Heavy Vehicle Propulsion Materials

Testing Standards

Project (PM 8925)

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NIST

September 13 -15, 2005

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Testing Standards

21CTP Technical Goal: **Develop and demonstrate an emissions compliant engine system for Class 7-8 highway trucks that improves the engine system efficiency from ~42% today to 50% by 2010.**

Project Objectives
Develop new test method standards to facilitate the incorporation of new materials in diesel engines.

FY 2005 Focus
Refine and standardize test methods for round shaped parts.

Planned Duration
October 2001 to September 2006

DOE Funding/Industry Cost Share
FY04: $75K; FY05: $75K

Refined test methods, reference materials, and standards support innovation and expedite the incorporation of new materials into engines.

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Accomplishments
13 ASTM, 3 ISO, and 1 MIL STD, and 1 US Customs standards have been created.

5 generic test standards have been used in a new silicon nitride ball bearing material specification: ASTM F 2094.

Methods for the fractographic detection of machining damage have been refined and standardized in ASTM C 1322.

Significant Future Milestones
An ASTM draft standard for flexural strength of round rods will be written and balloted in the Spring of 2006

Project ID/Agreement ID	Program Structure	Sub-Program Element	R&D Phase	Date
PM_8925	Materials Technology	HV Propulsion Materials	Applied Research	7-05

Objectives

- Develop new test methods standards to facilitate the incorporation of new materials in diesel engines.

Benefits

- Standard Test Methods and Reference Materials for material properties help move new materials from the laboratory to actual engineering applications.
- This project helps build an engineering infrastructure for new materials including standards, specifications, and data bases.
- Engineers have more confidence using the new materials.

Relevance to 21CT Goals

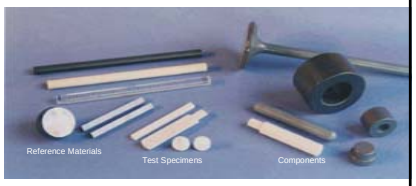
- Develop and validate advanced materials technology for improved efficiency of diesel engines. ✓
- Partner Involvement: Cummins Engine Co., Ceradyne, St Gobain-Norton, Oak Ridge National Laboratory.

Technology Transfer

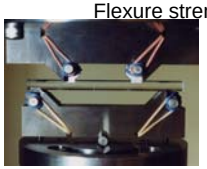
- Technical papers at major conferences and symposia.
- Direct contact with engine and material manufacturing companies.
- ASTM and ISO standards organizations.
- Interlaboratory studies via the VAMAS (Versailles Advanced Materials and Standards) collaboration.

Approach

- Refine and standardize test methods for advanced brittle materials.
- The test methods should be suitable for the size and shapes of parts and the materials that will be used in engines.
- Current work is focused on test methods for round shaped parts such as valves or fuel injector pins.



Flexure strength of full rods



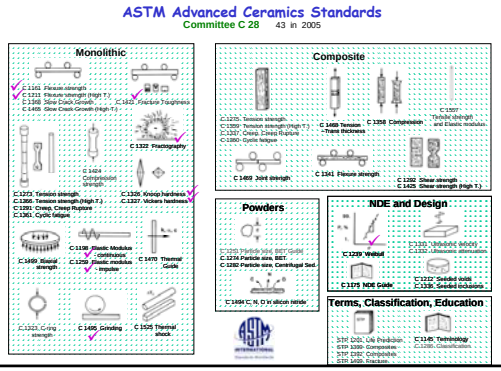
Flexure strength of split rods

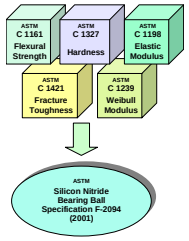
Technical Accomplishments/ Progress/Results

- 13 ASTM, 3 ISO, 1 MIL STD, and 1 US Customs standards have been created over the life of this task.
- The methods have been used as building blocks to help make other standards.

  Example: 5 test method standards created in this program have been used in a new ASTM silicon nitride ball bearing specification F 2094.

- The standardized methods will help engineers utilize new materials to overcome barriers A, Performance and B, Manufacturability.





Technical Accomplishments/ Progress/Results 2005

- Flexural strength testing has been completed on split cylinder specimens obtained from Cummins Engine company. These are zirconia rod blanks of the current injector pin material. The strengths matched Cummins' data.

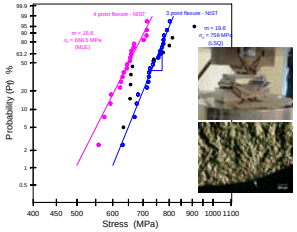
  Fractography was difficult but we identified the fracture initiating flaws.

- We designed and used simple adaptors so that conventional bend test fixtures can be used with minimal modifications. The new adaptors worked well.

- A major new Guide to Practice on how to do Fractography of Brittle Materials is almost finished.

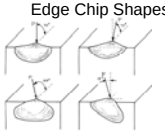
- A review paper on Reliability Analysis of brittle materials was prepared.

ZrO2 strength data - split cylinders

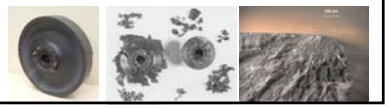


Example figure from the Guide:

Edge Chip Shapes

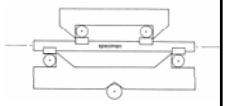


Model Rotor used by Ford in a reliability study

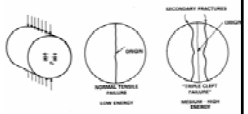
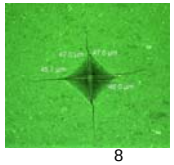


Future Work

- Standardize the flexural strength of cylindrical rods test method in ASTM.



- Investigate the diametral compression (Brazilian disk) strength test method and standardize it if it is appropriate.



- Prepare a technical paper on the drawbacks of the Vickers IF test method for fracture resistance of brittle materials.