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# **Tire Aging and Service Life**

## **NTSB Tire Safety Symposium**

Dec. 9 - 10, 2014

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Background: Tires degrade over time regardless of whether they are in service.

- Tire failures can result from thermo-oxidative degradation (“Tire Aging”) caused by:
  - Time
  - Ambient and operating temperatures
  - Partial pressure of O<sub>2</sub> in a tire
  - Flex fatigue
  - Construction and compounding characteristics



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# What Do Aged Tires Look Like?





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# What Do Aged Tire Failures Look Like?





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# What Do Aged Tire Failures Look Like?



- In June 2012 Owner took a nearly unused tire obtained from relative to tire dealer who mounted it on a Ford Ranger.
- Tire was made 31<sup>st</sup> week of 1991.
- Four months later tire suffered catastrophic tread separation causing a rollover and severe injuries to the driver.



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# What Do Aged Tire Failures Look Like?



- March 2010 towing service places virtually unused spare made in 22<sup>nd</sup> week of 2001 on 2001 Ford F250 during trip from MI to FL.
- April 2010 tires are inspected by tire service center in MI.
- July 2010 catastrophic tread separation in VA; severe injury.



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# What do Aged Tire Failures Look Like?



- Used tire made in 50<sup>th</sup> week of 2007 sold by shop in FL in July 2013.
- Placed on right-front position of 2002 Isuzu Trooper.
- Tread separation on highway Aug. 2013.
- Belted rear-seat passenger killed.



# Background

## **Effect of Antioxidants in Typical Rubber Stocks**

Marion C. Reed, B.F. Goodrich Co.; Industrial and Engineering Chemistry; Vol. 21, No. 4, p. 316, April 1929

- Describes tests using antioxidants on rubber stocks that become hot in service, like inner tubes and truck tire treads.
- Antioxidants valuable.
- Suggests that aging at 90 degrees C in air and inert gas will separate out the oxidation and over-cure in designing heat resistant rubber compounds.





# Background

## **The Effect of Tire Aging on Force and Moment Properties of Radial Tires**

M. Pottinger; et al of B.F. Goodrich; SAE; 1981

“[W]ell known that over extended periods of time the physical properties of rubber undergo significant changes. There are extensive discussions in the literature of how rubber properties such as modulus elongation, loss factors, etc. are affected by ozone, temperature, oxidation, humidity and other environmental factors.”



# Background

## **Accident Avoidance-How Age Deterioration Can Affect Car Safety**

M.A. Jacobson; presented at 9<sup>th</sup> ESV, 1982

- Addresses the aging effect on tires. Notes that sidewall and tread rubber harden and crack with age, exposure to oxygen, ozone, sunlight, and high temperatures.
- To counter these effects tires use "small quantities of fairly costly additives" in the compounds.
- Tire makers don't expect tires to be in regular use after 6 to 8 years after manufacture--"so some of these car tyres probably did not have sufficient special additives to remain supple for such a long life."

# Background

## **Long-term Durability of Tires**

Tokita; Uniroyal; presented at Intl. Rubber Conference;  
Kyoto, Japan 1985

- The internal durability of tires has "long been a concern for radial tires."
- Government-required short-term durability testing is done "without any consideration of chemical reaction, which would happen in long-term service."

# Background

## **The Aging of Tires - Influence on the Damage Frequency**

F. Nowakowski; DEKRA Industry Publication; 1986

- Correlated tire age to tire failures
- Examined 146 tread separation failures
- Dramatic increase in failures after 6 years
- Concludes: remove tires older than 6 years regardless of tread depth



# Background

1990s Automakers add warnings:

## Owner's Manual 1995 Jetta,

**WARNING**  
Old tires can fail in use, causing loss of vehicle control and personal injury. Replace tires after six years regardless of tread wear. Always reduce speed and drive cautiously if you must use an old tire in an emergency. Replace the tire as soon as possible.



Spare tires, 6 years and older, should only be used in an emergency and not used mixed with new tires.

## Owner's Manual 1992 Audi S4

### WARNING

■ Tires age even if they are not being used. Tires which are older than 6 years should only be used in an emergency and with caution.

TOYOTA

1990 Owner's  
Manual

Any tires which are over six years old must be checked by a qualified technician even if damage is not obvious.

Tires deteriorate with age even if they have never or seldom been used.



# Background



**Aging**—A reduction of physical and chemical properties of rubber by oxidation over a period of time.

- Rubber deteriorates as its aging qualities and strength are affected by continuous use in higher temperatures.

## TIRE AGING

Tires age even if they have not been used or have only been used occasionally. Cracking of the tread and sidewall rubber, sometimes accompanied by carcass deformation, is evidence of aging. Old and aged tires must be checked by a tire specialist to ascertain their suitability for further use.



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# Background

## Tire Retread Information Bureau Press Release

June 1988

(Reprint from Goodyear Commercial Tire Management "Sleeping Tires Wear Too")

What about tires out of service? By removing them from the aforementioned, do you, in effect, put tire wear and degradation on hold?

The answer is a qualified "no." Like most natural things, tires exposed to air, water and foreign substances eventually will weather, degrade and weaken, though it can take years before this natural aging process renders them unusable. Even tires placed in sheltered storage age, though not nearly as fast as those left out in the elements.

### **STORED TIRES GET OLD AND WEARY**

**When They Do, They Can Cause Trouble So  
You MUST Be On The Lookout!**



## Tire age raised in U.S. during Firestone ATX/ Wilderness Investigations in 2000.

### – TREAD Act

- Upgraded tire standards (FMVSS 139)
- Early Warning Reporting requirements  
*(limited to tires 5 years old or less)*
- Led to 2003 NHTSA proposed rulemaking to examine aging.





# Background

## THE WALL STREET JOURNAL.

### **Firestone Expands Its Top Warranty, Shortens Coverage**

*By Timothy Aepfel. Wall Street Journal. (Eastern edition). New York, N.Y.: Nov 3, 2000. pg. A.4*

- Bridgestone/Firestone expands its premium tire warranty to cover more tires but shortens the coverage period to three years from five “quietly acknowledging that the age of a tire can affect its durability.”
- "It became clear we were doing our consumers a disservice by giving the impression that they could expect their tires to last that long,' a Firestone spokeswoman said."



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# Background

## British Rubber Manufacturers' Association Ltd.



Registered Office: 6 Bath Place,  
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London EC2A 3JE  
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Fax: 020 7972 9008  
E-mail: mail@brma.co.uk

5<sup>th</sup> June 2001

### TYRE – AGEING

(Passenger Cars, Light Vans and Trailers up to 3.5 tonne GVW)

***Most drivers use the remaining tread depth of their tyres to determine when they should be replaced.***

In most cases, this approach is entirely appropriate since tyres usually wear out before the effects of age become critical. However, there are certain circumstances where the “ageing” process or, in other words, a deterioration of the rubber compounds, can render a tyre unserviceable even if it is unused.



# Background

## **2001 VRO (Association of Tire Specialists of Austria):**

- “Substitute tires should be used at the latest with only an age of six years, and only in emergencies. . . After 6-8 years motor vehicle tires no longer correspond in general in all features to the actual state of the art.”
- “Tires on trailer homes and [utility] trailers are subjected to greater stresses than in vehicles in regular use. Depending upon the individual conditions of use, the age limit can be reached before the wear limit.... At the age of ten years, such tires should be replaced, even if their external appearance is a good one.”



# Background

## 2003 Pirelli Tyre UK website FAQs:



**QUESTION:**

Do tyres grow old ?

**ANSWER:**

Tyres age even if they have not been used or have only been used occasionally. Cracking of the tread and sidewall rubber, sometimes accompanied by carcass deformation, is evidence of ageing. Old and aged tyres must be checked by tyre specialists to ascertain their suitability for further use.



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# Background



**2003**

“How old is too old? This is a difficult question. It depends on use, care and conditions. For a variety of reasons, tires that get a lot of use may actually last longer than those that don’t.”

“RV users, for example, often put no more than a few thousand miles on their tires a year. Their tires may need to be replaced because of age long before their treads are ‘worn out.’”

“The age of your tires, along with their overall wear, condition of sidewalls, etc. are all factors your tire dealer will take into consideration when inspecting your tires and advising you on tire replacement.”



# Background

## 2004 Tire maker customer service response regarding the use of 7 year old tire:

I would not recommend using that 7-year old tire. All rubbers will get harder with age. Think of that rubber hose on the air tank at the gas station that is all cracked due to age. The same can happen to tires.

Your tire may not show signs of age because it hasn't been used. But once you start to flex it, the cracks may start to appear.

Sorry about your old tire, but I hope this helps,



# Background

Post-Firestone recall, Ford Motor Co. studies tire aging:

- Led by Dr. John Baldwin, publishes series of papers beginning in 2003 through American Chemical Society.
  - Examined field aging, artificial aging, material science, included road-wheel testing.
- Ford includes following to 2006 MY owner's manuals:
  - “Tires degrade over time, even when they are not being used on the road. It is recommended that tires generally be replaced when they are six years or older.”
- “[data] suggest strongly that six years is an appropriate and defensible service limit for tires.”



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## Chrysler 2006 Owner's Manuals:

"Tires and spare tire should be replaced after six years, regardless of the remaining tread. Failure to follow this warning can result in sudden tire failure. You could lose control and have an accident resulting in serious injury or death."





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## TECHNICAL BULLETIN

October 2005

Ref. No. P-05-10

# Tire Inspection Guidelines



Continental Tire North America  
PLT Replacement Business Unit  
Customer Service  
(800) 847-3349

February 13, 2006

Product Service Information Bulletin PSIB 06-02

Tire Maximum Service Life for Passenger Car and Light Truck Tires

## TECHNICAL BULLETIN



Service Life for Passenger Car and Light Truck Tires  
including Spare Tires

# SERVICE BULLETIN

No. 112

Service Life for Passenger Car, Light Truck and Full-size  
Spare Tires



- NHTSA Report to Congress 2007
  - No rulemaking recommendations
  - Important Data – Major U.S. insurer reported:
    - 27% policyholders from five warm weather states (TX, CA, LA, FL, AZ) accounted for 77% of all claims nationwide and 84% of those claims involved tires older than 6 years.
- NHTSA Consumer Advisory issued summer 2008.
  - First consumer-level information issued by the agency
    - Did not define tire age – referred to vehicle and tiremakers recommendations.

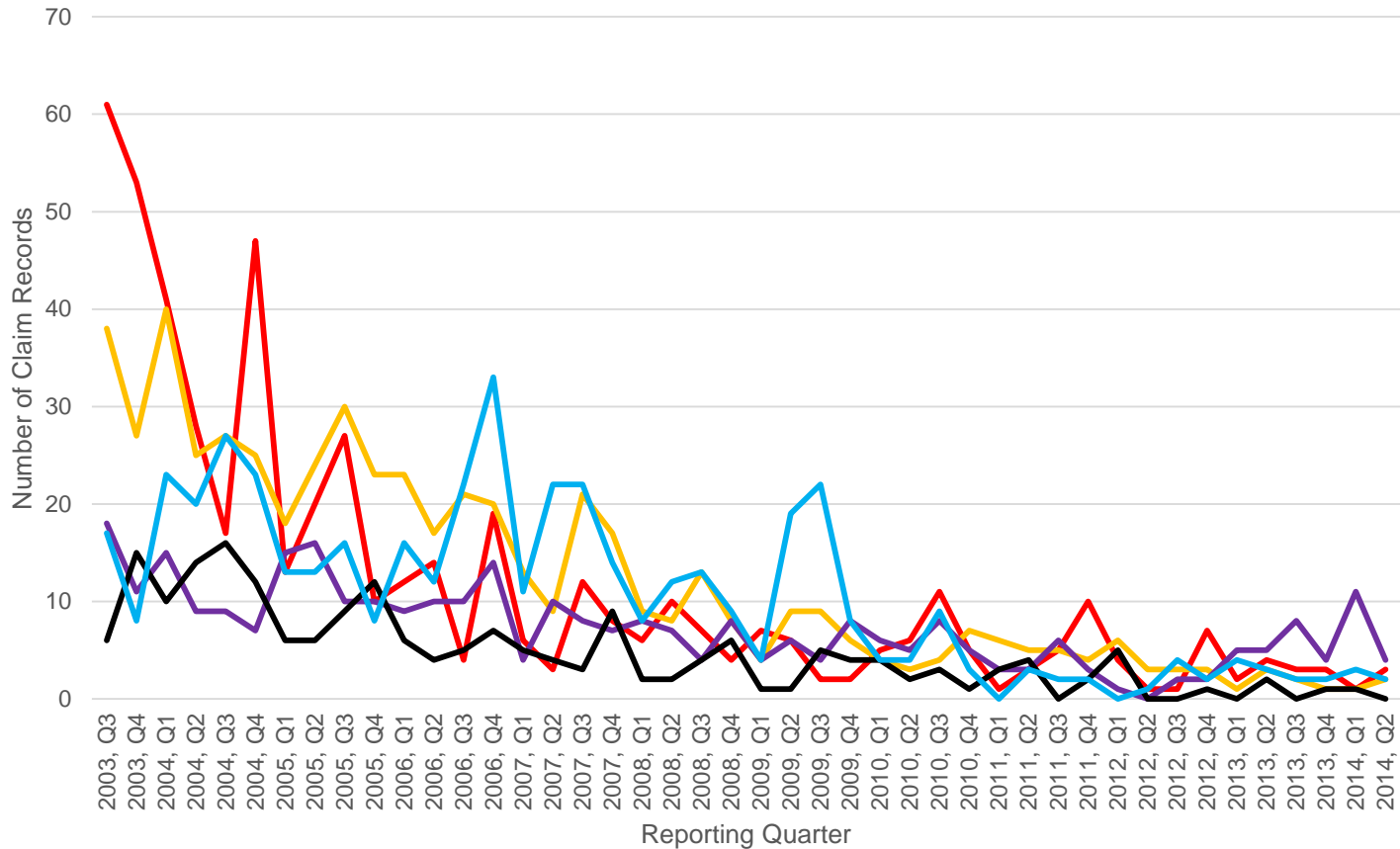


## States Consider Regulations

- Several states have considered bills to regulate tire age
  - Most related to customer notification of tire aging / tire age at point of sale.
  - One bill proposed tires 6 years or older could not pass annual state safety inspections.
- None have advanced.



### EWR Death and Injury Claims by Quarter



- Bridgestone/Firestone NA
- Goodyear Tire & Rubber Co.
- Michelin Tire NA
- Continental Tire The Americas LLC
- Cooper Tire



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- **Aged Spares**
  - Light trucks
  - Frequently service tech installed
- **Classic / low mileage vehicles**
- **Used tires**





- Tires will be put into service if they appear serviceable.
- Tires don't improve with age, they degrade.
- Aged tire related crashes are preventable.
- Aged tire failures will continue to be part of the tire-related crash landscape absent setting good policies and practices.

***[Additional background and comments by SRS on tire aging and TIN issues can be found in the following NHTSA dockets: 2005-21276; 2008-0169; 2012-0068; 2014-0084]***