

Northern Illinois University



2013 Clean Snowmobile Challenge



Snowmobile Selection



2007 Yamaha Phazer

What we set out to improve:

- Exhaust Emissions
- Sound Emissions
- Fuel Efficiency
- Ability to run on ethanol blend
- Power: Weight ratio



Consumer Appeal

- The average snowmobile buyers will be purchasing a snowmobile intended for purely recreational use.
- The team added the following enhancements and refinements to the factory configuration, which all benefit the consumer, environmentalists, and dealers.



Phazer Performance Enhancements



Engine-Cooling-Drivetrain

- MegaSquirt ECU
- Aerocharger turbo
- Intercooler
- Radiator
- Belt Drive

Handling

- C&A Pro Skis
- Timbersled
Barkbuster Front
End
- Fox Float Shocks
- Carbide skeys

MegaSquirt ECU

- Manage fuel curves, timing curves, boost maps, and alcohol Correction
- Full functionality comparable to the stock ECU, but with additional capabilities
- Works with the Phazer's engine design (odd-fire, dual trigger, C.O.P)
- Unlike previous years, completely replaces stock ECU, it controls all engine systems. (fuel, timing, ignition)
- Allows for end-user tuning (if more performance is desired)



Aerocharger Turbocharger System

Turbocharger

- Improves power
- Makes it possible to reach higher elevations while riding, due to the incoming air being at a higher pressure.
- improves engine efficiency by using otherwise wasted energy in exhaust to boost performance.

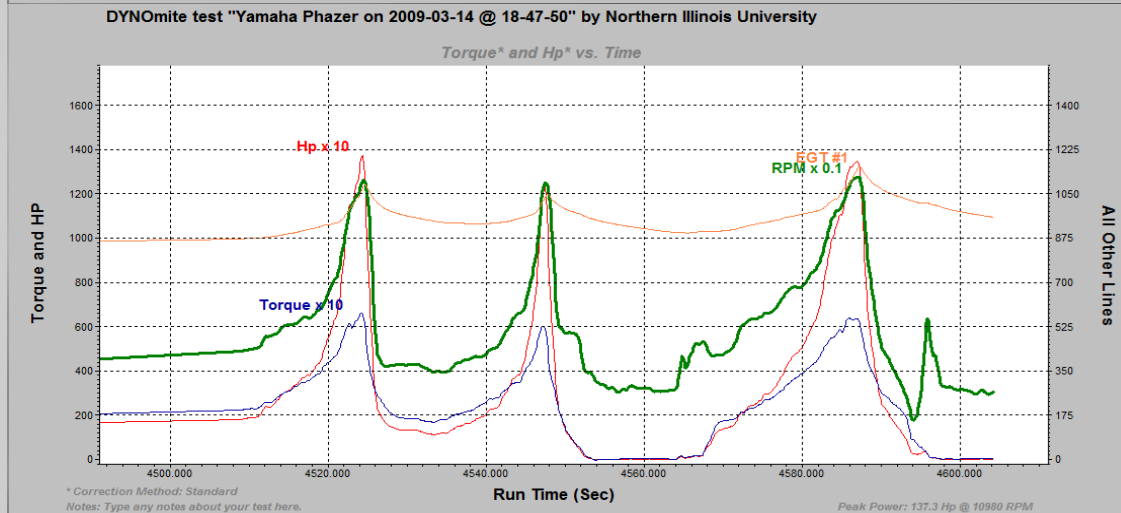
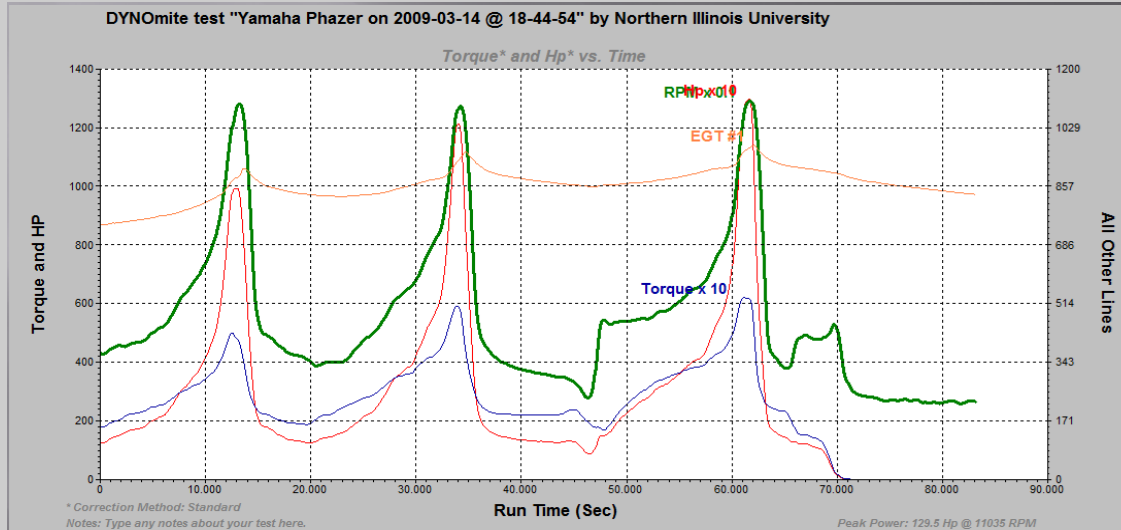
Intercooler

- Cools incoming air before entering the motor.
- Allows for a denser incoming air charge, which lets more fuel be added boosting performance



Dynamometer Testing

Dynamometer testing done on E10 and E85.



Gains of at least 40 HP over the stock rating of 88 HP.

Cooling System

Due to the additional heat brought on by the turbocharger, and the higher burning temperature of ethanol based fuel.

A radiator was added to the cooling loop to dissipate the additional heat that the factory heat exchanger would not be able to handle on its own.



Belt Drive



Reduced Noise Emissions

- Eliminates metal/metal contact

Eliminates the need for oil

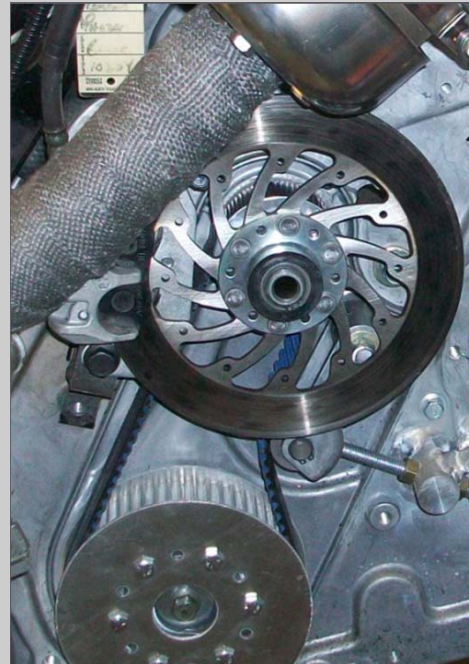
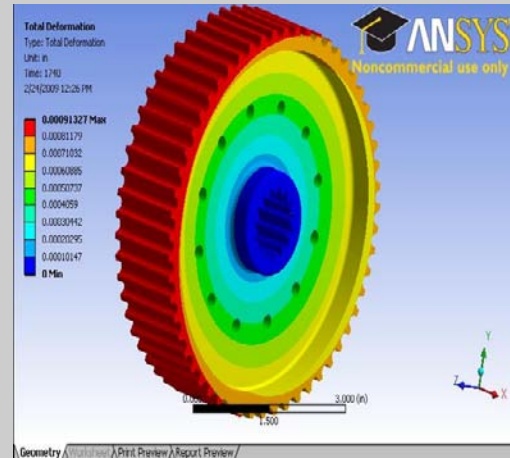
- Less risk for environmental pollution

Made from 6061-T6 Aluminum

- Reduces rotating mass
- Allowing for quicker acceleration and increased efficiency.
- High durability

Maintained stock 19:41 gear ratio

- Sustains factory calibrations



Handling

C&A Pro Skis / Woody's Carbides

- Reduces darting
- Allows for more steering grip in turns



Timbersled Bark Buster Front End kit

- Reduced weight by 9 Lbs
- Tighter turning radius
- 39" variable ski stance
- Allows for aftermarket shocks



Fox Float Shocks (Replaced all factory shocks)

- Weight reduction
- Increased range of adjustability
- Ease of adjustability



Emission Changes

Sound emissions

- Glass pack muffler
- Sound absorbing muffler
- Belt drive system
- Sound proofing on body panels

Exhaust Emissions

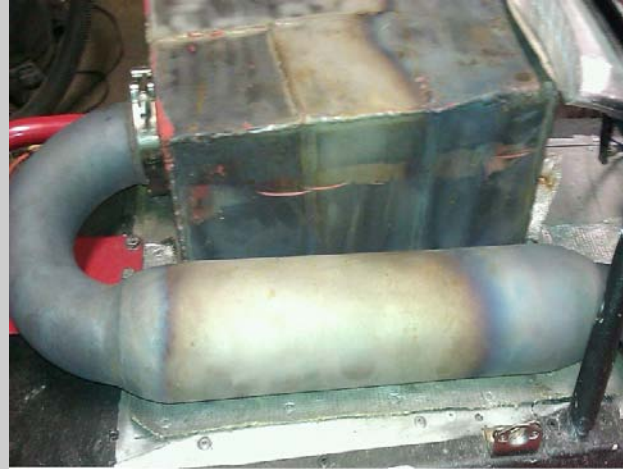
- Catalytic converter
- Turbocharger
- Ability to run on ethanol
- Megasquirt ECU



Sound Emissions

Glass Pack Muffler

- Absorbs some of the exhaust sound reducing over all volume

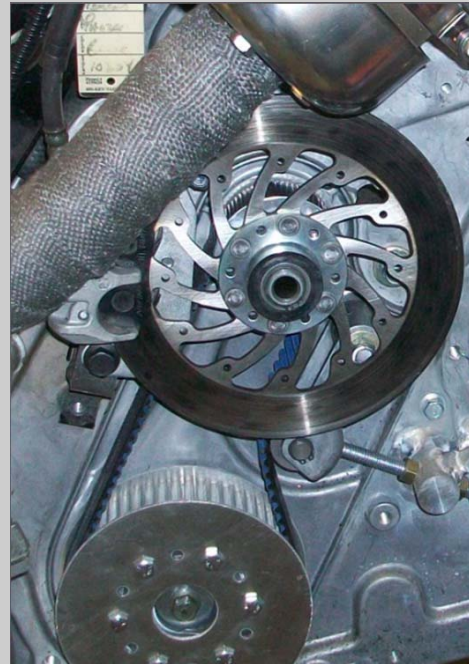


Sound Absorbing muffler

- Reduces sound by reflection sound waves, canceling some out, and others are absorbed by fiberglass packing.

Belt Drive System

- Removes metal to metal contact of a conventional chain drive reducing sound.



Sound proofing on body panels

- Sound absorbing material was placed on the inner body panels to reduce vibration noise.



Exhaust Emissions

Catalytic converter

- Reduces the amount of harmful gases in the exhaust.



Turbocharger

- Utilizes otherwise wasted energy to produce more power, also reducing CO2 emissions.



Megasquirt ECU

- Tunes the motor allowing for a more complete fuel burn.



Emissions testing

Emissions measurements were taken before and after the addition of the catalyst using a Nova Exhaust Analyzer.

Stock Exhaust Readings

	O2 (%)	CO (%)	CO2 (%)	HC PPM	(NO+NO2) PPM
Idle	1.3	1.7	13.5	198	110
Mid- Throttle	0.3	5.9	11.6	161	178

Post Catalytic Converter

E10	O2 (%)	CO (%)	CO2 (%)	HC PPM	(NO+NO2) PPM
Idle	0.3	1.2	14.7	299	3
Mid-Throttle / Mid- Load	0.1	3.8	12.9	119	138
100% Throttle/ 100% Load	0.2	8.7	9.7	760	181
E85	O2 (%)	CO (%)	CO2 (%)	HC PPM	(NO+NO2) PPM
Idle	0.3	3.3	12.6	176	1
Mid-Throttle / Mid Load	0	1.3	14	51	26
100% Throttle/ 100% Load	0.9	5.5	11.1	471	121



Ethanol conversion

Alcohol Sensor

- Detects the alcohol content of the fuel and sends a resistive value back to the ECU
- Allows the ECU to pick the corresponding fuel, and timing maps.
- Adjusts the motor for maximum performance and minimum emissions for varying fuel type.



Dealer Benefits

- This sled offers many desirable features as well as mid to high range performance when placed against other comparably priced and equipped snowmobiles.
- This sled's price falls above that of other comparable sleds. One of which is the 2012 Polaris Iq turbo, which as the name implies is also equipped with a turbo.
- The MSRP for the Polaris is \$11,299
- The Phazer's MSRP is \$13,258, mainly due to the additional upgrades that are placed on the sled
- The addition of these parts does not introduce any more tedious maintenance or parts that would need replacing.



Dealer And Consumer Benefits

- The MegaSquirt ECU allows for additional tuning to be done after purchase. Which the dealer could do if the owner wants to enhance the performance of their sled. For example, Adding a bigger turbo, or increasing the size of the fuel injectors, would both require a retune, which dealers could offer.
- The sleds higher performance nature opens the door to performance oriented riders as well as beginners. This lets dealers stock one sled that would appeal to both parts of the market.
- With all the modifications done to the sled all factory ergonomics and riding position were retained.



Questions?

