

CoolCab Truck Testing Project Update

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21 CTP Meeting
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NREL/PR-540-42396

Presented at the 21st Century Truck
Project Meeting held October 31, 2007
in Chicago , Illinois.



CoolCab Project

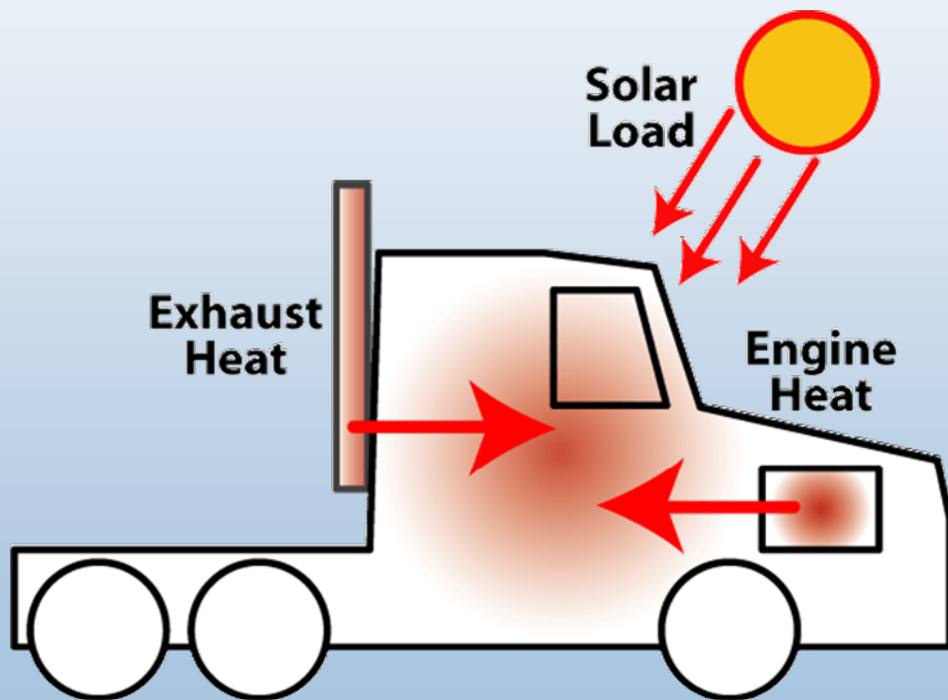
- The Problem
 - Trucks consume 2.5 million barrels of oil per day
 - Idling consumes 838 million gallons of fuel per year
 - Future emissions requirements
 - lower fuel economy
 - increase underhood temps.



Redesigning the Heavy Truck is an opportunity to reduce oil importation

CoolCab Project

- The Challenge
 - Cab climate control requires idling to provide comfort
 - Varying thermal conditions inhibit use of idle reduction technologies



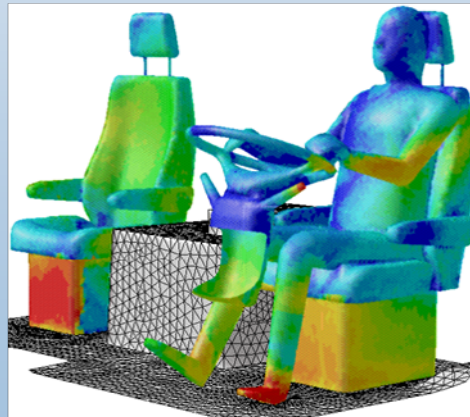
CoolCab Project



**Thermal Comfort
Manikin**

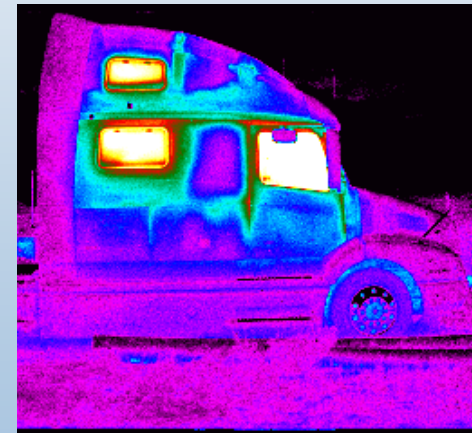


Solar Reflective Glazings



Integrated Numerical Modeling

- The Solution
 - Design efficient thermal management systems
 - Keep the cab comfortable
 - Eliminate excessive idling



Cab Insulation

CoolCab – Advanced Technologies

Exhaust Heat Recovery

Advanced Seating – Low Mass

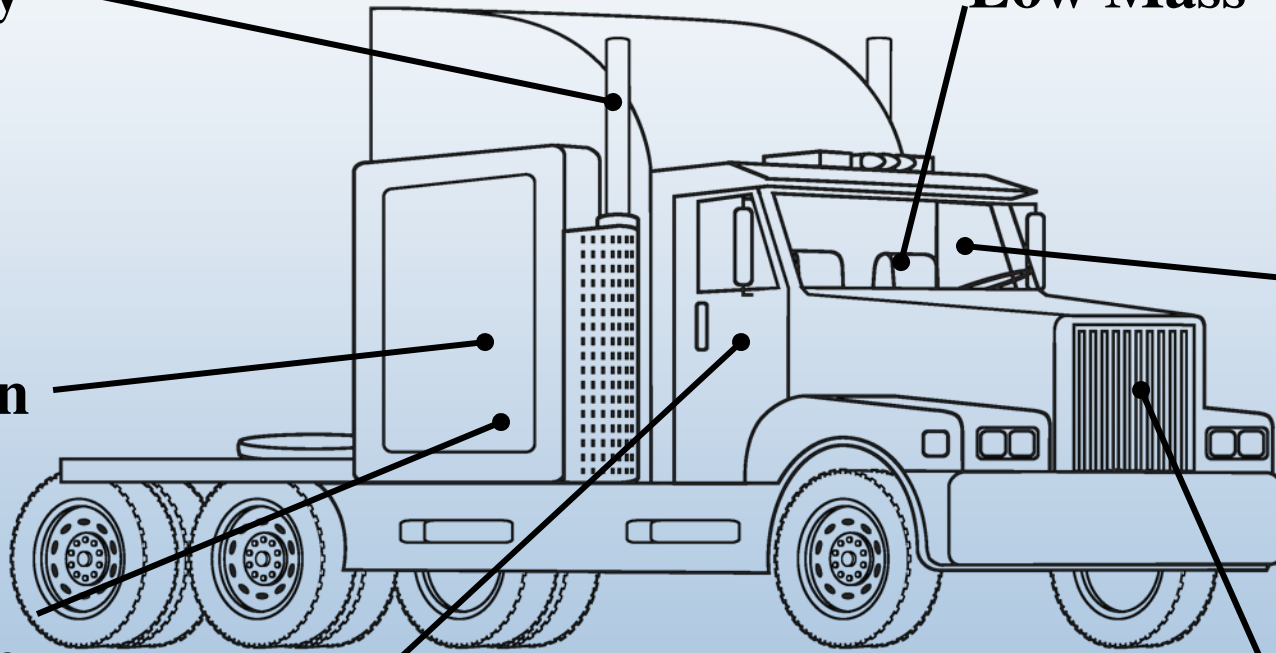
Advanced Glazings or Shades

Insulation

IR Reflective Materials

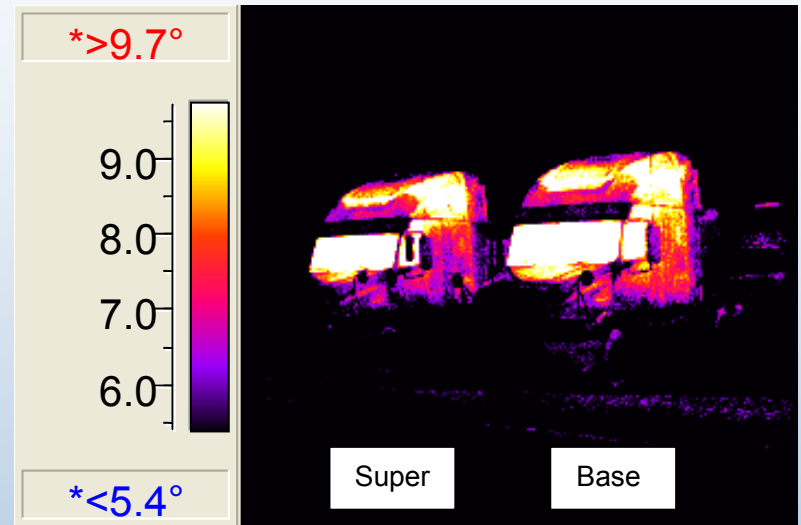
Comfort Based Air Distribution

Efficient HVAC Equipment



Infrared Image Test – Schneider National

- Investigate potential for improving cab efficiency
- Qualitative comparison
 - Identify high heat loss areas
 - Note areas with greatest potential for improvement



CoolCab Testing with Volvo

- Volvo Truck at NREL for testing
 - 77” sleeper cab
 - On-board idle reduction technologies
 - Bergstrom battery electric AC
 - Airtronic diesel-fired heater
- Objectives
 - Quantify truck cabin heat transfer
 - Identify potential areas for improvement



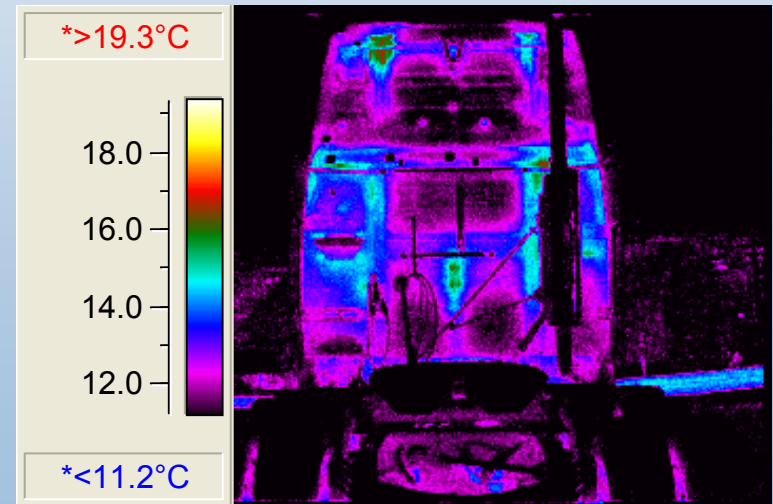
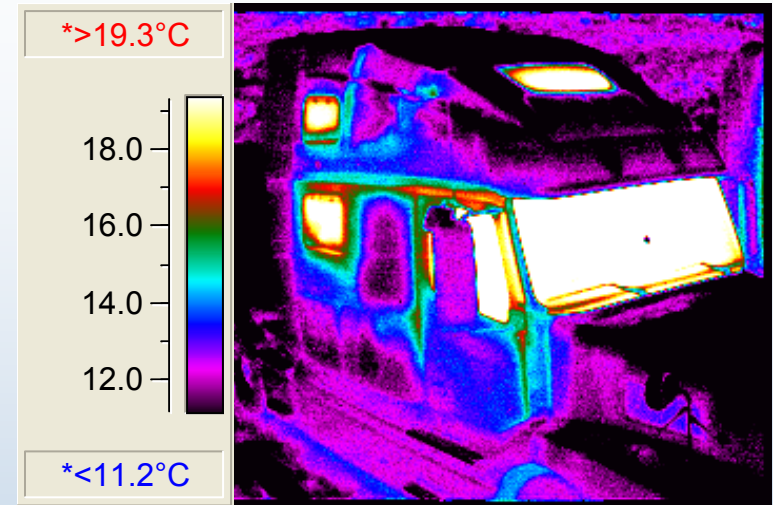
Testing Approach

- Co-heat tests to determine UA
 - Measure effect of sleeper curtain and window shades
 - Insulate windows to quantify loss
- Measure air exchange rate
- Solar soak tests to determine solar effects
 - Soak with windows insulated
- Infrared imaging to examine high heat loss areas
 - Hot spots



Volvo Test Results

- Heat transfer
 - UA = overall heat transfer coefficient = 65 W/K
 - 15% reduction (improvement) with sleeper curtain closed
 - 20% reduction with windows covered
- Solar heat soak
 - ΔT = temperature rise above ambient = 15°C
 - ΔT = 5°C with windows covered
- Air leakage rate
 - ~1 air change per hour



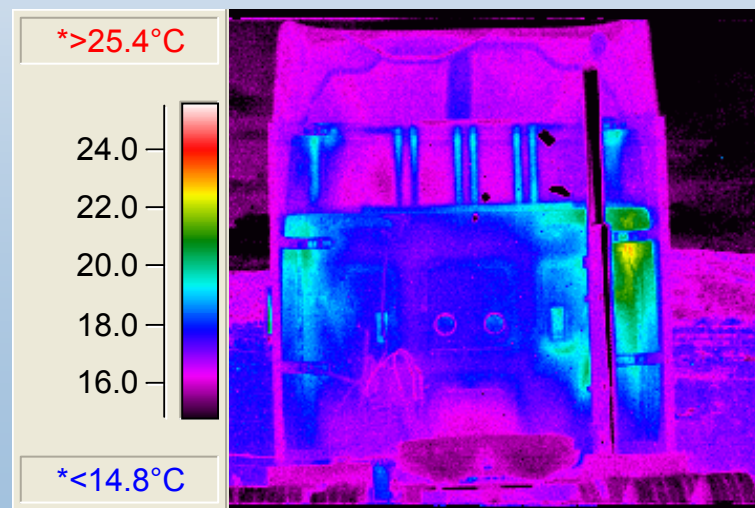
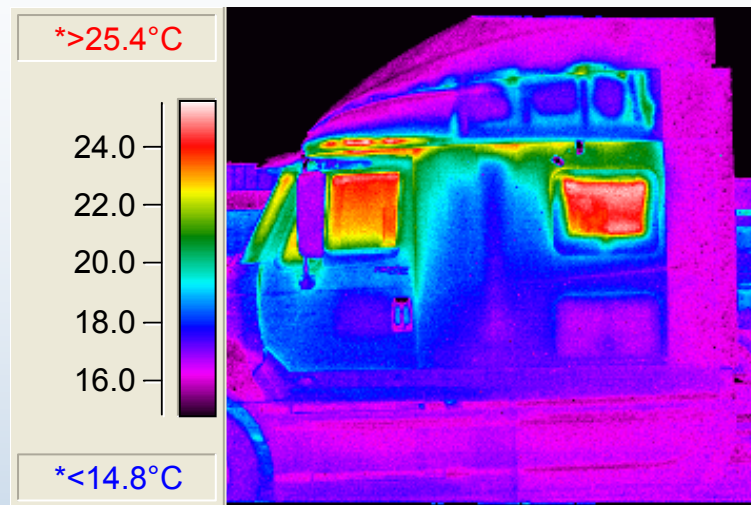
CoolCab Testing with International

- International Truck at NREL
 - ProStar sleeper cab tractor
 - Electric HVAC system with battery APU
- Objectives
 - Quantify truck cabin heat transfer
 - Predict HVAC system load requirements
- Began spring 2007



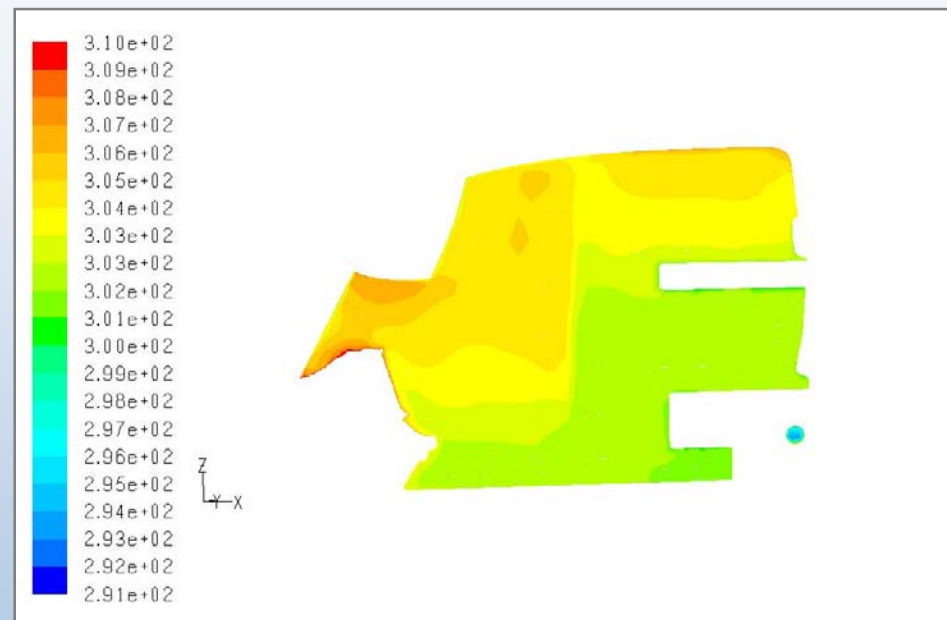
International Test Results

- Heat transfer
 - UA = overall heat transfer coefficient = 50 W/K
 - 20% reduction (improvement) with sleeper curtain closed
 - 25% reduction with arctic curtain
 - 13% reduction with windows covered
- Solar heat soak
 - ΔT = temperature rise above ambient = 11°C
 - ΔT = 7°C with windows covered
- Air leakage rate
 - ~0.5 air change per hour



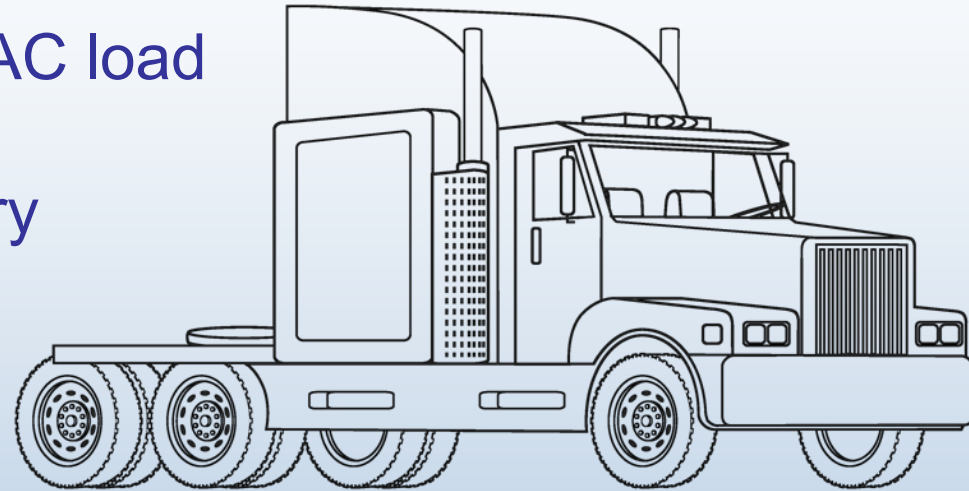
Thermal Modeling

- Previously developed model for International
 - Fluent CFD
 - Radtherm
- Validate with test data
 - Solar soak air temperatures predicted within 3°C
 - Apply multiple configurations
- Simulation runs
 - Baseline A/C case
 - Increased cab insulation
 - Solar reflective glass



Next Steps – FY08

- Begin development of HVAC load calculation tool
- Generic truck cab geometry
- Input key parameters
 - Climatic conditions
 - Vehicle geometry
 - Material properties
- Estimate potential load reduction
- Work with industry to define requirements
 - Truck OEMs
 - Idle reduction technology manufacturers



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