POLARIS XC600 PERFORMANCE TUNEUP
By Jim Czekala

This is John T. Cowie's 2001 XC600 (exhaust valve model) with 1000 miles on the odometer. The following series of dyno runs are the result of several days of testing by Sean Ray that added close to 10 HP on this otherwise stock machine. John T's riding is mostly fast trail/ haylot dragracing with full throttle limited to 1/4 mile at a time when 93 octane gas is used. We know this combination is safe for since it was trouble-free all last winter. Test data is shown from midrange to top end (7-8000). On many of these high power twins, low RPM WOT dyno testing is too "surgy" to provide meaningful repeatable data. Airflow data is not included since the stock airbox has the steering tube running through it and sealing around it is poor--getting accurate airflow meter readings is difficult. Inconsistent sealing can also cause fuel flow variation since the carb vent hoses are connected to the airbox. For example, if we didn't refit the airbox to the carb adapter correctly, fuel flow would increase because of the very slight drop in negative pressure. We like the fact that float bowls are vented into the box where they should be, but haphazard resealing can throw our desired fuel flow consistency out the window.

One positive change in the XC600 for 2004 is the water pump impeller speed has been doubled to increase coolant flow. Also, an additional tunnel heat exchanger has been added. These two new features improve combustion chamber cooling which increases resistance to detonation. Mod class snowcross racers discovered last season that they could run leaner and more powerfully, deto-free when they modified their crankshaft water pump drive gears (larger on the crank, smaller on the waterpump drive). This race mod was so successful, it was adopted by Polaris for production this year. Adding horsepower to any sled would warrant monitoring engine coolant temperature, especially when 100 HP cooling systems are asked to keep up with 150 HP (or more) worth of engine heat. That scenario is OK for short burps but on long lake runs or hillclimbs coolant temp can rise to dangerous levels inviting detonation. What temperature is "safe"? Colder is always better, assuming vaporization is decent. "Cold seizures" are usually the result of poor fuel vaporization, where too much fuel blows through the engine in unburnable blobs, effectively leaning out the engine into detonation and/ or piston seizure. That is one of the reasons why factories jet their stockers to .80 lb/hphr. Those of us who jet for high power (.65 lb/hphr on pump gas) must be careful to warm engines reasonably before running WOT. Warm engines help fuel to vaporize at the expense of some power (since the intake air is preheated more, making it less dense). This XC600 has a 120 degreeF thermostat which for most riders is a good all around temperature to operate at. But, without a gauge to monitor coolant temp (at the thermostat housing outlet) hard riders/ racers who exceed their cooling system capacity can get into trouble.

Back to John T's test session. To safely compensate for the 85 degree 29.2 in hg air, 340 main jets were used on the bone-stock engine. Later model carbs can be jetted leaner, since there is no airbleed the fuel flow appears 5-10% higher at WOT with the same main jets. Test #02JT801 is our bone stock baseline with the ignition switch turned to the premium gasoline setting.

Next, we bumped to ignition timing another two degrees by advancing the stator @1/8th inch. Test #02JT802 resulted in more torque and HP throughout the power band.

For test #02JT803 we installed Vforce Delta II reeds in the engine, leaving carburetion as is. Note that the fuel flow increased from 78 to 83 lb/hr, negating any benefit of just installing the reeds. This is probably as the result of "multiple carburetion" which could be caused by intake charge being forced back out the reed cages (maybe the reeds hang open more during the power stroke?). Every time air passes over the needle jet, regardless of direction, it picks up more fuel. So on test #02JT805 we tweaked the carburetion to compensate, dropping fist two sizes, but eventually winding up with one size leaner to show the reeds netted us about one HP all the way through the power band with BSFC corrected.

We lost torque and HP dramatically with the addition of a plastic Phazer-like boost bottle that connects the two carb boots, test #02JT806. Even though the boost bottle dropped our fuel flow, BSFC was still crisp in the mid .60's. After this test we removed the boost bottle and plugged the carb flanges.

Next we raise the cylinders with a custom basegasket suggested to Sean by Rich Daly of DynoPort. Rich had picked up on this in his previous (futile) attempt to design a trail pipe better than stock. The stock basegaskets are about .018" thick, and the custom gaskets are .029" thicker (total .047"). We also installed a head that had been cut .040" which would restore the lost compression, with a net of .011" tighter squish. Test #02JT808 was typical, with excellent torque and HP increase with a still-safe BSFC of .70 lb/hphr.

So we decided to lean it down two sizes to 310 (remember this is good for pump gas at 85 degreeF air temp--use your Mikuni Slide Rule to compensate!) and test #02JT810 resulted.

To test the effectiveness of the stock quiet airbox, we removed the shelf with the two long but smallish-looking air horns. Test 02JT813 showed a modest HP increase, probably mostly due to the reduced fuel flow. Adjusting the jetting two sizes to 330 brought the fuel flow back in line then seemed to negate our power increase. Test #02JT814 verifies the effectiveness of the bone stock airbox at this power level.

We left the shelf out, and cranked the last two degrees of timing into the engine by moving the stator all the way to the end of the slots. This is for dragracing, and a couple of extra HP throughout. Test #02JT815.

Finally, John T dug his boost bottle out from beneath the empty pizza box in the trash can to give it one more shot. Test #02JT817 showed that it was as bad on the tweaked engine as it was on the stocker. This does not mean everyone needs to plug their boost bottles! They helped a bit on Phazers, most Vmax 4's (Yamaha's FIII Vmax 750 race engines made more HP w/o the bottles). It shows the need for instrumented dyno testing when dialing in any performance mods. It also shows that we need to be doing more of this sort of detailed testing, since one HP here and one HP there can easily be negated by two negative HP from a mistake like this. Gaining or losing one or two HP is extremely difficult to find or to feel in the field, but when you add them up like we did on this engine, the gain is unmistakable in the field.

Next comes the clutch setup that works for John T., courtesy of our clutchmeister Sean Ray.

2001 POLARIS XC600 TUNEUP

02JT801 stock baseline, ignition switch set for premium fuel

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	74.7	102.3	83	0.74	72.5
7300	74.8	103.9	83	0.73	72.5
7400	76.6	107.9	84	0.71	73.1
7500	78.1	111.5	84	0.69	73.1
7600	77.7	112.4	83	0.69	73.7
7700	78.1	114.5	83	0.69	75.1
7800	78.1	115.8	83	0.71	76.8
7900	78.1	117.4	84	0.71	77.4
8000	77.1	117.5	84	0.69	77.1
8100	75.7	116.7	84	0.69	76.5
8200	74.3	116.1	84	0.71	76.9

02JT802 advance ignition timing two degrees

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	75.8	103.9	83	0.76	75.7
7300	76.7	106.7	83	0.71	72.9
7400	77.3	108.9	83	0.71	72.8
7500	78.3	111.9	82	0.69	73.8
7600	79.3	114.8	83	0.68	74.7
7700	79.7	116.8	82	0.68	76.6
7800	79.4	117.9	81	0.69	78.2
7900	78.6	118.2	81	0.69	78.7
8000	77.1	117.5	81	0.71	78.7
8100	74.4	114.8	82	0.71	78.5

02JT803 install delta force II reeds (note fuel flow increase)

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	75.6	103.7	84	0.76	75.5
7300	76.2	106.1	84	0.76	77.4
7400	78.1	109.9	84	0.74	78.3
7500	78.8	112.5	82	0.73	79.5
7600	79.6	115.2	82	0.73	80.6
7700	79.7	116.8	83	0.73	81.7
7800	79.5	118.1	84	0.72	81.8
7900	78.6	118.3	84	0.73	82.8
8000	77.2	117.6	84	0.74	83.1
8100	73.7	113.6	84	0.76	82.2

02JT805 reduce main jets one size to correct fuel flow

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7100	75.1	101.4	83	0.76	73.8
7200	75.1	103.1	84	0.75	73.8
7300	75.7	105.2	83	0.73	73.9
7400	77.8	109.7	83	0.72	76.1
7500	78.1	111.5	83	0.71	76.4
7600	80.1	115.8	84	0.71	77.8
7700	80.1	117.3	84	0.71	79.2
7800	79.8	118.6	84	0.71	79.1
7900	79.3	119.3	84	0.71	80.3
8000	78.2	119.1	83	0.71	80.6
8100	75.7	116.8	84	0.73	81.2

02JT806 install aftermarket plastic boost bottle in carb boots

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	73.5	100.8	85	0.69	66.6
7300	75.1	104.4	85	0.68	67.7
7400	76.1	107.1	85	0.66	68.1
7500	77.2	110.2	84	0.65	69.1
7600	78.4	113.5	85	0.65	70.8
7700	78.3	114.9	84	0.66	72.4
7800	78.8	117.1	85	0.65	72.3
7900	78.2	117.7	85	0.66	74.1
8000	77.6	118.2	85	0.66	74.3
8100	75.9	117.1	86	0.67	74.4
8200	72.9	113.8	87	0.71	75.8

02JT808 remove boost bottle, install thicker basegasket/ cut head

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7300	75.8	105.3	85	0.75	76.1
7400	77.4	109.1	84	0.75	78.4
7500	78.9	112.7	83	0.72	78.4
7600	80.1	115.8	83	0.71	79.1
7700	81.2	119.1	85	0.71	80.1
7800	81.2	120.5	85	0.71	80.8
7900	81.2	122.1	85	0.69	81.2
8000	80.1	121.8	84	0.71	81.8
8100	77.5	119.5	84	0.73	83.3

02JT810 reduce main jets two sizes

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	72.6	99.5	85	0.71	67.1
7300	72.5	100.8	84	0.71	67.7
7400	76.1	107.3	84	0.68	69.6
7500	77.5	110.6	84	0.67	70.8
7600	79.6	115.2	85	0.65	71.9
7700	80.1	117.4	85	0.65	72.6
7800	81.3	120.7	85	0.63	73.3
7900	81.3	122.3	85	0.63	74.1
8000	81.1	123.5	85	0.63	74.4
8100	80.5	124.2	84	0.64	76.3
8200	78.2	122.1	85	0.65	75.8
8300	73.9	116.8	86	0.69	76.9

02JT813 remove shelf from airbox (note leaner fuel flow)

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	72.1	98.7	85	0.67	63.1
7300	72.1	100.1	86	0.66	63.3
7400	76.5	107.7	86	0.63	65.4
7500	78.2	111.7	86	0.63	67.3
7600	78.9	114.1	86	0.62	67.2
7700	81.1	118.7	85	0.61	68.1
7800	81.1	120.2	85	0.61	68.7
7900	81.3	122.3	85	0.59	69.6
8000	81.6	124.2	87	0.59	70.6
8100	81.1	125.1	87	0.61	71.5
8200	79.7	124.5	87	0.61	72.2
8300	77.1	121.9	86	0.63	72.9

02JT814 increase main jets two sizes

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	72.5	99.3	85	0.71	66.7
7300	73.1	101.5	84	0.71	68.3
7400	74.7	105.3	85	0.68	68.8
7500	78.8	112.6	87	0.65	70.2
7600	79.1	114.5	86	0.65	71.1
7700	80.1	117.3	86	0.65	73.2
7800	80.1	118.9	86	0.65	73.5
7900	80.6	121.3	86	0.64	74.1
8000	80.2	122.2	86	0.63	74.1
8100	79.7	123.1	86	0.64	75.8
8200	78.7	122.8	88	0.66	77.6
8300	75.8	119.7	88	0.68	77.1

02JT815 increase ignition timing two more degrees for dragracing

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7300	76.2	105.9	85	0.69	70.1
7400	76.1	107.3	85	0.69	70.6
7500	76.4	109.2	85	0.68	70.8
7600	80.2	116.1	84	0.65	72.6
7700	81.1	119.1	84	0.64	72.6
7800	82.3	122.2	84	0.64	73.8
7900	82.2	123.6	84	0.64	75.1
8000	82.5	125.6	85	0.63	75.6
8100	81.8	126.1	85	0.64	76.3
8200	79.1	123.3	85	0.65	76.3
8300	74.7	118.1	85	0.69	76.9

02JT817 try the boost bottle w/ raised cylinders

EngSpd	STPTrq	STPPwr	AirTmp	BSFC	Fuel B
RPM	Clb-ft	CHp	degF	lb/hph	lb/hr
7200	70.6	96.8	86	0.65	60.1
7300	70.5	98.1	86	0.64	59.8
7400	71.6	100.9	86	0.62	60.1
7500	75.7	108.2	86	0.61	62.9
7600	76.2	110.2	86	0.62	63.5
7700	78.1	114.4	86	0.61	65.1
7800	79.5	118.1	86	0.59	66.9
7900	80.1	120.5	86	0.59	67.7
8000	80.1	121.9	86	0.59	68.2
8100	79.3	122.3	86	0.62	69.5
8200	78.3	122.3	87	0.61	70.1
8300	75.1	118.5	87	0.63	71.4