

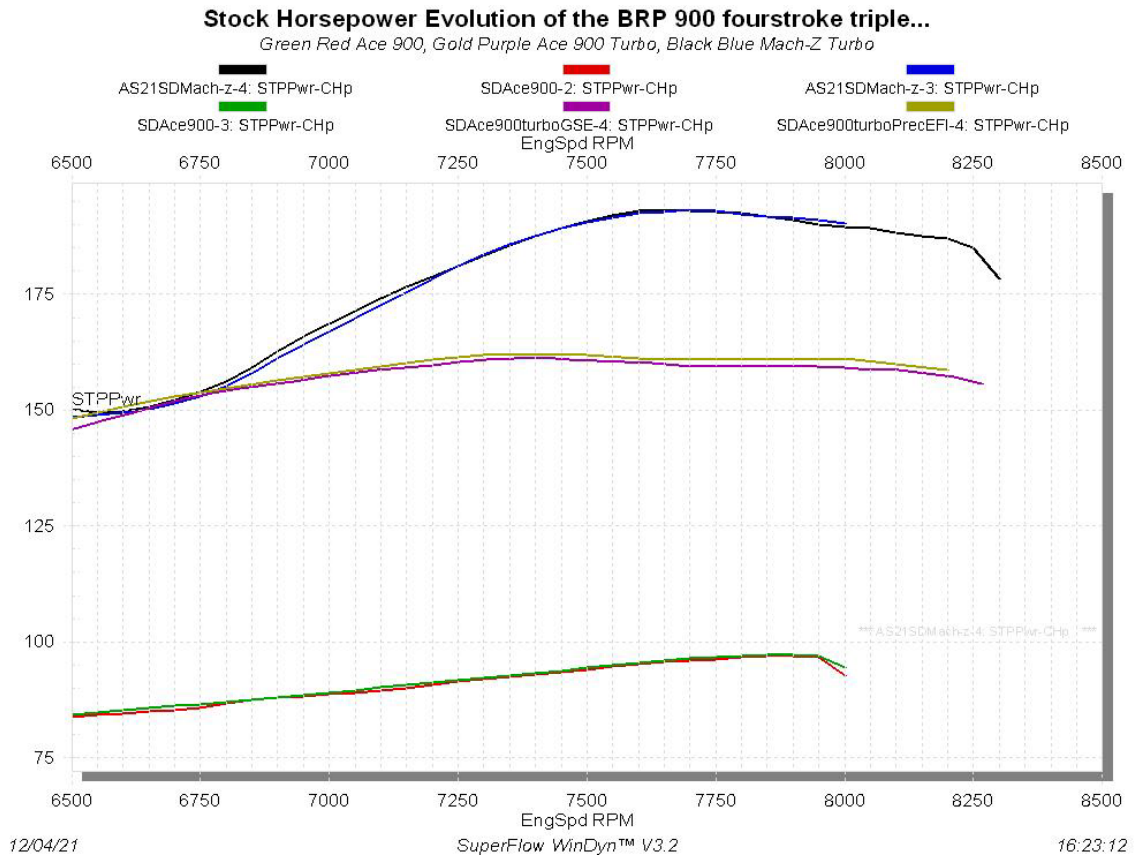
Stock Horsepower Evolution of the BRP 900 triple four stroke engine...

Here's our first new zero mile SkiDoo Mach-Z Turbo, brought here for documentation for the NY Kirsch Shootout at Inlet, NY on 12/11/21 by Tom Ferry of Arctic Adventures. Tom had been led to believe that there is no "breakin mode" in the Mach-Z, but our boost reading was slightly lower than the expected 17 psi—maybe that was due to where we picked up the boost signal, perhaps after the intercooler and after the throttle body—or maybe there is some reduced boost level initially (or possibly even some leakage in the T fitting feeding the 10' boost line from engine to dyno 902 box). At any rate, the dyno measured boost gradually rising with revs to peak at 14.3 psi then tailing off as revs climbed beyond 7650 to reduce HP beyond that RPM, so best acceleration will be experienced at that RPM. I wonder if that boost curve is controlled by the turbo wastegate or the electronically controlled throttle body (assuming we were reading boost between throttle body and engine)?

Every year the OEM's make it increasingly difficult for the aftermarket to sell hotrod tunes and parts, with stock two-stroke and four-stroke power continuing to climb. 2022 model year is typical—BRP now has boosted this 900 four stroke triple to 180+ HP bone stock with full warranty. This evolution from 97 HP to nearly double that is very likely at least in part due to the great reliability consumers have had with this engine even when boosted with aftermarket stuff! BRP has benefited from the many early NA Ace 900's that were fitted aftermarket turbo systems, and then Ace 900 turbo sleds that ran with greatly increased HP with more aggressive tuning and freer flowing mufflers, etc. (see the Precision EFI Ace 900 turbo reflash on 10/25/18). BRP surely monitored engine warranty claims, and also how many replacement engine parts (pistons, con rods, headgaskets, blocks, heads, complete engines etc) were sold each year.

The data must have been encouraging. On top of that positive data, BRP has increased the durability of the engine components, and uses a turbocharger that's ostensibly larger than that fitted on the Ace 900 Turbo. Finally, the original normally aspirated Ace 900 has had its HP approximately doubled. Remember, we assume that the boost level is baro pressure compensating to deliver similar actual horsepower (observed HP) while riding at all altitudes. So, like the Sidewinder and Thundercat the usual STP (Standard Temperature and Pressure) correction factor is only proper at sea level. So at higher altitudes (DTR is at @1000') the STP correction factor is a bit too generous. So expecting that the Mach-Z is tuned to provide 185ish actual, observed HP at all elevations, the higher the altitude the dyno is situated at, the more excessive the STP HP is. So maybe it's best to look at the observed HP on this day. The easiest way to decipher what observed HP is, divide the fuel flow LB/HR by the BSFC (pounds of fuel per *observed* HP per hour). In this case at 7650 RPM, 95.2 lb/hr of fuel flow divided by .505 lb/hphr = 188.5 HP. We can do the math and see a similar reduction in the Sidewinder/Tcat STP HP data. And note the BSAC (pounds of air per HP per hour) data. It's conceivable that the higher BSAC of the new engine helps evacuate active radical end gases that can detonate or left trapped in the combustion chamber(s) ahead of the following compression/ ignition event. Just surmising.

After burning out the assembly lube in this new engine and heating up the oil and coolant, we ran five or six acceleration tests—all repeating within a few tenths of a HP. Here is typical data, with a graph preceding showing the “evolution” in HP output of the three versions. We show two tests of each version—two tests of the Ace 900 done by GSE Performance who dyno tests/ optimizes their aftermarket mufflers on stock engines here, two tests on a bone stock Ace 900 Turbo—one done by GSE Performance and the other done by Precision EFI as baseline during the reflash testing. Dyno “repeatability”, year after year is as important as repeatability test after test on the same day.



Dyno data from the 2021 Mach-Z Turbo

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFCAB lb/hph	FuIAB lbs/hr	LM1AF1 Ratio	Air_1s SCFM	BSAC lb/hph	BoostP psig
6500	150.2	121.3	0.485	71.1	13.19	186.6	5.83	9.4
6550	149.5	119.9	0.496	72.3	13.20	189.1	5.94	9.5
6600	149.8	119.2	0.504	73.7	13.21	191.9	6.01	9.7
6650	150.8	119.1	0.507	74.6	13.18	194.4	6.05	9.9
6700	152.1	119.3	0.511	75.8	13.12	197.7	6.10	10.1
6750	153.9	119.8	0.515	77.3	13.06	201.6	6.15	10.4
6800	156.1	120.6	0.519	79.0	13.03	205.5	6.18	10.8
6850	159.1	122.0	0.521	80.9	13.01	209.5	6.18	11.3
6900	162.6	123.8	0.518	82.2	12.99	212.9	6.15	11.7

6950	165.9	125.3	0.514	83.2	12.97	215.8	6.11	11.9
7000	168.7	126.5	0.511	84.1	12.96	218.4	6.08	12.1
7050	171.4	127.7	0.512	85.6	12.96	221.7	6.07	12.3
7100	174.0	128.7	0.515	87.4	12.97	225.5	6.08	12.7
7150	176.5	129.6	0.515	88.6	12.98	228.4	6.07	13.0
7200	178.8	130.4	0.514	89.7	12.98	230.9	6.06	13.4
7250	181.1	131.2	0.513	90.7	12.97	233.7	6.06	13.7
7300	183.3	131.9	0.514	91.8	12.96	236.3	6.05	13.8
7350	185.5	132.5	0.515	93.1	12.95	238.9	6.05	14.0
7400	187.4	133.0	0.515	94.1	12.94	240.9	6.03	14.1
7450	189.3	133.4	0.514	95.0	12.93	242.6	6.02	14.1
7500	190.8	133.6	0.513	95.5	12.91	243.8	6.00	14.2
7550	192.1	133.6	0.510	95.6	12.90	244.2	5.97	14.3
7600	193.0	133.4	0.507	95.5	12.89	244.4	5.95	14.2
7650	193.3	132.7	0.505	95.2	12.87	244.5	5.94	14.0
7700	193.0	131.7	0.506	95.3	12.84	244.2	5.94	13.8
7750	192.9	130.7	0.508	95.6	12.82	243.8	5.93	13.7
7800	192.5	129.6	0.510	95.7	12.80	243.6	5.94	13.5
7850	191.8	128.4	0.513	96.0	12.77	243.8	5.97	13.3
7900	191.0	127.0	0.516	96.2	12.75	244.1	6.00	13.2
7950	190.1	125.6	0.520	96.4	12.72	244.2	6.03	13.0
8000	189.6	124.5	0.523	96.6	12.70	244.2	6.05	12.8
8050	189.2	123.5	0.525	96.8	12.68	244.3	6.06	12.7
8100	188.3	122.1	0.527	96.8	12.66	244.3	6.09	12.6
8150	187.5	120.9	0.530	96.9	12.63	244.7	6.13	12.5
8200	186.9	119.7	0.533	97.1	12.61	245.1	6.16	12.5
8250	185.1	117.9	0.539	97.3	12.60	244.3	6.20	12.5
8300	178.3	112.8	0.547	95.0	12.55	229.8	6.05	12.0

Dyno data from Ace 900 Turbo

EngSpd	STPPwr	STPTRq	BSFA	FuelA	LamAF1	Air_1c	BSAC	BoostP
RPM	Chp	Clb-ft	lb/hph	lbs/hr	Ratio	CFM	lb/hph	psig
4800	91.6	100.2	0.402	34.9	14.46	115.5	5.90	8.1
4900	101.2	108.4	0.400	38.3	14.48	126.0	5.83	9.2
5000	105.2	110.5	0.392	39.0	14.49	128.8	5.73	9.2
5100	106.9	110.1	0.395	40.0	14.50	132.0	5.78	9.3
5200	108.8	109.9	0.401	41.3	14.51	136.2	5.86	9.4
5300	111.5	110.5	0.399	42.1	14.52	139.7	5.87	9.5
5400	114.4	111.2	0.398	43.1	14.52	143.2	5.87	9.6
5500	117.2	112.0	0.401	44.5	14.51	146.5	5.85	9.7
5600	120.1	112.6	0.402	45.7	14.50	150.1	5.85	9.7
5700	122.5	112.9	0.406	47.0	14.50	153.4	5.86	9.8
5800	124.8	113.0	0.411	48.5	14.49	156.0	5.86	9.9
5900	127.3	113.4	0.417	50.3	14.38	159.1	5.85	9.9
6000	131.4	115.0	0.423	52.6	14.04	163.8	5.84	10.0
6100	135.7	116.8	0.421	54.1	13.88	167.1	5.77	10.2
6200	138.9	117.7	0.429	56.4	13.84	171.3	5.77	10.3

6300	142.1	118.5	0.438	58.9	13.74	174.9	5.76	10.3
6400	145.3	119.2	0.448	61.6	13.54	178.3	5.75	10.4
6500	148.1	119.7	0.457	64.1	13.23	181.7	5.74	10.4
6600	150.8	120.0	0.458	65.4	12.99	184.7	5.74	10.5
6700	153.0	120.0	0.458	66.3	12.88	186.2	5.70	10.6
6800	154.8	119.6	0.461	67.4	12.80	187.7	5.68	10.7
6900	156.4	119.1	0.462	68.3	12.75	189.7	5.68	10.7
7000	158.0	118.6	0.461	68.9	12.74	191.5	5.68	10.8
7100	159.5	118.0	0.456	68.8	12.82	193.0	5.67	10.9
7200	160.9	117.3	0.449	68.3	12.98	193.8	5.65	10.8
7300	161.8	116.4	0.446	68.1	13.09	194.3	5.63	10.7
7400	162.1	115.0	0.446	68.3	13.09	194.8	5.63	10.5
7500	161.8	113.3	0.449	68.5	13.04	195.5	5.66	10.0
7600	161.2	111.4	0.452	68.8	13.03	196.3	5.71	10.0
7700	160.9	109.8	0.460	69.9	13.02	198.0	5.77	10.2
7800	160.8	108.3	0.462	70.0	13.00	199.2	5.81	10.2
7900	161.0	107.0	0.463	70.3	13.00	200.7	5.85	10.1
8000	161.2	105.8	0.468	71.2	12.96	201.2	5.86	10.1
8100	160.0	103.7	0.483	72.8	12.74	201.1	5.90	10.0
8200	158.6	101.6	0.494	73.9	12.45	201.0	5.95	10.0

Dyno data from Ace 900

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BSFB lb/hph	FuelB lbs/hr	LamAF1 Ratio	Air_1c CFM	BSAC lb/hph	Baro_P InHga
5950	78.0	68.8	0.433	32.1	13.33	105.2	6.32	28.64
6000	77.9	68.2	0.437	32.3	13.31	105.8	6.36	28.64
6050	78.3	67.9	0.437	32.5	13.32	106.7	6.38	28.64
6100	78.9	67.9	0.438	32.8	13.34	107.6	6.39	28.64
6150	79.8	68.1	0.439	33.3	13.34	108.6	6.38	28.64
6200	81.0	68.6	0.439	33.7	13.34	109.6	6.34	28.64
6250	81.8	68.7	0.439	34.1	13.33	110.1	6.31	28.64
6300	82.3	68.6	0.441	34.5	13.32	110.4	6.28	28.64
6350	82.7	68.4	0.445	34.9	13.30	110.6	6.27	28.64
6400	82.9	68.0	0.451	35.5	13.25	111.0	6.27	28.64
6450	83.1	67.7	0.458	36.2	13.15	111.3	6.27	28.64
6500	83.7	67.6	0.459	36.4	13.09	111.5	6.24	28.64
6550	84.1	67.5	0.459	36.6	13.05	111.7	6.22	28.64
6600	84.6	67.3	0.458	36.8	13.02	111.9	6.20	28.64
6650	84.9	67.0	0.457	36.8	13.00	112.3	6.20	28.64
6700	85.2	66.8	0.456	36.8	12.99	112.9	6.21	28.64
6750	85.8	66.8	0.451	36.8	13.01	113.7	6.21	28.64
6800	86.7	67.0	0.447	36.8	13.04	114.3	6.18	28.64
6850	87.4	67.0	0.443	36.7	13.06	115.1	6.17	28.64
6900	87.9	66.9	0.440	36.7	13.09	116.0	6.19	28.64
6950	88.3	66.7	0.440	36.8	13.11	117.1	6.22	28.64
7000	88.6	66.5	0.441	37.0	13.13	118.3	6.26	28.64
7050	89.0	66.3	0.443	37.4	13.15	119.6	6.30	28.64

7100	89.5	66.2	0.444	37.7	13.17	121.2	6.35	28.64
7150	90.1	66.2	0.444	37.9	13.21	122.8	6.40	28.64
7200	90.8	66.2	0.442	38.1	13.26	124.7	6.44	28.64
7250	91.4	66.2	0.442	38.3	13.30	126.5	6.49	28.64
7300	91.9	66.1	0.443	38.6	13.30	128.2	6.54	28.64
7350	92.4	66.1	0.446	39.1	13.27	130.0	6.60	28.64
7400	92.9	66.0	0.448	39.5	13.23	131.7	6.65	28.64
7450	93.4	65.9	0.450	39.8	13.18	133.5	6.70	28.64
7500	93.9	65.8	0.451	40.1	13.12	135.8	6.78	28.64
7550	94.6	65.8	0.450	40.4	13.08	137.5	6.82	28.64
7600	95.1	65.8	0.450	40.6	13.05	138.8	6.85	28.64
7650	95.6	65.7	0.451	40.9	13.01	139.9	6.86	28.64
7700	96.0	65.5	0.451	41.0	12.96	140.9	6.89	28.64
7750	96.3	65.2	0.451	41.1	12.92	141.9	6.92	28.64
7800	96.6	65.0	0.450	41.2	12.90	142.7	6.94	28.64
7850	96.9	64.8	0.451	41.4	12.90	143.4	6.95	28.64
7900	97.0	64.5	0.453	41.6	12.93	143.0	6.93	28.64
7950	96.8	63.9	0.453	41.5	13.00	138.1	6.70	28.64
8000	92.8	60.9	0.433	38.0	13.02	116.6	5.91	28.64
