

#### National Transportation Safety Board

## Special Investigation Report: Selected Issues in Passenger Vehicle Tire Safety



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## Special Investigation Report: Selected Issues in Passenger Vehicle Tire Safety

Rafael Marshall, PhD

#### Background

- >500 die in tire-related passenger vehicle crashes each year
- ~19,000 injured
- Most of these crashes are preventable



### **Tire Safety Special Investigation**

Product of:Four crash investigationsTire safety symposium



#### Centerville, Louisiana February 15, 2014

- Left rear tire tread separation
- SUV crossed median and collided with school bus
- 4 fatalities, 32 injured





#### Centerville, Louisiana February 15, 2014

# 10 years oldPoorly maintained





#### Lake City, Florida February 21, 2014

- Left rear tire tread separation
- Ran off roadway and rolled over
- 2 fatalities,
   8 injured





#### Lake City, Florida February 21, 2014

Tire had been part of a safety recall in July 2012
Recall notices sent but not received







- 2002 Ford F250 crossed center median after front tire tread separation
- 5 fatalities, 2 injured





#### Patterson, California May 23, 2014

- 1999 Ford Explorer rolled over after tread separation on a 12-year-old right rear tire
- Driver died





Source: California Highway Patrol







www.ntsb.gov/tiresafety



#### Investigative Issues

- Tire registration and recall system
- Consumer guidance on tire aging
- Poor tire maintenance practices
- Barriers to innovation



### **Report Development Staff**

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Materials Testing Vehicle Simulations Statistical Analyses Statistical Analyses Safety Recommendations Graphics





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## Overview of Tire Construction and Summary of Tire Examinations

Donald Kramer, PhD

### **Functional Role of Tires**

Support weight of vehicle
Maintain traction with ground during acceleration, braking, and cornering



### **Overview of Tire Construction**





### Centerville, Louisiana

Inner edge of tread



Outer edge of tread

### Separated Side of Tread





Indications of Improper Maintenance and Use

Multiple penetrations of tread
Fractured wires in outer belt
Slipping of balance weight
Cracking of sidewall at shoulder *Tire was not properly maintained*



## Lake City, Florida











#### No Indications of Improper Maintenance or Use

- No indications of improper maintenance, underinflation, or overdeflection
- No patches or repairs
- No indications of third body damage
- No suspect tread wear patterns
- Tire appeared to be properly used and maintained





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## Tire Registration and Safety Recall

#### **Robert Squire**

#### Overview

- Improvements are needed to increase tire registrations
- Safety recalls could be improved by providing more information to tire owners
- Improvements are needed in tire identification number (TIN) labeling



- Lake City, FL, crash involved a failed tire that was the subject of a safety recall
- Tire had not been registered
- Because the tire was not registered, the owner could not be notified of the recall



- Sole purpose of tire registration is to notify owners of recalls
- Tire registration is vital for owner notification of any recall
- Responsibilities differ between manufacturer-controlled and independent tire dealers, which affects purchaser involvement



- Manufacturer-owned or -controlled dealers must register all tires they sell
- Independent tire dealers are required to provide a paper registration form to the purchaser



- Independent dealers have the option to register purchaser's tires
- Tire owners may also be able to register their tires through a manufacturer's website
- Tire owners may be unaware of the importance of tire registration



- ~100% registration rate for manufacturer-controlled tire dealers
- <10% registration rate for independent tire dealers
- 92% of tire retailers are independent dealers



- Point-of-sale registration by all dealers could increase the rate of registration and reduce purchaser confusion
- Technology can provide effective solutions for all dealers to register the tires they sell



### **Tire Safety Recalls**

- 2009–2013 average completion rate for tire recalls was 44%
- Recall rate for motor vehicles is about 78%
- Recall success depends on owner notification



### **Tire Safety Recalls**

- Manufacturers lack alternatives for owner notification
- Contact information is limited





### Tire Identification Number (TIN)

- Full TIN has 7–13 characters that uniquely identify week of production
- Last 4 numerals specify week and year of manufacture





### **Tire Safety Recalls**

- Currently, no means to search for tire recall by TIN
- Web-based TIN search tool for recalls would improve identification of recalled tires
- TIN search tool should be available through NHTSA and manufacturer websites



#### **Tire Identification Number**



#### Partial TINs facing outboard

TCH4

and the state and the second



#### **Tire Identification Number**





## Summary

- Registration of tires is crucial to safety recalls, and the process needs improvement
- Web-based TIN lookup tool would improve the recall process
- Tire owners would be better informed if the full TIN were on both tire sidewalls





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## Tire Aging

#### Rafael Marshall, PhD

#### Introduction

- Why is tire aging a concern?
- What has been done to address tire-aging risks?
- What more needs to be done?



### Tire Aging

"The reduction or loss in a tire's material properties, which over time leads to a reduction of its performance capabilities"

(NHTSA 2007)



## Tire Aging: Why a Concern?

- Tires degrade with time regardless of use
- Several vehicle manufacturers recommend replacement of tires after 6 years of service
- Several tire manufacturers recommend replacement of tires after 10 years, regardless of use



### Tire Aging: Why a Concern?

- Factors that accelerate tire aging:
  - High travel speeds
  - Chronically underinflated or overloaded tires
  - Prolonged exposure to elements
  - High ambient temperatures
- 23% of tire-related crashes involved tire aging



### **Examples of Tire Aging**





### Tire Aging: What's Been Done?

- Congress passed TREAD Act in 2000
- NHTSA required in 2007
  - Tire pressure monitoring systems (TPMS) (FMVSS 138)
  - More robust tires (FMVSS 139)
- Accelerated tire-aging protocol created but not included in regulation



### Tire Aging: What More Is Needed?

Confirm that risks associated with tire aging have decreased
Publish consistent information to targeted populations on how they can reduce tire-aging-related risk





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#### **Consumer Awareness**

#### Rafael Marshal, PhD

#### Introduction

- Basic tire maintenance
- Current outreach efforts
- Poor state of consumer tire safety awareness
- Next steps to improve consumer behavior



#### **Basic Tire Maintenance**

 Rotate, align, and balance in accordance with vehicle owners manual
 Feel vibration or hear a noise? Have your tires checked





#### **Drivers: Manage Tire Risks for a Safer Ride**

Tire Maintenance and Registration Can Decrease Crash Risk

#### www.ntsb.gov/safety/safety-alerts



## **Current Outreach Efforts**



Source: Michelin North America Inc.



49%

Less than half of teens fi driver's education completely prepared them to drive

#### Level of Consumer Awareness

- 50% use wrong tire inflation pressure
- 69% have an underinflated tire
- 63% don't rotate their tires
- 12% have at least one bald tire



### Next Step

- Outreach efforts have yielded little change in consumer behavior
- Evaluation of current efforts may identify techniques most effective in improving consumer behavior





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Technologies to Prevent/Mitigate Tire-Related Crashes

Shane Lack

#### Overview

Dynamics of Tire Failure
Technologies
Vehicle-based
Tire-based



#### **Front Tire Failure**



Reduced
Rotation
Lateral motion
Plowing (understeer)

#### **Understeer**



#### **Rear Tire Failure**



**Oversteer** 

Less stable
Excessive

Rotation
Lateral motion

Spin-out

(oversteer)



#### Risks Associated with Rear Tire Failure

- Forces generated by the tire failure may cause vehicle to veer off the roadway
- Sudden changes in handling
- Increased risk of driver accidently steering off the roadway



#### Vehicle-Based Technologies

- Electronic Stability Control Systems (ESC)
- Radar and cameras
- Tire Pressure Monitoring Systems (TPMS)
- Active steering



#### **Tire-Based Technologies**

- Integrated air pumps
- Integrated tread-monitoring systems
- Intelligent tires
- Non-pneumatic and run-flat tires



## Summary

• Tire failures pose unique challenges

- Potentially large, sudden changes in vehicle response characteristics
- Risk of driver accidently steering off the roadway
- Encourage technological improvements





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