2011 Polaris ProR 800 stock engine evaluation Jim Czekala

Casey Mulkins brought the newest performance model from Polaris to DTR for evaluation. The dealership Casey techs for—Three Seas Marine of Mayville NY sold this sled to local hotrodder Rob Maring who offered it up for dyno testing/ tuning.

But first Casey had to run the sled for 2.2 hours to get beyond the "breakin mode". This info was obtained from Polaris engineering, so Casey and Rob ran the sled just beyond the 2.2 hours as verified by the Polaris Digital Wrench ECU communication software.

To be sure, Casey brought along an ECU from a showroom sled with 4 minutes run time to compare dyno data.

This was the first official use of our new refrigeration system that is designed to provide cold dry winter air to the sleds' intakes regardless of outside weather conditions. Three commercial walkin freezer compressors and condensers purchased from Wayne Stoutner draw outside air into an insulated cold room—removing excess moisture and dropping temperature to below 20 degrees F. That cold dry air is ducted into the dyno room, and through the SuperFlow airflow meter mounted on the wall, then ducted directly into the sleds' air intakes. Remember how we struggled with the new Cat 800s in changing, humid air late last winter? The dyno computer can compensate somewhat to get us reasonable repeatability in changing conditions, but the sleds' ECUs have a mind, and programming of their own! Plus sleds' ECUs have no way of compensating for humidity in the air. Since sleds are said to be EPA tested at 70 degrees F, then it's understandable that everyone would be lean and clean and powerful during EPA testing. But when the cold weather arrives, all bets are off—let's make sure we have zero warranty issues even when sledders run that 75 octane stuff, purchased from the marina, left over from last summer!

Because of that scenario, I have suggested that EFI sled tuners wait until winter to dyno their machines. That's been the reason it's been so crazy here during the cold winter months. But we can't wait for winter to test new sleds like this ProR 800 will really perform, so our new "fridge" deal is especially useful.

Here is Rob's new machine, fed with 27-30 degree F dry air. We tested only with 93 octane gas, all of which in this region is supposed to be 10% ethanol. In this case, testing Rob's gas with the Briggs and Stratton ethanol tester left here by Billy Howard, we found that it was actually 8% ethanol. For the first set of tests, we used the ethanol resistor, which is supposed to enrichen mixture by 5% over the non-ethanol resistor that also comes with the sled. During each dyno test, coolant temp at the HP peak was 120-125 degrees F, and pipe center section temperature was 1100 degrees F or hotter.

We ran three or more tests like this, all within a few tenths of a HP. And just like the preproduction sled Casey brought here last spring, this one has a dandy, smooth dip-free HP curve that, unlike last year's Dragon 800, makes it difficult to discern just where those exhaust valves open. And just like the preproduction sled, this one was 143 HP with a reasonably decent A/F ratio unlike previous Dragon 800s which made similar power with much fatter A/F ratio! And here we noted that the airflow SCFM was lower than the preproduction 800, and way lower than the Dragon 800s. But perhaps this is due, in part, to the fact that we now have the airflow meter mounted remotely, with five cubic feet of duct between the meter and

the airbox. This may be dampening out intake air pulses that can slightly inflate airflow readings. I'll know more when we get our next stock Dragon 800 to test with the new dyno engine air intake system.

2011 ProR 800 with 93 octane ethanol fuel, ECU out of break in mode, set for ethanol fuel

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	AFRA_B	Air_1s	AirInT
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	SCFM	degF
5700	80.8	74.5	0.522	41.8	15.4	141	
5800	81.7	74.0	0.533	43.3	15.0	142	
5900	83.6	74.4	0.536	44.5	14.8	144	
6000	85.7	75.0	0.518	44.1	15.1	146	
6100	88.0	75.8	0.533	46.6	14.6	149	
6200	90.7	76.8	0.553	49.8	14.0	153	
6300	93.0	77.5	0.549	50.8	14.0	155	
6400	95.2	78.2	0.583	55.2	13.1	158	
6500	97.2	78.6	0.601	58.0	12.7	161	
6600	99.4	79.1	0.590	58.3	12.9	164	
6700	101.3	79.4	0.628	63.2	12.2	168	
6800	105.9	81.8	0.643	67.7	11.8	175	
6900	110.6	84.2	0.647	71.1	11.6	180	
7000	114.4	85.9	0.643	73.2	11.5	183	
7100	117.0	86.6	0.657	76.5	11.1	186	
7200	119.9	87.4	0.636	75.8	11.5	190	
7300	122.7	88.3	0.651	79.5	11.2	194	
7400	127.0	90.2	0.628	79.4	11.4	198	
7500	131.9	92.4	0.612	80.4	11.5	202	
7600	135.1	93.4	0.599	80.6	11.6	205	
7700	138.0	94.2	0.606	83.4	11.4	207	
7800	139.9	94.2	0.592	82.5	11.5	208	
7900	141.2	93.9	0.579	81.5	11.7	208	
8000	142.3	93.4	0.565	80.2	11.9	208	
8100	142.7	92.5	0.551	78.3	12.2	209	
8200	143.2	91.7	0.549	78.4	12.2	209	
8300	142.4	90.1	0.557	79.2	12.1	208	
8400	139.9	87.5	0.558	77.9	12.2	208	
8500	134.4	83.0	0.581	77.9	12.1	207	

Next, to be sure the 2.2 hour breakin time that Casey had exceeded was proper, we installed the new ECU commandeered from a new sled on Three Seas' showroom floor. This one had only a few minutes run time as indicated by Digital Wrench. During this test, Casey checked ignition timing and it was virtually identic to the peak RPM timing in the ECU with 2.5 hours on it. So it appears that the only breakin feature is adde fuel flow that reduces heat and HP as shown here.

2011 ProR 800 with 93 octane ethanol fuel, ECU IN break in mode, set for ethanol fuel

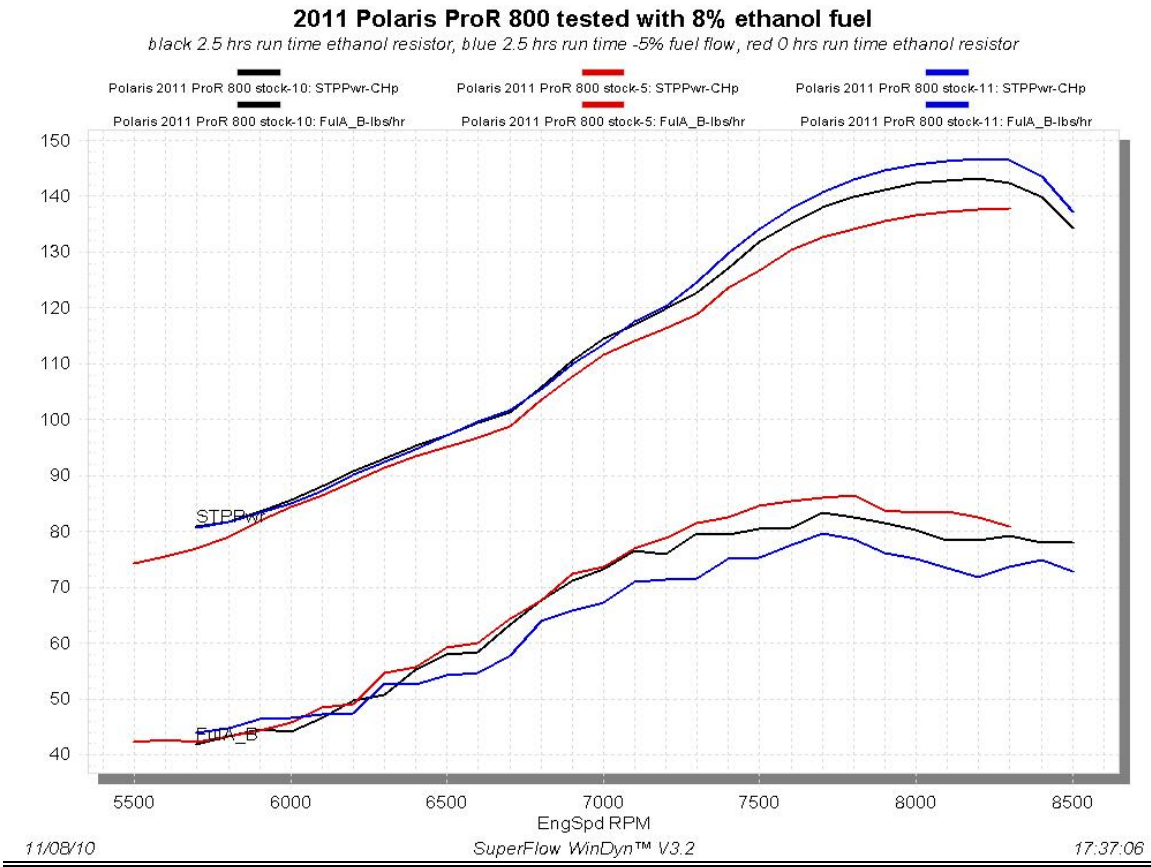
EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	AFRA_B	Air_1s	AirInT
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	SCFM	degF
5500	74.3	71.0	0.573	42.3	15.1	139	
5600	75.4	70.7	0.569	42.6	15.0	140	
5700	77.0	71.0	0.553	42.3	15.3	141	
5800	79.0	71.5	0.552	43.3	15.1	143	
5900	81.8	72.8	0.546	44.3	14.9	145	
6000	84.5	73.9	0.547	45.8	14.7	147	
6100	86.4	74.4	0.565	48.5	14.1	149	
6200	89.0	75.4	0.555	49.0	14.3	153	
6300	91.3	76.1	0.602	54.6	13.1	156	
6400	93.5	76.7	0.600	55.7	13.1	159	
6500	95.0	76.8	0.627	59.2	12.5	162	
6600	96.8	77.0	0.626	60.1	12.6	165	
6700	98.8	77.5	0.656	64.4	12.1	170	
6800	103.6	80.0	0.657	67.6	11.9	176	
6900	107.6	81.9	0.676	72.3	11.5	181	
7000	111.6	83.7	0.665	73.7	11.5	185	
7100	114.0	84.3	0.679	77.0	11.2	188	
7200	116.4	84.9	0.681	78.8	11.2	192	
7300	118.9	85.6	0.690	81.5	11.0	195	
7400	123.6	87.7	0.671	82.5	11.1	200	
7500	126.8	88.8	0.670	84.5	11.0	203	
7600	130.3	90.1	0.659	85.4	11.1	207	
7700	132.7	90.5	0.652	86.0	11.1	209	
7800	134.1	90.3	0.648	86.5	11.1	210	
7900	135.6	90.1	0.620	83.6	11.5	211	
8000	136.7	89.7	0.613	83.4	11.6	211	
8100	137.3	89.0	0.611	83.5	11.6	211	
8200	137.7	88.2	0.602	82.6	11.7	211	
8300	137.9	87.3	0.590	80.9	11.9	211	

Finally for today, we leaned out the fuel mixture by about 5% by inserting the non-ethanol resistor in place of the ethanol resistor. This brought the A/F ratio into the max HP range around 13/1 which showed zero detonation on the Digital Wrench during the dyno session. We were able to duplicate this A/F ratio with a power Commander 5 prototype unit—we created a map that pulled even more fuel from the hump at torque peak, but added no power compared to just plugging in the leaner resistor. But fooling the ECU with the wrong resistor may invite some annoying midrange leanness. Only driving will tell. But the people who

want max power from their ProR800 stockers where only non-ethanol fuel is available will need to reduce fuel with PCV, Boondocker, or other tuners that can reduce fuel flow at only WOT by a similar amount.

2011 ProR 800 with 93 octane ethanol fuel, ECU out of break in mode, set for non-ethanol fuel

EngSpd	STPPwr	STPTrq	BSFA_B	FulA_B	AFRA_B	LamAF1	Air_1s
RPM	CHp	Clb-ft	lb/hph	lbs/hr	Ratio	Ratio	SCFM
5700	80.7	74.4	0.547	43.8	14.8	15.0	
5800	81.6	73.9	0.553	44.8	14.6	14.9	
5900	83.3	74.2	0.560	46.3	14.3	14.7	
6000	84.9	74.4	0.553	46.6	14.4	14.7	
6100	87.3	75.2	0.545	47.2	14.6	14.5	
6200	90.1	76.3	0.531	47.4	14.7	14.5	
6300	92.4	77.1	0.574	52.7	13.5	14.4	
6400	94.8	77.8	0.559	52.6	13.8	14.2	
6500	97.1	78.5	0.562	54.2	13.6	14.0	
6600	99.6	79.3	0.551	54.6	13.9	14.1	
6700	101.6	79.7	0.572	57.8	13.3	14.1	
6800	105.5	81.5	0.609	63.9	12.5	14.0	
6900	109.9	83.7	0.601	65.7	12.5	13.6	
7000	113.5	85.1	0.597	67.3	12.5	13.5	
7100	117.5	86.9	0.607	70.9	12.1	13.2	
7200	120.3	87.7	0.596	71.3	12.2	13.1	
7300	124.6	89.7	0.577	71.5	12.5	13.0	
7400	129.7	92.1	0.582	75.2	12.1	13.0	
7500	134.1	93.9	0.564	75.2	12.3	13.0	
7600	137.8	95.2	0.566	77.6	12.1	13.0	
7700	140.7	95.9	0.568	79.5	11.9	12.9	
7800	142.9	96.2	0.553	78.6	12.1	12.8	
7900	144.6	96.2	0.528	76.0	12.6	12.8	
8000	145.7	95.7	0.518	75.1	12.7	13.0	
8100	146.3	94.9	0.504	73.4	13.0	13.1	
8200	146.7	94.9	0.501	72.7	13.2	13.2	
8300	146.5	92.7	0.505	73.7	13.0	13.3	
8400	143.7	89.8	0.524	75.0	12.7	13.2	
8500	137.3	84.8	0.533	72.9	13.0	13.1	



Casey has indicated that the cylinders' port timing is more conservative (ie: lower) than the Dragon 800. Remember, Casey made way more power on his D8 with *raised* ports compare to stock. So why would the ProR 800 have lowered cylinders? Emissions? Big torque and HP off the bottom? Drivability?

Or could it be, at least in part, the need to have ample cylinder pressure to slam those exhaust valves open, exactly when commanded? As I indicated in the prior discussion here about the possible cause of the mysterious lean midrange that has plagued many Dragon 800 owners, the mechanical cylinder pressure operated exhaust valves may be the culprit! Remember, if those valves stay closed when the ECU thinks they are open, airflow will climb with insufficient fuel flow and leanout/ stumble/ deto/ seizure can occur. Late opening valves can cause airflow to *increase as revs climb—the opposite of what we might expect!*

Perhaps, by lowering exhaust ports a bunch, the part throttle cylinder pressure reaching the exhaust valves many times higher than we experienced with the Dragon 800s. This could make those pesky pressure operated exhaust valves slam open on demand, eliminating the strange and inconsistent lean midrange that may have cost Polaris millions in warranty claims and gave Dragon 800s—an otherwise excellent machine—a bad rap. So did Polaris just sacrifice a few ProR 800 HP in exchange for perfect synchronization of exhaust valves and ECU commands?

Casey Mulkins is planning to create a batch of cylinder shims to match the port timing of the powerful Dragon 800 that he rode last year. He will also need to machine the stock heads to compensate, perhaps necessitating dropping the combustion chambers down into the cylinders to maintain that nice tight squish

clearance. Maybe Sean Ray can get involved in that project, utilizing his CNC machined combustion chamber shape that has worked well in the Dragon 800 engines.

By then, the pipe people may have stuff to try (nothing was available as of 11/8/2010). 170 plus HP should be doable if we can keeps revs fairly high and torque below 110 lb/ft (that seems to be about the pump gas limit at below 8000 RPM at low altitude). But Casey says the new chassis' cooling system is far superior to the Dragon's, so maybe this engine can run knock-free beyond 110 lb/ft. But will those higher exhaust port cause us to be lean in the midrange? A little midrange fuel tuning will cure that. More to come.