21st International Technical Conference on the Enhanced Safety of Vehicles

Stuttgart, Germany
June 15-18, 2009

Ensuring the Safety of Future PCIVs
Paper 09-0316

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U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA
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Congressional Guidance for PCIV Safety Research 2006-09

- The Committee recognizes the development of plastics and polymer-based composites in the automotive industry and the important role these technologies play in improving and enabling automobile performance.
- [Conduct] research into the ***possible safety benefits of lightweight plastics and composite intensive vehicles (PCIV)*** and to help facilitate a foundation of cooperation between DOT, the Department of Energy, and industry stakeholders for the *development of* ***safety-centered approaches*** *for future* ***lightweight automotive design****."*

Congressional Funding History

- Congressional funding levels for NHTSA PCIV safety research have been modest:
  - FY06: $248K
  - FY07: $250K
  - FY08: $292K
  - FY09: $475K (Pending)

Accomplishments to date

- Surveyed Subject Matter Experts on: crash safety, advanced composite materials, and simulation tools
- Developed 2020 PCIV Safety Vision
- Identified and prioritized:
  - Barriers to/opportunities for PCIV development
  - R&D needs, gaps, collaboration opportunities
- **Developed a safety-centered PCIV Safety R&D Roadmap to 2020 to complement industry plan**
- **Conducted August 2008 workshop to refine near-term safety R&D priorities**

Vision For PCIV Safety in 2020

"NHTSA, in partnership with Federal agencies, industry, and academia, will support research on safety-centered design and performance modeling and validation to enable and foster superior, integrated safety performance of future light-weight Plastics and Composite Intensive Vehicles (PCIVs)."

PCIV Safety Research Roadmap

RESEARCH AND TECHNOLOGY INTEGRATION FOR PLASTICS AND COMPOSITE INTENSIVE VEHICLES SAFETY			
Present	**SCREEN & SELECT COMPOSITE MATERIALS FOR PLASTICS AND COMPOSITE INTENSIVE VEHICLES LIGHT-WEIGHTING DATABASE TAILORED TO PART DESIGN AND FEATURES.**		
Near-term (3-5 years)	**Mid-term (5-10 years)**	**Long-term (10-15 years)**	**Far-term (15+ years)**
Use Computational Crashworthiness Model To Predict Loading, Crash Energy Management, And Failure Behavior.	Prototype Component Or Sub-System (e.g. Door Panels)	Integrate Into Full Scale Concept Car, Field Test And Compare Safety Performance In Standardization Tests	NHTSA, Revi PCIV (F
Compile A Comprehensive Database On Mechanical Properties (Static & Dynamic)	Perform Accelerated Validation & Verification Static And Dynamic Lab Scale Test To Optimize Crash Performance	Develop Test Procedures	Collect Crash- Verify Ol S
Optimize Design for Crash Safety Performance, focusing on Older Demographic		Field Test PCIV Prototypes to Improve Production Model	

Enhancing Plastics and Composite Intensive Vehicles Safety Performance with Plastics			
Challenges / Milestones	•Design concepts •Materials screening •Testing Standards •Simulations and Validation		•Systems Integration •Crash Safety Testing •Performance Metrics •PCIV Deployment
Performers	**Near-term (3-5 years)**	**Mid-term (5-10 years)**	**Long-term (10-15 years)**
Industry – Government – University Public Private Partnerships (P3)	Research, Development and Technology on Automotive Composites	Test & Evaluation Of PCIV Prototype Crash Safety	System Integration of PCIV Safety Technologies 10-15 yrs.
	Develop Testing Standards and Safety Evaluation Tools for PCIV Designs 1 yr.	Crash-Safety Verification & Validation Simulations 5-6 yrs.	PCIV Commercial Deployment 15+ yrs.
	Select Light-weight Structural Materials for PCIV 2-3 yrs.		
	Develop PCIV Materials Processing / Parts Fabrication 3-5 yrs.	Crash Safety Testing & Validation For PCIV Subsystems and Vehicle 6-8 yrs.	
NHTSA Role	NHTSA Monitors Progress in Crash Safety Research and Development	NHTSA Evaluates Results of Crashworthiness Verification & Validation	NHTSA Verifies PCIV Crash Safety Compliance (NCAP and FMVSS)

PCIV Roadmap Report is available at **www.volpe.dot.gov/library/published/4680pciv_safetyroadmap-nov2007.pdf**

August 2008 PCIV Safety Workshop:
Knowledge Gaps and Research Priorities

- Monitor ongoing efforts to analyze and predict crash failure of composite materials and structures
- Develop relevant testing standards (CMH-17, SAE, ASTM)
- Develop and refine predictive tools for:
  - Structural characterization of advanced materials
  - Multi-scale damage characterization
  - Failure predictions
  - Crash energy absorption of component and vehicle structures
- Workshop prospectus, agenda, presentations, and summary are posted at http://www.volpe.dot.gov/safety/pciv/index.html

Research Collaboration for PCIV Safety

- NHTSA Vehicle Safety Research:
  - Program Managers: Stephen Summers/Sanjay Patel
  - **USDOT/RITA Volpe Center: Aviva Brecher (Principal Investigator), John Brewer, Samuel Toma**
  - Related NHTSA Research Areas:
    - Integrated Safety Research
    - CAFE Fuel Efficiency Regulations
    - Safety R&D (e.g. H_2 and other advanced vehicles)
- American Chemistry Council – Plastics Division (ACC-PD):
  - 2002 Technology Integration Roadmap
  - 2006 Workshop ("Enhancing Automotive Safety With Plastics")
  - 2008 Updated Roadmap Development
- DOE/USCAR FreedomCar Partnership: R&D Consortia for Automotive Light-weighting Materials
- Standards Developing Organizations (SAE, CMH-17/ASTM)
- University Centers of Excellence

Current PCIV Safety Project Tasks

- **Partner with the automotive industry**: Continue collaboration with the American Chemistry Council-Plastics Division (ACC-PD) and DOE/USCAR consortia on crashworthiness issues
- **Partner with Standards Developing Organizations:** Support SAE, ASTM, and CMH-17 in developing appropriate testing standards for automotive structural plastics and composites to improve crash energy management (CEM)
- **Partner with DOE** on light-weighting materials R&D and crash performance models validation
- **Partner with University Centers of Excellence**
- **Conduct pilot crash analysis** on composite-body vehicles to derive safety benefits estimates

Call for International Collaboration & Coordination

- The NHTSA/Volpe approach focuses on “partnering” with stakeholders
- We are inviting collaborations to leverage modest funding:
  - Ideas for projects
  - Interest in co-funding
  - Committee participation
  - Standards development by ISO TCs, others

BACK-UP SLIDES

SAE Compressive Test Standard for Composites- A Priority Need

- The SAE High Strain Rate Plastics Consortium (HSRPC) developed "Recommended Practice J-2749 - High Strain Rate Tensile Testing of Polymers" (November 2008)
- Volpe Center seeks to leverage SAE/HSRPC experience to develop a compressive test standard relevant to crash performance
  - Would require multi-year commitment
  - May require collaborative funding (e.g., ACC-PD, DOE, NIST) for timely results

Research Project for a University Center of Excellence

- Volpe SOW: "*Crash Safety Assurance Strategies for Future Plastics and Composite Intensive Vehicles (PCIV)*"
- Leverages related expertise
- Procurement currently in process
  - May require multi-year funding or collaborative funding

Pilot Crash Analysis for PCIV analogs

- Need to evaluate safety benefits of structural composites in real car crashes
- Compiled a list of contemporary automotive composite components and structures
- Industry and experts inputs on suitable vehicles PCIV analogs were solicited and received
- Perform relevant crash injury analysis against 3 similar vehicles for 3 model years
- Volpe Center invites industry “lessons learned”
- Volpe Center may perform this analysis with contractor support