

Michigan Technological University Clean Snowmobile Enterprise

Improvement of the Polaris Switchback Assault:
Innovations for a Greener Tomorrow

*Team President:
Dylan Truskolaski*

*Chassis Team Leader:
Clay Hendricks*

March 7th, 2012



Fueling Performance through Innovation



Design Intent

- Redesign a production snowmobile
- Reduce Emissions
- Reduce Noise
- Increase Fuel Efficiency
- Maintain Stock Power to Weight Ratio
- Improve Vehicle Dynamics
- Maintain Reliability
- Operate on flex fuel (E10 – E39)



Fueling Performance through Innovation



Performance



- Turbocharged Weber MPE750
- Lightweight modern chassis & components
- Improved vehicle dynamics
- Maintain stock weight to power ratio



Fueling Performance through Innovation



Engine / Chassis Combination

Weber MPE 750

- 4-stroke
- Turbocharged
- 9:1 compression ratio
- 12 psi boost pressure
- Designed and fabricated intake

2011 Switchback Assault

- Minimal chassis weight
- Increased chassis rigidity
- Ergonomics
- Vehicle Dynamics
- Modern aesthetics



Fueling Performance through Innovation

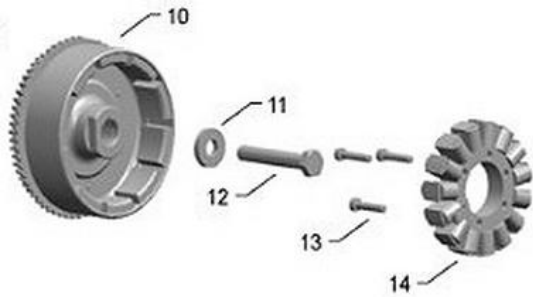


Engine Modifications

- Watcon high output stator charging system
 - Packaging
 - Lightweight
 - AEM requires a greater power output than the factory Weber stator system provides



- Crankshaft modification
 - Machine larger keyway for high output stator flywheel



Fueling Performance through Innovation



Engine Modifications

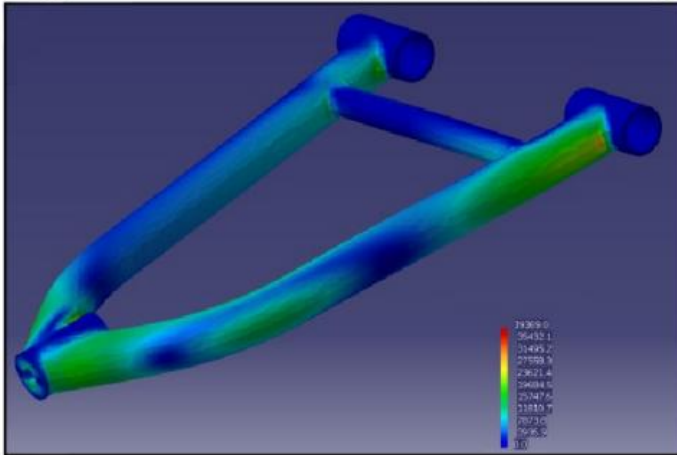
- Intake Manifolds
 - Redesigned to allow fitment of the intake plenum and stock fuel tank
 - Improved flange seal from 2011 design
 - Increased length from 2011 design



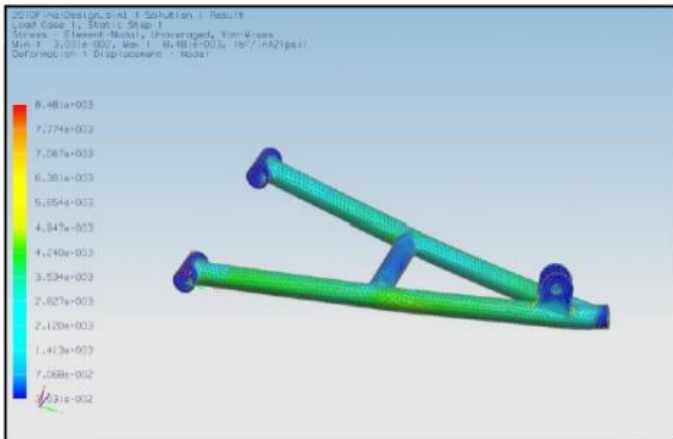
Fueling Performance through Innovation



Front Suspension



- MTU designed and fabricated A-Arms
 - 6061-T6 Aluminum upper A-arm
 - 4130 Chromoly lower A-arm
- Aluminum and Chromoly compared for lower A-arm design

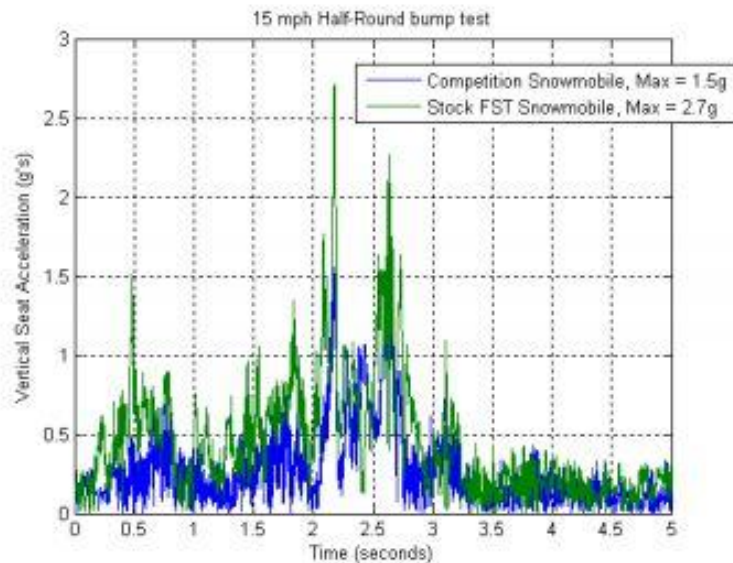


Fueling Performance through Innovation



Rear Suspension

- *Ski-Doo SC-5*
 - *Light weight configuration*
 - *20 pound reduction*



- *Bump Course Data*
 - *Closed constructed bump course*
 - *Max acceleration reduction*



Fueling Performance through Innovation



Weight/Power ratio



- MTU Switchback FST
 - Dry weight: 476 lb
 - Power: 110 hp
 - Weight/Power: ~4.3 lb/hp
- 2012 Polaris Turbo IQ
 - Dry weight: 599 lb
 - Power: 140 hp
 - Weight/Power: ~4.3 lb/hp



Fueling Performance through Innovation



Environmental Concerns



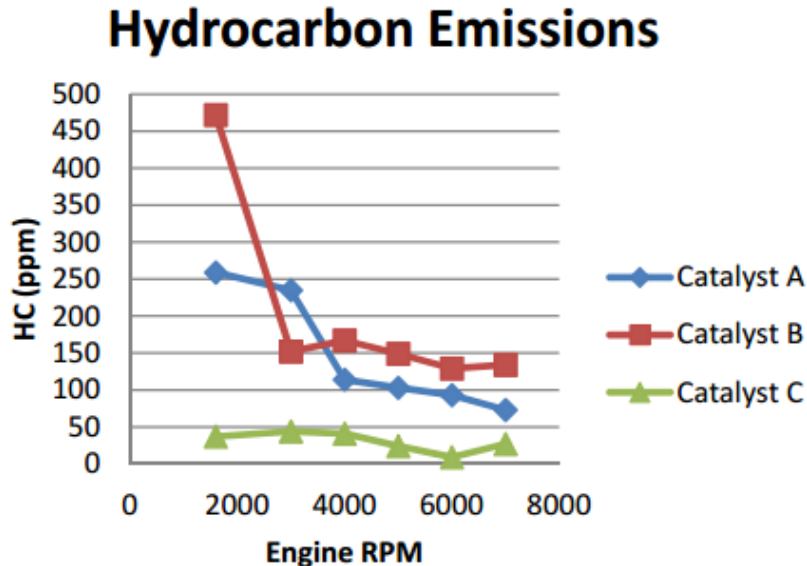
- MTU muffler and catalyst to decrease noise and emissions output
- AEM engine management
- Flex fuel implementation



Fueling Performance through Innovation



Catalyst Selection



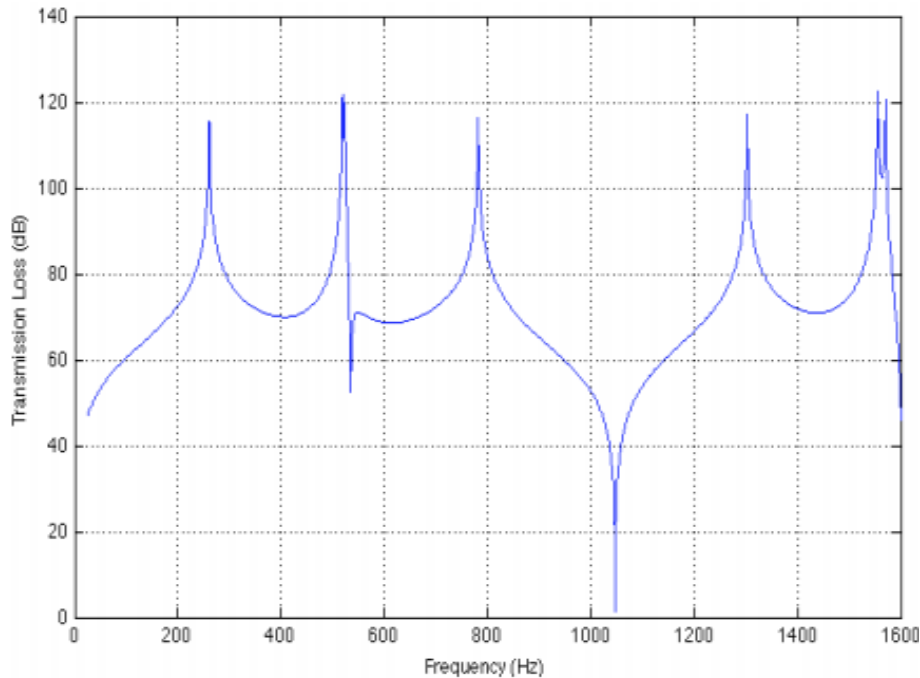
- Single pass Vconverter catalyst chosen to reduce tailpipe emissions
- 79% reduction in HC
- 23% reduction in CO
- Increase in NOx



Fueling Performance through Innovation



Muffler Design



- MTU 2-chamber muffler model was create
- MATLAB transmission loss simulation was used to determine its effectiveness before final product fabrication



Fueling Performance through Innovation



Exhaust System

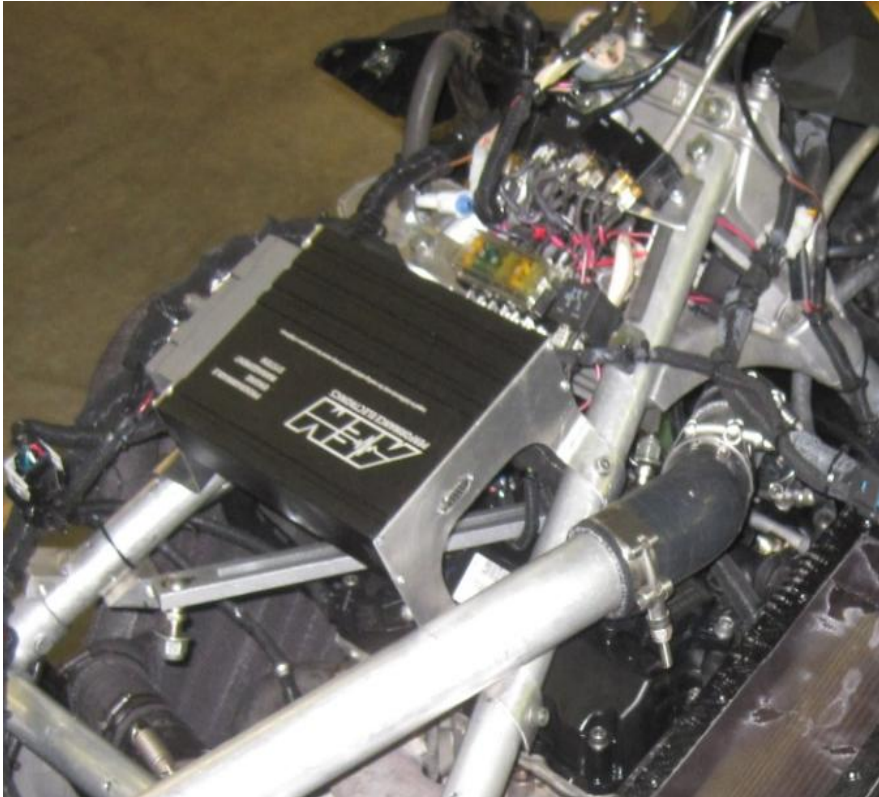
- Components
 - 2-Chamber muffler
 - V-Converter Catalyst
- Packaging
 - Within stock plastics
- Concerns
 - Lower catalyst temperature following muffler
 - Increased likelihood of blocking flow of catalyst



Fueling Performance through Innovation



Engine Management



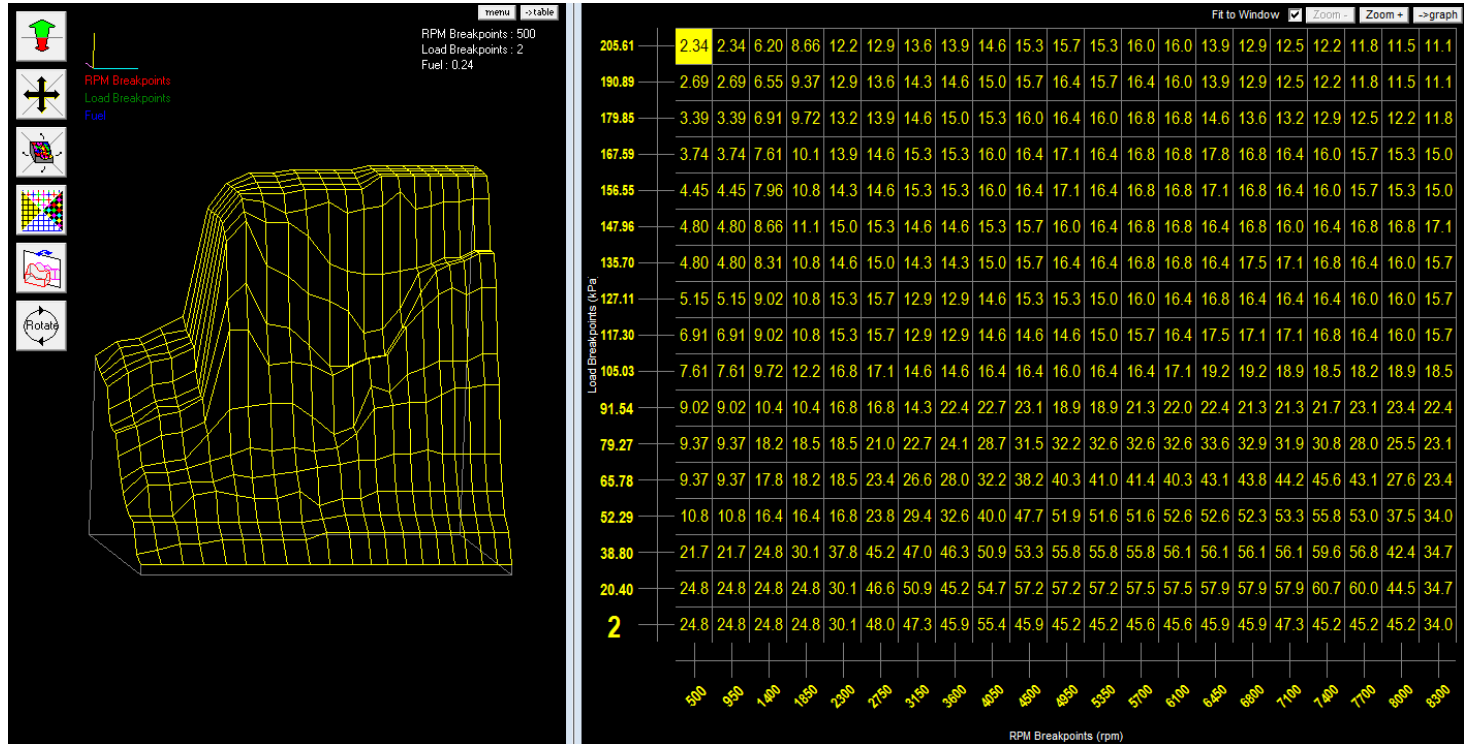
- AEM standalone engine management system
- Allows for precise fuel and ignition control
- Multiple user-defined inputs



Fueling Performance through Innovation



Engine Management



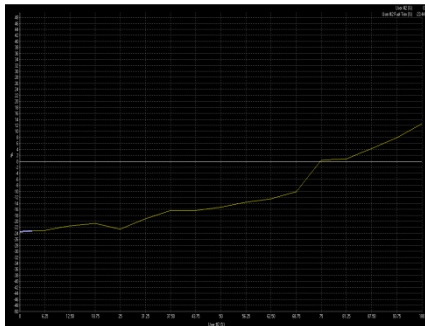
- 350 load break points based on MAP vs. RPM
- Multiple trim tables to correct for varying conditions



Fueling Performance through Innovation



Flex Fuel Implementation



- Siemens ethanol content sensor (50 to 150 hz)
- Zietronix Analog to Digital converter (0-5v)
- AEM Input
- MTU generated ethanol content trim table
- Ignition tuning



Fueling Performance through Innovation



MSRP & Resale

Manufacturer Suggested Retail Price

- 2012 MTU Switchback FST
 - MSRP: \$12,576.95
- 2012 Polaris Turbo IQ
 - MSRP: \$11,199.00
- Overall increase in price is justified by the following:
 - Noise and emissions reduction
 - Innovative chassis selection
 - Flex fuel technology

Resale

- Reliability of 4 stroke engine ensures minimal maintenance
- Best selling chassis available in current market
- Flex Fuel implementation allows for future increases in ethanol content



Fueling Performance through Innovation



Conclusion

- Innovative engine and chassis configuration
- Significant weight reduction with an improvement in both ergonomics and vehicle dynamics
- Flex Fuel capabilities
- All parts designed and fabricated with mass manufacturing intent
- Reasonable MSRP



Fueling Performance through Innovation



-Questions-



Fueling Performance through Innovation

