Comparing SnoCross 600cc engine HP

This 2019 SkiDoo 600RS E-TEC race sled was brought here by Ohioan Tim Baird. I was told that the 2019 race calibration was done by the SkiDoo Race Shop on 100LL Av gas, and this year they revised the tuning on their dyno with more volatile Sunoco Surge 105 octane spec fuel. Tim's sled has the 2021 race calibration. The wideband reading was fairly rich looking appearing compared with both the carbureted and EFI Polaris'. Normally E-TEC engines show a leaner-than actual A/F reading in the exhaust. This is because nearly all of the short-circuited air is devoid of fuel vapor. This small amount of pure short-circuited air mixes with the exhaust gas before it reached the O2 sensor indicating leaner than actual mixture. We didn't measure fuel flow on this engine since I was concerned about breaking the plastic return fuel nipple on the engine trying to remove the brutal Oetiker hose clamp, making dyno testing impossible. Fuel flow may have given us a better indication of the actual mixture based upon BSFC. The other possibility is that the 2021 600RS may have higher flow port timing, said by some pro SkiDoo racers to be good for an extra HP, requiring extra fuel to compensate. But then if a SkiDoo race muffler were fitted for racing, most often those are more restrictive than the stock muffler so that should offset any added airflow from 2021 cylinders.

The 2019 Polaris 600R engine came to the dyno with max HP jetting already installed so our data is maximum HP for the engine on Surge fuel with stock muffler—350 mains at a Density Altitude of 1100'. As we can see from the final graph, the peak HP is nearly identical to the 2019 600RS, but midrange HP was a bit lower. Since we were testing this engine only from 7950 on up, that initial slight HP advantage at 7950 is due to the engine being held steady state before each test begin. The first reading is devoid of much of the crankshaft inertia that eats some HP during actual acceleration (the inertia loss is partially compensated for by the dyno software).

The first 2021 sled on the DTR dyno was the 2021 Polaris 600R that Hentges Racing brought to enable them to optimize their race mufflers for the new engines. The new 600R engine is fitted with EFI, 48mm throttle bodies and new "Patriot engine architecture". I assume that includes the modern reduced coolant volume in head and cylinder castings like we've measured on the 850 Patriot. The reason for reduced coolant passage volume is to create increased coolant velocity and turbulence (see KC's article here "Turbulence Needed"), which improves the scouring of heat from the engine. As I understand it, there is slightly improved port timing. That, along with the higher flowing throttle bodies (compared to the 40mm carbs) resulted in higher airflow from midrange to top end. The porous airbox snorkel material made mechanical measuring of airflow impractical, so we include estimated airflow that the SuperFlow computer calculates with mechanically measured fuel flow (pump flow to rail minus returned flow from rail back to tank) compared to wideband A/F (pounds of air/ pounds of fuel) reading with an O2 sensor fitted to the pipe's center section. Note the lean A/F ratio and low BSFC of the race calibration. There may be some pure air short-circuiting that fools the O2 sensor, but the low fuel flow lb/hr seems to match. This is possible with the highly volatile (8 PSI RVP) Sunoco Surge 105 octane spec fuel that was used in all three engines shown here.

2019 SkiDoo 600RS E-TEC with 2021 ECU calibration, stock muffler

EngSpd	STPPwr	STPTrq	AirInT	DenAlt	LamLM1	LM1AF1	ElpsTm	Air_1c
RPM	CHp	Clb-ft	degF	Feet	Lambda	Ratio	Secnds	CFM
7100	92.0	68.1	47.8	-146	0.93	13.74	2.53	182.4
7150	92.9	68.2	47.8	-145	0.93	13.74	2.76	184.5
7200	93.6	68.3	47.8	-145	0.93	13.73	2.95	187.0
7250	94.4	68.4	47.8	-144	0.93	13.72	3.13	189.6
7300	95.2	68.5	47.8	-144	0.93	13.71	3.30	192.5
7350	96.2	68.7	47.8	-144	0.93	13.70	3.45	196.0
7400	97.3	69.1	47.8	-144	0.93	13.69	3.60	200.3
7450	98.7	69.5	47.8	-144	0.93	13.67	3.72	205.6
7500	100.2	70.1	47.8	-144	0.93	13.64	3.84	210.0
7550	102.1	71.1	47.8	-144	0.93	13.60	3.96	213.9
7600	104.7	72.4	47.8	-146	0.92	13.56	4.07	217.3
7650	108.4	74.4	47.8	-144	0.92	13.51	4.20	220.2
7700	112.0	76.4	47.8	-142	0.92	13.49	4.35	223.2
7750	114.7	77.7	47.8	-141	0.92	13.50	4.55	227.3
7800	117.3	79.0	47.9	-140	0.92	13.50	4.73	231.2
7850	119.8	80.1	47.9	-140	0.92	13.50	4.86	234.6
7900	122.8	81.6	47.9	-140	0.92	13.48	5.01	236.8
7950	126.5	83.5	47.9	-140	0.91	13.38	5.16	239.0
8000	129.5	85.0	47.8	-141	0.90	13.25	5.35	241.6
8050	132.1	86.2	47.8	-141	0.89	13.13	5.59	244.3
8100	134.2	87.0	47.8	-142	0.89	13.05	5.81	247.0
8150	135.8	87.5	47.8	-143	0.88	12.99	6.01	248.8
8200	137.2	87.9	47.8	-143	0.88	12.95	6.21	251.0
8250	138.6	88.3	47.8	-144	0.88	12.91	6.37	253.8
8300	139.7	88.4	47.8	-144	0.88	12.89	6.56	255.9
8350	140.5	88.4	47.8	-145	0.88	12.90	6.82	258.3
8400	141.0	88.1	47.8	-145	0.88	12.91	7.02	259.9
8450	141.0	87.6	47.8	-145	0.88	12.94	7.20	260.1
8500	140.6	86.9	47.8	-145	0.88	12.98	7.36	258.8
8550	140.3	86.2	47.8	-145	0.89	13.03	7.53	258.5
8600	139.7	85.3	47.8	-144	0.89	13.09	7.69	257.9
8650	138.5	84.1	47.8	-144	0.90	13.17	7.83	257.7
8700	137.6	83.1	47.8	-144	0.90	13.23	7.96	257.8
8750	136.2	81.8	47.8	-143	0.90	13.28	8.13	257.2
8800	134.1	80.0	47.8	-143	0.91	13.33	8.26	256.6
8850	131.8	78.2	47.8	-143	0.91	13.38	8.41	256.5
8900	128.4	75.8	47.8	-142	0.91	13.44	8.59	256.1
8950	123.8	72.7	47.8	-141	0.92	13.49	8.76	255.8
9000	118.5	69.1	47.8	-139	0.91	13.43	8.96	255.5

2019 Polaris 600R carbureted engine tuned to max HP, stock muffler

EngSpd	STPPwr	STPTrq	BSFB	FuelB	LamAF1	LM1Air	CoolFw	DenAlt

RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	SCFM	GPM	Feet
7950	128.8	85.1	0.565	69.2	14.14	-219.6	34.3	1141
8000	129.0	84.7	0.566	69.5	14.08	-219.3	34.7	1141
8050	129.6	84.6	0.561	69.1	13.93	-215.9	35.0	1141
8100	131.2	85.1	0.552	68.9	13.82	-213.6	35.1	1140
8150	133.3	85.9	0.546	69.2	13.79	-214.1	35.2	1140
8200	134.7	86.3	0.544	69.7	13.82	-216.0	35.3	1140
8250	136.0	86.6	0.543	70.3	13.82	-217.8	35.6	1140
8300	137.6	87.1	0.543	71.0	13.79	-219.5	35.9	1140
8350	139.4	87.7	0.536	71.0	13.80	-219.9	36.0	1140
8400	140.6	87.9	0.533	71.2	13.81	-220.5	36.2	1140
8450	140.8	87.5	0.529	70.8	13.82	-219.4	36.5	1140
8500	140.7	86.9	0.531	71.0	13.79	-219.7	36.6	1140
8550	140.1	86.1	0.537	71.5	13.77	-220.9	36.7	1139
8600	139.4	85.1	0.538	71.3	13.76	-220.0	36.8	1139
8650	138.2	83.9	0.543	71.3	13.78	-220.4	37.1	1138
8700	137.4	83.0	0.550	71.8	13.81	-222.4	37.3	1138
8750	135.0	81.0	0.566	72.5	13.84	-225.3	37.5	1138
8800	130.7	78.0	0.582	72.2	13.92	-225.5	37.7	1138

2021 Polaris 600R EFI engine, stock muffler

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	LM1AF1	FulPrA	LM1Air	CoolFw
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	psig	SCFM	GPM
6500	80.8	65.6	0.629	48.0	14.90	62.9	163.1	16.2
6600	84.0	66.8	0.606	48.1	14.73	62.8	161.7	15.8
6700	86.4	67.8	0.623	50.9	14.56	62.6	169.1	15.5
6800	88.6	68.4	0.651	54.4	14.34	62.5	178.1	15.4
6900	90.1	68.6	0.698	59.4	14.08	62.4	190.7	15.5
7000	92.3	69.3	0.709	61.9	13.88	62.3	195.9	15.6
7100	95.3	70.5	0.710	64.0	13.79	62.2	201.2	15.3
7200	98.5	71.9	0.698	65.0	13.81	62.2	204.7	15.3
7300	102.8	74.0	0.683	66.3	13.94	62.1	211.0	15.9
7400	106.9	75.9	0.666	67.3	14.06	62.1	215.9	16.6
7500	110.9	77.6	0.649	68.0	14.16	62.1	219.7	17.3
7600	115.3	79.7	0.626	68.3	14.18	62.1	220.9	17.5
7700	121.1	82.6	0.598	68.5	14.21	62.0	222.1	17.8
7800	127.4	85.8	0.563	67.8	14.29	62.0	220.9	17.9
7900	131.6	87.5	0.534	66.4	14.45	62.1	219.1	18.2
8000	134.4	88.2	0.514	65.2	14.64	62.1	218.0	18.4
8100	136.6	88.6	0.505	65.2	14.75	62.1	219.4	18.6
8200	139.2	89.2	0.507	66.8	14.70	62.0	224.0	18.3
8300	141.8	89.7	0.513	68.7	14.58	61.9	228.6	17.4
8400	143.8	89.9	0.520	70.6	14.46	61.8	233.1	16.3
8500	144.0	89.0	0.514	69.9	14.41	61.9	229.8	15.1
8600	142.9	87.3	0.505	68.2	14.44	61.9	224.7	14.3
8700	140.3	84.7	0.496	65.7	14.62	62.0	219.3	14.1

8800	136.4	81.4	0.494	63.6	14.87	62.1	215.9	14.7
8900	130.1	76.5	0.489	60.0	15.28	62.3	209.5	16.3