Arctic Cat ZR8000 muffler comparison

Darren Kaczor and his brother Jim brought Darren's brand new ZR8000 to DTR for a muffler comparison. Cat tech guru Trevor Chadwick came along to monitor the Arctic Cat diagnostic computer, which would show us coolant temp and reaction to even light clicks of detonation. Dead 1 Dave Craiglow helped out as well.

Back in 2010 we did a two-session single pipe shootout on the Cat Crossfire/ M 800. Since then Jaws designed has been selling single pipe/ Y pipe combos, and a HardcoreSledder/ DTR member shipped us a Jaws full set to test. The Jaws pipe set includes an oversize plastic airbox adaptor that Jaws owner Greg Balchin says is necessary to optimize the tuning of his exhaust. We didn't receive the Jaws airbox adaptor with the pipe set, so Greg kindly drove 4.5 hours from Canada to bring us one for the Sunday test session. Like most of the big eastern performance shops did, Greg used to frequent my dyno facility in the late 1980s and early 1990s when he was getting into business building pipes and engines. And like the other shops he realized he needed his own dyno for development and built his own state-of-the-art facility, so it was good have him visit DTR after 20 years.

Darren also had a D&D Riot kit to install on his sled after the muffler comparison and Jaws pipe test—a tighter squish, but lower compression head, Y pipe, timing key and muffler that should bring the HP up by around 10. Why lower compression? The stock head is a stout 13/1 and D&D has seen light deto in the field that silently pulls timing and reduces HP. We've seen that on the dyno, where light clicks barely audible on the copper tube result in timing pulled by the ECU as observed on the Arctic Cat diagnostic computer. Lower compression with advanced timing can sometimes create even better HP than high compression and retarded timing. Sean Ray has tuned lots of early Polaris 800 twins here and made more HP with remachined stock heads with tighter squish and less compression, and stators cranked to the stops. And, Sean did the same for the early Dragon 800 engine—tighter squish and less compression = more HP, but that engine didn't like advanced timing with Sean's head. Remember that tighter squish clearance can create higher velocity and turbulence which can cause the flame front to move more quickly causing peak combustion chamber pressure to occur earlier. Plus, whatever air/fuel mixture is packed into an oversize squish area will burn way too late to add to combustion pressure. Whew! So perhaps the D&D Riot LCR head creates more power than a stock head because of that. The advantage is in causing the A/F mixture to burn optimally in less time. Detonation is time-dependant!

On to the muffler test. There are several factors that sled owners consider when selecting a muffler to replace the OEM unit in differing order depending on where/ how they ride: weight, HP output compared to stock, sound levels in decibels (dB), airflow capacity and backpressure (related), appearance, workmanship and cost. For most of us who don't quite understand dB readings we have an excellent explanation by DTR member Don Elzinga back in the archives—Volume 6 #2 page 10 (scroll down the list of

articles to find it). Our sound measurement followed the new NY law setting dB limits for snowmobiles at 4000rpm (fast idle) and WOT at peak operating RPM. So we set our dB meter on the top of the dyno console and observed readings behind the shatterproof glass at those conditions, which gave us relative readings for comparison.

Backpressure and airflow Cubic Ft/ Min (CFM) is critical in selecting a muffler that is best suited to your typical riding conditions. Remember, the test data shown here is based on two back-to-back 10 second WOT acceleration tests. Flatlanders who run the trails and lakes WOT for ¼ mile at a time might expect airflow and backpressure as shown. The madmen that like to run WOT for many miles at a time can expect the backpressure to rise and CFM to drop due to the temperature of the metal in the pipe and muffler and the gases inside continuing to climb. There's a great article on the effects of climbing pipe temperature by running for very long periods of time at WOT in the archives—Volume 5 #4 pages 13-16 "Hot Pipes and Cold Facts" by Kevin Cameron (there are over 30 excellent KC tech articles in those scanned copies back there). The other variable is altitude. Since mountain riders typically suffer with thin, low HP producing air the actual CFM their engines pump is low creating lower effective backpressure even with pipes smoking as they run WOT for minutes at a time either burrowing under windshield-high powder with snow obstructing the muffler outles, or climbing those terrifying vertical snow covered walls. So even the "tightest" mufflers tested here at 700' altitude for 20 seconds at WOT might be fine at 10,000 ft for minutes at WOT. A pressure gauge tapped into the pipe's center section might be a good thing to monitor to be sure. Ted from Terra Alps Racing does that, and is able to fine-tune his mufflers that way.

So our average pipe pressure measures at 2.5-3.5 psi. But we know that there are violent swings from high pressure to negative pressure in this ZR8000 pipe—16,000 times per minute. Greg Balchin suggested peak pressure might be as high as 30 psi, and negative pressure as low as –7psi! But I asked Kevin Cameron that same question:

Email to Kevin Cameron:
I'm working on a muffler test on a new Arctic Cat 800 twin, comparing stock to a variety of aftermarket mufflers (dB, backpressure, airflow, HP). I'm using a dyno pressure transducer connected by a 8' hose to the center section of the single pipe. If we're seeing a constant 3-3.5psi at 8000rpm can we estimate what the actual pressure peaks and valleys might be? Probably higher at the ex port than in the center section, but I'm trying to make sense of it. Regards, Jim

KC's reply:
In round figures, the full throttle cylinder pressure at the beginning of blowdown is 100 psi. Because it takes 1/10 of a revolution for the cylinder pressure to fall (from exhaust opens to transfers open) there is some throttling, and the rest of the pressure drop is the rapid expansion of what's in the cylinder. Even after expansion by several cylinder volumes (bringing the gas into the center section, surely) the pressure is still considerable (we know, for example, that if we make a rectangular-section pipe, the exhaust waves will quickly break it - as they did Yamaha's flat pipes on the 1974 TZ750A). I think a fairly high pressure enters the center section like 30 psi? But that is rapidly expanded further, some is reflected back to the cylinder, and some squeezes out the tailpipe in a "screen-door-closer-like" energy loss process.

Values I've seen on graphs for the low pressure reflected back to the port are like 7 psi negative, so your 3 psi average positive would be reasonable as the result.
KC

So with this crazy sine pressure wave thing going on, it may explain why with some mufflers pressure is higher at lower RPM than at the HP peak RPM. Other mufflers have different pressure curves from low revs to high. And then, for example if we look at the Jaws trail muffler it has lower peak pressure than stock yet makes a bit more HP than stock. So could that muffler be creating a different shape sine wave that has a high peak at just the right time, but lower average? And since Jaws deals with the mad Canadian lake runners who need to survive for 20km at WOT with cherry red pipes on 85 octane gas, low backpressure is a must. There are excellent articles by KC in the V1-7 archives relating to detonation and the active radicals that cause it. High backpressure keeps those nasty nitroglycerin-like gases trapped in the combustion chamber as the exhaust port closes. Lower that backpressure and let those AR's escape!

As this test would prove to me, these particular aftermarket manufacturers are doing their homework to ensure reasonably HP levels compared to stock. Years ago when there were no dyno's and no internet, anyone with a welder and chop saw could make and sell loud mufflers that often lost lots of HP. I try to keep stock mufflers for some models in case a dyno customer arrives with a poorly designed can. As I recall worst can ever was 10hp less than stock.

On this day, in the mad thrash we (I) forgot to test the SLP and BMP mufflers on the shelf. Somewehere in the mail are new MBRP and Speedwerx mufflers that should be here any time. Plus we had slightly less than expected results with the D&D Riot kit that was rectified by D&D the following day. So our plan is to do the rest of the mufflers and then put the Riot kit on brother Jim Kaczor's virgin ZR8000 probably after the AmSnow Shootout (where D&D is entering their own Riot kitted ZR8000 in Trail Mod).

I tested Darren's pump gas and it was 92.1 octane with 5% ethanol. Greg Balchin had some Canadian Tire 94 octane "ethanol-free" gas with him that actually registered 93.6 octane but showed 6.5% ethanol on the Zeltex meter. We double-checked the ethanol with the B&S water shaker and it indicated 7%. You buy your gas, and you hope for the best.

Test Data

We warmed up the engine with the hood on and made two dyno runs. Then we lifted the hood in the front, opening up the airbox so we could fit it with the dyno airflow meter. HP was exactly the same, so that hood-mounted air intake system appears non-restrictive. But it probably not as good as the seemingly-magical front airboxes on the Crossfire 800 and the F7. With the stock plastic air inlet horn those were typically 2%

higher CFM and HP at peak than if the stock inlet was replaced with a larger aftermarket billet inlet—even on big bore versions (midrange CFM and HP, though, is typically 2% higher with the bigger inlet). Is it the size and shape of the inlet venturi, or the Vshape front of the box, or a combo of both? That might explain three of the HP seemingly missing from the later ProCross and ZR models compared to the 2010 Crossfire 800. The rest would probably be in the less restrictive mufflers, and maybe a degree or two of timing.

The following test data was achieved with Trevor closely monitoring coolant temperature so that we could make two or more tests on each component—one ending at @115 degrees F and one at @125 degrees F. We tried to make sure that each test was made with pipe center section temp at 1000F where the ECU seems happiest.

ZR8000 Stock Muffler-20 lb 6 oz, 4000 70 dB, WOT 82 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	111.8	89.0	0.600	64.6	13.57	191.3	1.3	919
6700	112.9	88.5	0.604	65.7	13.66	196.2	1.5	930
6800	114.9	88.8	0.612	67.8	13.65	202.1	1.7	938
6900	118.8	90.4	0.622	71.1	13.56	210.8	1.8	948
7000	122.3	91.8	0.624	73.6	13.44	215.9	1.9	956
7100	125.2	92.6	0.632	76.3	13.26	221.0	2.0	961
7200	127.9	93.3	0.648	79.8	13.00	226.6	2.1	965
7300	131.3	94.5	0.660	83.5	12.72	232.1	2.2	970
7400	137.6	97.7	0.670	88.8	12.33	239.2	2.6	980
7500	144.1	100.9	0.664	92.2	12.09	243.4	2.8	991
7600	149.1	103.0	0.657	94.4	11.93	246.1	2.9	1002
7700	152.7	104.2	0.653	96.1	11.80	247.8	2.7	1013
7800	154.7	104.2	0.651	96.9	11.72	248.3	2.5	1022
7900	155.2	103.2	0.652	97.4	11.66	248.2	2.5	1027
8000	152.5	100.1	0.669	98.2	11.53	247.4	2.3	1026
8100	140.2	90.9	0.737	99.4	11.18	242.7	2.2	1007
8200	123.1	78.8	0.814	96.4	10.65	224.2	2.0	984

Next to approximate the backpressure of the powerful 2010 Crossfire 800 muffler we dropped in a 2.5" long piece of 1.75" exhaust tubing, flared at one end to seal it against the muffler inlet flange and to keep it from falling into the muffler. Then the stock pipe outlet donut seals against the flare. Keep in mind the Arctic Cat factory didn't reduce backpressure for no reason—this was very likely for minimizing detonation in severe conditions.

Install restrictor in the stock muffler

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FuelA lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	113.7	90.5	0.591	64.7	13.26	187.5	2.0	891

6700	115.2	90.3	0.600	66.5	13.20	191.8	2.2	900
6800	118.2	91.3	0.618	70.3	13.05	200.4	2.2	914
6900	122.0	92.9	0.618	72.6	12.99	205.9	2.3	924
7000	125.6	94.3	0.619	74.8	12.94	211.5	2.4	933
7100	128.8	95.3	0.626	77.7	12.85	218.0	2.5	941
7200	131.6	96.0	0.637	80.7	12.63	222.6	2.6	946
7300	135.1	97.2	0.650	84.5	12.34	227.8	2.8	952
7400	141.2	100.2	0.659	89.5	11.97	234.1	2.9	961
7500	147.4	103.2	0.651	92.4	11.79	238.0	2.8	970
7600	151.8	104.9	0.644	94.1	11.69	240.4	2.8	979
7700	155.2	105.8	0.640	95.6	11.60	242.3	3.1	988
7800	157.7	106.2	0.636	96.6	11.53	243.3	3.1	997
7900	159.3	105.9	0.635	97.4	11.46	243.8	3.1	1006
8000	159.4	104.7	0.639	98.1	11.38	243.8	3.2	1013
8100	156.5	101.5	0.652	98.2	11.32	243.0	3.1	1012
8200	147.3	94.3	0.690	97.7	11.28	240.5	2.8	999
8300	133.1	84.2	0.751	96.1	11.28	236.7	2.7	986

We installed the SanDale muffler—created out of a properly sized MIG welded stainless steel MagnaFlow muffler and TIG welded stainless brackets and inlet and outlet pipes.

SANDALE muffler- 6 lb 10 oz, 4000rpm 70 dB, WOT 89 dB

EngSpd	STPPwr	STPTrq	BSFCAB	FulAB	AFRAB	Air_1s	ExhPrs	Exh_2
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	SCFM	psig	deg F
6600	111.8	89.0	0.592	63.6	13.82	192.0	1.5	888
6700	112.9	88.5	0.600	65.2	13.82	196.8	1.6	900
6800	115.1	88.9	0.613	67.9	13.72	203.5	1.8	912
6900	119.1	90.6	0.619	70.9	13.61	210.9	1.9	923
7000	122.9	92.2	0.619	73.1	13.53	216.2	1.9	931
7100	125.7	93.0	0.630	76.1	13.33	221.7	2.0	937
7200	128.2	93.5	0.638	78.7	13.13	225.8	2.1	941
7300	132.0	95.0	0.651	82.7	12.84	232.0	2.3	948
7400	139.2	98.8	0.657	88.0	12.45	239.2	2.4	960
7500	145.9	102.2	0.651	91.4	12.18	243.3	2.3	970
7600	150.9	104.3	0.646	93.8	12.01	246.2	2.3	981
7700	154.2	105.2	0.642	95.2	11.92	247.8	2.5	991
7800	155.9	105.0	0.640	96.1	11.84	248.4	2.6	1000
7900	156.3	103.9	0.642	96.5	11.78	248.2	2.6	1006
8000	153.9	101.0	0.654	96.8	11.69	247.2	2.5	1007
8100	139.2	90.3	0.729	97.5	11.33	241.3	2.3	985

This is the incredibly light and surprisingly quiet at WOT Diamond S titanium muffler. The Diamond S manufacturer primarily makes titanium high $ bicycles and since he's a mountain snowmobile guy here's his muffler with beautiful welds (difficult on titanium).

DIAMOND S, 2 lb 10 oz (!), 4000 73 dB, WOT 86 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	112.8	89.8	0.593	64.5	13.41	189.0	1.6	884
6700	114.0	89.3	0.602	66.1	13.47	194.5	1.8	896
6800	116.2	89.8	0.611	68.5	13.41	200.6	2.0	904
6900	120.6	91.8	0.618	71.9	13.28	208.6	2.2	915
7000	124.6	93.5	0.616	74.0	13.17	213.0	2.3	922
7100	128.3	94.9	0.621	76.8	12.98	218.0	2.3	929
7200	131.6	96.0	0.633	80.4	12.71	223.3	2.5	934
7300	135.5	97.5	0.645	84.3	12.45	229.2	2.6	940
7400	140.7	99.9	0.650	88.2	12.23	235.6	2.7	949
7500	146.5	102.6	0.643	90.9	12.10	240.4	2.5	958
7600	151.4	104.6	0.641	93.6	11.93	243.9	2.5	968
7700	155.1	105.8	0.640	95.8	11.77	246.2	2.8	978
7800	158.3	106.6	0.635	96.9	11.70	247.6	3.0	990
7900	160.4	106.6	0.630	97.4	11.66	248.0	3.0	999
8000	160.8	105.6	0.633	98.2	11.57	248.1	3.0	1007
8100	156.6	101.6	0.657	99.1	11.39	246.5	2.9	1005

Here's the Canadian manufactured MPX muffler—a combo of mild steel and light aluminum housing that's riveted together. This one came with a variety of outlet restrictor washers, maybe necessary for high altitude running. But zero washers seemed optimal for 700 ft altitude:

MPX, 4 lb 15 oz, 4000 72 dB, WOT 88

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	113.3	90.1	0.595	65.0	13.58	192.9	1.8	902
6700	114.4	89.7	0.600	66.2	13.71	198.2	1.9	912
6800	116.8	90.2	0.613	69.0	13.68	206.3	1.8	923
6900	120.3	91.6	0.616	71.4	13.64	212.7	1.9	931
7000	123.9	92.9	0.617	73.7	13.54	218.0	1.9	938
7100	126.9	93.8	0.628	76.8	13.32	223.3	2.0	943
7200	129.9	94.8	0.641	80.3	13.04	228.7	2.2	949
7300	134.5	96.8	0.654	84.8	12.70	235.2	2.4	957
7400	141.1	100.1	0.654	88.9	12.39	240.6	2.7	967
7500	146.9	102.9	0.648	91.7	12.17	243.9	3.0	976
7600	151.6	104.7	0.643	94.0	12.00	246.4	3.0	985

7700	155.0	105.7	0.642	95.9	11.85	248.2	2.7	994
7800	156.8	105.6	0.641	96.9	11.75	248.7	2.7	1001
7900	157.2	104.5	0.643	97.4	11.68	248.4	2.6	1006
8000	154.7	101.6	0.655	97.7	11.59	247.2	2.7	1007
8100	141.8	91.9	0.721	98.4	11.26	242.0	2.4	987

The D&D muffler we tested was for Darren's Riot kit—the adjustable outlet tuner allows fine tuning for all altitudes/ conditions. This test is with the outlet set for maximum backpressure. Made of black hi temp coated mild steel.

D&D adjustable, 7 lb 12 oz, 4000 75 dB, WOT 84 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	112.6	89.6	0.594	64.4	13.36	188.0	1.8	888
6700	113.8	89.2	0.602	66.0	13.30	191.7	1.9	898
6800	116.2	89.7	0.610	68.2	13.22	197.1	2.0	908
6900	120.2	91.5	0.616	71.3	13.13	204.6	2.1	922
7000	124.4	93.4	0.619	74.2	13.02	211.0	2.2	933
7100	127.5	94.3	0.629	77.3	12.86	217.2	2.3	941
7200	130.0	94.8	0.644	80.6	12.62	222.3	2.4	946
7300	133.1	95.8	0.656	84.1	12.39	227.7	2.6	952
7400	139.6	99.1	0.662	89.0	12.09	235.1	2.8	964
7500	145.8	102.1	0.654	91.9	11.92	239.2	3.1	973
7600	150.6	104.1	0.650	94.3	11.76	242.1	3.2	982
7700	154.0	105.1	0.649	96.3	11.61	244.2	3.2	991
7800	156.0	105.1	0.650	97.7	11.49	245.3	3.1	1000
7900	156.8	104.2	0.651	98.2	11.44	245.4	3.0	1008
8000	155.5	102.1	0.656	98.2	11.40	244.5	3.0	1012
8100	147.8	95.8	0.694	98.7	11.19	241.1	2.7	1004
8200	130.2	83.4	0.779	97.5	10.84	230.9	2.5	984

Sno Stuff makes this "Rumble Pack" muffler—beautiful polished stainless steel with excellent brackets tig welded to the main housing. This was the loudest of the bunch at WOT, but nearly as quiet as stock at 4000rpm. Stock backpressure = stock HP in this case.

RUMBLE PACK, 5 lb 15 oz, 4000 71 dB, WOT 92 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6500	111.4	90.0	0.596	64.0	13.46	188.1	1.5	910
6600	112.4	89.5	0.594	64.4	13.66	192.2	1.6	920
6700	113.6	89.1	0.605	66.3	13.71	198.4	1.7	929
6800	116.3	89.8	0.617	69.2	13.67	206.6	1.8	940
6900	119.9	91.3	0.620	71.6	13.63	213.3	1.9	950

7000	123.2	92.4	0.622	73.9	13.53	218.4	1.9	958
7100	126.0	93.2	0.637	77.3	13.29	224.5	2.0	964
7200	128.9	94.0	0.647	80.3	13.07	229.3	2.2	968
7300	133.8	96.3	0.660	85.1	12.72	236.4	2.4	975
7400	140.2	99.5	0.660	89.2	12.40	241.5	2.4	984
7500	145.9	102.1	0.655	92.1	12.16	244.7	2.3	994
7600	149.9	103.6	0.654	94.6	11.95	246.8	2.3	1002
7700	152.9	104.3	0.654	96.3	11.79	248.2	2.5	1009
7800	154.7	104.2	0.652	97.3	11.71	248.9	2.5	1015
7900	155.1	103.1	0.654	97.7	11.66	248.8	2.5	1020
8000	152.8	100.3	0.665	97.9	11.59	247.8	2.5	1019
8100	140.7	91.2	0.727	98.5	11.34	244.0	2.2	1002
8200	122.4	78.4	0.833	98.0	11.12	238.1	2.0	979

The Jaws mild steel trail muffler was next, and we tried it on the stock exhaust. Note that it made better than stock HP with less than stock peak RPM backpressure.

JAWS TRAIL MUFFLER, 5 lb 12 oz, 4000 74 dB, WOT 86 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	111.9	89.1	0.597	64.3	13.82	194.2	1.5	914
6700	112.8	88.4	0.606	65.8	13.88	199.5	1.6	925
6800	114.6	88.5	0.618	68.2	13.89	206.9	1.7	936
6900	117.8	89.7	0.623	70.6	13.85	213.7	1.8	946
7000	121.5	91.2	0.624	73.0	13.73	218.9	1.8	953
7100	125.1	92.5	0.634	76.3	13.46	224.3	1.9	959
7200	128.2	93.5	0.645	79.6	13.18	229.0	2.0	963
7300	132.7	95.5	0.661	84.4	12.79	236.0	2.1	970
7400	138.1	98.0	0.664	88.2	12.52	241.2	2.5	976
7500	144.3	101.1	0.656	91.0	12.34	245.4	2.9	985
7600	149.9	103.6	0.646	93.2	12.20	248.4	2.9	996
7700	153.6	104.8	0.643	95.0	12.07	250.3	2.4	1006
7800	155.5	104.7	0.641	95.8	11.99	251.1	2.3	1014
7900	156.1	103.8	0.643	96.6	11.92	251.4	2.3	1022
8000	154.1	101.2	0.657	97.4	11.80	251.0	2.2	1023
8100	132.5	85.9	0.773	98.3	11.37	244.3	2.0	989
8200	114.7	73.5	0.883	97.2	11.06	234.9	1.8	964

The HPS muffler is tubular mild steel with glossy silver ceramic coating. It was one of the quietest aftermarket mufflers at 4000 rpm and not too bad at full throttle.

HPS, 5 lb 6 oz, 4000 72 dB, WOT 88 dB

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	AFRAB Ratio	Air_1s SCFM	ExhPrs psig	Exh_2 deg F
6600	113.3	90.2	0.581	63.4	13.70	189.6	1.5	888

6700	114.3	89.6	0.594	65.4	13.76	196.5	1.7	902
6800	116.7	90.1	0.610	68.5	13.71	205.3	1.8	916
6900	120.1	91.4	0.614	71.0	13.66	212.0	1.9	926
7000	123.6	92.7	0.619	73.6	13.52	217.5	2.0	934
7100	126.7	93.7	0.632	77.1	13.26	223.5	2.1	941
7200	129.5	94.4	0.640	79.9	13.05	227.6	2.2	946
7300	134.8	97.0	0.656	85.2	12.64	235.2	2.5	955
7400	141.6	100.5	0.652	89.0	12.36	240.3	2.5	966
7500	147.5	103.3	0.646	91.8	12.16	243.9	2.4	976
7600	151.5	104.7	0.645	94.1	11.98	246.3	2.4	984
7700	154.3	105.2	0.645	95.8	11.84	247.6	2.6	993
7800	155.8	104.9	0.642	96.4	11.77	248.0	2.6	1000
7900	155.8	103.6	0.646	97.0	11.69	247.7	2.6	1006
8000	153.2	100.6	0.661	97.4	11.58	246.5	2.5	1005
8100	138.5	89.8	0.736	98.1	11.28	241.7	2.3	984

With all the mufflers (we thought) tested, Darren and Jim installed the Jaws Y pipe and single pipe with the stock muffler for comparison with the 2010 Crossfire 800 pipe shootout. The Jaws Y pipe has noticeably larger outlet with custom donut gasket. The Jaws plastic intake replaced the SuperFlow airflowmeter, so SCFM is computed, based upon wide band A/F ratio (the Jaws single pipe comes with an O2 sensor bung) and measured fuel flow. We put Greg's % Boondocker map (listed in the instructions) in our PCV and only had to tweak the fuel at 8500 to make it spot-on.

JAWS Y PIPE AND SINGLE PIPE, STOCK MUFFLER

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	LamAF1 Ratio	LM1Air SCFM	ExhPrs psig	Exh_2 deg F
6600	112.4	89.4	0.656	71.0	14.19	222	1.2	856
6700	113.3	88.8	0.665	72.6	14.08	225	1.4	863
6800	115.2	89.0	0.672	74.6	13.97	230	1.6	868
6900	118.6	90.3	0.679	77.7	13.81	236	1.8	878
7000	123.4	92.6	0.676	80.5	13.79	244	1.9	887
7100	127.2	94.1	0.682	83.7	13.78	254	2.0	894
7200	130.2	95.0	0.693	87.0	13.66	262	2.1	899
7300	134.6	96.9	0.707	91.8	13.40	271	2.4	908
7400	141.1	100.2	0.708	96.4	13.05	277	2.6	919
7500	147.8	103.5	0.700	99.8	12.83	282	2.6	930
7600	153.0	105.7	0.695	102.6	12.65	286	2.6	938
7700	157.6	107.5	0.689	104.7	12.45	287	2.7	948
7800	161.5	108.7	0.676	105.2	12.39	287	2.7	957
7900	164.7	109.5	0.662	105.2	12.46	289	2.7	970
8000	166.7	109.4	0.656	105.5	12.53	291	2.7	980
8100	166.9	108.2	0.658	106.0	12.57	293	2.8	989

8200	164.2	105.2	0.673	106.5	12.67	297	2.8	994
8300	153.8	97.3	0.720	106.7	12.98	305	2.6	991

We were reminded that the 2010 pipe shootout was done with the tight 2010 stock muffler, so we dropped the 1.75" restrictor into the 2014 muffler inlet. This increased backpressure and HP, but at the same time enrichened A/F ratio.

JAWS Y PIPE AND SINGLE PIPE, RESTRICTED 2014 MUFFLER SIMILAR TO STOCK 2010 MUFFLER

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	LamAF1 Ratio	LM1Air SCFM	ExhPrs psig	Exh_2 deg F
6600	111.0	88.4	0.669	71.6	13.37	211	1.7	852
6700	112.3	88.0	0.682	73.7	13.32	216	1.8	863
6800	114.5	88.4	0.696	76.8	13.11	222	2.0	876
6900	117.5	89.5	0.698	79.1	12.95	226	2.2	885
7000	120.6	90.5	0.700	81.3	12.90	231	2.3	890
7100	123.8	91.6	0.706	84.2	12.92	240	2.4	896
7200	126.9	92.6	0.713	87.2	12.87	247	2.6	900
7300	131.2	94.4	0.722	91.2	12.67	255	2.9	907
7400	137.7	97.7	0.727	96.4	12.33	262	3.3	920
7500	143.5	100.5	0.721	99.7	12.12	266	3.6	930
7600	148.8	102.8	0.715	102.5	11.91	269	3.6	938
7700	154.5	105.4	0.705	105.0	11.70	271	3.4	948
7800	158.3	106.6	0.692	105.5	11.66	271	3.4	954
7900	161.6	107.4	0.678	105.5	11.74	273	3.4	965
8000	164.8	108.2	0.667	105.9	11.93	279	3.4	980
8100	167.5	108.6	0.663	107.0	11.95	282	3.5	993
8200	168.7	108.1	0.661	107.4	11.87	281	3.5	1002
8300	168.0	106.3	0.662	107.1	11.97	283	3.5	1011
8400	163.2	102.1	0.681	107.0	12.24	289	3.4	1020
8500	145.2	89.7	0.759	106.0	12.37	289	3.4	1015

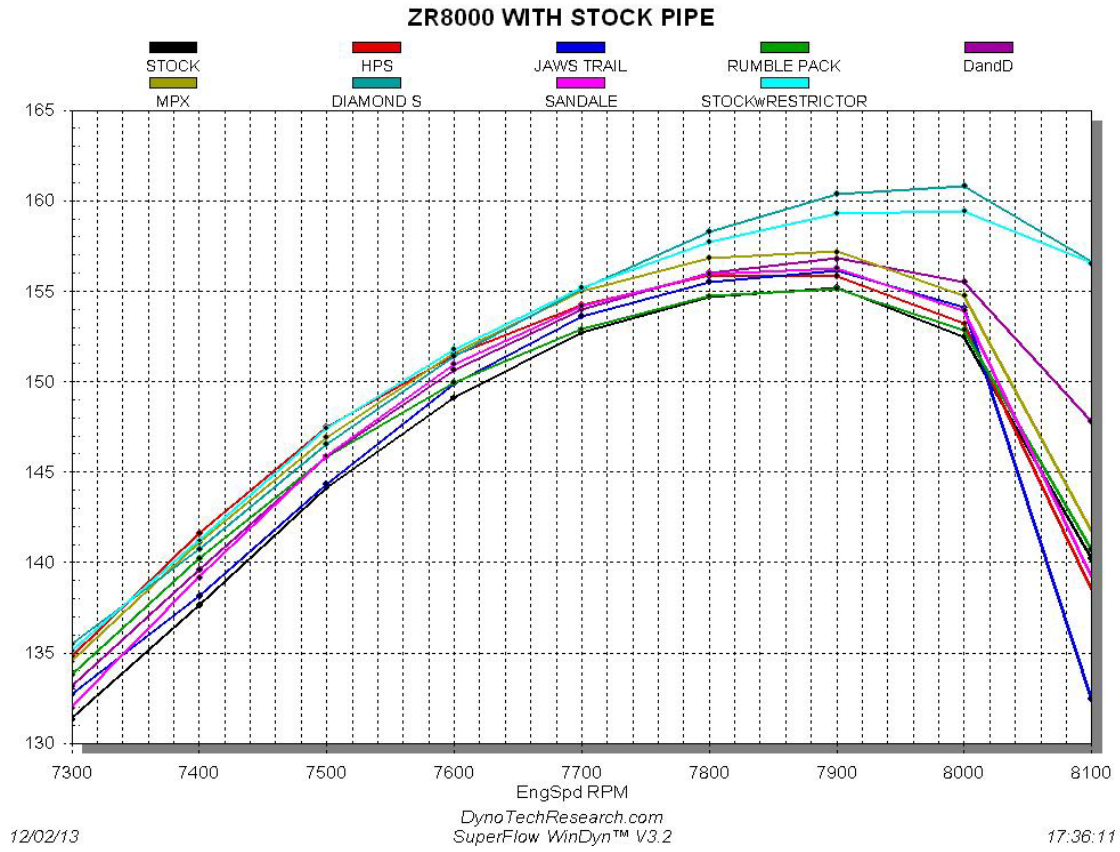
We noted that the reduced airflow enrichened A/F ratio so we tweaked the map on the PCV to reduce fuel flow. Here are the results, with fuel reduced by the % shown:

JAWS Y PIPE AND SINGLE PIPE, RESTRICTED 2014 STOCK MUFFLER, FUEL FLOW REDUCED

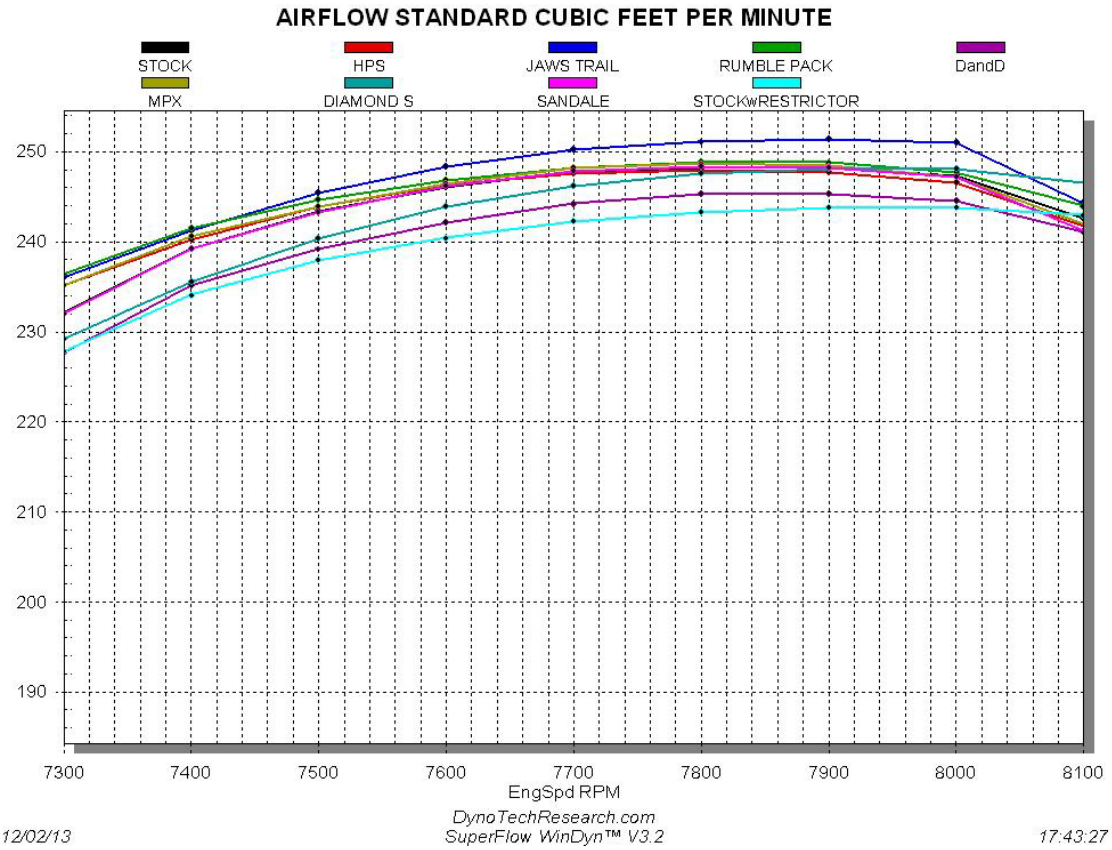
EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FulAB lbs/hr	LamAF1 Ratio	LM1Air SCFM	ExhPrs psig	Exh_2 deg F
6600	109.5	87.1	0.676	71.2	13.24	208	1.7	840
6700	110.8	86.8	0.682	72.7	13.32	214	1.8	852
6800	112.7	87.0	0.692	75.0	13.20	219	2.0	861
6900	115.8	88.2	0.701	78.1	12.99	224	2.2	872
7000	119.9	90.0	0.704	81.2	12.90	231	2.3	882

7100	123.2	91.2	0.711	84.4	12.87	240	2.5	888
7200	126.2	92.1	0.716	86.9	12.81	246	2.7	894
7300	131.3	94.5	0.724	91.5	12.66	256	2.9	908
7400	137.3	97.4	0.714	94.3	12.53	261	3.2	920
7500	143.6	100.6	0.700	96.8	12.42	265	3.6	934
7600	148.4	102.6	0.688	98.3	12.30	267	3.7	945
7700	152.2	103.8	0.678	99.4	12.20	268	3.5	953
7800	156.3	105.2	0.665	100.0	12.15	268	3.4	962
7900	161.3	107.2	0.646	100.4	12.20	270	3.4	978
8000	165.2	108.5	0.635	101.0	12.26	273	3.4	993
8100	167.9	108.9	0.629	101.7	12.28	275	3.5	1010
8200	169.6	108.6	0.626	102.2	12.27	277	3.5	1023
8300	170.0	107.6	0.629	102.9	12.26	278	3.6	1036
8400	167.9	105.0	0.643	104.0	12.27	281	3.6	1046

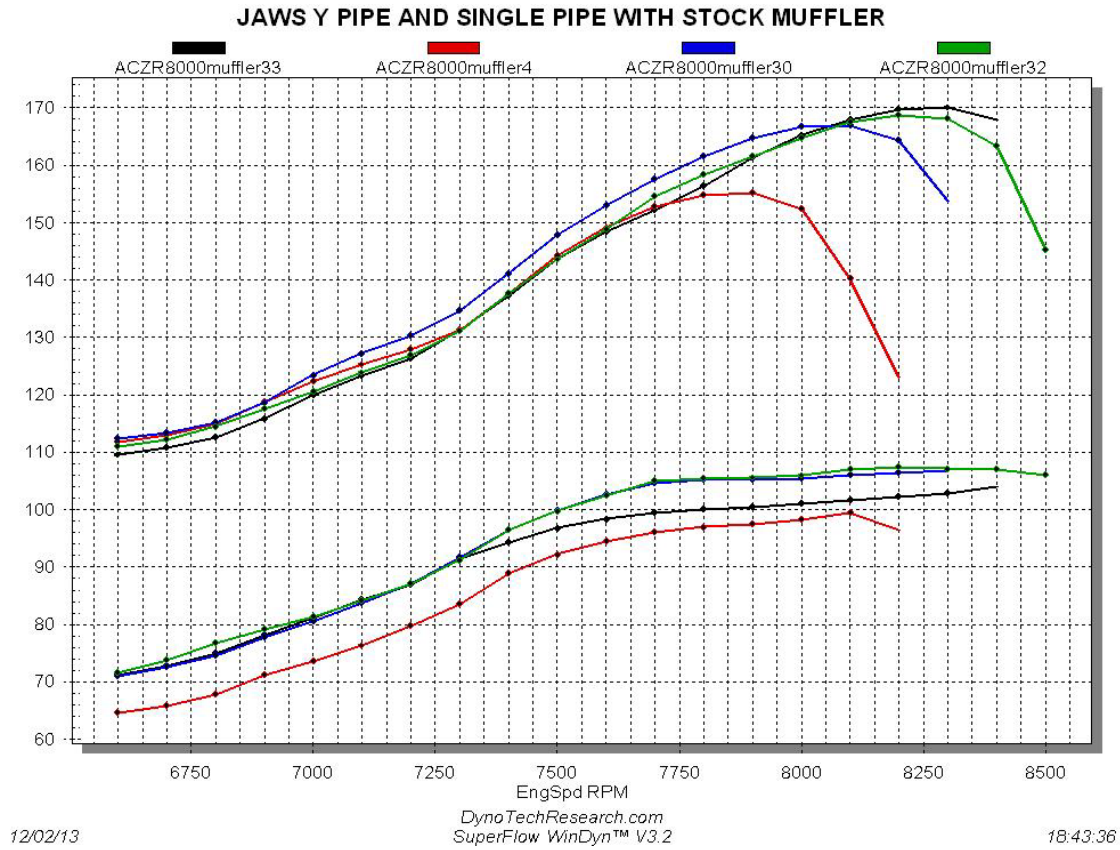
Top row Rumble Pack, D&D, SanDale, Diamond S
Bottom row Jaws Race (no test on stock engine), Jaws Trail, MPX, HPS



horsepower/ RPM comparison—note the tighter pipe = higher RPM and backpressure.



AIRFLOW COMPARISON



HP AND FUEL FLOW STOCK PIPE (RED) COMPARED TO JAWS WITH STOCK MUFFLER (BLUE), RESTRICTED MUFFLER (GREEN) AND RESTRICTED MUFFLER WITH REDUCED FUEL FLOW (BLACK)

Coming next—muffler test phase 2