

Stock engine Yamaha Nytro with Stage II Full Power Performance turbo system report by Jim Czekala

Justin Fuller, owner of Full Power Performance (www.fullpowerperformance.com) creates and manufactures turbocharger systems for many different sleds, bikes and ATVs. This Nytro system is one of his best sellers—with the proper supplied EFI tune and appropriate pump or race gasoline, a bone stock engine can be reliable, as shown here, at very high power levels.

A feature unique to the FPP Nytro Turbo system is the mounting of the Garrett GT2560 turbocharger in the back of the sled. This allows the hot compressed charge air to be cooled by twin air-to-snow and water intercoolers mounted above the track—one on each side of the tunnel. With the FPP system, charge air is split at the turbo compressor outlet, and directed to each side of the tunnel through finned aluminum extrusions. Typical front mounted air to air intercoolers often get little airflow for cooling even at high vehicle speeds due to stock hood design. They are fine for intermittent use because their aluminum mass will absorb charge air heat momentarily. But front mounted intercoolers shielded by plastic bodywork can become hot during extended periods of operation on boost—even to the point of being “interheaters”. Trail riders can blast WOT for a few seconds, exchanging heat from charge air to the mass of the intercooler—then during cruise the hot intercooler will be cooled *internally* by the cool un-boosted intake air that follows. The worst-case scenario is mountain climbing madmen who enjoy big boost at relatively low vehicle speeds for long periods of time. But the FPP tunnel heat exchangers get blasted with snow regardless of vehicle speed, as long as track speed is high. Incredibly, with the FPP system charge air temperature entering the engine can be equal to, or even lower than ambient in high boost, high track speed conditions! Cool intake air not only makes more HP, but also helps stave off detonation.



Here's a photo of the split turbo compressor outlet viewed from under the sled tunnel. The finned extrusions can be seen on the right side of the stock engine heat exchanger.



Note the long, fairly quiet straight muffler tucked alongside the turbo, exiting out the stock tailpiece. The O2 sensor feeds info to a wideband A/F ratio meter—a must-have for any boosted engine!

Stock engine reliability

How can stock engines deliver reliable performance with turbochargers boosting power levels to more than double stock output? According to engineering data, when we double stock engine horsepower with intake pressure boost, peak combustion chamber pressure (occurring about 15-18 degrees ATC) is increased only by 20%! But with boosted operation, combustion chamber pressure at 90 degrees ATC is many times higher than normally aspirated. So effectively, the boosted power stroke is extended way beyond TDC adding huge torque as the crankshaft heads toward BDC. This is said to result in a smooth, torsional vibe-free boosted power stroke that is relatively gentle on stressed components.

But if fuel tuning is bad, or octane insufficient for the desired power levels, then detonation and preignition can send combustion chamber pressure to the moon. Gaskets pop, studs pull, pistons break, blocks distort, rods bend all because we have tried to cheat mother nature. All of the following data was achieved with completely stock engine with FPP tuning, and octane appropriate for the task. For pump gas, FPP has set 7 psi boost as the maximum for safe operation on 91 octane gas. But for those who want to operate on lower octane gas, even 5 psi boost will give you more than stock Cat Z1 turbo horsepower as shown. Any boost level above 7 psi Justin recommends higher octane gas—with the final 19psi boost test done with Sunoco Maximal race gas. There were zero

clicks of deto during all of these tests! This sled is now owned by Dave Peterson, and used for trail riding and successful open mod Hilldrag racing. Even for dragracing, the clutch engagement is only 2800rpm—a testament to turbo system design, proper fuel tuning, and the quick-spooling Garrett GT series ball bearing turbochargers.

Stock Yamaha Nytro tested for the AmSnow DTR Adirondack Shootout

EngSpd	STPPwr	STPTRq	LamAF1	AirInT
RPM	CHp	Clb-ft	Ratio	degF
5000	76.0	79.8	13.2	31.1
5100	77.1	79.4	13.2	31.1
5200	79.3	80.1	13.3	31.2
5300	81.2	80.4	13.3	31.2
5400	83.1	80.9	13.4	31.3
5500	85.9	82.1	13.3	31.3
5600	88.7	83.2	13.2	31.3
5700	90.8	83.7	13.1	31.3
5800	92.4	83.6	12.9	31.4
5900	93.7	83.4	12.8	31.4
6000	95.1	83.2	12.8	31.4
6100	96.8	83.3	12.8	31.4
6200	98.5	83.5	12.9	31.4
6300	101.4	84.6	13.1	31.4
6400	104.4	85.7	13.1	31.4
6500	106.8	86.3	13.1	31.5
6600	109.2	86.9	13.2	31.5
6700	111.6	87.5	13.2	31.5
6800	113.8	87.9	13.2	31.5
6900	115.5	87.9	13.1	31.5
7000	116.8	87.7	13.0	31.5
7100	118.0	87.3	12.9	31.5
7200	119.0	86.8	12.9	31.5
7300	120.2	86.5	12.8	31.5
7400	121.5	86.2	12.8	31.6
7500	122.9	86.1	12.9	31.6
7600	124.5	86.0	13.0	31.6
7700	126.5	86.3	13.2	31.6
7800	128.6	86.6	13.2	31.6
7900	130.4	86.7	13.3	31.6
8000	131.9	86.6	13.3	31.6
8100	133.1	86.3	13.3	31.6
8200	134.0	85.9	13.3	31.6
8300	134.7	85.3	13.2	31.6
8400	135.0	84.4	13.1	31.6
8500	135.3	83.6	13.1	31.6
8600	135.6	82.8	13.0	31.6
8700	136.0	82.1	12.9	31.6
8800	136.6	81.6	12.8	31.6
8900	135.9	80.2	12.8	31.6
9000	135.4	79.0	12.8	31.7
9100	134.5	77.6	12.7	31.7
9200	132.6	75.7	12.7	31.7

Pump gas 5 psi boost

EngSpd	STPTrq	STPPwr	BSFC A	Fuel A	A/F A	FuelP	Air 2	BOOST
RPM	Clb-ft	CHp	lb/hph	lb/hr	Ratio	psig	scfm	Psig
6500	114.9	142.2	0.49	66.6	11.01	47.6	160	3.8
6600	113.2	142.2	0.49	66.8	10.94	47.5	160	3.8
6700	114.7	146.3	0.49	68.5	11.00	47.6	165	3.9
6800	116.1	150.3	0.49	70.3	10.99	47.5	169	4.3
6900	117.3	154.1	0.48	71.4	11.26	47.5	176	4.1
7000	116.1	154.7	0.48	71.9	11.39	47.5	179	4.1
7100	118.8	160.6	0.46	71.5	11.76	47.4	184	4.2
7200	116.9	160.3	0.46	70.9	11.90	47.5	184	4.2
7300	116.9	162.5	0.46	72.1	11.84	47.4	186	4.3
7400	115.9	163.3	0.46	72.8	11.82	47.4	188	4.3
7500	116.3	166.1	0.47	75.1	11.69	47.3	192	4.4
7600	115.8	167.6	0.46	74.4	12.00	47.4	195	4.4
7700	117.5	172.3	0.47	77.2	11.77	47.2	198	4.5
7800	116.1	172.3	0.47	77.7	11.82	47.3	201	4.5
7900	115.4	173.6	0.48	79.5	11.75	47.0	204	4.6
8000	116.0	176.6	0.49	82.3	11.61	46.9	209	4.8
8100	116.8	180.1	0.49	84.0	11.62	46.7	213	4.8
8200	116.1	181.2	0.50	87.0	11.34	46.9	216	4.8
8300	114.6	181.2	0.51	88.5	11.25	46.8	217	4.9
8400	114.2	182.7	0.52	90.6	11.11	46.6	220	5.0
8500	113.8	184.2	0.53	92.7	10.98	46.8	222	5.0
8600	111.4	182.5	0.54	93.7	10.90	46.8	223	5.0
8700	111.4	184.5	0.54	94.9	10.85	46.6	225	5.1
8800	109.0	182.6	0.54	93.8	10.91	46.6	223	5.1
8900	107.2	181.7	0.54	94.8	10.86	46.6	225	5.1
9000	106.1	181.8	0.55	95.7	10.78	46.7	225	5.2
9100	103.4	179.2	0.55	95.0	10.90	46.9	226	5.2

Pump gas 7 psi boost (max for pump gas)

EngSpd	STPTrq	STPPwr	BSFC A	Fuel A	A/F A	FuelP	Air 2	BOOST
RPM	Clb-ft	CHp	lb/hph	lb/hr	Ratio	psig	scfm	Psig
6500	124.0	153.4	0.49	73.0	10.94	47.4	174	5.6
6600	122.2	153.5	0.50	73.6	10.92	47.4	176	5.5
6700	124.0	158.2	0.49	74.3	11.16	47.4	181	5.5
6800	127.1	164.6	0.48	76.3	11.25	47.3	187	5.7
6900	126.3	166.0	0.48	77.1	11.27	47.3	190	5.7
7000	128.6	171.4	0.48	78.4	11.44	47.3	196	5.8
7100	130.0	175.7	0.46	77.5	11.80	47.2	200	5.9
7200	128.7	176.4	0.45	76.4	12.01	47.1	200	6.0
7300	128.3	178.4	0.46	79.4	11.74	47.1	204	6.0
7400	127.9	180.3	0.46	79.4	11.87	47.3	206	6.0
7500	126.7	181.0	0.46	80.5	11.87	47.2	209	6.1
7600	126.7	183.4	0.47	82.7	11.79	47.1	213	6.1
7700	126.5	185.4	0.47	83.1	11.87	47.0	215	6.1
7800	126.9	188.5	0.48	86.6	11.55	46.8	218	6.1
7900	126.4	190.1	0.50	90.9	11.25	46.7	223	6.2
8000	126.8	193.1	0.50	92.5	11.21	46.6	226	6.3

8100	125.3	193.3	0.50	93.3	11.20	46.6	228	6.3
8200	126.1	196.8	0.49	92.2	11.54	46.6	232	6.4
8300	126.1	199.2	0.48	91.8	11.75	46.6	236	6.5
8400	124.5	199.1	0.48	91.8	11.99	46.7	240	6.5
8500	124.2	200.9	0.48	93.0	11.87	46.7	241	6.6
8600	122.6	200.8	0.48	91.8	12.14	46.6	243	6.6
8700	121.3	200.9	0.48	92.2	12.08	46.7	243	6.6
8800	119.6	200.3	0.47	91.1	12.28	46.6	244	6.9
8900	118.7	201.1	0.47	91.1	12.39	46.6	246	6.8
9000	116.5	199.7	0.48	92.2	12.29	46.8	248	6.8
9100	114.2	197.9	0.48	91.7	12.39	47.4	248	6.9

100+ octane Gas 11 psi boost

EngSpd	STPPwr	STPTRq	BSFA_B	FulA_B	LM1Air	LamAF1	BoostP	STPCor
RPM	CHp	Clb-ft	lb/hph	lbs/hr	SCFM	Ratio	psig	Factor
6460	165.9	134.9	0.605	93.7	287	10.92	10.5	1.064
6580	166.0	132.5	0.615	95.3	282	10.78	10.4	1.064
6700	166.7	130.7	0.623	96.8	278	10.66	10.3	1.064
6800	168.8	130.4	0.624	98.3	276	10.60	10.2	1.064
6900	172.9	131.6	0.620	100.0	278	10.60	10.3	1.064
7000	178.2	133.7	0.611	101.6	280	10.64	10.4	1.064
7100	183.8	135.9	0.600	102.8	282	10.69	10.4	1.064
7200	188.6	137.6	0.591	104.0	285	10.76	10.4	1.064
7300	192.2	138.3	0.587	105.2	287	10.81	10.4	1.064
7400	194.0	137.7	0.587	106.3	289	10.83	10.3	1.064
7500	195.0	136.5	0.592	107.6	291	10.83	10.3	1.064
7600	196.2	135.6	0.597	109.2	294	10.84	10.3	1.064
7700	198.1	135.1	0.602	111.1	298	10.84	10.4	1.064
7800	200.5	135.0	0.603	112.8	301	10.84	10.5	1.064
7900	203.7	135.4	0.601	114.0	305	10.87	10.7	1.064
8000	208.1	136.6	0.593	115.1	309	10.93	10.9	1.064
8100	213.6	138.5	0.582	115.9	313	11.03	11.1	1.064
8200	218.2	139.8	0.572	116.2	316	11.13	11.2	1.064
8300	221.6	140.2	0.565	116.6	319	11.22	11.2	1.064
8400	223.7	139.9	0.562	117.2	322	11.29	11.1	1.064
8500	223.9	138.3	0.564	117.6	322	11.31	10.9	1.064
8600	222.4	135.8	0.569	117.8	322	11.29	10.7	1.064
8700	220.9	133.4	0.575	118.2	322	11.27	10.6	1.064
8800	220.1	131.3	0.579	118.5	321	11.25	10.5	1.064
8900	219.8	129.7	0.580	118.6	320	11.23	10.4	1.065
9000	219.4	128.0	0.582	118.9	320	11.20	10.4	1.065
9100	218.0	125.8	0.589	119.3	320	11.16	10.4	1.065
9220	214.7	122.3	0.600	119.8	320	11.11	10.5	1.065
9340	211.1	118.7	0.614	120.3	321	11.06	10.5	1.065

100+ octane Gas 12.5psi boost

EngSpd	STPPwr	STPTRq	BSFA_B	FulA_B	LM1Air	LamAF1	BoostP
RPM	CHp	Clb-ft	lb/hph	lbs/hr	SCFM	Ratio	Psig
7000	210.8	158.1	0.513	100.9	284	11.25	13.1
7100	212.8	157.4	0.513	102.0	285	11.26	13.1
7200	214.1	156.2	0.510	101.9	286	11.33	13.1
7300	216.7	155.9	0.511	103.3	291	11.42	13.0
7400	219.8	156.0	0.508	104.3	292	11.47	13.0
7500	222.2	155.6	0.514	106.7	298	11.48	13.0
7600	224.1	154.9	0.516	108.0	301	11.49	13.0
7700	226.3	154.4	0.520	109.7	306	11.50	13.0
7800	227.2	153.0	0.524	111.0	308	11.46	12.9
7900	227.6	151.3	0.526	111.6	308	11.43	12.8
8000	227.9	149.6	0.529	112.5	311	11.42	12.7
8100	228.6	148.2	0.537	114.5	313	11.44	12.6
8200	230.6	147.7	0.534	114.9	314	11.48	12.6
8300	232.8	147.3	0.529	114.9	315	11.52	12.6
8400	234.3	146.5	0.528	115.3	316	11.54	12.5
8500	235.4	145.4	0.525	115.1	315	11.53	12.4
8600	235.3	143.7	0.531	116.4	318	11.52	12.3
8700	236.2	142.6	0.532	117.1	321	11.53	12.3
8800	236.5	141.1	0.536	118.0	323	11.54	12.2
8900	237.0	139.8	0.536	118.3	323	11.52	12.1
9000	238.6	139.2	0.535	118.9	324	11.50	12.0
9100	240.3	138.7	0.533	119.1	324	11.47	12.0
9200	238.5	136.1	0.543	120.4	327	11.44	12.0
9300	234.7	132.5	0.555	121.1	327	11.42	12.1

Race gas 16.5psi boost

EngSpd	STPPwr	STPTRq	BSFA_B	FulA_B	LM1Air	LamAF1	BoostP	STPCor
RPM	CHp	Clb-ft	lb/hph	lbs/hr	SCFM	Ratio	Psig	Factor
7100	238.8	176.7	0.431	96.3	295	12.38	16.6	1.064
7200	241.6	176.2	0.427	96.4	299	12.53	16.7	1.064
7300	244.9	176.2	0.425	97.2	304	12.66	16.8	1.064
7400	248.9	176.7	0.426	99.1	309	12.77	16.8	1.064
7500	253.1	177.2	0.425	100.6	313	12.89	16.9	1.064
7600	258.0	178.3	0.420	101.1	316	12.99	17.0	1.064
7700	261.8	178.5	0.417	102.0	319	13.00	17.1	1.064
7800	264.1	177.9	0.421	103.9	323	12.95	17.1	1.064
7900	265.2	176.3	0.425	105.2	325	12.88	17.1	1.064
8000	266.0	174.6	0.430	106.8	329	12.84	17.0	1.064
8100	267.7	173.6	0.430	107.5	330	12.81	16.9	1.064
8200	269.3	172.5	0.435	109.2	334	12.82	16.8	1.064
8300	271.8	172.0	0.430	109.1	333	12.85	16.8	1.064
8400	273.5	171.0	0.432	110.3	337	12.87	16.7	1.064
8500	275.0	169.9	0.428	109.9	336	12.92	16.6	1.064
8600	277.0	169.1	0.426	110.0	338	12.96	16.5	1.064
8700	278.1	167.9	0.428	111.2	342	12.97	16.4	1.064
8800	276.2	164.9	0.438	112.9	347	12.97	16.2	1.064
8900	277.5	163.7	0.435	112.7	346	12.96	16.3	1.064
9000	280.3	163.6	0.431	112.8	347	12.98	16.4	1.064

9100	283.9	163.9	0.428	113.2	350	13.07	16.6	1.064
9200	283.5	161.9	0.429	113.4	353	13.16	16.9	1.064
9300	282.8	159.7	0.435	114.5	356	13.15	17.0	1.064

Race gas 18.7 psi boost

EngSpd	STPPwr	STPTRq	BSFA_B	FulA_B	LM1Air	LamAF1	BoostP	STPCor
RPM	CHp	Clb-ft	lb/hph	lbs/hr	SCFM	Ratio	Psig	Factor
7400	262.5	186.3	0.443	108.7	336	12.42	17.3	1.065
7500	265.8	186.1	0.441	109.5	333	12.39	17.5	1.065
7600	266.8	184.4	0.443	110.4	334	12.44	17.6	1.065
7700	269.8	184.0	0.444	111.7	339	12.50	17.8	1.065
7800	273.4	184.1	0.441	112.5	342	12.56	18.0	1.065
7900	277.8	184.7	0.438	113.6	346	12.58	18.3	1.065
8000	282.0	185.1	0.436	114.8	349	12.58	18.5	1.065
8100	285.9	185.4	0.431	115.1	352	12.65	18.6	1.065
8200	290.0	185.7	0.430	116.5	359	12.75	18.8	1.065
8300	293.2	185.5	0.432	118.2	363	12.85	18.8	1.065
8400	295.9	185.0	0.431	119.1	366	12.94	18.9	1.065
8500	298.3	184.3	0.432	120.3	371	13.02	19.0	1.065
8600	300.5	183.5	0.435	122.0	377	13.07	18.9	1.065
8700	301.7	182.1	0.431	121.4	376	13.09	18.8	1.065
8800	303.4	181.1	0.431	122.1	378	13.09	18.7	1.065
8900	303.2	178.9	0.432	122.2	378	13.08	18.7	1.065
9000	299.9	175.0	0.444	124.0	383	13.06	18.8	1.065
9100	295.7	170.7	0.451	124.3	383	13.04	18.8	1.065
9200	296.2	169.1	0.449	123.9	381	13.00	18.8	1.065
9300	297.1	167.8	0.454	125.8	384	12.93	18.8	1.065

Race gas 22 psi boost

EngSpd	STPPwr	STPTRq	BSFA_B	FulA_B	LM1Air	LamAF1	BoostP
RPM	CHp	Clb-ft	lb/hph	lbs/hr	SCFM	Ratio	Psig
7000	259.9	195.0	0.424	106.0	322	12.57	18.7
7100	261.9	193.8	0.436	110.0	333	12.62	18.9
7200	267.7	195.3	0.440	113.3	346	12.82	19.1
7300	274.6	197.5	0.433	114.5	364	13.07	19.5
7400	281.9	200.1	0.421	114.2	376	13.29	20.0
7500	290.9	203.7	0.409	114.7	378	13.32	20.6
7600	292.5	202.2	0.412	116.2	379	13.25	20.5
7700	293.5	200.2	0.417	117.8	379	13.12	20.5
7800	296.4	199.6	0.424	120.9	373	13.06	20.7
7900	301.7	200.6	0.425	123.6	379	13.06	20.9
8000	310.5	203.9	0.420	125.7	395	13.28	21.5
8100	316.7	205.4	0.414	126.3	397	13.31	21.8
8200	318.9	204.2	0.414	127.0	398	13.21	21.8
8300	321.7	203.6	0.422	130.8	399	13.20	22.0
8400	324.7	203.0	0.423	132.2	401	13.20	22.1
8500	325.0	200.8	0.429	134.1	402	13.08	21.9
8600	323.6	197.6	0.434	135.3	400	12.94	21.7
8700	323.3	195.2	0.437	135.9	400	12.89	21.5
8800	322.7	192.6	0.450	139.7	409	12.83	21.5
8900	320.1	188.9	0.465	143.2	409	12.56	21.6

9000	319.4	186.4	0.475	145.8	412	12.26	21.8
9100	321.3	185.4	0.473	146.2	415	12.16	22.1
9200	321.7	183.6	0.464	143.7	417	12.26	22.2
9300	316.7	178.8	0.442	134.6	403	12.41	22.6

