2018 Arctic Cat ZR8000 CTEC

Tom Ferry [Arctic Adventures Arctic Cat in Rosendale, NY] brought this 2018 ZR8000 to DTR for evaluation with five hours run time on it. Tom's initial understanding was that "breakin mode" which creates slightly richer fuel mixture was gone after three hours of running at normal vehicle speed (not sitting idling for three hours). But after dyno testing and not quite reaching 160HP, Tom called Cat engineering and found out breakin mode lasted six hours. Here is our DTR test results of Tom's ZR8000 while still in breakin mode:

first 15 second test, coolant temp ending 110f

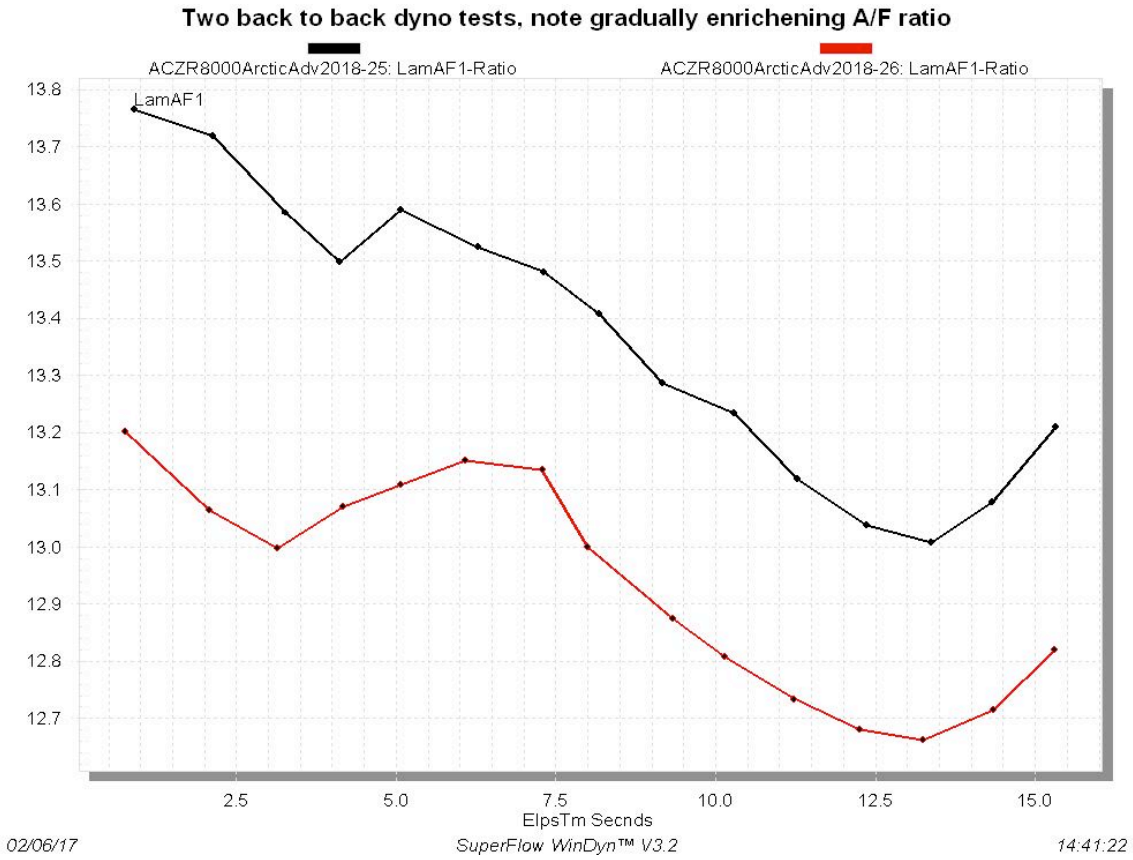
EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA lb/hph	FuelA lbs/hr	LamAF1 Ratio	LM1Air SCFM	FulPrA psig	STPCor Factor
7000	129.7	97.3	0.669	84.5	13.76	254	58.5	1.024
7100	131.8	97.5	0.671	86.0	13.72	258	58.4	1.025
7200	134.5	98.1	0.678	88.7	13.58	263	58.3	1.025
7300	138.0	99.3	0.668	89.5	13.50	264	58.3	1.026
7400	143.5	101.9	0.645	90.0	13.59	268	58.3	1.026
7500	147.5	103.3	0.639	91.4	13.53	271	58.3	1.026
7600	150.3	103.8	0.629	91.8	13.48	271	58.2	1.027
7700	153.0	104.4	0.621	92.2	13.41	271	58.2	1.027
7800	156.3	105.3	0.613	93.0	13.29	271	58.2	1.027
7900	158.1	105.1	0.621	95.1	13.23	276	58.1	1.028
8000	158.7	104.2	0.618	95.1	13.12	274	58.1	1.028
8100	159.5	103.4	0.617	95.3	13.04	273	58.1	1.029
8200	158.7	101.7	0.621	95.4	13.01	273	58.1	1.029
8300	157.9	99.9	0.618	94.4	13.08	272	58.1	1.030
8400	154.2	96.4	0.624	92.9	13.21	270	58.2	1.030

Second 15 second test, back to back, coolant temp ending 125f

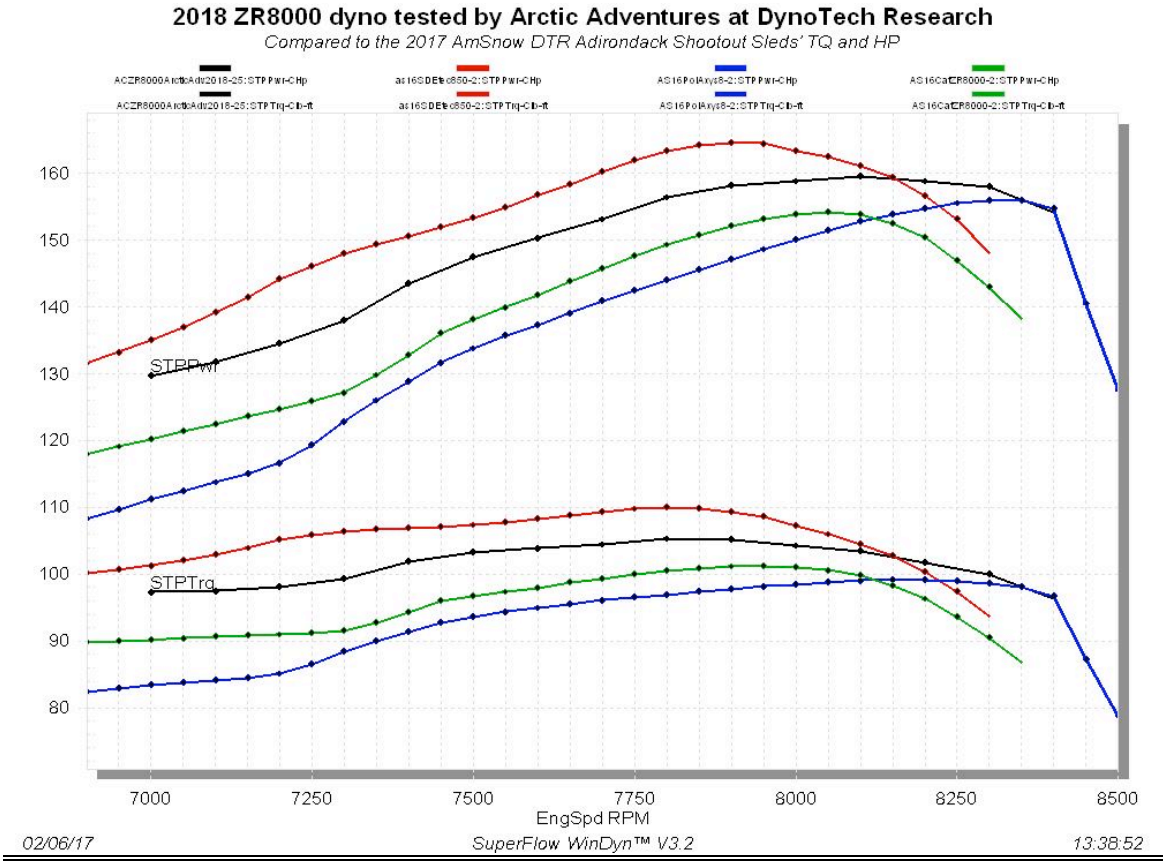
EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA lb/hph	FuelA lbs/hr	LamAF1 Ratio	LM1Air SCFM	FulPrA psig	STPCor Factor
7000	120.9	90.7	0.703	82.0	13.20	239	58.4	1.032
7100	125.0	92.5	0.700	84.4	13.06	244	58.4	1.033
7200	128.6	93.8	0.703	87.1	13.00	251	58.3	1.033
7300	132.1	95.1	0.683	86.9	13.07	252	58.3	1.034
7400	134.5	95.4	0.675	87.3	13.11	254	58.2	1.035
7500	138.4	96.9	0.671	89.2	13.15	261	58.2	1.035
7600	142.9	98.8	0.656	90.2	13.13	263	58.1	1.035
7700	145.8	99.5	0.653	91.5	13.00	265	58.1	1.036
7800	150.3	101.2	0.642	92.6	12.88	266	58.0	1.037
7900	152.6	101.5	0.639	93.5	12.81	267	58.1	1.036
8000	155.6	102.1	0.635	94.8	12.73	269	58.0	1.037
8100	157.8	102.3	0.626	94.8	12.68	268	58.0	1.037
8200	158.8	101.7	0.619	94.3	12.66	266	58.0	1.038
8300	158.8	100.5	0.614	93.4	12.71	265	58.1	1.038

8400	158.0	98.8	0.613	92.8	12.82	265	58.1	1.038

Note that the second hotter engine/ pipe test the wideband A/F ratio appears to enrichen—fuel flow lb/hr was fairly unchanged, but computed airflow Cubic Feet per Minute was lower. This may be just the pipe becoming hotter (greater expansion of exhaust gas creating higher backpressure), or a combo of pipe and internal engine heat (greater expansion of intake air before reaching the combustion chambers—similarly impeding airflow). This is a common occurrence in typical open loop EFI sled engines, something that doesn't occur with carburetors (or closed loop EFI that adjusts fuel in response to measured airflow or wideband A/F ratio) that automatically reduce fuel flow as airflow drops! Since some Arctic Cat Snowcross racers have switched from carbs to EFI this year, there have been struggles, perhaps due in part to this phenomenon.



Here is an overlay comparison of HP and TQ between this 2018 ZR8000 in breakin mode, compared to the 800+ cc sleds we dyno tested for last December's AmSnow/ DTR shootout.



It was also suggested to Tom Ferry that this new engine has particularly tough nickasil in the cylinder bores that requires lots of hard run time to truly break in completely. This is similar to what we experience with the new Polaris 800 HO engines—dyno breakin is ideal since we can create good ring load/ contact with the cylinder bores running WOT with constantly varying engine speed. But this requires cooling the engine with the thermostatically controlled dyno cooling tower, a fairly time consuming project—but a time saver if a large number of repeat tests are planned, compared to blow-cooling the outside surface of the engine with 80mph air from the dyno air delivery system. Tom has offered up another new ZR8000 to do this with. Remember—we typically see HP increase dramatically (often 10 or more HP) on Polaris 800 HO engines from out-of-the-crate to 50-80 repeat dyno tests. There is more to be learned!

After this first dyno test session, Tom put another three hours trail riding/ lake running in Old Forge, NY and came back certainly out of breakin mode (eight hours total run time). We used 89.4 R+M/2 octane over 9% ethanol fuel to obtain this HP level with 100F coolant and @950F pipe temperature—those two temperatures seem to be the "sweet spot" for this engine, delivering a lean 13+/1 A/F ratio and just enough pipe heat to make

over 160HP. On this day it was warm and rainy so we used the dyno intake air refrigeration system to deliver 25 degree F low humidity air to the airbox. What we don't yet know is if we have rings that are truly seated, or are they still in the "wearing-in" process? But Tom Ferry is pleased with 160.6 HP (actually there was 160.8 HP at 8133 RPM as shown on the Arctic Adventures FaceBook page)—that sounds much better than 159.5!

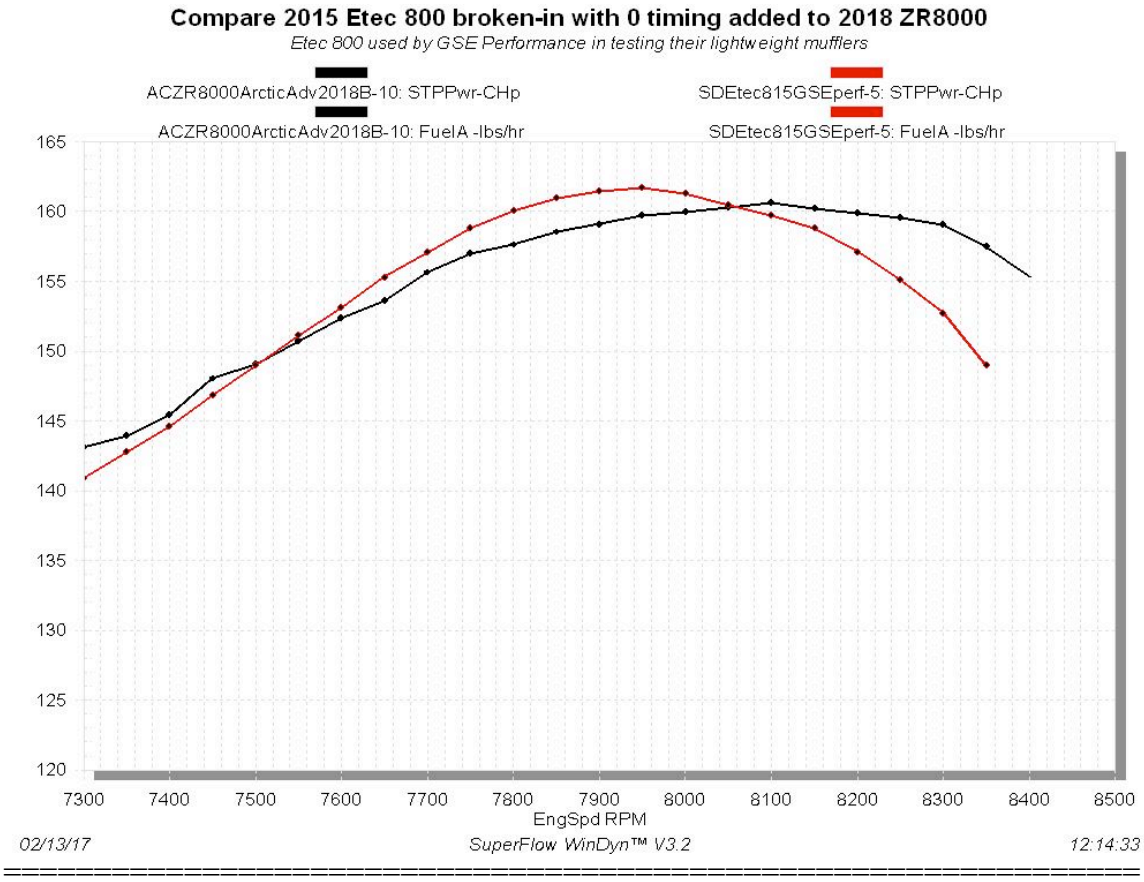
After breakin mode is gone

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA lb/hph	FuelA lbs/hr	LamAF1 Ratio	LM1Air SCFM	FulPrA psig	ElpsTm Secnds
7300	143.1	103.0	0.651	89.1	14.60	281	58.0	0.45
7350	144.0	102.9	0.652	89.7	14.58	282	57.9	1.07
7400	145.4	103.2	0.649	90.1	14.47	281	57.9	1.38
7450	148.0	104.4	0.641	90.6	14.39	282	57.9	2.25
7500	149.0	104.4	0.641	91.2	14.26	280	57.9	2.61
7550	150.7	104.8	0.646	93.0	14.19	281	57.9	3.23
7600	152.3	105.3	0.642	93.4	14.13	282	57.8	3.67
7650	153.6	105.4	0.638	93.6	14.07	282	57.8	4.11
7700	155.6	106.1	0.636	94.6	13.96	281	57.8	4.82
7750	157.0	106.4	0.634	95.0	13.87	280	57.8	5.18
7800	157.6	106.1	0.631	95.0	13.79	282	57.7	5.64
7850	158.5	106.1	0.628	95.1	13.74	284	57.7	6.19
7900	159.1	105.8	0.632	96.0	13.71	284	57.7	6.93
7950	159.7	105.5	0.632	96.4	13.64	285	57.7	7.33
8000	160.0	105.0	0.631	96.4	13.57	284	57.7	7.81
8050	160.3	104.6	0.633	96.8	13.53	283	57.6	8.31
8100	160.6	104.1	0.634	97.1	13.54	282	57.6	8.79
8150	160.2	103.3	0.634	96.9	13.53	284	57.6	9.37
8200	159.9	102.4	0.637	97.2	13.52	283	57.7	9.91
8250	159.6	101.6	0.634	96.5	13.55	281	57.7	10.44
8300	159.0	100.6	0.633	95.9	13.60	282	57.7	10.83
8350	157.5	99.1	0.638	95.7	13.65	283	57.7	11.30
8400	155.3	97.1	0.643	95.1	13.73	282	57.7	11.85

Also note the extreme "flatness" of the HP curve—much flatter than the 2017 ZR8000 curve just below in the graph. That, along with relatively high BSFC, often indicates retarded timing. It would be good if DynoJet would create a PCV with timing control so we can try adding a few degrees at, say, 7500-8000 and maybe one at 8250 (leaving 0 or -1 at 8500 should keep the HP band very broad). But for now, the 11-021 PCV for the ZR6000 is expected to control (add or subtract) fuel flow on the new 800. If Tom Ferry (or Billy Howard) comes for an extended breakin session, an offset timing key will need to be tried.

And for comparison, here's a bone stock 2015 Etec 800 out of breakin mode compared to this 2018 ZR8000. If I'm correct, a two degree offset key could reshape the ZR8000 HP curve to about match the Etec 800's HP curve. To generalize, a HP curve can be likened

to a pile of soft clay—push it down on overrev and pile it higher in the middle and at the peak!



Here's one of the few times that you'll see duct tape actually being used on ducting! This is the insulated ductwork that delivers refrigerated dry air to the sled's intake for proper winter testing/ tuning even in warm humid weather. This year, the ZR8000's intake air temperature probe is, properly, located in the airbox. That's the SuperFlow dyno air temperature/ humidity/ baro pressure sensor--specially modified for rapid response--fitted to the ductwork.

And here's great guy/ great dealer Arctic Adventures' Tom Ferry, pleased with the new ZR8000's HP. Tom deserves the Nobel Peace Price from Arctic Cat for his time/ effort/ expenses absorbed in promoting first the new Thundercat turbo and now this new ZR8000.

And thanks to our DTR members who support this independent testing/ analysis! Lots of hours go into testing and assessing then trying to explain it [to myself as well as to you guys!]. Feel free to talk and post about the numbers and findings, but please no copying and pasting!