University of Idaho's Flex Fuel Two-Stroke Snowmobile

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UICSC Design Goals

- Meet NPS emissions standards
  - Noise (73 dBA J192)
  - Emissions (E-Score 170 with catalyst)
- Optimize Fuel Economy
- Maintain Stock Power
- Maintain Two-stroke Riding Experience
- Deliver OEM Packaging
- Improving Handling and Minimizing Cost

All While Running Flex-Fuel

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Blended Ethanol Fuel

- Flex Fuel – Any blend from E10 to E85
- Ethanol Facts
  - ~ 65.5% of the Energy Content of Gasoline
  - Additional Hazardous Emissions
    - Formaldehydes & Acetaldehydes
  - Reduced Measured Emissions (CO & HC)
  - Poor Shelf Life (<90 days)
  - Corrosive

UICSC History

UICSC Has Proven that Both Two and Four Stroke Snowmobiles Can Meet Competition Goals

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2009 Design Strategy

- **Clean**
  - Flex Fuel
  - Catalytic Converter
- **Quiet**
  - Sound Deadening Material
  - Custom Exhaust and Modified Body Panels
- **Quick and Agile**
  - Light REV-XP Chassis
    - Suspension and Drive-train Upgrades
  - Two-stroke Power Density

Engine Selection

- Fuel Consumption on E75
  - 2009 UI 2-stroke: 13.3 mpg
  - 2008 CSC best 4-stroke: 11.23 mpg
- Power-to-Weight
  - 2009 UI 2-stroke: 0.20 hp/lb
  - 2008 CSC best 4-stroke: 0.12 hp/lb

Chassis and Engine

- Chassis
  - 2008 Ski-Doo MXZ REV-XP
    - Performance Oriented
    - Proven Rider Comfort
    - Improved Handling
- Engine
  - Rotax 593cc H.O. Two-Stroke
    - Semi-Direct Injection, Reed Valved, and Loop Scavenged
    - Variable Exhaust With Tuned Pipe
    - High Power-to-Weight Ratio

Chassis Upgrades

- Suspension
  - Fox Float-2 Front Shocks
  - Holz Front A-arms
  - C & A Skis
- Power-train
  - Camoplast Ice-Ripper Track

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Flex-Fuel System Design

- Continental Fuel Alcohol Content Sensor
- Walbro Engine Controller
- Ethanol Compatible Fuel Lines
- Continuous Flow Fuel rail
- Analog Fuel Composition Output

Engine Tuning/Calibration

- Power
- Fuel Economy
- Ridability

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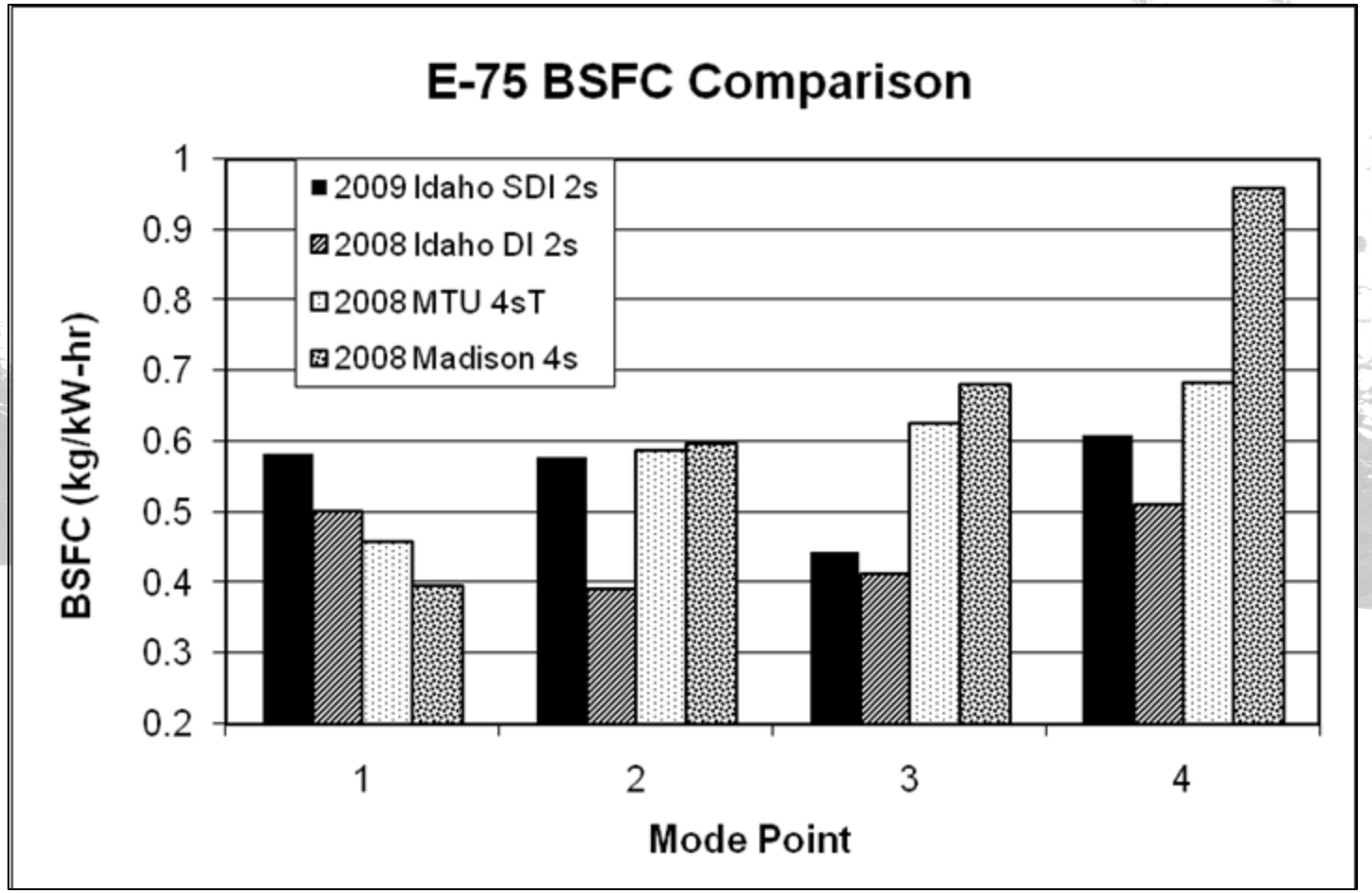

Resulting in 13.3 mpg (E75) 16.5 mpg (E10)

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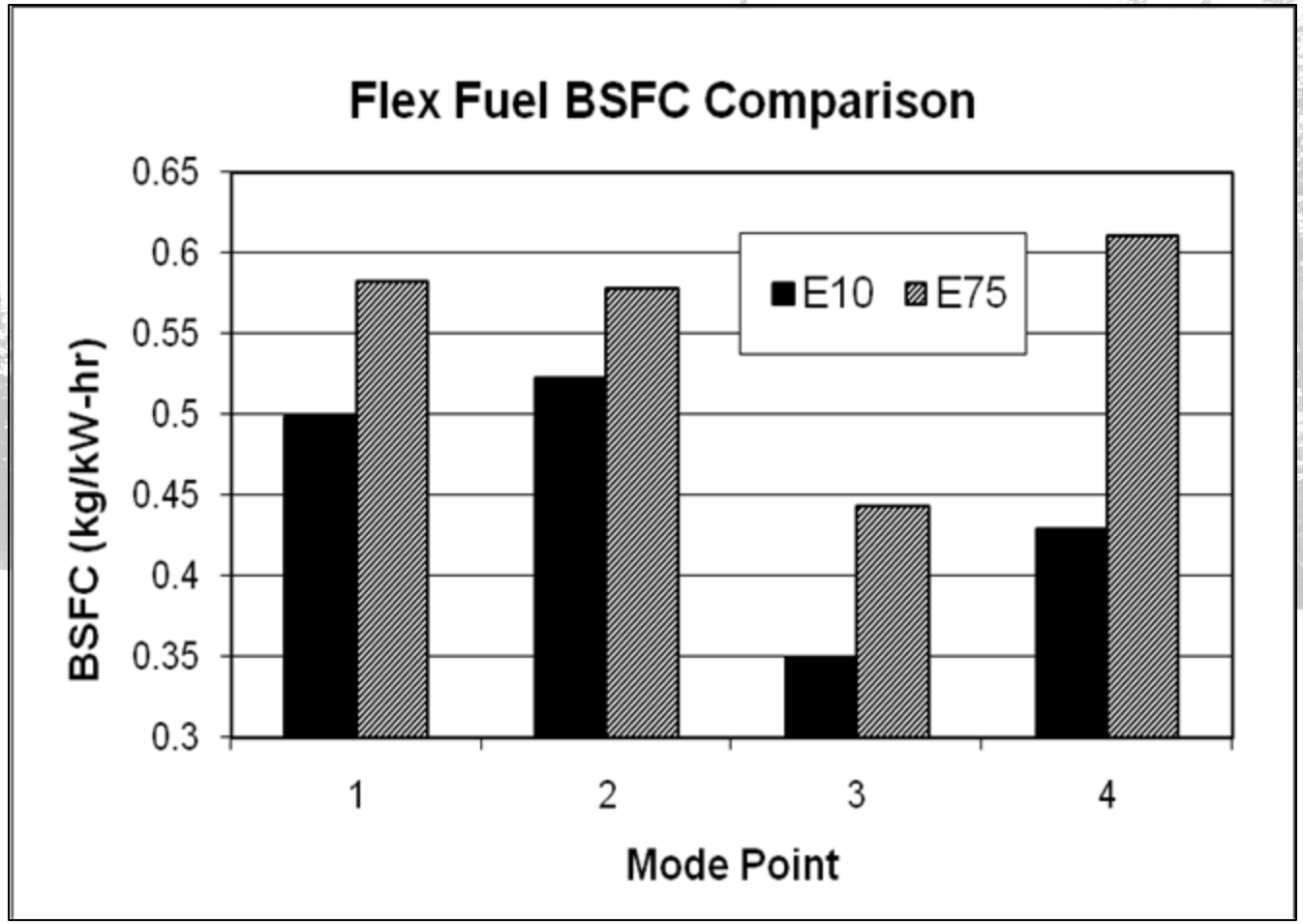

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Noise Reduction

- Carbon Panels with Melamine and Hoodliner
- Redirected Intake Opening
- Tunnel Stiffeners

Prototyped Sound Reduction Devices

- Helmholtz Resonator for Intake and Exhaust
- Laminar Flow Exhaust

Helmholtz Resonators

Two Different Designs

Design Variables: Volume, Neck length, Neck Diameter, Frequency

Adjustable Volume

Ring Type Resonator With Five Separate Volumes

Kinsler, Lawrence et.al. Fundementals of Acoustics. New Jersey: Hoboken, John Wiley and Sons, Inc., 1989.

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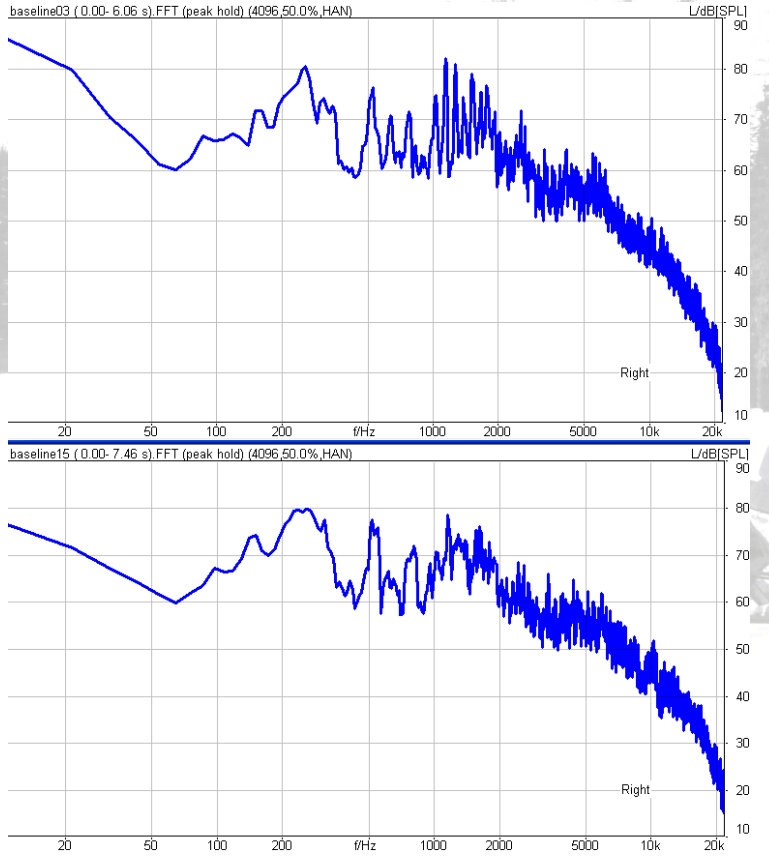
Noise Reduction

Comparison of stock panels Using FFT Analysis.



Carbon Panels Without Deadening Materials

Carbon Panels With Deadening Materials

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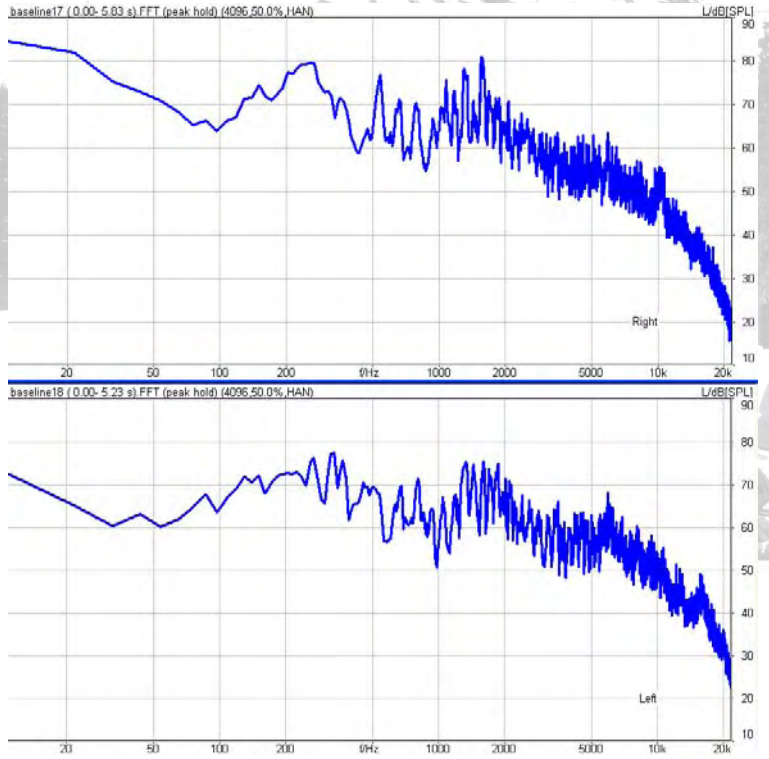
Noise Reduction

Comparison of intake and exhaust sides of the 2009 snowmobile during a J-192 test.



Intake Side Pass

Exhaust Side Pass

Benefits of 2009 UICSC

- **Rider**
  - Lightweight, Easy, and Fun to Ride
  - Fuel Economy(13.3 to 16.5 mpg)
  - Competitive Cost (MSRP = $10,830)
- **Dealer/Outfitter**
  - Low Fuel Use and Maintenance
  - Easy to Sell
- **Environmental**
  - Reduced Exhaust Emissions
  - Reduced Noise Emissions

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Summary

- Fun to Ride Flex-Fuel Two Stroke
- Meets EPA Noise Emission Standard (J192 score of 78 dBa)
- Fuel Economy (13.3 mpg) on E75
- Improved Ride, Comfort, and Handling
- Maintains a High Power-to-Weight Ratio

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THANK YOU

Questions?

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MSRP Break Down

- Base Price $9,649
- Chassis Modifications $492
- Engine Modifications $689

- Total MSRP **$10,830**

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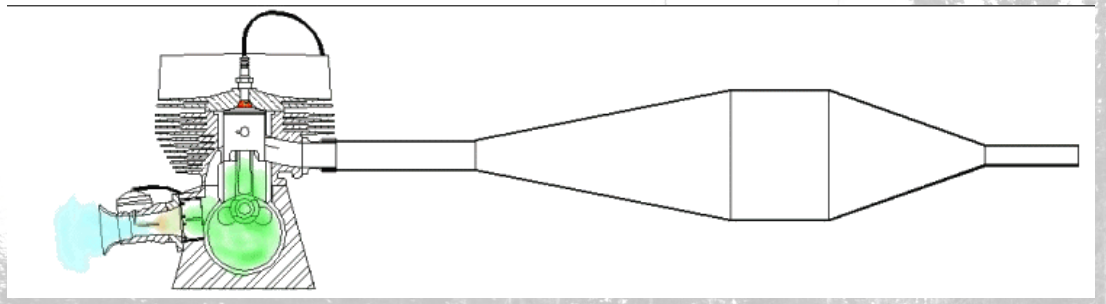
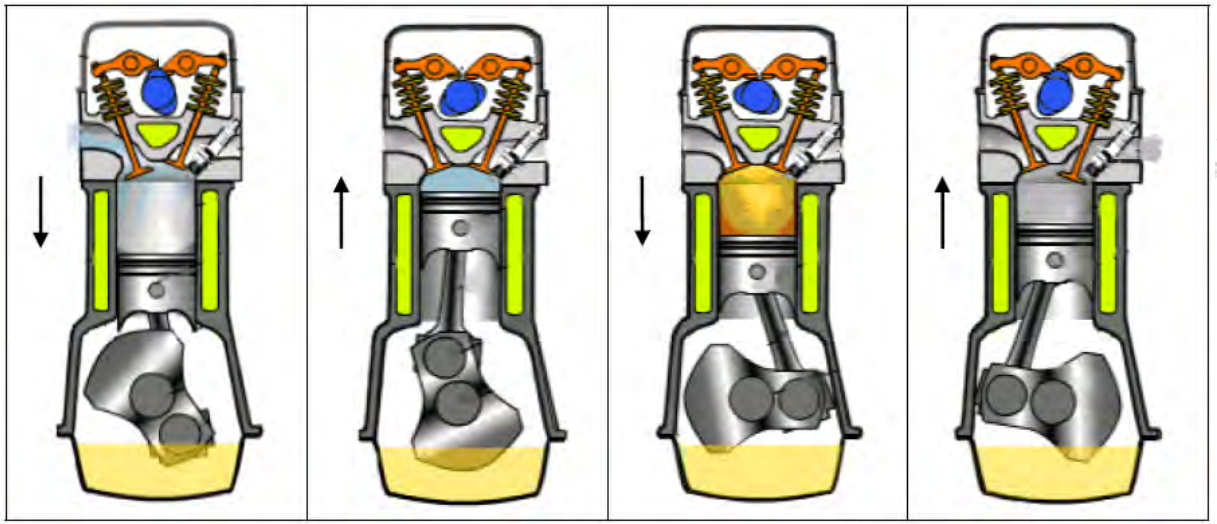
Two-Stroke Vs. Four-Stroke





Intake **Compression** **Power** **Exhaust**

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