Arctic Cat F1000 Y Pipe/ Single pipe/ muffler comparison

This is Dave Craiglow's stock 07 F1000 tested for nine hours last Sunday with many iterations of aftermarket exhausts for the Big Cat. During the test session we had Tom Pettit, Dan Leitz, Jeff Cary and BMP's Jake Jenkins observing/ providing assistance and/ or moral support. We used what we hoped was 93 octane gas I bought at the car wash around the corner from the dyno.

We began with the stock engine and exhaust, but with POD REMOVED to enable us to provide airflow measurement with the dyno airflow meter attached with Gorilla duct tape to the rectangular opening in the rear. This is equivalent to the HP we get with stockers with side panels removed or replaced with aftermarket filters. In each case we ran two or more tests each repeating within ½%. With the engine connected to our dyno water cooling tower, all tests were begun at identical coolant temp. Dave is fanatical, and looking out for the well being of his engine (no air pockets in cylinder head) he also monitored cylinder head surface temp with his infrared gun. All tests were done with nearly identical head surface along with coolant temp. Also, Dave jockeyed his boondocker settings for things that added airflow to ensure that real A/F ratio remained constant.

Also note that all testing was done with exhaust valves open. Testing with valves closed is not meaningful since in the field valves now open as quickly as throttle is opened. On the dyno valves stay closed during gradual acceleration, until somewhere around 6500 where they whack open with a surge. We began our tests at a speed above that surge line.

F1000 stock w/ pod removed

EngSpd	STPTrq	STPPwr	BSFC A	Fuel A	FuelP	Air1+2	A/F A
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6600	125.4	159.2	0.63	96.2	39.8	234	11.15
6700	125.5	160.1	0.63	97.6	39.8	235	11.05
6800	126.9	164.3	0.64	101.5	39.7	242	10.91
6900	127.6	167.7	0.64	104.2	39.7	248	10.88
7000	127.8	170.3	0.64	105.5	39.7	252	10.92
7100	126.9	171.5	0.64	105.3	39.7	252	10.94
7200	125.3	171.8	0.64	105.4	39.7	252	10.95
7300	123.1	171.1	0.63	104.3	39.7	253	11.10
7400	119.6	168.5	0.63	102.5	39.7	254	11.36
7500	115.2	164.6	0.63	100.3	39.8	255	11.63
7600	108.3	156.8	0.66	99.4	39.8	255	11.75
7700	106.5	154.7	0.66	99.0	39.8	255	11.80

Next Dave removed stock reeds and installed eight petal Vforce3 reed cages, a common modification on F1000s. While the Vforce3 reeds showed minimal improvement over the stock reeds, there may be more benefit with ported/ larger bore engines. After Dave installed the Vforce reeds, our airflow readings were a bit lower. I expect that this is the

result of less than perfect airbox fitment to the throttle bodies and to the large duct to the rear of the sled where the airflow meter is taped during dyno tuning. I doubt that HP picked up if airflow dropped. That happened once, 16 years ago on Tim Bender's then-new F3 Vmax 4 race engine from Yamaha Japan. When we removed the large reed cages and installed larger motocross bike cages we picked up CFM and lost a bit of HP. So next we installed a smaller set of PZ reed cages, lost some airflow and picked up HP. Who knows? But since HP rules the PZ cages were in the terrifying (to the poor devils that had to race them) Vmax4 F3 race sleds until they were wisely banned from the ovals when 600cc became max.

But once Dave had installed the Vforce reeds, the airbox system went unmolested, and I consider the dyno airflow numbers from pipe to pipe to pipe as being consistent.

Stock F1000 with Vforce3 eight petal reeds

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6100	103.8	120.6	0.53	61.1	40.2	187	14.00
6200	103.5	122.2	0.54	63.1	40.2	185	13.41
6300	102.6	123.1	0.54	63.6	40.3	185	13.32
6400	102.7	125.2	0.53	63.6	40.2	185	13.31
6500	103.7	128.3	0.52	64.7	40.1	186	13.18
6600	105.1	132.1	0.52	65.6	40.0	188	13.15
6700	107.3	136.9	0.52	68.5	39.9	191	12.76
6800	112.8	146.0	0.56	78.8	39.8	197	11.45
6900	127.5	167.6	0.64	103.8	39.7	231	10.21
7000	127.2	169.6	0.64	104.8	39.7	237	10.34
7100	126.4	170.9	0.64	106.1	39.7	238	10.28
7200	125.8	172.5	0.64	105.9	39.7	243	10.52
7300	123.2	171.2	0.64	105.1	39.7	242	10.56
7400	120.9	170.4	0.63	103.8	39.8	245	10.80
7500	118.6	169.3	0.61	100.0	39.8	244	11.19
7600	114.6	165.8	0.62	99.0	39.9	247	11.43
7700	108.7	159.4	0.64	98.7	39.9	248	11.52

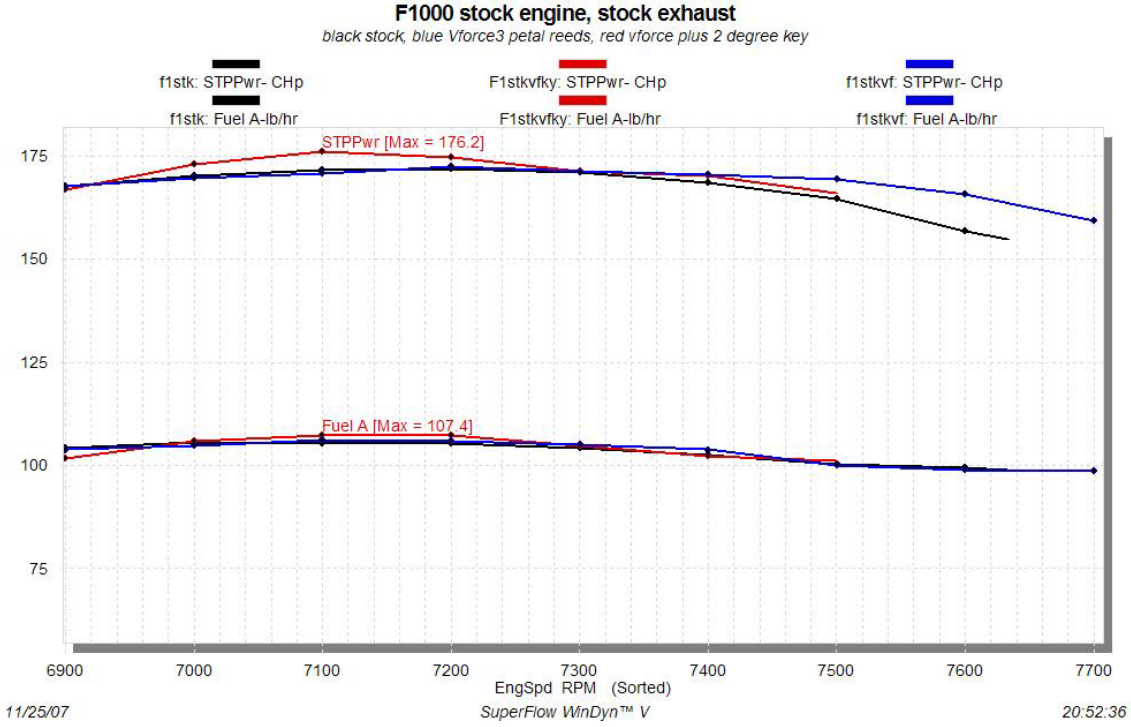
Next and very impressively we installed a $20 two degree advance offset key. This added lots of midrange and topend HP compared to the stock key and lost some overrev HP, typical of adding to base timing. Ideally, a different timing curve would be better—advancing timing in the midrange and at HP peak, then returning to the stock curve past HP peak to maintain better overrev power. But no one but AC can do that, so keys are for now the best compromise. Note that even with the reeds and key, BSFC is still in a reasonable range even with the added HP with the stock exhaust system.

F1000, VF3 reeds, 2 degree key

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6600	128.3	161.2	0.61	95.2	39.9	222	10.69

6700	129.8	165.6	0.62	99.3	39.9	229	10.56
6800	129.1	167.1	0.63	101.8	39.9	231	10.41
6900	127.1	167.0	0.63	101.8	40.0	233	10.50
7000	129.9	173.1	0.63	105.9	39.8	237	10.23
7100	130.3	176.2	0.63	107.4	39.8	242	10.30
7200	127.4	174.6	0.64	107.4	39.8	245	10.45
7300	123.3	171.4	0.63	104.7	39.8	248	10.85
7400	120.8	170.2	0.62	102.3	40.0	251	11.24
7500	116.3	166.0	0.63	101.2	40.0	253	11.46

Graph F1000 stock, Vforce3 8 petal reeds, 2 degree key



Now comes a comparison of three aftermarket Ypipes vs the awful stock Ypipe. We can only surmise that the restrictive stock Ypipe was the result of either inept AC engineers (impossible), trying to comply with required sound levels (probable), limiting exhaust emissions (probable), or HP level requested by AC marketing people (unlikely). But whatever the case the purveyors of F1000 good Ypipes who now drive Lamborghinis to work are grateful. Just kidding there; these guys work very hard to create good things for consumers. The F1000/ F8 Ypipe windfall might make up for some of the extensive R&D and production cost of more minimal horsepower upgrades for power-hungry consumers.

Here is the same VF3 and keyed engine tested now with higher flowing Ypipes. Due to some miscommunication and time constraints, a D&D F1200 Y pipe sent to us was not tested on Dave's engine. Visibly longer, it would have lowered RPMs a bit and possibly increased airflow even more. But as is the D&D F1000 Ypipe is an excellent power adder especially with the fuel-restricted stock ECU.

F1000 D&D Ypipe stock pipe and muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6400	127.8	155.7	0.59	89.3	40.0	220	11.26
6500	128.7	159.3	0.59	91.6	39.9	224	11.18
6600	131.7	165.5	0.59	94.7	40.0	230	11.13
6700	133.2	169.9	0.60	99.1	39.9	235	10.88
6800	132.5	171.5	0.61	101.8	39.9	242	10.89
6900	129.6	170.3	0.61	99.6	39.9	242	11.13
7000	131.4	175.1	0.59	100.2	39.7	243	11.11
7100	135.6	183.3	0.60	106.9	39.7	253	10.82
7200	135.9	186.4	0.59	105.3	39.7	264	11.47
7300	132.9	184.7	0.59	105.2	39.7	262	11.41
7400	128.7	181.4	0.59	102.4	39.8	260	11.64

F1000 Bikeman Ypipe stock pipe and muffler

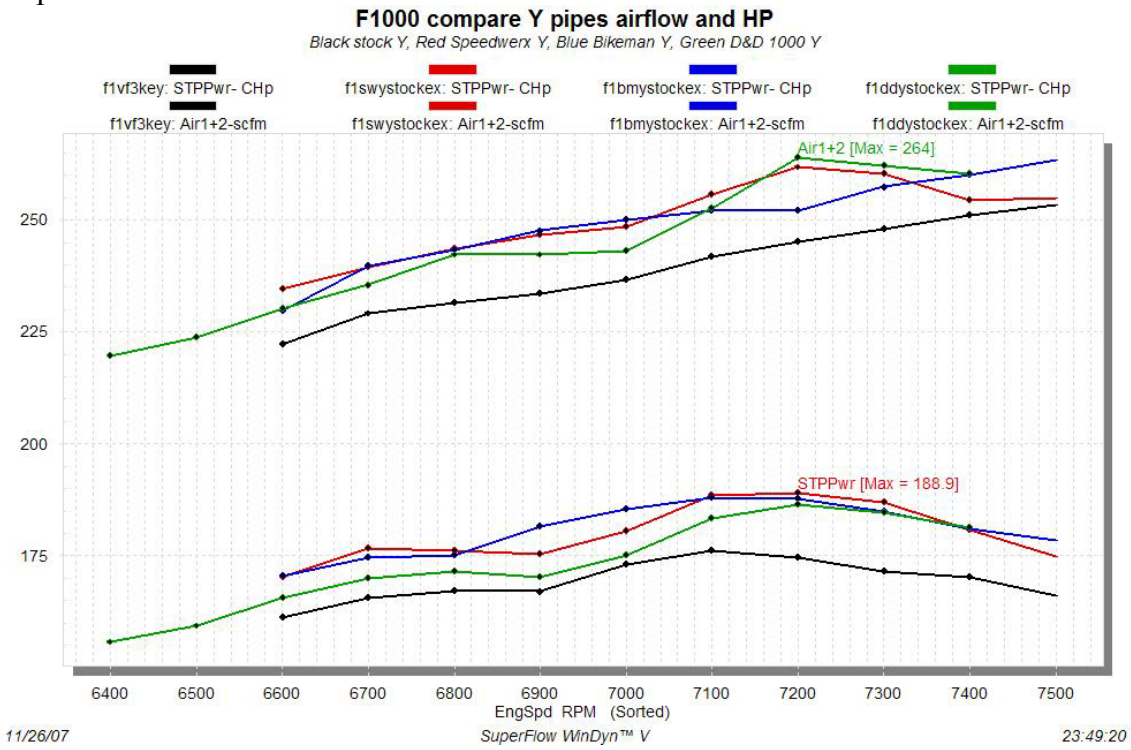
EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6600	135.6	170.4	0.59	96.4	40.0	230	10.90
6700	136.9	174.6	0.59	99.5	39.9	240	11.03
6800	135.3	175.2	0.59	100.2	40.0	243	11.12
6900	138.2	181.6	0.60	104.9	40.0	248	10.81
7000	139.0	185.3	0.59	106.1	39.9	250	10.79
7100	139.1	188.0	0.59	106.9	39.8	252	10.80
7200	136.9	187.7	0.59	105.8	39.9	252	10.91
7300	133.0	184.8	0.59	104.8	40.0	257	11.24
7400	128.5	181.1	0.60	104.1	40.1	260	11.44
7500	124.9	178.4	0.59	101.0	40.0	263	11.94

F1000 Speedwerx Ypipe Stock pipe and muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6600	135.5	170.2	0.57	94.7	40.0	235	11.35
6700	138.5	176.6	0.58	99.0	40.0	239	11.07
6800	136.1	176.2	0.61	103.6	40.0	244	10.76
6900	133.5	175.4	0.61	102.9	40.0	247	10.98
7000	135.5	180.6	0.60	104.2	39.9	248	10.92
7100	139.4	188.5	0.59	107.8	39.9	256	10.86

7200	137.8	188.9	0.58	105.7	39.9	262	11.34
7300	134.5	187.0	0.59	105.7	40.0	260	11.28
7400	128.2	180.7	0.60	104.4	39.9	254	11.16
7500	122.5	174.9	0.60	101.3	40.0	255	11.52

Graph F1YPIPES



Next we left the stock muffler in place and tested each Ypipe with its' corresponding manufacturers' replacement single pipe. All tests were done at 100 rpm/ second. Note differences in airflow CFM with stock muffler. All combinations tested within a HP of one another. Airflow CFM was lowest with the BMP stock pipe mod, highest with the BMP single pipe, and the D&D and Speedwerx singles were in the middle. Generally we expect that good HP with high airflow CFM is good in that it ensures that the active radicals (there is good info on those nasty things in the DTR archives by Kevin Cameron) that contribute to detonation are purged out of the combustion chamber instead of being packed back in by the returning wave. Though these test results are probably typical of a half mile lake blast; longer runs might = higher pipe center section temp = lower CFM from the hot gases expanding in the pipe acting like a tighter outlet = more active radicals trapped in the combustion chamber to rob HP and possibly promote detonation. But for most riders the CFM from all these pipes is probably fine. Only those that desire to run for miles on the lakes or that infamous road called "piston alley" where sleds are run at max speed until the gas tanks are empty should be very concerned about max pipe airflow.

F1000 BMP Ypipe, BMP stock pipe mod, stock muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio
6600	133.7	168.1	0.59	95.5	237	11.35
6700	133.8	170.6	0.60	98.4	238	11.08
6800	133.8	173.3	0.62	102.8	241	10.74
6900	134.5	176.7	0.61	104.2	238	10.46
7000	135.7	180.9	0.61	105.8	241	10.42
7100	135.9	183.7	0.61	108.8	245	10.32
7200	136.4	187.0	0.60	107.7	255	10.84
7300	135.6	188.4	0.59	108.0	267	11.32
7400	134.9	190.1	0.59	107.7	267	11.37
7500	134.0	191.4	0.58	106.7	263	11.31
7600	132.4	191.7	0.57	105.1	269	11.72

F1000 BMP Ypipe, BMP single pipe, stock muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio
6500	131.3	162.5	0.61	95.7	231	11.06
6600	130.7	164.3	0.61	96.1	231	11.00
6700	131.6	167.9	0.62	100.1	235	10.76
6800	133.9	173.4	0.62	104.2	236	10.39
6900	133.8	175.8	0.62	105.0	235	10.26
7000	135.6	180.7	0.61	106.5	237	10.18
7100	137.1	185.4	0.60	106.8	250	10.74
7200	138.1	189.3	0.59	107.1	258	11.05
7300	138.6	192.6	0.57	105.3	265	11.51
7400	138.2	194.7	0.57	106.0	264	11.42
7500	137.1	195.7	0.55	104.4	267	11.72
7600	135.2	195.7	0.55	103.9	263	11.61
7700	129.3	189.6	0.58	105.1	264	11.51

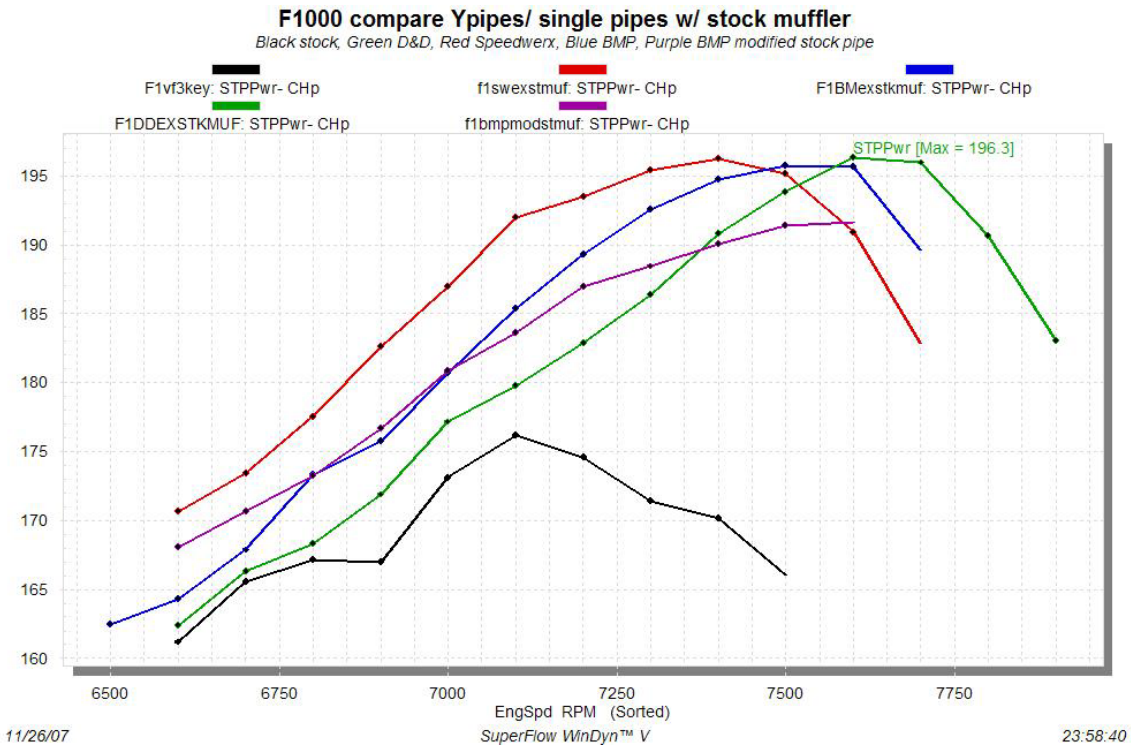
F1000 D&D 1000 Ypipe, D&D single pipe, stock muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6600	129.2	162.4	0.60	93.1	40.1	230	11.31
6700	130.3	166.3	0.60	96.3	40.1	229	10.90
6800	130.0	168.3	0.60	97.8	40.0	236	11.05
6900	130.8	171.9	0.61	101.2	40.0	249	11.25
7000	132.9	177.1	0.61	104.6	40.0	254	11.13
7100	133.0	179.8	0.62	107.5	40.0	257	10.95
7200	133.4	182.9	0.61	107.2	40.0	257	11.01

7300	134.1	186.4	0.59	105.2	40.0	253	11.00
7400	135.4	190.8	0.57	104.3	40.0	255	11.20
7500	135.8	193.9	0.55	103.2	40.0	259	11.48
7600	135.7	196.3	0.55	104.0	40.0	255	11.22
7700	133.7	196.0	0.55	104.0	40.0	253	11.14
7800	128.4	190.6	0.59	107.6	39.9	262	11.15
7900	121.7	183.0	0.61	107.4	39.9	254	10.83

F1000 Speedwerx Y pipe, Speedwerx single pipe, stock muffler

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio
6600	135.8	170.7	0.56	91.9	242	12.04
6700	135.9	173.4	0.57	94.3	246	11.96
6800	137.1	177.6	0.59	100.0	251	11.47
6900	139.0	182.6	0.59	104.0	257	11.31
7000	140.3	187.0	0.59	106.4	262	11.29
7100	142.0	192.0	0.58	107.1	265	11.33
7200	141.1	193.5	0.57	106.8	265	11.35
7300	140.6	195.5	0.56	105.0	261	11.40
7400	139.3	196.2	0.56	104.4	259	11.35
7500	136.6	195.1	0.56	104.5	256	11.20
7600	131.9	190.9	0.56	102.3	256	11.46
7700	124.7	182.8	0.59	104.0	258	11.36



Finally we tested each manufacturer's Y pipe and single pipe with each manufacturer's lightweight "can" exhaust. Though some cans are quieter than others it's still appropriate to call them "cans" because all are louder than stock. As the following data shows on the F1000, the stock muffler provides quiet operation with backpressure that's optimal for this engine. Loud cans that blindly increase airflow decrease backpressure and usually decrease HP and piss off influential landowners along trails and lakeshores. Cans can be made tighter to match stock backpressure and save some weight with a bit more noise. We tested D&D's standard can that increased airflow and lost some HP compared to stock muffler, but saves weight, maybe better for long multi-mile blasts. Then we tested a D&D high altitude can with adjustable outlet restrictor. At max restriction setting, this can matched the airflow and HP of the stock muffler, but was tighter below and above the peak HP RPM whatever that means. The Bikeman can about matched the airflow of the stock muffler and matched the HP at peak, and airflow and HP in the midrange was even higher than stock probably due to leaner mixture there?
The Speedwerx can was tighter than stock and lost airflow and HP compared to the stock muffler when fitted to the Speedwerx Ypipe and Speedwerx single pipe.

F1000 D&D Ypipe, D&D single pipe, D&D can

EngSpd RPM	STPTrq Clb-ft	STPPwr CHp	BSFA-B lb/hph	FulA-B lb/hr	FuelP psig	Air1+2 Scfm	A/FA-B Ratio
6600	120.6	151.5	0.61	88.8	40.2	229	11.79
6700	122.3	156.0	0.60	89.7	40.2	230	11.75
6800	128.3	166.1	0.61	96.8	40.1	237	11.23
6900	130.9	172.0	0.61	101.3	40.0	243	10.97
7000	131.1	174.7	0.63	105.4	40.0	246	10.70
7100	131.2	177.4	0.63	107.2	40.0	255	10.89

7200	132.4	181.5	0.61	105.6	40.0	262	11.37
7300	131.9	183.3	0.60	106.0	40.0	263	11.38
7400	132.9	187.3	0.59	106.2	40.0	267	11.53
7500	132.1	188.6	0.59	106.1	40.0	268	11.57
7600	130.8	189.3	0.59	107.0	40.0	274	11.71
7700	128.1	187.9	0.59	107.5	40.0	273	11.62

F1000 D&D 1000 Ypipe, D&D single pipe, D&D adjustable can, max restriction

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	FuelP	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	psig	scfm	Ratio
6700	128.0	163.2	0.60	95.1	40.2	217	10.44
6800	128.2	165.9	0.61	97.7	40.0	220	10.31
6900	130.0	170.8	0.61	100.4	40.0	225	10.25
7000	130.5	173.9	0.63	105.4	40.0	233	10.10
7100	130.6	176.5	0.63	107.5	39.9	240	10.22
7200	131.4	180.2	0.62	107.3	40.0	246	10.49
7300	132.1	183.7	0.60	105.5	39.9	252	10.95
7400	133.6	188.2	0.58	104.9	40.0	257	11.21
7500	134.4	191.9	0.56	104.0	40.0	254	11.19
7600	135.9	196.7	0.54	103.3	40.0	248	11.00
7700	134.1	196.6	0.55	104.9	40.0	245	10.71
7800	130.3	193.6	0.57	107.1	39.9	250	10.68
7900	126.2	189.8	0.59	107.9	40.0	258	10.95

F1000 BMP Ypipe, BMP single pipe, BMP can

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio
6700	134.9	172.1	0.58	95.9	241	11.49
6800	137.6	178.1	0.59	101.6	242	10.90
6900	137.6	180.8	0.60	104.3	246	10.80
7000	140.0	186.6	0.60	107.2	249	10.65
7100	140.8	190.3	0.60	109.1	253	10.60
7200	139.6	191.4	0.59	109.3	255	10.68
7300	138.8	192.9	0.59	109.0	258	10.85
7400	138.4	195.0	0.58	108.5	264	11.13
7500	137.1	195.8	0.56	106.5	266	11.43
7600	134.7	194.9	0.56	105.2	269	11.69
7700	127.1	186.3	0.60	107.8	272	11.54

F1000 Speedwerx Ypipe, Speedwerx single pipe, Speedwerx can

EngSpd	STPTrq	STPPwr	BSFA-B	FulA-B	Air1+2	A/FA-B
RPM	Clb-ft	CHp	lb/hph	lb/hr	scfm	Ratio
6600	135.6	170.5	0.56	92.1	241	11.97

6700	136.0	173.4	0.57	95.8	245	11.69
6800	137.2	177.6	0.60	102.4	247	11.02
6900	138.5	181.9	0.60	104.2	249	10.94
7000	141.1	188.1	0.59	107.2	249	10.65
7100	140.9	190.5	0.59	108.5	249	10.52
7200	141.7	194.3	0.58	108.1	255	10.82
7300	139.9	194.5	0.58	108.1	262	11.09
7400	137.5	193.7	0.58	107.3	261	11.15
7500	134.4	191.9	0.58	106.4	262	11.26
7600	127.9	185.0	0.59	105.3	263	11.43

EPILOGUE:

During this testing Boondocker settings were tweaked constantly to create similar A/F ratio, and the low BSFC indicates max HP on Batavia 93 octane purchased next door. But all was equal. Those who run bar gas for miles at WOT can't run these good HP Boondocker settings. But if you ride like that you probably aren't looking at this. As they say, your results may vary.

The three single pipes/ Ypipe combos all created virtually identical HP. And HP curves are nearly identical as well. Some might think that the lower revving pipes that make more torque are better for trail riding. Others might think that the D&D pipe with its' higher peak HP RPM will be faster on the lake with fixed DD gear ratio. But since most of us know that torque does nothing, only HP does work, it's the HP curve not the torque curve that should be most important in assessing performance potential. Now I don't pretend to be a clutch person but I understand fairly well the physics of engine power. If a sled was set at fixed 3000 rpm engagement for all three aftermarket pipes, the Speedwerx pipe combo might be quickest from a dead stop since the midrange HP arrives at lowest RPM. But since the D&D single combo creates peak HP a couple of hundred revs higher than the Speedwerx setup, having a clutch engagement at, say, 3300 RPM would equal things out. But according to Dan at D&D those who desire that low RPM grunt with lowest clutch engagement would obtain that with the use of their longer F1200 Ypipe. But top speed may suffer with fixed final drive ratio. Your pick.

This dyno assessment of the cans was typical—if a canmaker can match the stock muffler HP he's done a great job. For some, especially mountain riders, light weight is surely a benefit even if it costs a couple of HP. Calling cans "ear bleeders" or "shreikers" is surely good for sales but testing done here on this F1000 model is typical. In the past I've seen a few cans that added just a few HP to some models like early SkiDoo twins, but as the OEMs are forced to create less sound, the OEM sound wave savvy engineers have generally found ways to create max HP quietly, and those highly engineered suitcase-size mufflers' performance can be hard to improve upon. I don't need to get involved in the politics of being neighbor friendly—I ran annoyingly loud piped sleds for years before I had a dyno to tell me that "loud" can fool you into thinking you're going fast, just like I used to be fooled when I removed the air cleaner on my dad's 273 Plymouth when I was 16, to impress my five high school pals riding with me.