2017 SkiDoo Etec 850 Jim Czekala

Tom Ferry of Arctic Adventures (Arctic Cat and SkiDoo dealer in Rosendale, NY) brought this [1000+ miles] SkiDoo demo sled to DTR from the SnowFest in Old Forge. This was a 300 mile round trip detour on his way back to Rosendale in eastern NY, but Tom and everyone else was anxious to see the DTR SuperFlow dyno test data. Information provided by Bombardier to the media described the Etec 850 engine as making "165 observed (uncorrected) HP". But we always use STP Standard corrected HP—the most optimistic estimate of the torque and HP an engine would make at sea level (29.92 in.hg.) in 60 degree F dry air. On this day at the dyno, air was 45-50 degrees F, baro pressure was 28.52 in.hg. and humidity was 80+% (.29 in.hg. is deducted from observed baro pressure), so the STP correction factor would add @5% to the observed HP.

Humidity saps some HP—it's a "triple whammy" on EFI sled engines. The ECU doesn't recognize water vapor that displaces O2 molecules, resulting in richer than expected mixture. Unnecessary extra fuel also displaces O2. Finally, that water vapor and extra fuel absorbs valuable heat that would normally be expanding combustion gases that push the pistons down in the bores!

Jim Cooper of Cooper's Sales and Service SkiDoo (Waterport, NY) joined us, and brought his new BUDS2 computer, for monitoring engine data during testing. We had also hoped to advance timing—something that added torque and HP to the Etec 800s. But unfortunately, the early version of software requires a "key" entered in order to communicate with each 850, and that key was not available (final BUDS2 will not require a "key" for each sled). So today, we would test the engine without monitoring exhaust temperature, intake air temperature, exhaust valve position, and levels of even light detonation. We were able to observe the digital coolant temp readout on the instrument pod duct taped to the seat in view of the control room. All testing was done with the sled's cooling system intact, so each repeat test resulted in elevated pipe *and* coolant temperature.

And without being able to monitor intake air temp with BUDS2, it wasn't practical to utilize the DTR intake air refrigeration system to eliminate the humidity—if the stock air temperature thermocouple is shrouded in plastic like the other Etecs it will be fine for winter riding where temperature gradients are gradual, but too slow to react to the rapid change in intake air temperature when we run an engine on chilled dry air on a warm day, resulting in leaner more powerful mixture that shouldn't be documented (we had that issue with the Yamaha Sidewinder). I have an early Etec air temperature thermocouple that I modified by carefully grinding away the plastic, exposing the metal thermocouple making it quick reacting. But the new 850 uses a different air intake temp sensor, so we couldn't use the modified thermocouple.

We ran about 12 back-to-back, and sometimes back-to-back-to-back dyno tests with coolant temps peaking at 120-145 degrees F. As is often the case, the second hot pipe test

was usually the best. The engine repeated dandily—167+-168+ HP. Tantalizingly close to 170. Damn the humidity!

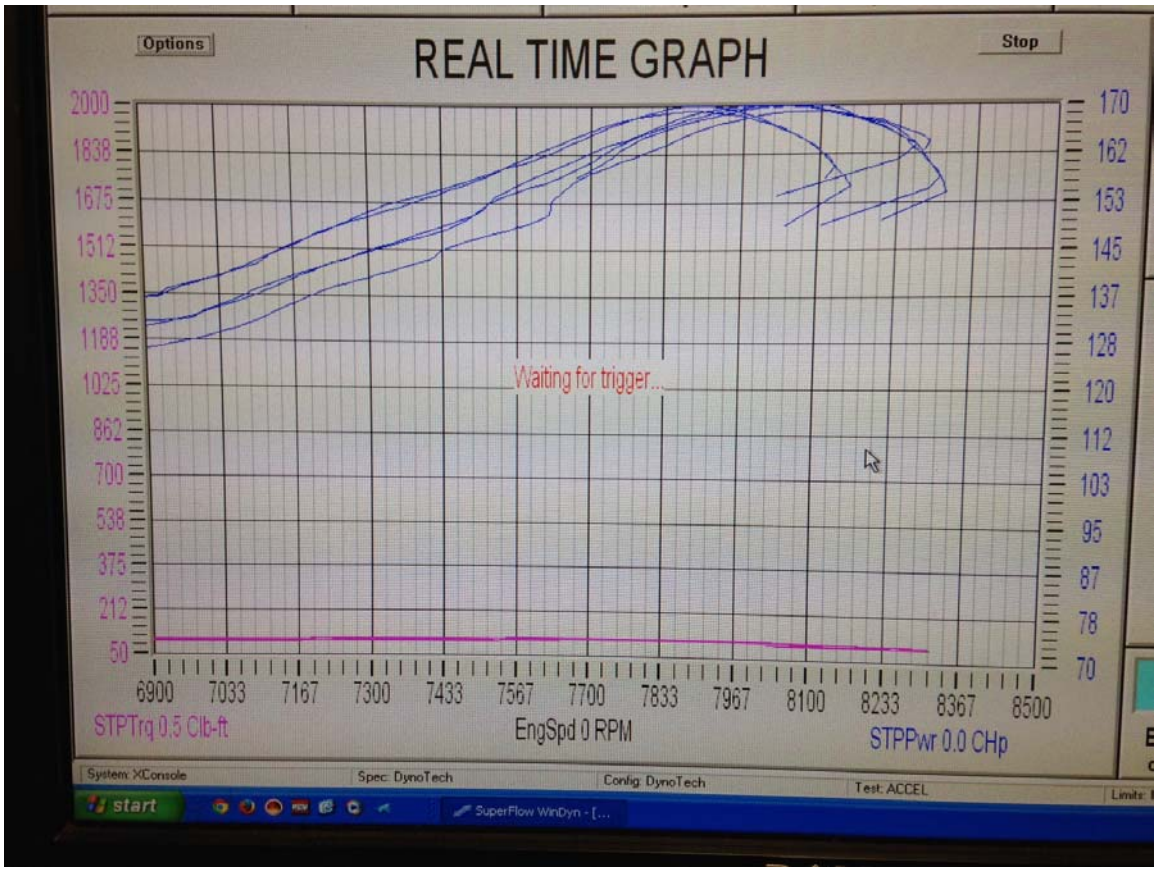
We tested the week(s) old demo fuel in the tank, and it was 91.1 octane zero ethanol. And, it was comparatively stale—instead of 10+PSI winter blend RVP it tested at 5.5. All that sloshing in the tank in Tom's trailer during those 200 miles from Old Forge to Batavia NY surely caused the front ends of the fuel to escape, reducing volatility. [If you Google YouTube/ Jim Czekala/ Reid Vapor Pressure/ Volatility you can see how we test fuel's volatility and how we can fix stale race gas before dyno tuning race engines]. And since ethanol has some O2 in it, we decided to pump out the old fuel and replace it with fresh 89 or 93 octane ethanol fuel. Tom bought five gallons each of 89 and 93 ("up to" 10% ethanol) to see if we could make 170+. We started with the "89" which actually tested at 88.3 with only 4.6% ethanol, but that was enough to add the 1.5 HP we needed to go over 170. We never did try the 93. Was the slightly increased HP due to the O2 in the ethanol, the improved vaporization of the higher RVP (improved vaporization will result in more of the mixture being burned—resulting in less globs of unvaporized fuel *absorbing* heat instead of adding to it), or the slightly higher burning speed of the more completely vaporized fuel (= same result as increasing timing advance)? Or was it a combination of all of the above?

With the fresh fuel, we ran several back to back 170 HP dyno tests (as evidenced by the real time graph on the dyno computer that follows the test data). Here's a 170+ dyno test. 170.1 is way better than 169.9!

2017 Etec 850

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFA_B lb/hph	FulA_B lbs/hr	ElpsTm Secnds	LamAF1 Ratio	Air_1s SCFM	FulPrA psig
6900	131.6	100.2	0.662	82.5	0.72	13.55	234.6	47.3
6950	132.1	99.9	0.663	82.9	0.96	13.53	236.0	47.3
7000	133.6	100.2	0.664	84.0	1.41	13.49	238.5	47.2
7050	135.4	100.8	0.660	84.5	1.61	13.46	240.3	47.2
7100	137.7	101.9	0.654	85.3	1.95	13.41	242.0	47.2
7150	139.5	102.5	0.650	85.8	2.17	13.38	244.4	47.3
7200	141.2	103.0	0.646	86.3	2.39	13.34	246.5	47.3
7250	142.9	103.5	0.643	87.0	2.62	13.29	248.3	47.4
7300	144.8	104.2	0.641	87.8	2.94	13.20	250.2	47.4
7350	146.3	104.6	0.637	88.2	3.11	13.15	252.4	47.3
7400	148.2	105.2	0.633	88.8	3.41	13.05	254.6	47.3
7450	149.9	105.7	0.630	89.4	3.59	12.97	256.5	47.2
7500	152.0	106.4	0.627	90.2	3.82	12.88	259.6	47.2
7550	155.3	108.0	0.626	92.0	4.20	12.77	261.5	47.2
7600	157.6	108.9	0.622	92.8	4.41	12.73	263.3	47.1
7650	159.9	109.8	0.619	93.6	4.64	12.71	266.8	47.1
7700	162.0	110.5	0.615	94.2	4.92	12.68	268.2	47.1
7750	163.8	111.0	0.610	94.6	5.11	12.67	270.5	47.1
7800	165.5	111.4	0.607	95.0	5.40	12.67	272.7	47.1
7850	167.0	111.8	0.601	95.0	5.66	12.71	274.7	47.1

7900	168.3	111.9	0.595	94.7	5.91	12.77	277.3	47.1
7950	169.3	111.8	0.585	93.7	6.21	12.87	278.5	47.2
8000	169.9	111.6	0.575	92.4	6.56	12.96	279.7	47.2
8050	170.1	111.0	0.571	91.8	6.89	13.01	280.7	47.2
8100	169.6	110.0	0.572	91.7	7.19	13.05	281.9	47.2
8150	168.3	108.5	0.576	91.6	7.48	13.08	282.8	47.2
8200	166.2	106.5	0.581	91.2	7.78	13.11	283.2	47.1
8250	163.7	104.2	0.587	90.7	8.07	13.13	282.9	47.0
8300	158.0	100.0	0.565	84.2	8.50	13.11	282.1	46.9

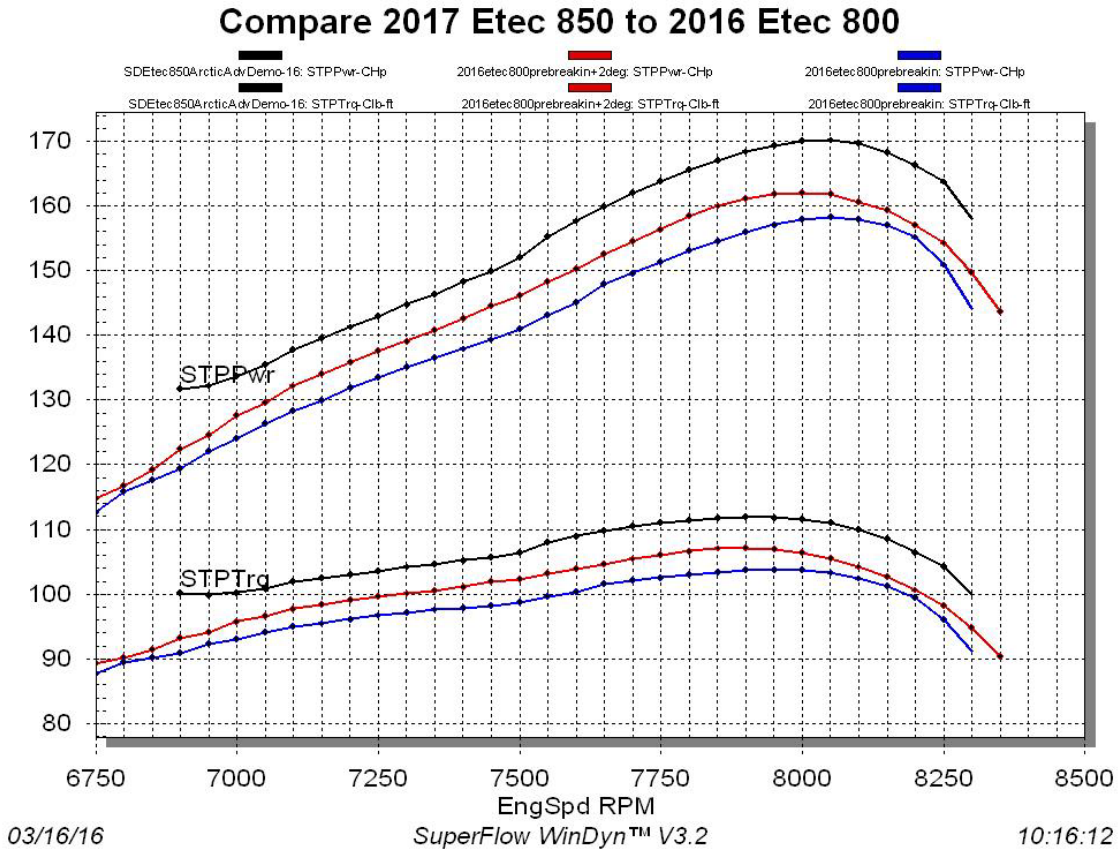


Here's more test data including observed (actual power EngPwrHP), SAE and STP correction factors. STP is obviously the most optimistic and even though it's technically obsolete, aftermarket dyno testers and DTR continue to use it, as we have for 29 years.

EngSpd RPM	EngPwr Hp	SAEPwr CHp	STPPwr CHp	SAECor Factor	STPCor Factor	Baro_P InHga	Humidy %	Vap_P InHg
6900	124.61	125.8	131.6	1.008	1.049	28.52	81.5	0.29
6950	125.10	126.3	132.1	1.008	1.049	28.52	81.5	0.29
7000	126.47	127.7	133.6	1.008	1.049	28.52	81.6	0.29

7050	128.15	129.3	135.4	1.008	1.049	28.52	81.6	0.29
7100	130.36	131.6	137.7	1.008	1.049	28.52	81.7	0.29
7150	132.07	133.3	139.5	1.008	1.049	28.52	81.7	0.29
7200	133.71	135.0	141.2	1.008	1.049	28.52	81.7	0.29
7250	135.29	136.6	142.9	1.008	1.049	28.52	81.8	0.29
7300	137.06	138.3	144.8	1.008	1.049	28.52	81.8	0.29
7350	138.52	139.8	146.3	1.008	1.049	28.52	81.9	0.29
7400	140.31	141.6	148.2	1.008	1.049	28.52	81.9	0.29
7450	141.87	143.2	149.9	1.008	1.049	28.52	81.9	0.29
7500	143.84	145.2	152.0	1.008	1.049	28.52	82.0	0.29
7550	146.92	148.4	155.3	1.008	1.049	28.52	82.0	0.29
7600	149.15	150.6	157.6	1.008	1.049	28.52	82.1	0.29
7650	151.24	152.7	159.9	1.009	1.049	28.52	82.1	0.29
7700	153.27	154.8	162.0	1.009	1.049	28.52	82.1	0.29
7750	154.90	156.5	163.8	1.009	1.049	28.52	82.2	0.29
7800	156.51	158.1	165.5	1.009	1.049	28.52	82.2	0.29
7850	157.96	159.6	167.0	1.009	1.049	28.52	82.2	0.29
7900	159.17	160.8	168.3	1.009	1.049	28.52	82.2	0.29
7950	160.04	161.7	169.3	1.009	1.049	28.52	82.3	0.29
8000	160.66	162.3	169.9	1.009	1.049	28.52	82.3	0.29
8050	160.79	162.5	170.1	1.009	1.049	28.52	82.3	0.29
8100	160.30	162.0	169.6	1.009	1.049	28.52	82.4	0.30
8150	159.01	160.7	168.3	1.009	1.050	28.52	82.4	0.30
8200	156.99	158.7	166.2	1.009	1.050	28.52	82.4	0.30
8250	154.58	156.2	163.7	1.009	1.050	28.52	82.5	0.30
8300	149.17	150.8	158.0	1.009	1.050	28.52	82.5	0.30

For comparison, this graph shows the broken-in but stock timing Etec 850, overlayed with a 2016 (still in breakin mode) with stock timing and with two degrees added timing. We are hoping that when we get BUDS2 to communicate with one of the 850's we'll see a similar improvement in torque and horsepower!



Tom Ferry and Jim Cooper, pleased with what they have for their customers this year!

Here’s the Reid Vapor Pressure test results of the “stale” winter pump gas.