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SAE Snowmobile Team

University of Wisconsin-Madison

2013 SAE Clean Snowmobile Challenge

Design Presentation

Presented by:

Mike Solger
Derek Landwehr

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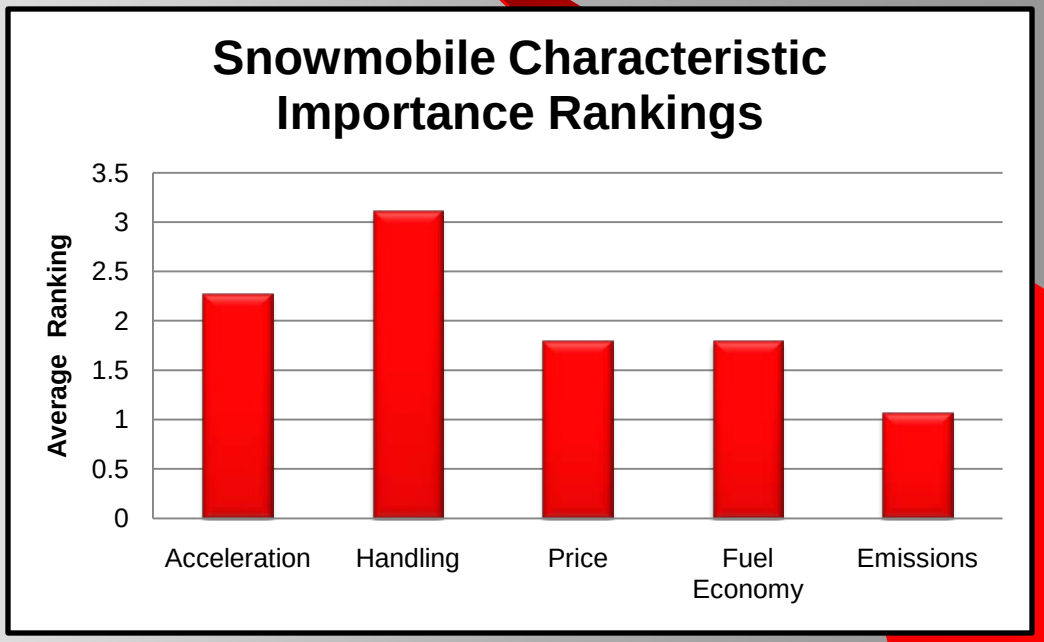
Clean
Quiet
FAST

Design Considerations:

Market Survey

- Approximately 120 surveys
- Customers Want:
  - Trail Handling
  - Acceleration
- Historical Best Sellers
  - Ski-Doo Rev XP 600 SDI
  - Polaris Rush 600



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Bucky ACE Turbo

How it Appeals to Snowmobilers

Ultra Quiet
20+ mpgge
Flex-Fuel Capable
Improved Acceleration
Electric Start
BAT+ Compliant

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Dealer & Outfitter Perspective

- Sales
  - Cleaner/Quieter Performance Model
  - High Fuel Economy, BAT Compliant
- Benefits
  - Integrated Catalyst/Muffler – Bolt-on Replacement
  - Plug and Play Intake/Fuel System
    - ETC, Flex-Fuel Sensor
  - Low maintenance, reliable
- Rider Comfort
  - OEM Seat, Handlebars, Suspension, Reduced Noise
- Novice Snowmobiler Operation
  - OEM Controls

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Chassis Selection

2013 Ski-doo MXZ Sport

- Lightweight
- Rider-forward ergonomics
- SC-5 suspension
- Cost-effective

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Engine Selection

- Primary: Fuel Economy
- Secondary: Engine-out emissions

	Power (kW)	Weight (kg)	Fuel Economy (km/L)	Emissions (g/kW-hr)		
				HC	CO	NOx
Ski-Doo ACE 600	42	40	12.3	8	90	N/A*
Polaris FST	112	64	7.2	6.2	79.9	N/A
Ski-Doo 4-Tec 1200	97	62	7.6	9	116	N/A

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Turbocharged Rotax ACE 600

Engine Type	Four Stroke
Cooling	Liquid
Cylinders	2
Displacement	600 cc
Bore x Stroke (mm)	74 x 69.7
Ignition	Custom
Exhaust	Custom 2-into-1
Fueling	EFI
Compression Ratio	12:1

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Turbocharger Choice

Garrett GT1241

- 37-90 kW applications
- Externally Wastegated
- Benefits:
  - Improved efficiency
  - Increased power when needed

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Engine Control & Flex-Fuel Capability

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Engine Management

Woodward/Mototron PCM565

- Automotive/Marine Environments
- -40°– 130 °C
- 18 g Shock Load
- Up to 3 Meters Underwater

MATLAB/Simulink Engine Modeling

MotoHawk Automatic Code Generation

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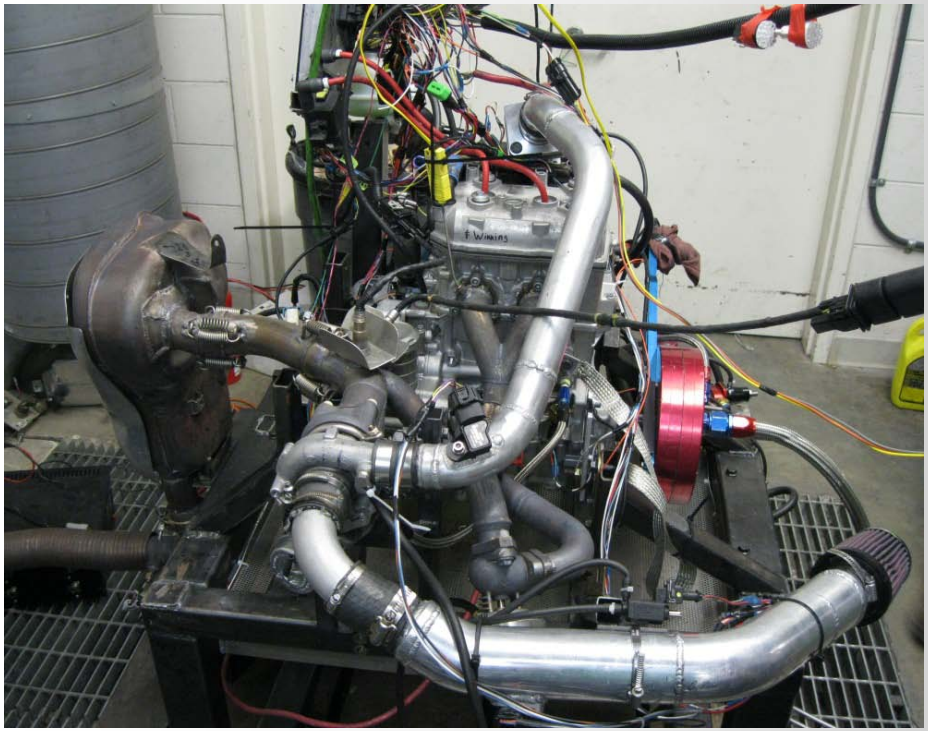
Engine Calibration



- DYNOmite Water-Brake Dyno
- Heated wide-band O_2 sensor
- Exhaust Thermocouples

- Calibrated:
  - Spark Advance
  - Fueling
  - Throttle Control

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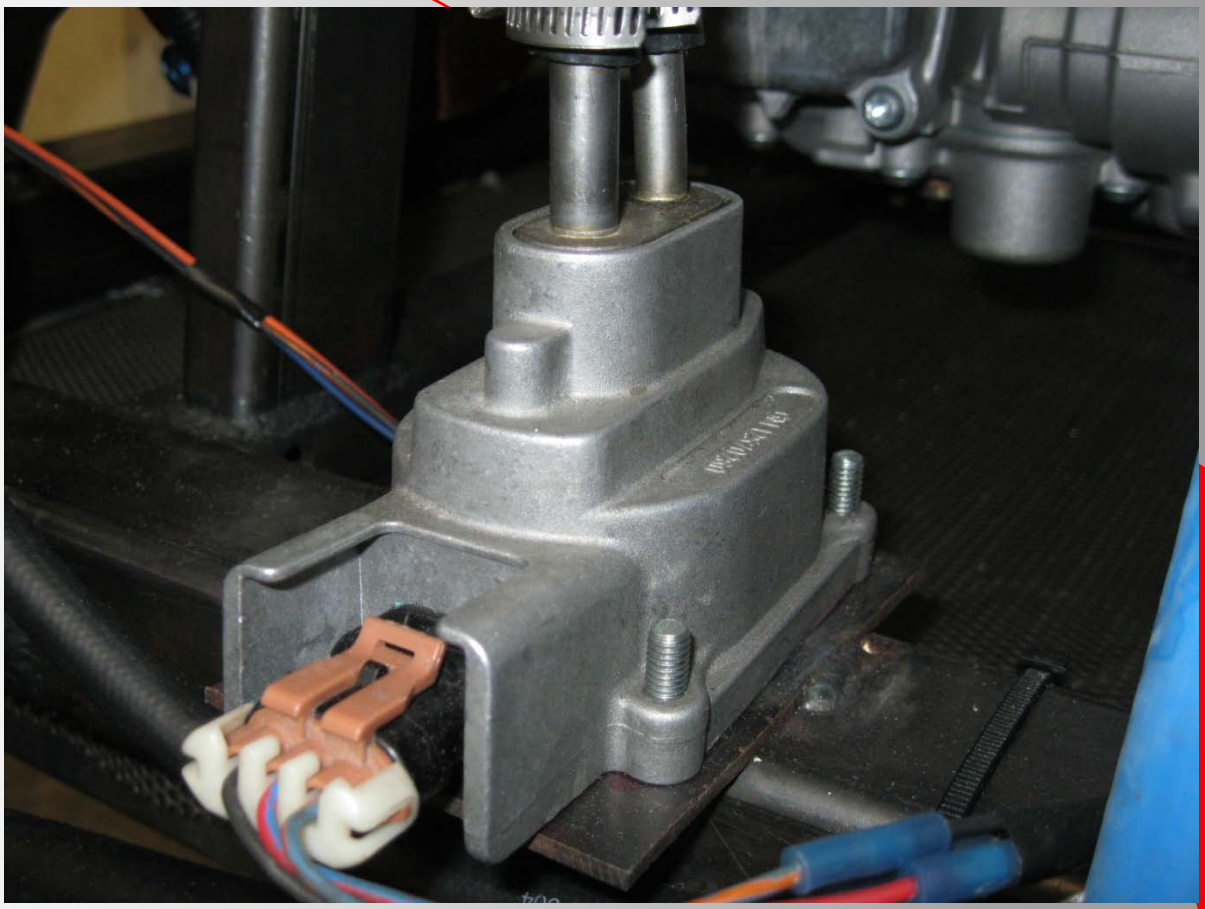
Flex-Fuel Capability



Continental Flex-Fuel Sensor

- Reports ETOH content & fuel temperature

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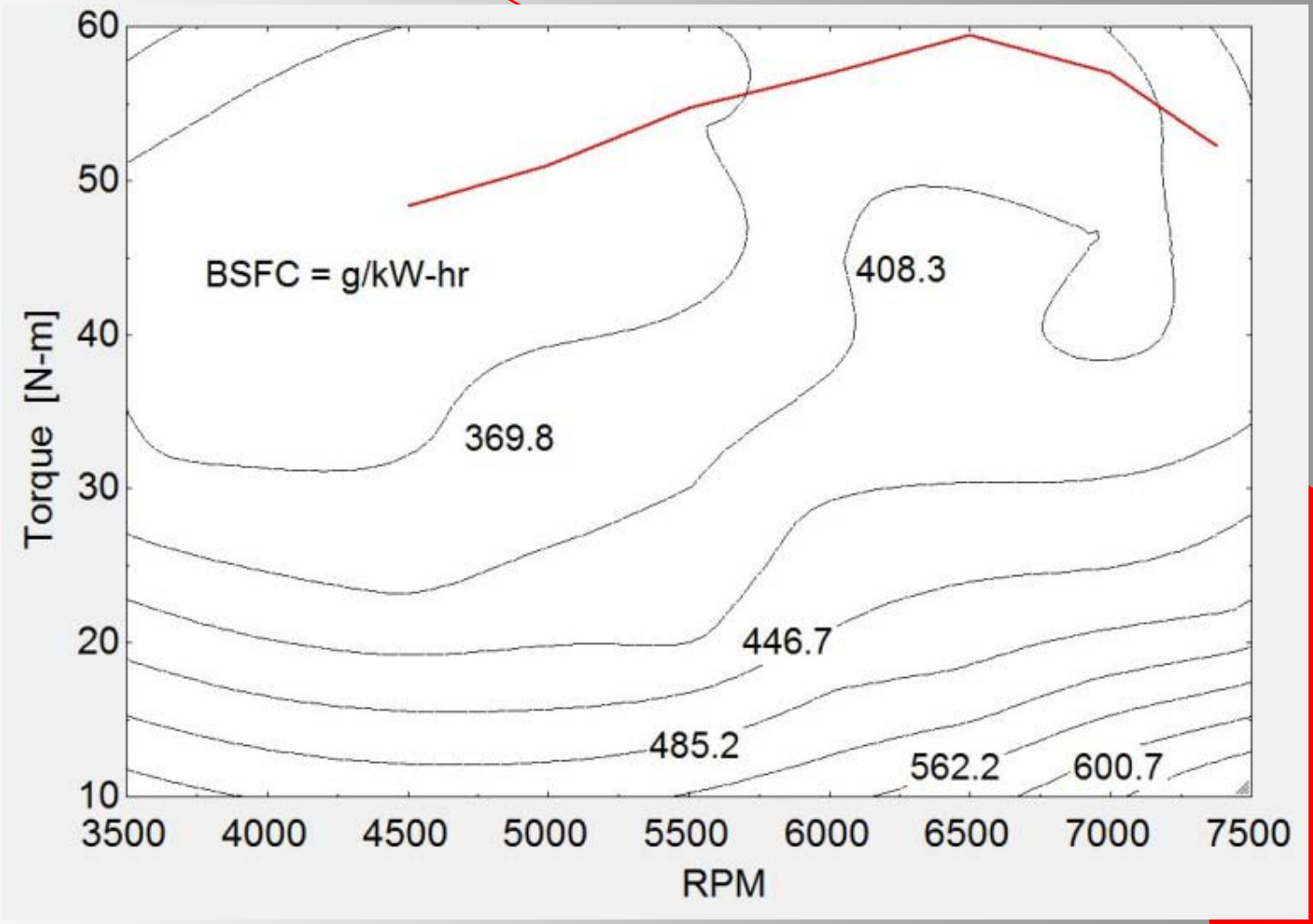
Fuel Economy



Snowmobile Weight: 597lbs.

20-25 mpg

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Emissions & Sound Reduction

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Emissions Reduction

Manufacturer	W.C Heraeus GmbH
Diameter	70mm
Length	149mm
Substrate	SuperFoil® Metal Honeycomb
Density	600 cpsi (cells per square inch)
Loading	Platinum 11.1 g/ft^3 Palladium 55.6 g/ft^3 Rhodium 8.3 g/ft^3

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Emissions Results

60% reduction from stock BAT-compliant Rotax ACE

Calculated E-Score: 201

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Noise Emissions

- Measured Sound Emissions using J192 test procedure
  - J192 Limit: 78 dBA
  - Bucky ACE Turbo: 69 dBA

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Cost Summary

Base MSRP: MXZ Sport ACE600		**$7,899.00**
Turbocharger	$657.93	
Electronic Throttle Body	$325.35	
Ethanol Sensor	$494.00	
3-way Catalyst	$156.12	
Pre-studded Track	$563.40	
Sound Attenuation Material	$39.99	
Others	$235.85	
Modifications		**$2,472.64**
Bucky ACE Turbo MSRP		**$10,371.64**

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Questions?

Key Design Points

- Turbocharged
- Lightweight Chassis
- Catalytic exhaust
- Woodward/Mototron control system
- Flex-Fuel Capable
- Studded Track