Gus Bohne turbo tuning, Phase II

Gus came back recently to assess his carbureted two-stroke turbo systems on Art Bass' Polaris 1080 triple and Steve Bueti's Mach Z twin.

Last time here we experienced difficulty with carburetion and detonation on Art's big triple. This time, the carburetion issues were resolved but we still experienced deto even with perfect A/F ratio, exhaust temp and ignition timing. The engine was creating excellent HP but our copper tube hanging in the control room, and extended into the engine room and bolted to the coolant outlet manifold would emit loud snapping sounds warning us of deto that could hurt parts if allowed to continue so we quit at 9500. We figured that the 120 motor octane race fuel Gus brought for Art and Steve's engines must be substandard or stale (or maybe both). So we wisely quit at 21 psi boost. Here, as the engine would approach 250 lb/ft of torque the clicking would begin and the test was aborted. So Gus' plan to run up to 30 psi would have to wait.

Art Bass' Turbo 1080 triple at 21 psi

EngSpd	STPPwr	STPTrq	LamAF1	BoostP
RPM	CHp	Clb-ft	Ratio	psig
8600	383.9	234.4	12.98	19.7
8700	388.4	234.5	12.91	19.9
8800	396.0	236.3	12.83	20.0
8900	407.1	240.3	12.71	20.2
9000	417.6	243.7	12.61	20.3
9100	426.2	246.0	12.53	20.5
9200	436.4	249.1	12.45	20.6
9300	447.0	252.4	12.38	20.7
9400	458.4	256.1	12.28	21.0
9500	463.5	256.3	12.24	21.0

Steve Bueti brought his turbo Mach Z back to test and tune with new twin pipes that Gus had come up with (modified Crankshop RT1000 twin pipes) that replaced the single pipe with which Gus and Steve made 403 HP at 25 psi during our last tuning session (posted here on 12/30/2011). Since the single pipe made the turbo Mach Z's peak HP at low RPM, Gus figured, correctly that bringing peak revs higher with

one shorter pipe per cylinder would be beneficial. As shown in the photo, each pipe had its own waste gate welded to its center section. The rest of Gus' turbo system was the same as when we tested last time. The stock ECU is replaced with a programmable MSD ignition so that timing can be optimized and rev limit extended to higher RPM.

After after our experience with mysterious clicks of deto on Art's engine, Steve was a bit anxious about using the same fuel in his Mach Z twin. But before we sent out for different fuel, we would give it a try—knowing that with our copper tube detonation could be heard loudly and clearly, allowing us to avoid hurting parts if the fuel was, indeed, substandard.

But on the Mach Z twin, Gus' fuel seemed fine—zero clicks all the way to 22 psi where it made 425 HP. When Steve attempted to raise his boost pressure to 25 psi with his digital boost control it was discovered that one pipe had cracked in the Heat Affected Zone next to the TIG welded waste gate flange, allowing exhaust (and boost) pressure to escape. So 25 (and maybe 30) psi will have to wait until Steve has the wastegate flange welds reinforced.

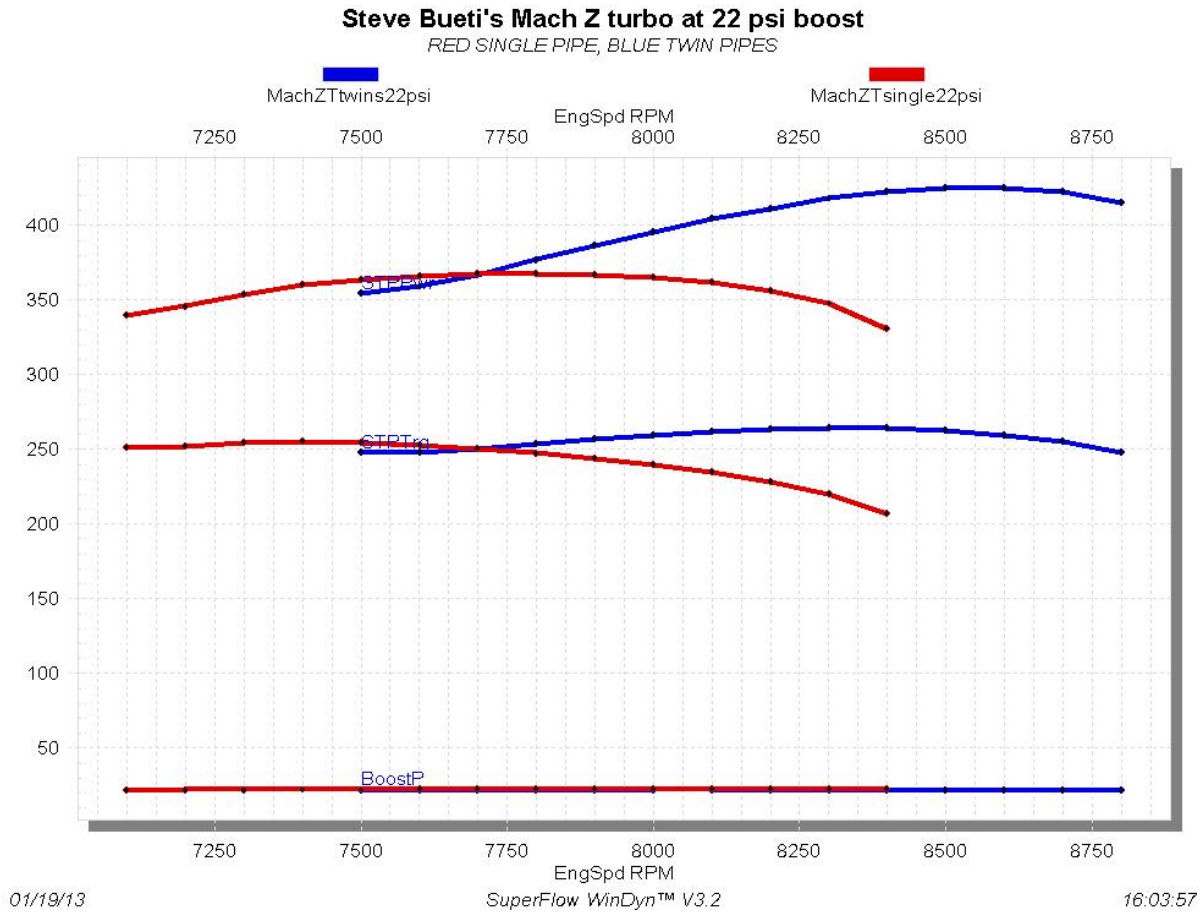
For comparison, here is data interpolated from our previous single pipe tuning session with 22 psi compared to just under 22 psi with Gus' twin pipes. Note that torque is increased slightly with the twins, but spinning at higher RPM = much higher HP.

Steve Bueti's Mach Z turbo, 22 psi with single pipe

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BoostP psig	ExhPrs psig
7100	339.5	251.2	21.8	22.9
7200	345.8	252.2	22.0	23.2
7300	353.7	254.5	22.1	23.3
7400	359.9	255.5	22.1	23.4
7500	363.6	254.6	22.2	23.5
7600	365.8	252.8	22.3	23.6
7700	367.3	250.5	22.4	23.5
7800	367.5	247.4	22.4	23.5
7900	366.5	243.7	22.3	23.4
8000	365.0	239.6	22.2	23.4
8100	361.7	234.5	22.2	23.4
8200	356.2	228.2	22.2	23.4
8300	347.5	219.9	22.3	23.4
8400	330.9	206.9	22.3	23.2

Steve Bueti's Mach Z turbo, 22 psi with twin pipes

EngSpd RPM	STPPwr CHp	STPTrq Clb-ft	BoostP psig	ExhPrs psig	LamAF1 Ratio
7500	354.3	248.1	22.1	24.6	13.33
7600	359.0	248.1	22.0	24.7	13.40
7700	366.6	250.1	21.9	25.0	13.37
7800	377.0	253.8	21.9	25.1	13.30
7900	386.4	256.9	22.0	25.3	13.21
8000	395.6	259.7	22.1	25.4	13.13
8100	404.3	262.1	22.0	25.5	13.05
8200	411.3	263.4	22.0	25.5	12.98
8300	418.0	264.5	22.0	25.5	12.91
8400	422.4	264.1	21.9	25.5	12.83
8500	424.6	262.4	21.8	25.5	12.70
8600	425.2	259.6	21.8	25.5	12.58
8700	422.3	254.9	21.9	25.3	12.41
8800	415.2	247.8	22.0	25.1	12.27



Here's the Mach Z turbo again—this time with twin pipes feeding the big Garrett ball bearing turbo. Separate wastegates are attached to each pipe. The odd brass T fitting on the top pipe's centersection allows dyno measurement of exhaust backpressure (for assessing turbine sizing) and temperature (to assure proper mixture from carb to carb, and determining what RPM peak HP will occur at).

What about the strange detonation on the mag cylinder on Art's 1080 triple? Now we're thinking it could be an air pocket around that combustion chamber, caused perhaps by a leaking combustion Oring. Air pockets around the outer surface any engine's combustion chambers can create almost instant WOT deto—even on properly tuned engines! Remember several years ago (before we learned to listen for knock with our copper tube) Rich Daly brought his "air-cooled" PS1000 SkiDoo triple to dyno test here. Rich is extremely weight conscious, and was running this engine w/o coolant—just bare domes bolted to the cylinders without covers. As we tested the overrich engine, and began jetting the big CS carbs down, at about .650 lb/hphr the spark plug ceramic began snapping from violent detonation. We couldn't hear it, but those broken spark plugs acted to protect the engine by eliminating the spark. Air doesn't do much to cool those smooth combustion chamber domes!

A structural assessment of Art's mag cylinder and head, and perhaps static pressure testing may reveal the source of an air leak which would displace coolant and create detonation. With that rectified, then the boost can be cranked up. Stay tuned for 25 or 35 psi!