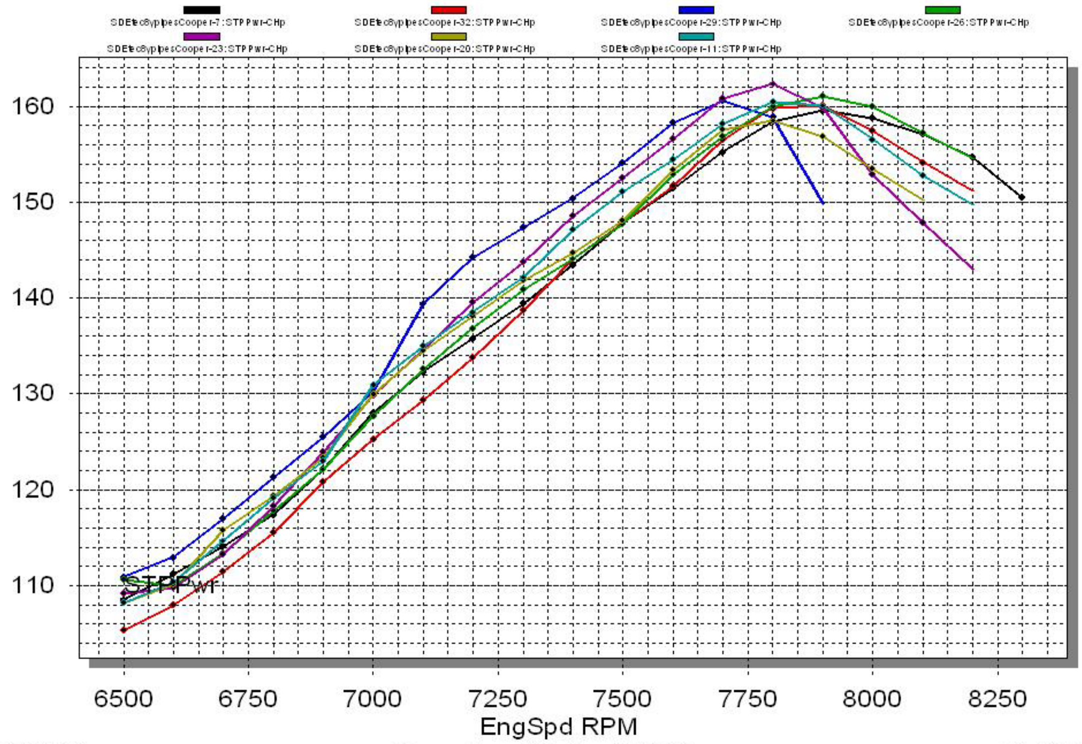
7100	136.7	101.1	0.608	77.2	13.52	242	226.2
7200	139.9	102.1	0.588	76.4	13.54	240	229.2
7300	142.4	102.5	0.570	75.4	13.69	239	231.9
7400	145.4	103.2	0.560	75.6	13.96	244	236.0
7500	149.9	105.0	0.550	76.5	14.13	250	240.4
7600	156.5	108.2	0.535	77.8	14.06	253	246.3
7700	160.8	109.7	0.537	80.1	13.82	256	251.5
7800	158.9	107.0	0.561	82.7	13.54	259	255.0

Here are all of the Y pipes, compared side by side on each one's first, second, and third tests:



Compare test TWO of each Y pipe, stock pipe and muffler

black stock, bluegreen SSI, gold Petschke, purple Crankshop, green Terra Alps, blue early BMP, red SPI



02/07/16 *SuperFlow WinDyn™ V3.2* *16:08:29*

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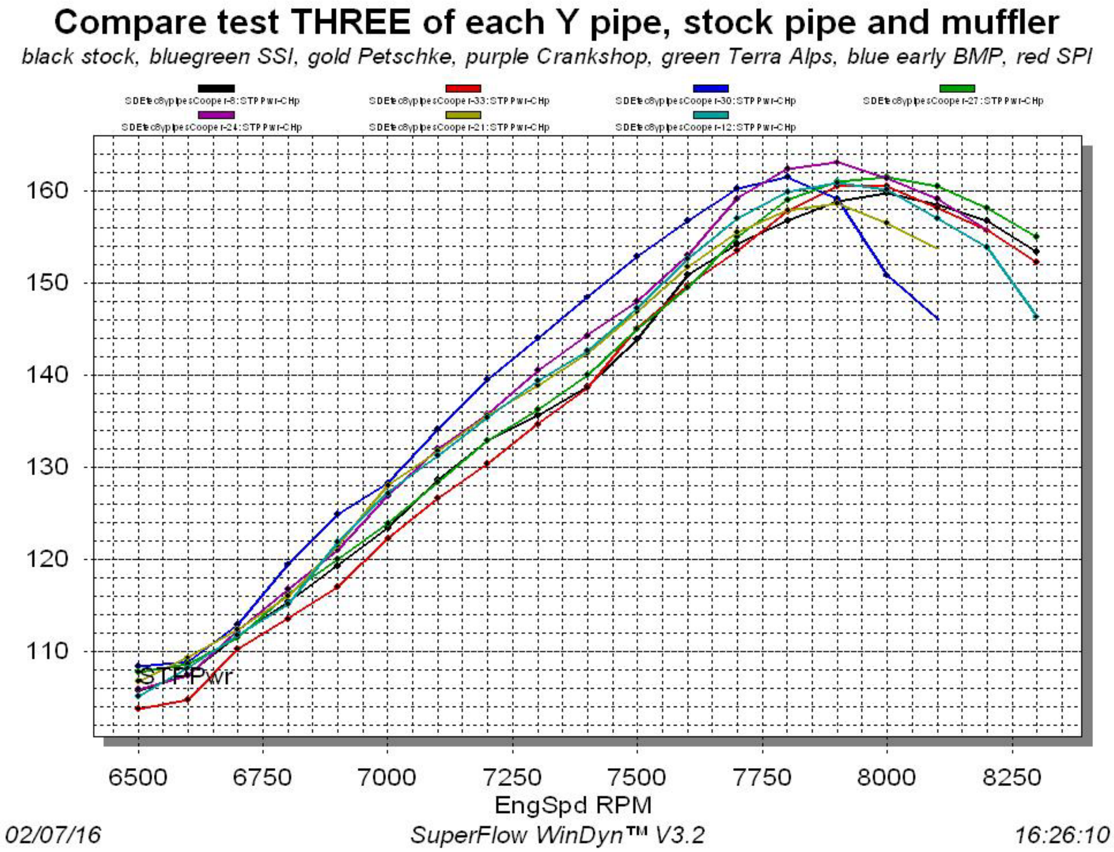
Compare test THREE of each Y pipe, stock pipe and muffler
black stock, bluegreen SSI, gold Petschke, purple Crankshop, green Terra Alps, blue early BMP, red SPI
SDEtec8ypipesCooper-8:STPPwr-CHp
SDEtec8ypipesCooper-33:STPPwr-CHp
SDEtec8ypipesCooper-30:STPPwr-CHp
SDEtec8ypipesCooper-27:STPPwr-CHp
SDEtec8ypipesCooper-24:STPPwr-CHp
SDEtec8ypipesCooper-21:STPPwr-CHp
SDEtec8ypipesCooper-12:STPPwr-CHp
160
150
140
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120
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STPPwr
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EngSpd RPM
02/07/16
SuperFlow WinDyn™ V3.2
16:26:10

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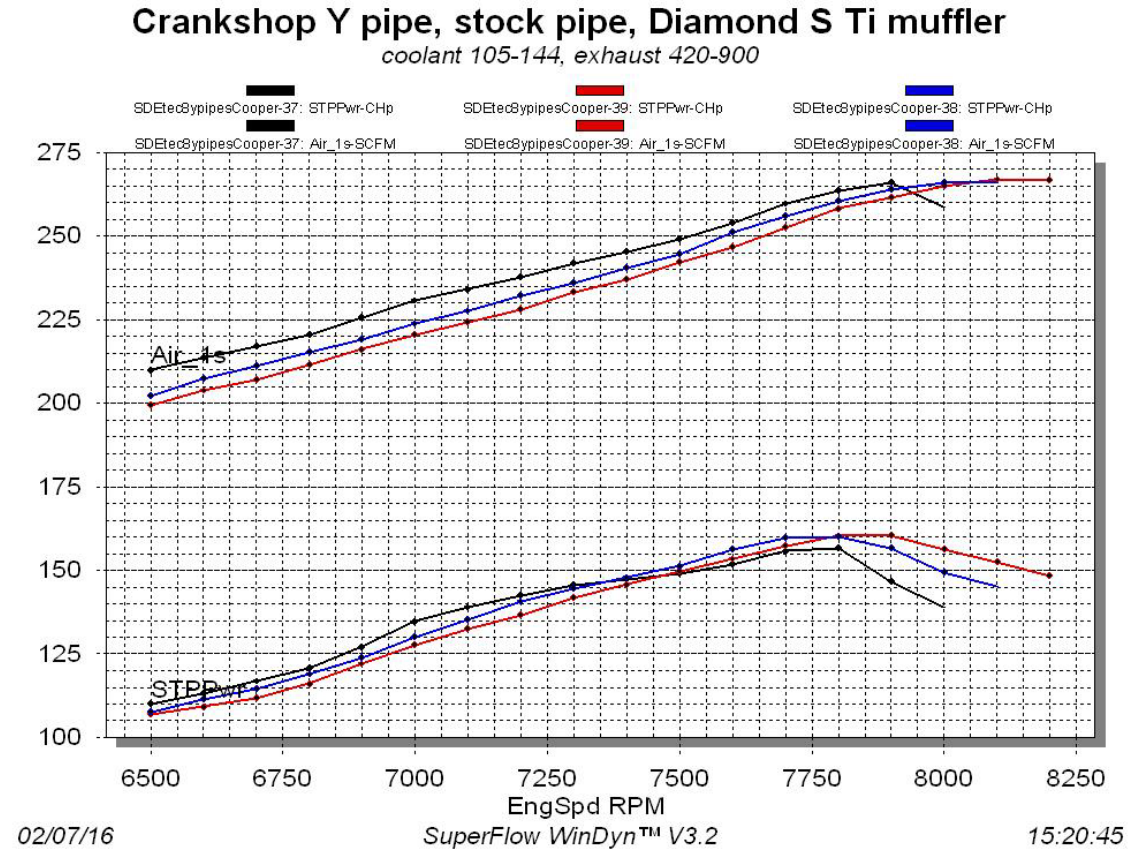
Greedy Chad insisted on reinstalling the Crankshop Y pipe and leaving with it. He also had with him a new Diamond S titanium muffler that he planned to hill drag with. We also had a stainless steel/ carbon fiber tube glasspack from Carbon Sled Parts—a straight through very loud muffler with some restriction/ noise baffling via a large flat washer welded into the exhaust stream. As tests would show, both mufflers had higher airflow/ lower backpressure that resulted in less peak HP with all pipe temperature levels. Both mufflers can likely be tuned to match the stock muffler by experimenting with stinger inserts, etc. Buyers of loud mufflers should always use their clutches/ tachometers as "can dynos". With clutches set "heavy" revving at or just below peak HP RPM with stock muffler, try a different muffler and if revs stay the same or increase, you're in good shape. But if you lose RPM, the muffler is probably either too loose or too tight.



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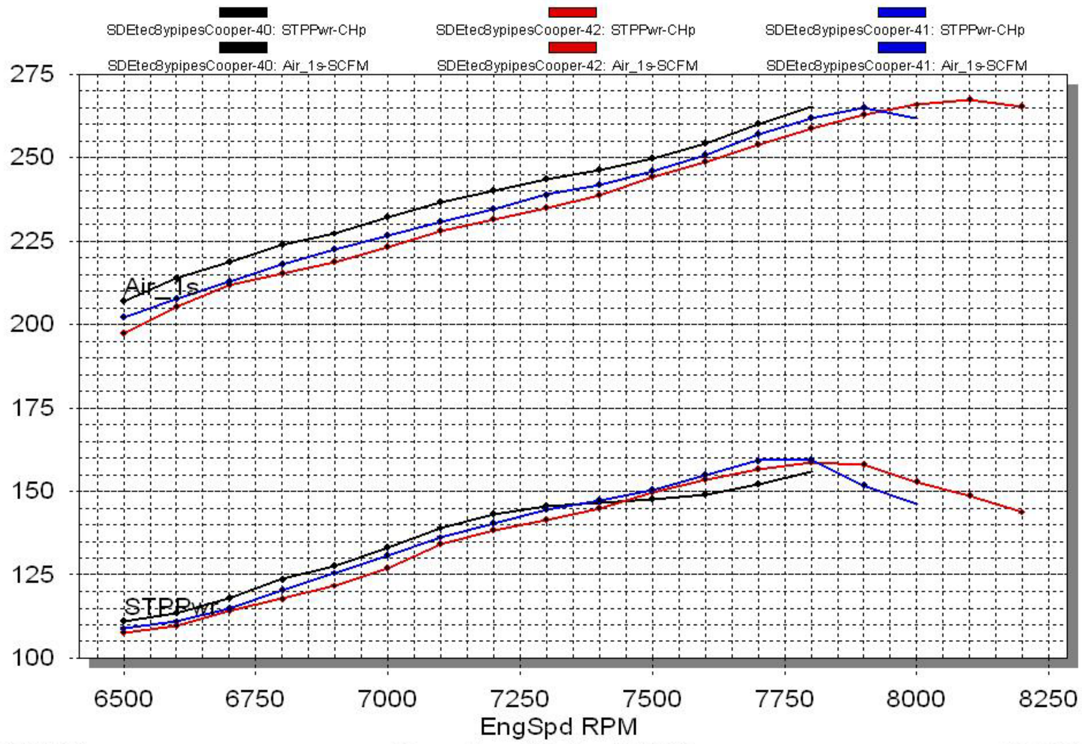
Crankshop Y pipe, stock pipe, Carbonsledparts muffler

coolant begin temp 107 other temps not recorded



02/07/16 *SuperFlow WinDyn™ V3.2* *15:39:09*

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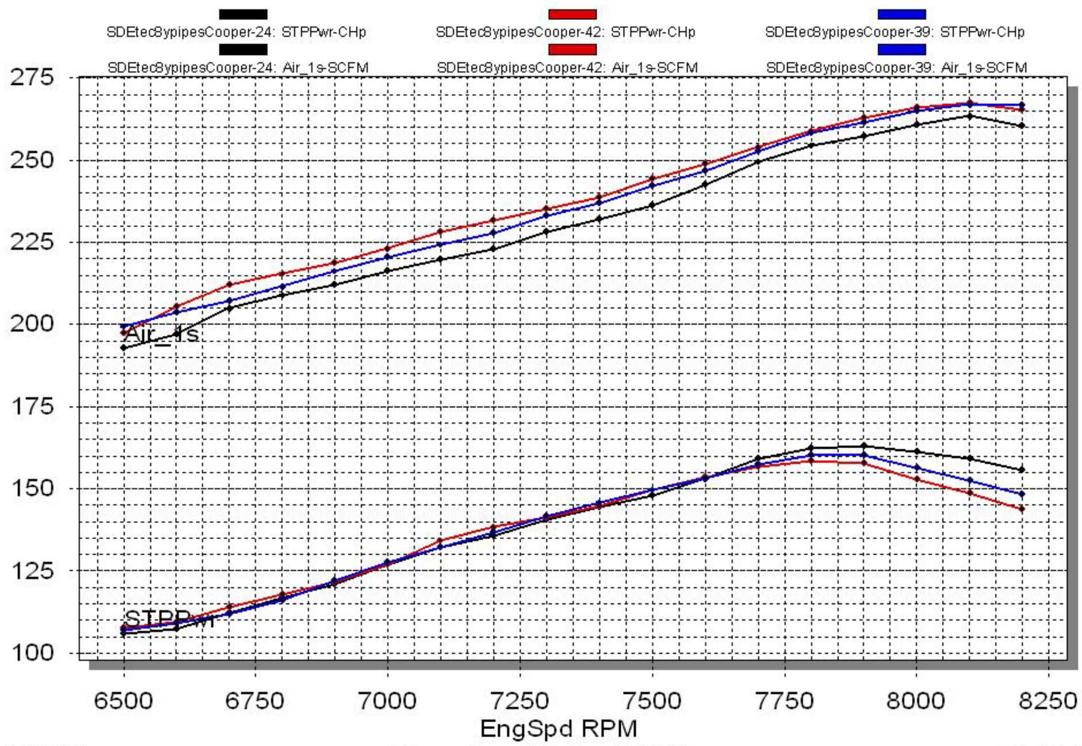
Crankshop Y pipe, stock pipe, and three mufflers--HP and airflow CFM

Black stock muffler, blue Diamond S Ti, red Carbonsledparts



02/07/16 *SuperFlow WinDyn™ V3.2* *16:55:10*

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One final test was to reinstall the stock muffler and have Jim Cooper tweak the timing up to +3. Midrange HP was improved, but peak and overrev HP suffered a bit. So +2 is the best HP timing for this 2015 Etec 800.

Here are Jim Cooper and Chad Giesler madly swinging wrenches. Note the insulated flexible duct feeding intake air from the cold room next door to the SuperFlow airflow meter attached to the stock air intake tube. When doing back-to-back, repeat dyno tests, even with 80mph outside air blowing at the sled, inadvertent EGR (exhaust gas recirculation) can sap HP and skew results. The cold room's replacement air comes from the roof of the building.

And just a reminder—please no cutting and pasting of this data on the internet!