SkiDoo 1200 4tec muffler/ header testing

“Hill” Billy Howard, of Howards SkiDoo/ Arctic Cat/ Kubota in Coutersport PA set this test session up. He brought the stock 09 4tec mule sled from his dealership, and obtained this multitude of headers and mufflers etc. He also invited his young, lighter weight driver and right hand tech/ engineering student Dave VonArx, and his pal and fellow good guy/ gearhead Bobby Donatelle from MN to help in this long awaited multi-part assessment.

Billy and Bobby had this pile of stuff to try on the bone stock, but well-broken (in as the result of a summer’s worth of asphalt racing) 2009 SkiDoo 4tec:

Straightline black painted mild steel 3-1 header
MBRP stainless steel 3-1 header
Straightline “quiet” round glasspack muffler
Straightline “loud” round glasspack muffler\
Hindle SS glasspack round muffler
Oversize throttle bodies
Boyesen experimental wings that fit into the throttle bodies

Coming by special delivery during the day:
Full Power/ CJ Motorsports stainless steel oval glasspack muffler

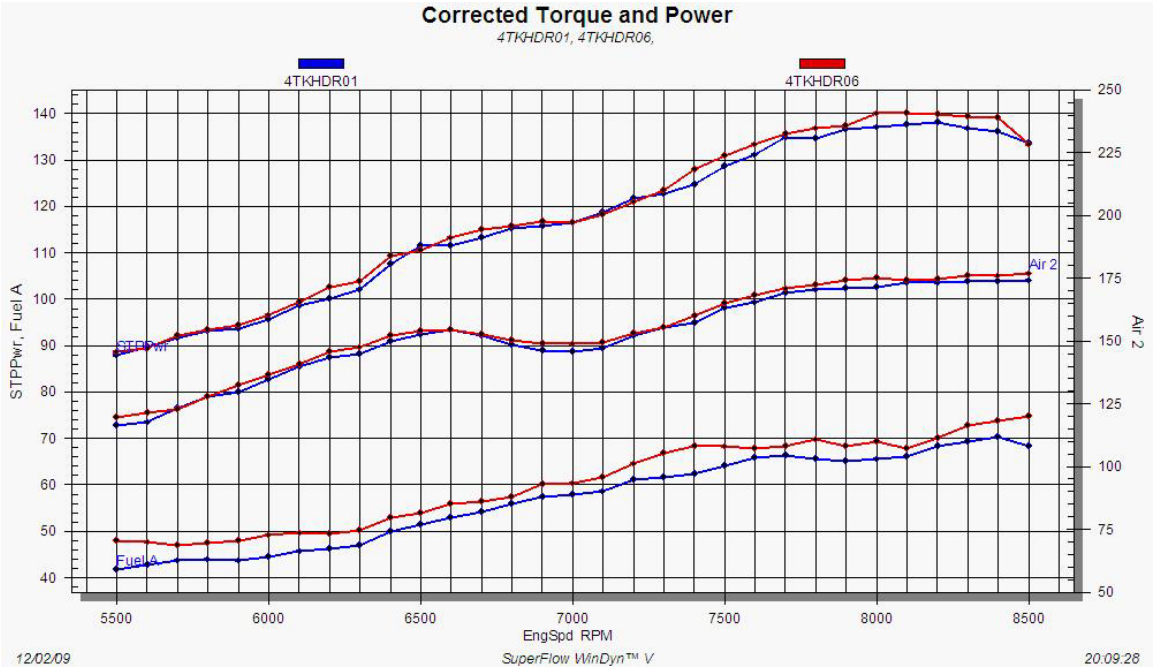
Coming via personal delivery by DynoPort owner Rich Daly during the day:
CrankShop/ DynoPort ceramic coated mild steel header
DynoPort baffled high flow (no glass packing) quiet muffler

We were, unfortunately, faced with dramatically changing weather conditions from morning to early evening when Billy had to shuffle Bobby D off to the Buffalo airport. The dropping barometric pressure and increasing humidity (water grains per pound of air) as the day went on changed our baseline. The stock EFI doesn’t seem to compensate for the slight reduction in baro on this day, and surely can’t adjust for water vapor in the air (displacing O2). And the dyno correction factor only makes up for a portion of that, if the ECU isn’t cooperating! So I have to show this test data in blocks, as air density dropped from .074 lb/ cu ft in the morning to .072 lb/ cu ft in late afternoon (nearly three percent). These three blocks of data are with air density of .074, .073, then .072 respectively. And because of this changing air density, I’m only showing the graphic comparison of components tested in those blocks of similar air density.

And another critical issue that we have when recording dynamometer data—the Superflow computer records data every 100 RPM, and it TRIES to catch a reading exactly on the 100. But it works out that the data recorded might be at 98 RPM, 99 RPM, or 102 RPM and it will consider it 100 RPM. Here, we have a fuel cut off rev limiter at 8500, and if the SF901 dyno measures torque at 8499 all is well. But if the dyno measures torque on a particular test at 8503 RPM there is no fuel there, and it causes a huge drop in the HP curve from 8400-8500 (8503 with zero fuel). So our HP dyno curves

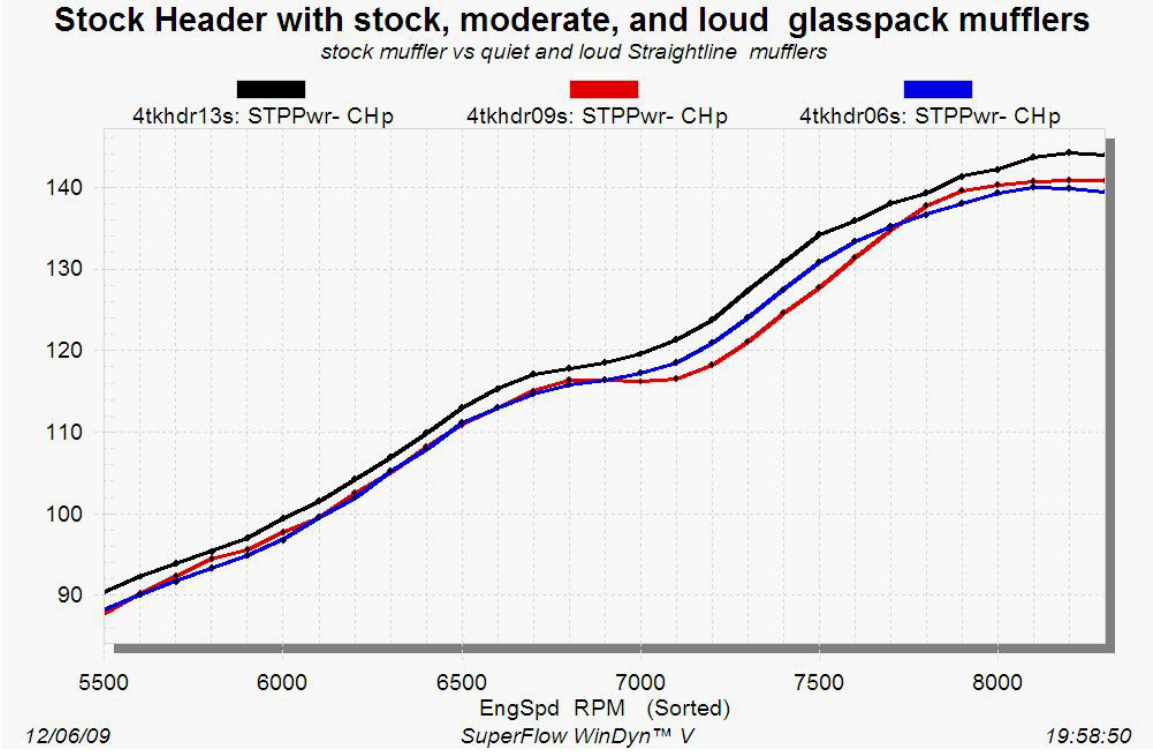
(after the following stock graph) are cut off at 8300, where the stock header and mufflers tail off, and aftermarket headers/ mufflers lie flat from 8300-fuel cut at 8500. And because of the changing air density, exact HP data will be discussed in text, but not shown in print. The graphs are adequate for us to assess the value of exhaust parts here. And to make things easier to understand, the graphs are smoothed by computer to eliminate HP spikes.

Since airflow would vary from part to part, we would use a new DynoJet Power Commander V with Autotune function to maintain ideal A/F ratio during testing. The Autotune uses a Bosch wide band O2 sensor to measure A/F ratio during each test. We found that the stock engine with stock exhaust made best power at a commanded 12/1 A/F ratio, and the PCV and Autotune adjusted fuel flow quickly to achieve best HP A/F ratio for each component. Interestingly, we made more HP with the bone stock exhaust system by allowing the PCV/ Autotune to enrichen A/F ratio in these weather conditions! So it is important to understand that adding airflow to an already-lean stock 4tek with headers and/ or mufflers will require enrichening the fuel flow with PCVs or whatever electronic devices are available to add the appropriate amount of fuel. Here is the stock 4Tec with fuel added by PCV Autotune, showing how maintaining proper A/F ratio adds to airflow CFM and HP:

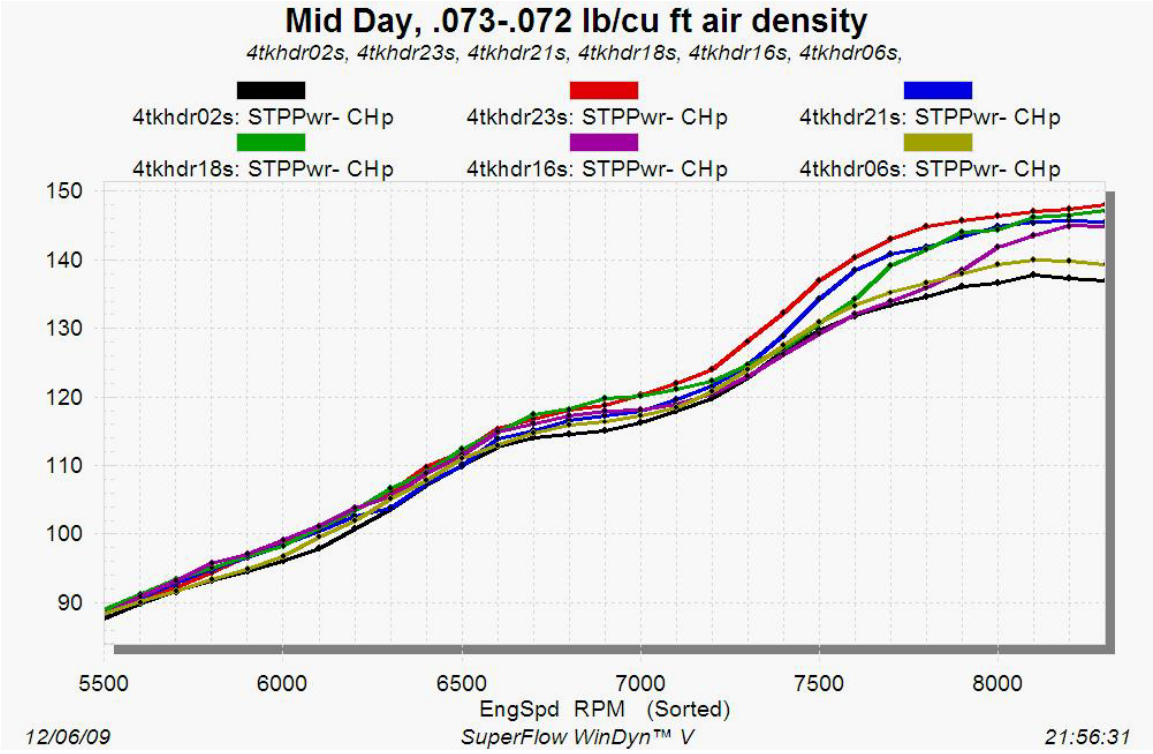


So here is test block one, stock header tested in the AM with .074 lb/ cu ft air density. This was early morning, cold not too humid air with high baro. We tested the stock header with stock muffler, then allowed Autotune to enrichen mixture and make a bit more HP. Here is the listing of the tests/ graphs and what was changed:
4tkhdr06s Blue stock header stock muffler fuel flow enriched by PCV

4tkhdr09s Red stock header Straightline “quiet” glasspack muffler
4tkhdr13s Black stock header Straightline “loud” glasspack muffler



Block two is mid day, air density is worsening to .073 lb/ cu ft. Here we compare the bone stock 4tec header to the Straightline black painted mild steel header with the MBRP stainless steel header, with the various mufflers we had at that juncture:
4tkhdr02s Black bone stock test 2
4tkhdr06s Gold bone stock w/ fuel added with PCV
4tkhdr16s Purple Straightline header w/ stock quiet muffler
4tkhdr18s Green Straightline header w/ Straightline loud muffler
4tkhdr21s Blue MBRP stainless header w/ stock quiet muffler
4tkhdr23s Red MBRP stainless header w/ Straightline loud muffler



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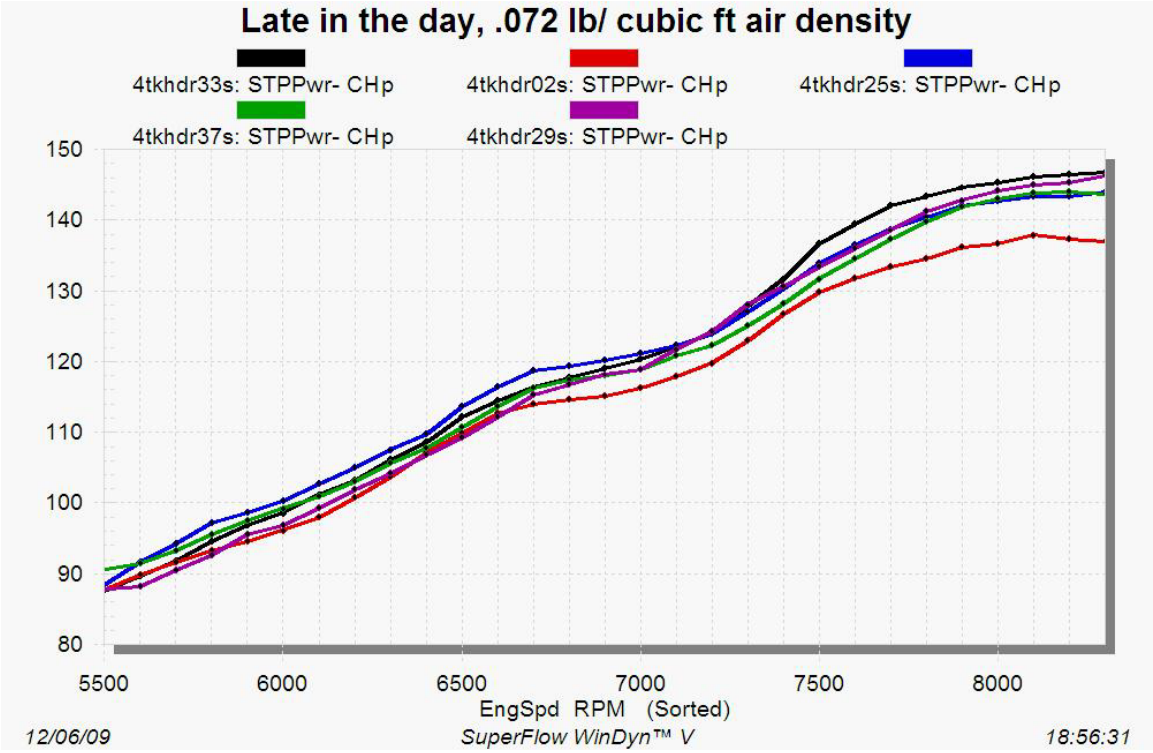
Later in the day, with weather conditions deteriorating, Rich Daly arrived with the CrankShop/ DynoPort header and baffled (not glasspacked) DynoPort oval quiet silencer that would prove to flow nearly as well as the very loud open glasspack mufflers. The header is made of mild steel but is coated with DynoPort's glossy ceramic coating. For reference, we tested the MBRP header with the stock muffler and the DynoPort quiet but high flowing baffled muffler. Not that the MBRP header made a bit less HP with the stock muffler in the late afternoon with air density of .072 lb/cu ft.
4tkhdr02s Red stock everything
4tkhdr25 Blue CS/DP header with stock muffler
4tkhdr29 Purple CS/DP header w/ DP quiet baffled muffler
4tkhdr33 Black MBRP stainless header w/ DP quiet baffled muffler
4tkhdr37 Green MBRP stainless header w/ stock muffler



During this session we tested other mufflers, back to back with the ones shown in the graphs. Billy had a Hindle brand stainless glasspack that looks like it was designed for a sportbike and required a new large hole be cut in the bellypan to accommodate the single outlet pipe. It was a bit quieter than the Straightline loud muffler, and made about one HP less due to airflow that was more on par with the Straightline quiet glasspack.

Full Power sent over a large oval stainless steel glasspack that flowed nearly as well as the Straightline high flow glasspack. And it's larger volume of fiberglass media resulted in less noise. The Full Power stainless muffler also had twin outlets that matched the two holes in the bellypan.

The DynoPort baffled oval muffler had airflow almost as as high as the biggest glasspacks but with much less obvious bB. We never did a back to back in the same air with the highest flowing glasspack (Straightline loud muffler) but HP results looked similar. And we were not able to test the quiet DynoPort baffled muffler with the stock header on this day due to time restrictions.

But before we finished, we tested an experimental Boyesen wing-like device that fits into the single throttle body, with a loss in airflow CFM in the midrange and top end, no gain in HP. We also tested a larger diameter custom throttle body—no gain in CFM or HP even with the MBRP header installed on the engine. That single throttle body might seem smallish for a 1200 triple but remember that it feeds those big cylinders one at a time! So at 8500 RPM it's not really much different from having three similarly sized throttle bodies—one on each cylinder.

Phaze II of the 4tec HillBilly/ Bobby Donatelle collaboration is higher airflow via camshafts that, as this is written, are said to be being ground. But adding airflow with cams will likely mean higher revs for max HP. This will require someone to figure out how to override the SkiDoo 4tec rev limiter, with valve springs adequate to prevent valve float.

As we can see from this session, adding optimal exhaust to an engine that seems tuned perfectly for boost (extremely low Brake Specific Air Consumption when boosted with turbocharging) helps some. But drastic camshaft/ valvetrain changes will be necessary if we want to fill the huge HP/$$$ void that exists between current stock Normally Aspirated HP and boosted HP. NA now is just shy of 150 HP, and boosted 4teks can make 200 HP on pump gas if tuning is correct. Can we split the difference at 175 with camshafts/ valve springs?

According to Billy and Bobby, there is more good NA stuff to come.