NIU MotorSports

CLEAN SNOWMOBILE TEAM

SAE

SAE Clean Snowmobile Challenge 2008

Team Background

- Inaugural Year
- Began with Senior Design Project
- Gathered Strong Student and Faculty Support.

SAE Clean Snowmobile Challenge 2008

Team Timeline

December
Decision for Senior Design Project

January 14
Register for SAE CSC 2008 without a Team Snowmobile

February 4
Pick-up Donation of the Formula SLS Snowmobile!

February 4 – Few Hours After Pick-up
Snowmobile Seat became missing.

February 6
SNOW DAY- Testing Out the Condition of Sled.

February 6
Engine Tear Down. 40+ miles were put on with cut oil line.

February 8
Purchased SKI DOO 600 SDI

February 12
Motor Dropped in Chassis

February 23
Runs on E85

February 24
Catalyst Testing Overheating Occurs

February 27
Re-Design of Exhaust system Complete Testing and Analysis

March 1-9
Finishing Touches, Last Minute Changes, and Safety Requirements

March 10-15
CSC 2008






BEFORE → AFTER

SAE Clean Snowmobile Challenge 2008

Presentation Outline

- Chassis Selection
- Engine Choice
- Conversion to E85
- Modifications
  - Engine
  - Exhaust
  - Air Intake Box
- Emission Reduction
- Noise Reduction
- Testing
- Results
- Customer Appeal
  - Safety of Rider
  - Cost Effectiveness

Chassis Selection

- 1996 SKI DOO FORMULA SLS
  - Light Weight
  - Large Hood Space
  - Engine Mounting Clearance
  - Greatest Snowmobile Ever?

Engine Choice

- SKI DOO 600cc Semi Direct Injection 2-Stroke

Decision Matrix

Key

1	+
0	S
-1	-

#	Criterion	Importance	Alternatives: 2 Stroke- Carburated	2 Stroke- E.F.I/S.D.I	4 Stroke- E.F.I	4 Stroke- E.F.I Forced Induction
1	Durability	10	1	0	1	1
2	Cost	10	1	0	-1	-1
3	Functionality	14	1	1	1	1
4	Maintenance	6	0	1	0	0
5	Manufacturing Feasibility	5	1	0	0	0
6	Parts Availability	8	1	0	0	0
7	Weight	7	1	1	-1	-1
8	Performance	6	0	1	-1	0
9	Fuel Mileage	8	-1	1	1	1
10	Noise Emissions	13	-1	0	1	1
11	Exhaust Emissions	13	-1	0	1	1
	Totals	100	20	41	35	41

Key Criteria

» Functionality
» Maintenance
» Weight
» Performance
» Fuel Mileage

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Conversion to E85

- Higher octane rating (104)
- Power increase possibilities
- Increase compression
- More fuel
- Advance Timing
- Less energy
- Decreased fuel economy

Engine Modification

Increase In Performance

- Straight Line Performance Billet Head
  - Raised Compression
  - Better Cooling
- Advance Timing Keyway
  - Better Performance
  - Better Emissions (more complete burn)

Fuel Mapping System

- BoonDocker “Piggy Back”
  - Modifies stock injector pulse width
  - Allows stock BRP ECM to adjust for air temp, coolant temp, TPS, RPM, ect.
  - Correct stock lean/rich conditions based on load & RPM

Air Box Design

- Two chamber design
- Upper expansion chamber with 3” diffuser tube, ¼” holes
- Lower chamber containing five baffles.
- Draws air from underneath engine

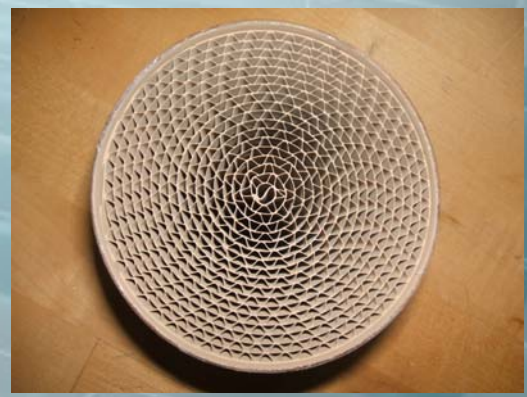
Exhaust System

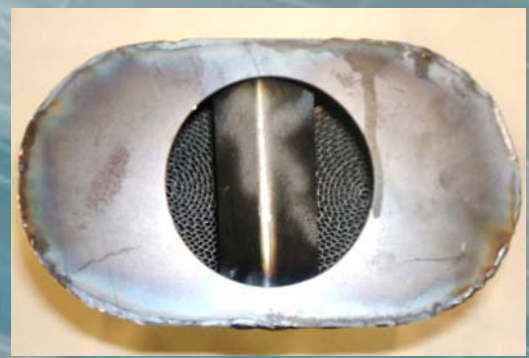
- Exhaust Pipe Fitment
  - Modifying Expansion Chamber
  - Utilizing Hood Space
  - Minimizing Outer Exposure
- Implementing Catalytic Converter

Emission Reduction

Environmentally Friendly

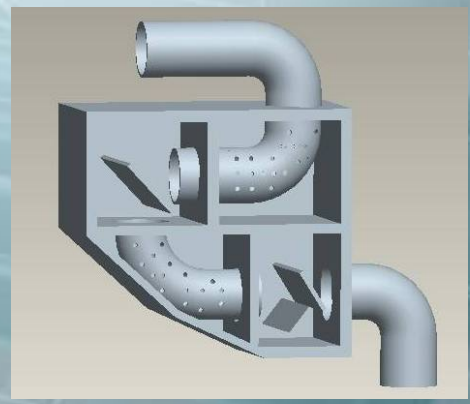
- 3 way Catalyst, Palladium, Platinum, Rhodium
- Two 4” Catalytic Converters





Noise Reduction

- Multiple Chamber Design
  - High Frequency Dampening
- Re-Design
  - Fitment Issues
  - Sound Improvement
  - Catalyst Arrangement



Noise Reduction

- Hood and Compartment Insulation
  - Clutch Side and front vents closed
  - Exhaust vents open for cooling

Testing

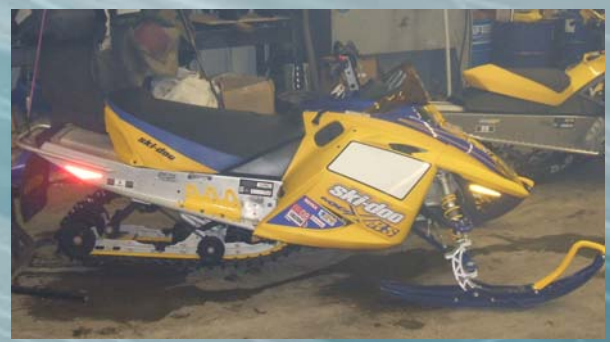
- Emission Analysis
  - OTC Genysys 5 gas analyzer
- Catalytic Converter Analysis
  - Fluke Temperature Meter
- Sled Dyno Testing
  - Engine Tuning

Testing

SKI DOO	NOx	CO	HC	CO2
2009 E-TEC	0.1	20.61	33.77	297.99
2006 600 SDI	0.15	58.96	49.37	182.68
NIU Team Snowmobile	0.06	41.73	17.56	309.74

(g/mi)

2009 600 E-Tec



2006 600 SDI

2008 Team Sled

Consumer Appeal

- Low Cost
  - Low MSRP
- High Durability
  - Little Modification to Critical Components
- Practical
  - Can Easily be Manufactured

Conclusion

- Re-Engineered for Better Noise and Exhaust Emissions
- Fuel Efficient
- Increase In Performance
- Practical Applications

Questions?

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