

SUNY University at Buffalo

2007 SAE Clean Snowmobile Challenge



Project Goals

- Implement Diesel Engine
- Design Exhaust to Pass 2012 Emissions Standards
- Vehicle Performance Comparable to SI Engine
- Pass SAE Procedure J192

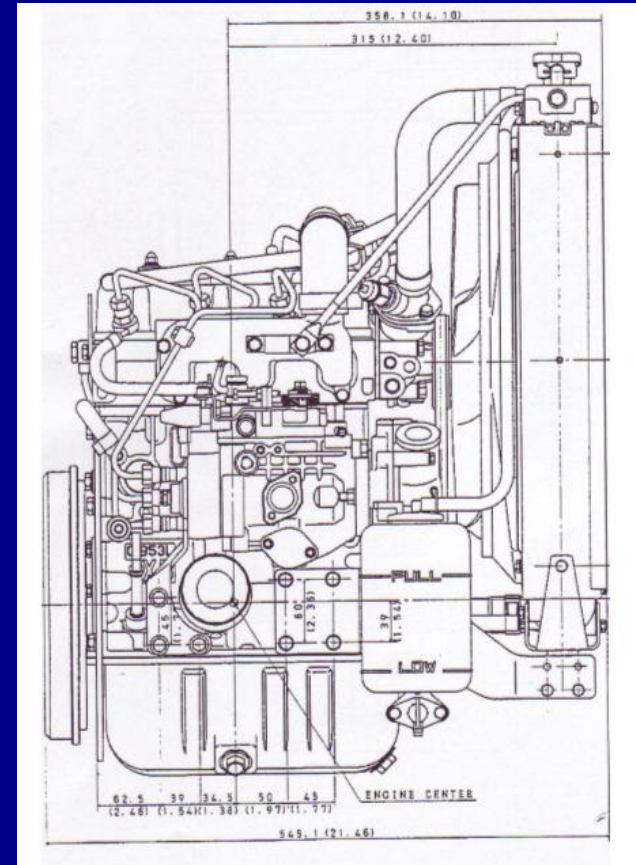
Chassis Selection

- 2003 Polaris Pro-XR 440
- Suspension
 - Edge Pro-X Rear with Walker Evans shocks
 - Pro-X Trailing Arm Style with Fox Float Shocks



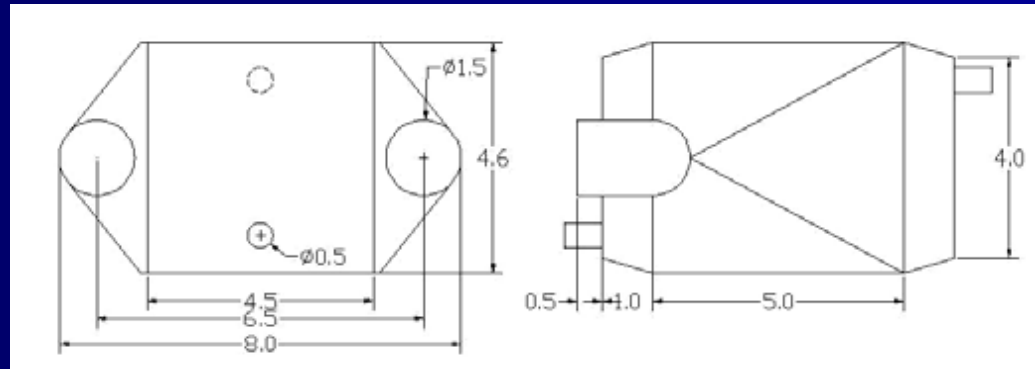
Engine Selection

- Engine
 - Daihatsu 32HP Diesel
 - 952cc Inline Triple
 - Passes Current EPA Emission Standards
 - 15° Running & 25° Intermittent Angle
- Compatible Engine/Chassis Dimensions
- 10° Rearward Engine Rake



Intake Design

- Total Length 22 inches
- Total Pressure Loss .5psi
 - Flow through tube equations
 - Model Intercooler as tube bank
- Water to Air Intercooler (Bell)
- Water to Water Heat Exchanger
- Independent Coolant System
- Constant 30°F Intake Temperature



Exhaust

- Emitec Catalyst/PM-Filter DOC Hybrid
 - Oxidizing Catalyst
 - PM Filter
 - De-Oxidizing Catalyst
- Aero 194 Stealth Muffler
 - Flow Through Design
- Stainless Components
 - Do not rust



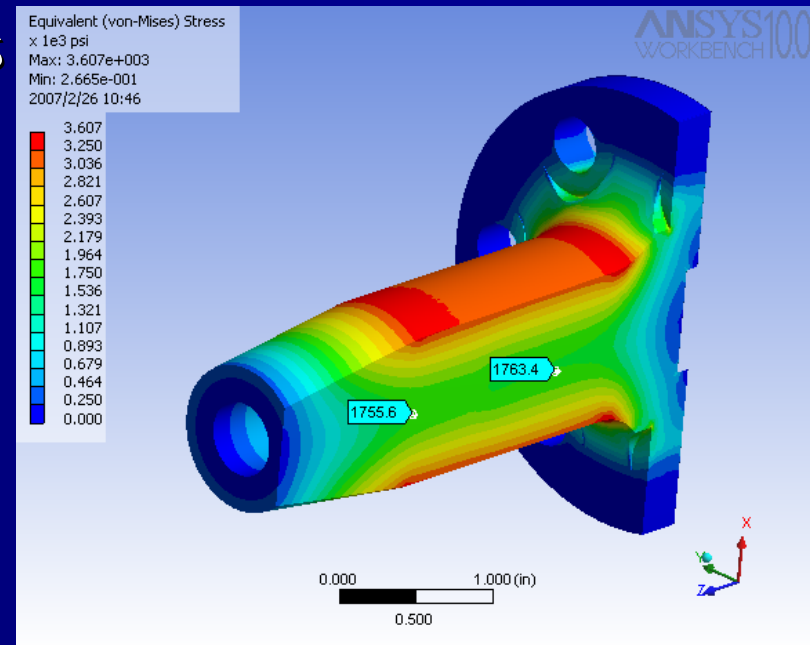
Fuel System

- Mechanical Injection Pump
 - Distributor style
 - Controls timing, engine stop, and governor
- Inline Fuel Filter
 - Priming pump
 - Water Sensor



Clutch Adapter

- 3° Taper (Polaris Clutch)
- Material Selection
 - 1020 Low Carbon Steel (Cold Rolled)
- Finite Element Analysis
 - Deflection:
 - .0004" max
 - Von-Mises Stress
 - 3,706psi max
 - 35,000psi yield



Clutching & Gearing

- Gears:
 - Top-25 Tooth $\frac{3}{4}$ " HYVO
 - Bottom-26 Tooth $\frac{3}{4}$ " HYVO
- Chain
 - Morse TEC 66 Pitch HYVO Chain
- Clutching:
 - Primary
 - Secondary



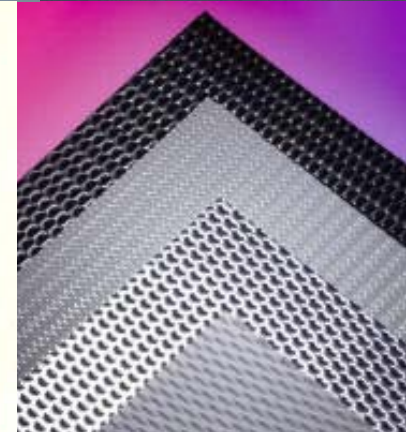
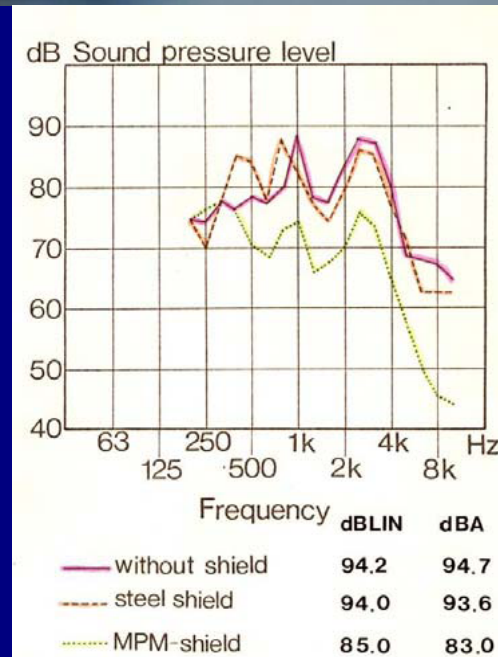
Traction Devices

- 1.25" Camoplast Ripsaw Track
 - Aggressive Crescent design
 - Quietest Camoplast Track
- 1.325" Woody's Gold Digger Studs
 - Used for added traction during acceleration and stopping



Sound Reduction

- PDP
- Hushcloth
- Melamine Foam
- Visco Elastic Matting (VE)
- Millennium Metal



Cost Analysis

- **MSRP \$13,862.43**
 - **Engine**
 - \$5,152.10
 - **Exhaust**
 - \$467.84
 - **Intake**
 - \$194.59
 - **Traction Components**
 - \$485.95



Future Improvements

- Chain case
 - Improve Gear ratio
 - New Chain case design
- Clutching
 - Implement new clutching system
- Weight Reduction
 - 2007 Competition weight of 732 lb
 - Create a more even weight distribution
- Electronic Fuel Injection (2009)
 - Control Fuel Consumption
 - Decrease Emissions
 - Decrease Cold Start Temperature

Summary

- Emissions reduction results in much lower pollution and overall environmental impact
- Quiet snowmobile disturbs residents and animal populations much less
- Sporty chassis results in handling characteristics better than an average trail sled
- Increased fuel economy allows for longer distances between necessary fuel stops

Outfitter Perspective

- Mostly OEM parts used to maintain high reliability
- Safe for use by inexperienced riders
- 4 stroke Diesel Engine uses less fuel and oil
- Can be run on Biological Fuels