Northern Illinois University

2009 Clean Snowmobile Challenge

Team Background

- Second year for competition
- Started as senior design project
- Inaugural results
  - Objective handling: 2nd
  - Cost Analysis: 3rd
  - Fuel Economy: 4th
  - Acceleration: 4th
  - Overall: 6th
- Recently Acquired a Land and Sea Dynamometer and Nova Exhaust Analyzer

Riding for a Cause

- This year we teamed up with Pink Ribbon Riders
  - Organization that raises the awareness of breast cancer in the snowmobile community.
  - Raise money to give to families that are dealing with cancer.
- This is the reason for the “Pink Themed” Snowmobile for CSC 2009.

Snowmobile Selection

2007 Yamaha Phazer

- Potential for success in multiple categories
  - Exhaust noise
  - Lower emissions
  - Power : Weight
  - Fuel efficiency
  - Ethanol capabilities

Weight Savings

- Replaced Stock Skid with Custom Skid
  - Weight Savings = 26 lbs
- Replaced Front A-arm Kit
  - Weight Savings = 10 lbs
- Addition of Belt Drive

MegaSquirt ECU

- Manage fuel curves, timing curves, boost maps, and alcohol correction
- Full functionality of any “normal” ECU, but with additional capabilities
- Work with the Phazer’s engine well (odd-fire, dual trigger, C.O.P
- Unlike previous years, completely replaces stock ECU controlling all engine systems

Alcohol Sensor

- **Using a stock GM alcohol sensor**
- **Works in conjunction with MegaSquirt**
  - Adjusts timing to take advantage of higher octane rating with higher ethanol blends
- **Outputs to boost control to adjust turbo**

Turbocharger

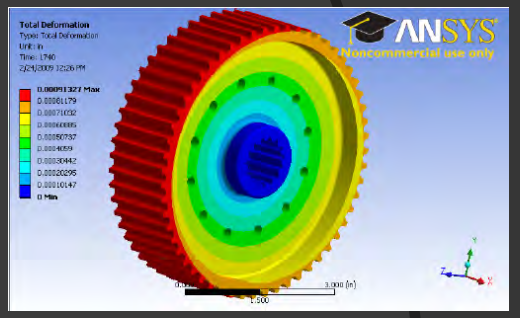
- **Improves power**
  - Makes it possible to reach higher elevations in parks
- **Maintains or improves engine efficiency**
  - Uses otherwise wasted energy in exhaust to boost performance
  - Keeps parks clean and allows quick transportation without sacrificing environmental friendliness

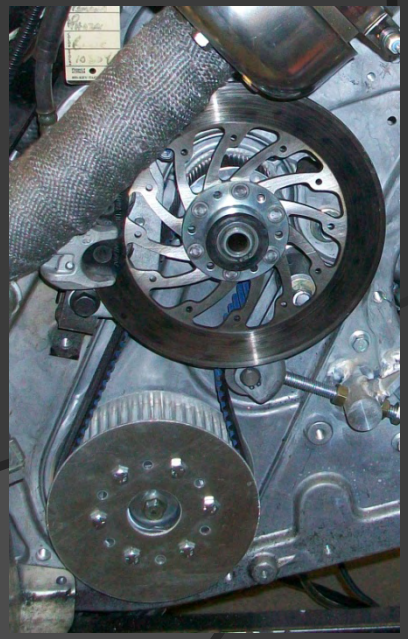
Exhaust Design

- **Must accommodate turbo**
- **Adapt catalytic converter**
  - Decreases exhaust emissions
- **Equal runner length on exhaust manifold**
  - Allows better exhaust scavenging and even flow
- Using a two stage approach
  - Stage One
    - Absorption style – Glass-Pack
  - Stage Two
    - Specific frequency cancellation – Custom designed muffler
- **All done to decrease sound emissions**
  - Won’t frighten Bambi

Belt Drive

- **Reduce noise emissions**
  - Eliminates metal on metal contact
- **Custom designed and built gears**
- **Reduce weight**
- **Made from 6061-T6 aircraft aluminum**
  - Low weight
  - High durability
- **Maintained stock gear ratio 19:41**

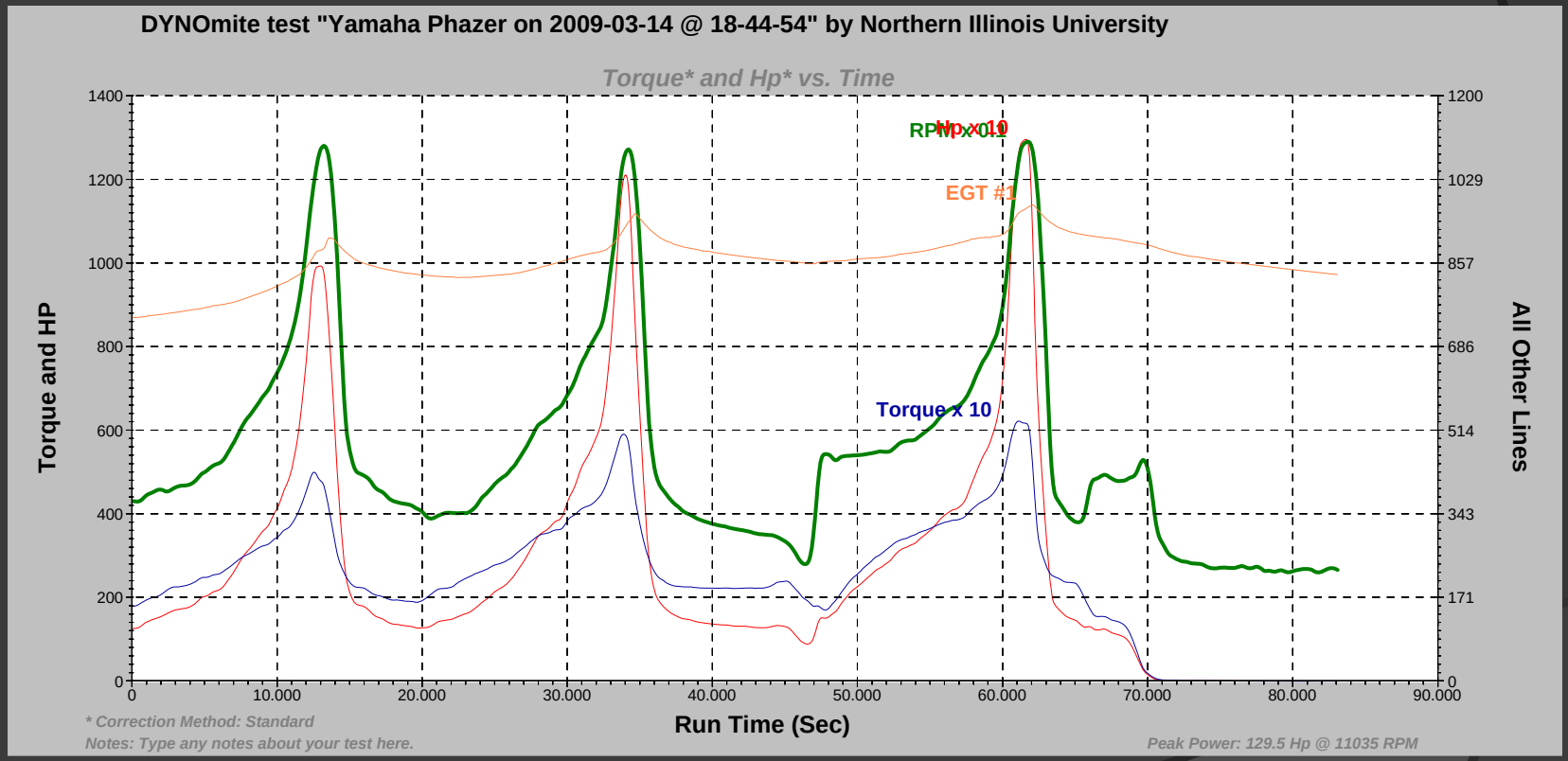




Dynamometer Testing

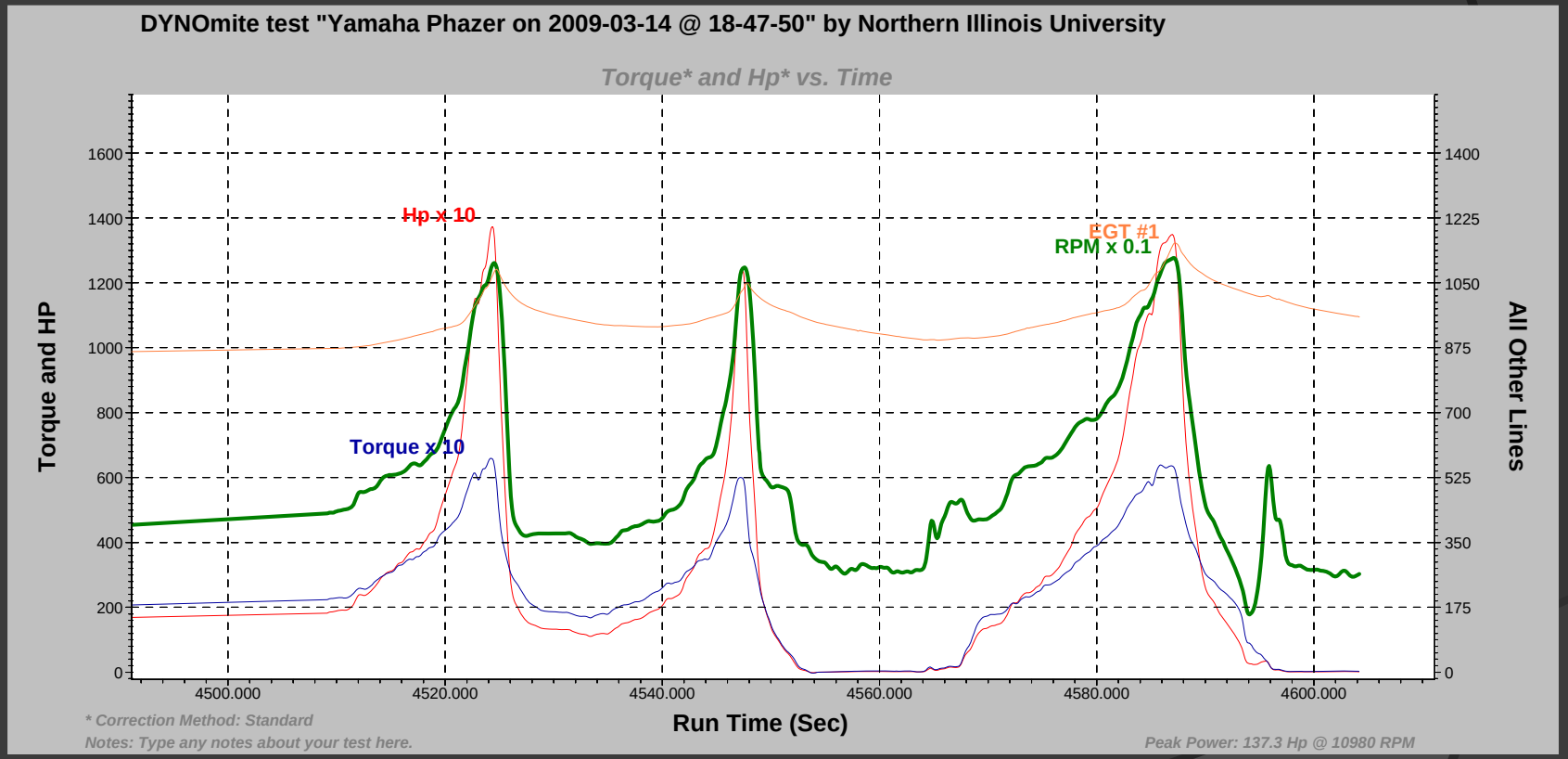
- **Simulates Real World Loading**
  - The water-break absorber resists the rotation of the engine.
- **We are able to monitor most diagnostics of the engine.**
  - **RPM**
  - **Horsepower**
  - **Torque**
  - **Exhaust Temperature**
  - **Air Intake Flow**
- **Horsepower with Stock Exhaust = 88 HP**

Dynamometer Run on E10



Peak Power: 129.5 hp around 11000 RPM

Dynamometer Run on E85



Peak Power: 137.3 hp around 11000 RPM

Emission Testing

- **Exhaust measurements were taken before and after addition of catalyst.**
- **The Nova Exhaust Analyzer is relatively new.**

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

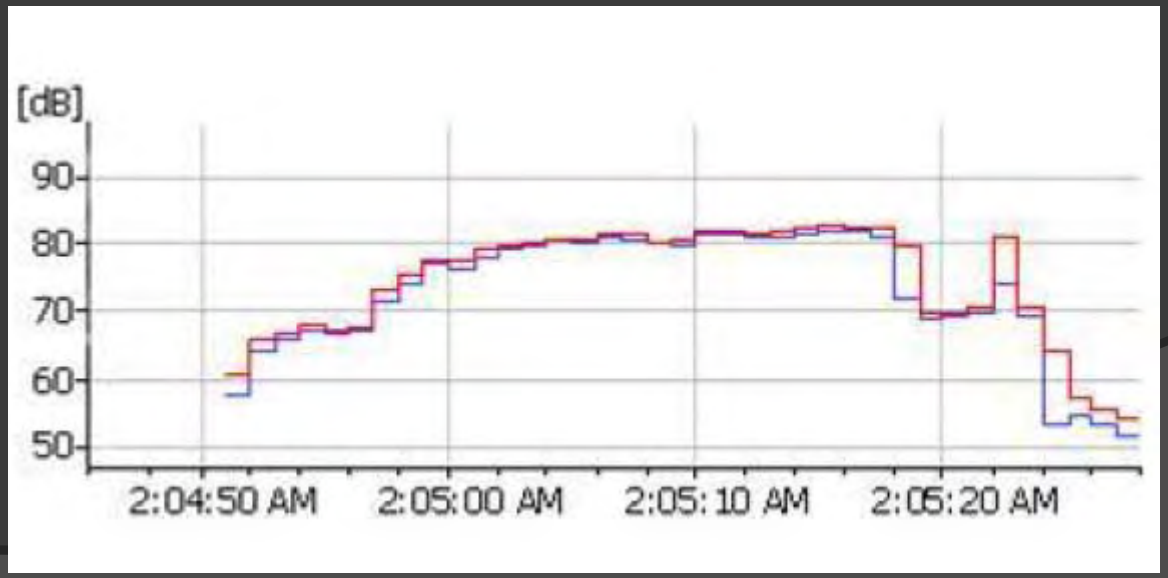
Emission Testing

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

Sound Testing

- Using SAE J192 specifications for testing we conducted a sound test with the stock exhaust.



Cost Analysis

- MSRP - $9,986.00
  - Includes
    - Turbo
    - Alcohol sensor
    - Catalyst
- This fits consumer wants – making our sled desirable to both the manufacturer and consumer

Conclusion

- Snowmobiling is becoming more popular and the effort for improved, dependable, and environmentally friendly vehicles will take manufacturers to a new level.

- Our team took these ideals and figured out an economical way to modify a currently available consumer snowmobile to push snowmobiling forward for both recreationalists and environmentalists.

Questions?


NIU MotorSports
CLEAN SNOWMOBILE TEAM
EVOLVED
ARISTO
CATALYST TECHNOLOGY
ROAD RANGER
Timbersled
CHICAGO HISPANIC HEALTH COALITION
Sign Ink
CA PRO
RIDE LIKE A PRO
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