2003 Polaris ProX 440 stock evaluation
The pushbutton flamethrower is the best invention that Sean and I have ever come up with!
By Jim Czekala

In the fall of 2001, DynoTechResearch contributing editor/ engine/ clutch/ shock/ chassis guru Sean Ray dyno tuned his 2002 Polaris 440 snow cross sled here, and discovered just how critical pipe center section temperature is in order to make maximum HP quickly with this engine. As we have experienced in the past with some other sleds, notably the XCR600, the 440 single pipe needs to be "smoking" hot to have quick enough sound waves and enough backpressure to make good off-the-line power for that all important holeshot (more information of this phenomenon is detailed in several early DynoTech issues). For a race sled this is a dilemma; while it's practical/ possible to create adequate pipe center section temperature before the start of a race, it requires the sled to placed on a jack stand and the engine wailed repeatedly until the pipe temperature becomes hot enough (ie: doubling the temp K of the exhaust gas in the tuned pipe with a fixed pressure bleed = nearly double the backpressure...use your google search for the "ideal gas law" for clarification). Sean and his teammates knew what pipe center section temperature they needed to create that ideal backpressure (backpressure in the exhaust is extremely critical to assist the returning sound wave in "supercharging" the two-cycle engine) and power peak, but by the time that could be achieved the engine coolant would be very hot which negated a lot of the gain of the "properly" heated pipe.

The best of both worlds on this particular sled is a cool engine (for maximum combustion air density) and smoking hot pipe (for proper backpressure and constant RPM power peak from holeshot to the end of the race).

In November '01, Sean and I brainstormed about this situation with the '02 440 pipe. Why not momentarily retard the timing severely to preheat the pipe? This sled has a double timing map in the ignition module controlled by a dash-mounted switch (one map is more advanced for extra power with high octane gas). Obviously on a race sled the low octane timing curve would never be used, so why not get that curve reprogrammed to allow the driver to temporarily severely retard the timing with a button-operated relay? Retarding ignition timing drastically increases EGT and at the same time reduces combustion chamber heat. Our idea was to have Polaris custom program the low octane ignition curve to fire just before the exhaust port opens so most of the A/F mixture would burn inside the tuned pipe. We wanted to create just enough combustion chamber pressure to maintain 5000 rpm at WOT (just below clutch engagement), perhaps sounding and acting like a creosote fire in a woodstove chimney. A button operated relay could allow Sean and his teammates to hold the retard curve before the start of each race, then switch to full advance as the green flag is waved, acting like a two-step ignition on drag bikes/ cars. Their competitors might even feel compassion for them the first time they lined up for the start, as their sleds gurgled and popped with seemingly fouled sparkplugs, as their pipes came into the proper temp range!

Sean relayed a request to the Polaris race dept for a reprogrammed ignition, to try a flat 20 degree ATC curve in the regular gas mode. Instead, Polaris sent a box reprogrammed to about 20 degrees ATC only at 5500 rpm, but normal everywhere else, and it was useless because you couldn't hold the engine speed there even at part throttle. Subsequent requests for the fully reprogrammed curve went unanswered, with Polaris contacts indicating that the ignition was not able to be programmed to the extreme recurve that Sean requested. For the remainder of the race season, Sean and his teammates resorted to a combination of jackstand preheating and part to full throttle braking on the line to obtain the necessary pipe heat, albeit at the expense of hotter engine/ coolant temp. But more often than not, they could start the race at or near the front with that method.

One year later, along comes the new production 2003 Polaris ProX 440, with a "mystery" button on the handlebar. Before Sean and I dyno tested the sled for this article, Sean fired the sled up in our front lawn, depressed the button and engine hung at about 5000 RPM and stayed right there, whooshing and popping, just below clutch engagement, as the throttle was held wide open! Then, releasing the button the sled took off blasting a rooster-tail of sod from my previously well manicured lawn. Obviously to us, this was our idea and Polaris had robbed it from us. Sean had a fit when he saw how well our idea worked on the new sled, and he was even more distraught when he saw the "patent pending" sticker on the CDI!

To show the importance of a cool engine and hot pipe, Sean dyno'd this sled while measuring the exhaust gas inside the center section of the single pipe. An exhaust probe was inserted into the center section, next to the stock temp probe that is used by the ECU to optimize the pipe temp. The stock pipe/ engine combo is tuned to make an incredible 105+ HP (this power level is equivalent to the highly tuned, 10,000 rpm 440 factory hot rods with 44mm carbs and twin pipes during the late '70's tested on our "stingy" dyno!). But, part of the trade-off for this incredible HP number at only 8500 rpm is that the engine performance in the midrange can be described as "cantankerous". From clutch engagement to 8000 rpm, the dyno has difficulty holding the engine steady enough to obtain accurate torque readings, so meaningful data is only achieved from about 8100 on up. Lean 240 main jets provided maximum top end power with 100+ octane race gas in 45 degree F air, and probably contributed to some of the midrange surginess. According to Sean that midrange surging has little effect on field operation since the engines are operated at WOT most of the time.

2003 Polaris ProX 440, COOL center section temp data…

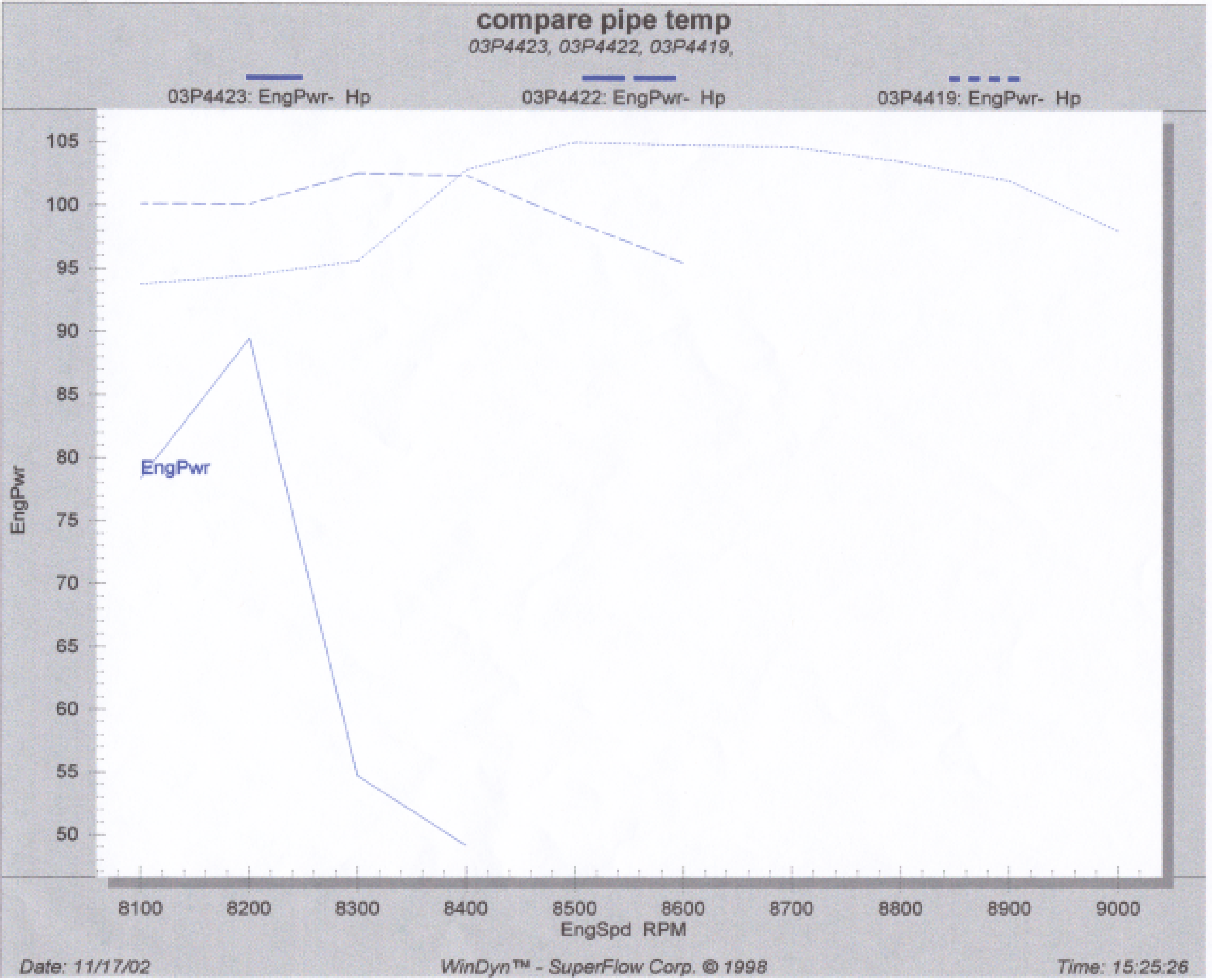
EngSpd	EngTrq	EngPwr	AirTmp	BSFC	WtrOut	Fuel B	CentSect
RPM	lb-ft	Hp	degF	lb/hphr	degF	lb/hr	EGTdegF
8100	50.8	78.4	43	0.68	62	51.7	403
8200	57.3	89.5	43	0.63	63	54.4	428
8300	34.6	54.7	43	1.07	63	56.6	502
8400	30.7	49.1	43	1.19	63	56.6	507

2003 Polaris 440 ProX, MEDIUM center section temp data…………………………..

EngSpd	EngTrq	EngPwr	AirTmp	BSFC	WtrOut	Fuel B	CentSect
RPM	lb-ft	HP	degF	lb/hphr	degF	lb/hr	EGTdegF
8100	64.3	99.2	48	0.58	67	57.4	686
8200	63.3	98.8	48	0.58	67	57.4	687
8300	61.9	97.8	48	0.59	67	57.4	703
8400	61.8	98.8	48	0.58	67	57.4	706
8500	61.8	100	48	0.59	67	58.5	708
8600	61.8	101.2	48	0.61	67	61.7	708
8700	55.5	91.9	49	0.67	68	62	731
8800	32.1	53.8	48	1.12	69	60.3	749
8900	26	44.1	47	1.32	69	58.2	760
9000	22.9	39.2	46	1.56	69	61.3	760

2003 Polaris 440 ProX, HOT center section t temp data…

EngSpd	EngTrq	EngPwr	AirTmp	BSFC	WtrOut	Fuel B	CentSect
RPM	lb-ft	Hp	degF	lb/hph	degF	lb/hr	EGTdegF
8100	60.8	93.8	45	0.61	87	57	918
8200	60.5	94.5	44	0.61	87	57.8	919
8300	60.5	95.6	45	0.62	87	58.8	919
8400	64.3	102.8	45	0.57	88	58.4	926
8500	64.9	105	45	0.56	89	59	937
8600	64	104.8	45	0.57	90	59.2	946
8700	63.2	104.7	45	0.57	91	60	957
8800	61.8	103.6	45	0.56	92	57.9	966
8900	60.2	102	45	0.58	94	58.7	979
9000	57.2	98	45	0.65	97	64.1	990


compare pipe temp
03P4423, 03P4422, 03P4419,
03P4423: EngPwr- Hp
03P4422: EngPwr- Hp
03P4419: EngPwr- Hp
EngPwr
105
100
95
90
85
80
75
70
65
60
55
50
EngPwr
8100
8200
8300
8400
8500
8600
8700
8800
8900
9000
EngSpd RPM
Date: 11/17/02
WinDyn™ - SuperFlow Corp. © 1998
Time: 15:25:26