

Tire aging: a human factors analysis of failure to warn and inform

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Abstract. A scenario of an automotive accident caused by tire failure is given followed by a human factors analysis of the information available to consumers on tire aging. Consumers have not been told that the age of the tire is a safety concern. It is not easy to decode the date of manufacture on tires. More publicity and prominent warnings are needed to communicate the dangers of older tires. Also, better ways to present the date of manufacture so that consumers can more easily and accurately assess tire age are needed.

Keywords: Tires, Aging, Manufacture Date, Safety, Warnings

1. Introduction

The following scenario is illustrative of similar events that have occurred in the past. Some specifics such names and places have been changed for anonymity.

Fred Ramos was driving along I-10 in Louisiana in his 1979 Triumph TR7 with his girlfriend, Amy Strand. They were returning home to the Atlanta area from a trip to Houston. There had been two reasons for their long weekend trip. One was to visit his sister's family to see his nieces and nephew. The other reason was to participate in a car show in Galveston, just south of Houston. It's now after midnight, early AM Monday; it is a lot later than he wanted to be driving, but they both needed to get back to work.

Fred was proud of his car. It had won second place in the 1970s international category at the car show over the weekend. The vehicle is in pristine condition. He had all original parts. There was not a scratch on it. He waxed it before the trip and wiped it down throughout the car show. He even had the original spare tire in the trunk with only slight tread wear. That was until recently, because he had to use the spare when his right rear tire blew out on I-10 about 70 miles east of Houston. That's the reason he's driving so late—he had to fix that tire, and wasted about 3 hours. He will get the nail removed

and possibly plugged when he gets back to Atlanta. Good thing he had a spare tire, he thought. There were no service stations open for miles at that time of night. He loosened the bolts, jacked up the car, took the wheel off and put on the full size original spare tire from the trunk, reapplied the bolts, tightened them up and tightened them up again before getting back on the road.

Amy was now asleep or trying to sleep, leaning against the window with her rolled up jacket as a pillow against the window. The seatbelt was uncomfortable in that position but she did not detach it. While driving through east Texas and into Louisiana, he was letting his mind wander. Then all of a sudden, out of nowhere, the car shook once as he heard a loud explosion. The car started going sideways, he tried to steer but at that moment none of his steering inputs had an effect and then the car started to flip. That is the last point in time he remembered about the accident. Accident reconstructionists say the car rolled 4 times across the center median and into the lanes of on-coming traffic and slammed into another car coming towards it. Fred Ramos had a broken neck but no spinal injury. Amy, his girlfriend received a traumatic brain injury when she struck the roof and window, perhaps more than once. With extensive training, she has made a remarkable recovery but must have a 24-hour attendant some three years after the accident. Fred has taken 11 months before he was able to walk

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without thinking about it. It hurts to walk most of the time. The driver of the other car, a 1992 Saturn that collided with Mr. Ramos' Triumph during its last roll, died at the scene.

Accident investigation by the Louisiana State Police indicated that a portion of the tread of the right rear tire had torn off from the steel belted casing; parts of it disintegrated and were not fully recovered at the scene. This was, of course, the spare tire that Fred had put on a few hours earlier.

At his deposition, Fred admitted being an amateur car enthusiast. He has won a few prizes at car shows. He received a check for \$250 this past weekend. He liked working on his car. He took care of it. He testified that he checked the air in the spare tire regularly and specifically checked the day before they left on the trip. He keeps a tire pressure gauge in his car for that purpose. The investigating officer commented that the way he installed the spare appeared correct, and his description was consistent with good practices. Indeed, his tire mounting technique was ruled out as the cause. Law enforcement and expert witnesses all agreed that there were deep grooves on the tread of the spare tire indicating that it had hardly been on the road. Yet the tire failed.

Although the tire appeared nearly new, this old tire was dangerous. It was 12 years old and should never have been put into service at that age.

Fred testified in his deposition that he had never heard that older tires were a hazard. He admits that the idea makes sense—it just never occurred to him that tires go bad simply with age. He knows that tires are reasonably durable, in most cases lasting thousands of miles on the road. He has never heard or seen any recommendations about discarding older tires that still have plenty of tread on them. He has changed all 4 tires of the driving wheels on two occasions at major tire stores since he bought the car. No one told him that any of the tires that he was getting rid of would be a better spare than his original spare tire. Before the accident, he believed that if the tread is still good and if you keep the air pressure in the recommended range that the tire is good to go.

2. Human Factors Analysis

From 1994 to 2004, the U.S. National Highway Traffic Safety Administration estimates that 400 fatalities per year were associated with tire failures [13]. Vehicles, roadways, and people have changed over the years. Vehicle restraint systems are better. There

are fewer amateur mechanics today because of time constraints and because control systems were changed from being mostly mechanical to computer controlled. Several decades ago, almost all gas stations had mechanics. A generally expected free service was oil check, cleaning the windows, etc. Employees at gas stations commonly checked the tires' air pressure. Except for a few states such as New Jersey, drivers now pump their own gas, and generally there are no persons to do maintenance work, except the owner/driver. In many states, regular state inspections have been eliminated. As a result, people may not be checking the mechanical and electrical aspects of their vehicle to the extent that they should. Research indicates that many operators of vehicles lack basic knowledge of vehicle maintenance, including tire care [5, 10, 15]. They do not know how to change tires, and every year, there are people who have gotten hurt or killed doing this task. Consumers are also unaware of basic tire inflation guidelines and where they can be found [e.g., 15]. Many people report that they never check the air pressure at all on their vehicle [4, 5]. Some rely on other people to check their tire pressure, and commonly the checks are irregular and infrequent [5]. However, NHTSA and vehicle manufacturers advise that tire inflation pressure should be checked at least monthly. As mentioned above few people comply with this directive. This is true despite a positive economic reason for having the correct air pressure as it increases fuel mileage and enhances the vehicle's handling [12].

There is an additional cost for not checking the air pressure. It is dangerous. Incorrect pressure can lead to tire failure and loss of vehicle control.

A more well known tire-related hazard is insufficient tread. Severely worn Tires with extensive tread wear reveal wear indicators or patches purposely embedded in the tread so as to be noticed. A commonly described way to measure whether the tread reaches a point of necessary tire replacement is to use a U.S. penny and when inserted into the tread if the top of his Lincoln's head can be seen then that indicates that the tread is too worn.

3. Tire Aging

Besides improper air pressure and worn tread, tires can become unsafe due to their age. As tires age, their internal components dry out and the adhesion holding the components together deteriorates. Oxidation and heat quickens the deterioration [13]. The

extent of deterioration is greater with lesser-used (e.g., recreational vehicle) or unused (e.g., spare) tires because road use is needed to activate anti-aging compounds that are added to the rubber emulsions [2, 6]. The deterioration can cause tread separation (i.e., the tread detaches from rest of the tire) resulting in the tire blowing out.

Tires do not have to be *ancient* to be deemed unusable. Some vehicle manufacturers and auto safety advocates recommend replacing tires that are over 5 or 6 years from the *date of manufacture (DOM)*. In 2001, the British Rubber Manufacturers Association issued a recommendation that “previously unused tires not be used if they were more than six years old and that all tires be replaced 10 years from the date of their manufacture.”

Older tires may fail even if the tread looks adequate [6]. An older tire may not show any visual indications of aging because the degradation occurs within its internal structure. Thus visual inspection may suggest that an older tire is okay when there may be substantial structural degradation. Specialized equipment not commonly found at vehicle maintenance facilities (e.g., an X-ray machine) is necessary to determine whether there is internal damage. Even if this equipment were available, its use and diagnostic value would require extensive training of technicians operating it.

There was no mention of a tire aging problem in Fred’s original Triumph TR owner’s manual. Fred stated had never read any warning that said that after 6 years, passenger vehicle tires must be discarded. He stated that if he had known that, he would have realized the original spare was dangerous to use.

Research indicates that many consumers are unaware of tire aging and its dangers. Cowley, Kim, and Wogalter [4] found that of 225 participants asked to report ways tires could fail, few mentioned anything about the age of the tires. In another study, approximately 25% of respondents over-estimated the recommended tire life span by four years or more [5]. Kalsher et al. [5] also reported that participants over-estimated how long spare tires could be stored in a vehicle trunk.

4. Information about Tire Aging

Why are people largely unaware of the tire aging issue? There has been relatively little media exposure about the tire-aging hazard. ABC News [1] had a segment on it. Most vehicle manufacturers are in-

cluding tire-aging information and recommendations in owner’s manuals [8]. The problem is that it consists of only a few sentences on the topic inconspicuously printed within the text of hundreds of pages of the manual.

A 2006 BMW manual states “BMW recommends that you replace all tires after 6 years at most, even if some tires may last for 10 years.” The wording reduces the potential impact of the message because it allows for people to consider that *their* tires might last 10 years. Later in the 2006 manual, it says “BMW recommends tire replacement after no more than 6 years, regardless of the actual wear of the tires.” Note that this warning is simply a recommendation, i.e., a suggestion. The manufacturer is not saying that it is mandatory to replace the tires after 6 or even 10 years. More importantly safety is not directly stated as the reason.

Unfortunately, few people read the manuals, and those that do, usually read them incompletely [9, 11]. Also few consumer-directed guidelines include it as a concern. Materials distributed by automobile clubs, insurance companies and other entities who have consciously taken on the role of proffering advice about tire maintenance to consumers, make little or no mention of tire aging as a potential hazard. Consumers Union [3] is one of first entities that has started to point out the potential problems of older tires to consumers.

Thus the public has not been adequately apprised of tire aging problems. Some tire manufacturers have sent warnings to their dealers in the form of mailed or emailed safety bulletins. However, many dealers have not passed this information on to consumers. Together the evidence presented here suggests that information and warnings about tire aging has not been adequately dispersed to the public.

Most people in the U.S. purchase fresh tires at “big box” warehouse stores, or at authorized dealers of tire manufacturers. Used tires are generally purchased through smaller establishments. Besides visible tread wear, it is difficult to tell the condition of the tire, even with training. The tire can be damaged in many ways. One particularly dangerous location is damage around the rim areas (toe beads) that hold the tire to the wheel when pressurized. Also, as mentioned earlier, there could be internal damage that is not visibly obvious. The problem with most used tires is that the purchaser does not know their history. Why a used tire was removed from service is seldom known.

So one aspect of the problem is that people do not know about tire aging. It would seem that such in-

formation could be communicated to consumers if it were given greater emphasis by the entities who are currently giving advice on tires to consumers.

Another aspect of the problem is that the task of determining the age of the tires is not easy. An important step to assess the age of the tire is to determine its *Date of Manufacture* or *DOM*. How would you know what the DOM is? It is not apparent that there is a date of manufacture on tires. Looking at an exemplar new tire placed on the table at his deposition, Mr. Ramos could not find the date of manufacture. First, it was difficult to read any of the print. The lettering on tires is black on a black background. Forty-six year old Fred Ramos is a presbyope. He, like others his age and older, has reduced ability to focus on print and needs more light than is often available.

Second, the date is obscure. A “code” is given at the end of the DOT number (as required by U.S. Department of Transportation). It is the last four digits. Fred looked and saw that these four numbers read “2610.” “This does not look like a date,” he exclaimed at his deposition. Taking a stab at what the code, he stated that “it might be February 6, 2010.” Actually, that is a pretty good guess—he is correct about the year. He stated that “if you had not told me that these numbers were the date, then I would not have known it.” However, the date he guessed is not exactly correct. The first two numbers indicate the week (from 01-52); so it is actually the 26th week of 2010 (which is about the last week of June).

It is not easy to read the print and it is not obvious that there is a date of manufacture on the tire. Even when told where to look, the code can produce an incorrect interpretation.

These conclusions are supported by research [4, 5,16]. Since people commonly do not know about the tire aging issue, they would not likely know or care about their tires’ DOM. But even if they sought the age of the tire, the DOM is not obvious. Even when pointed out where the date code is—that it is last four digits at the end of the DOT number—many people will not determine the correct date because the first two numbers are numbered in weeks, not months as they would expect [16]. Changing the date to a different format would make it easier to correctly determine the age of the tire (e.g., in the format of MM/DD/YY [16]).

Tire manufacturers and dealers have done very little to communicate tire aging hazards to the public. There is a tread label attached to the tire when purchased new that consumers frequently do not see or read. There is a warranty that usually indicates a

time period or mileage such as 5 years or 50,000 miles. It is a prorated so after 3 or 4 years you do not get much towards a new tire if it fails prematurely. The main problem is that the warranty does not communicate any personal injury hazards associated with tires past the warranty period. Indeed, there is the potential for the opposite effect to occur. A consumer might actually feel good about the fact that he or she is able to get a few more extra years out of their tires.

5. Some Solutions

Clearly there needs to be more and better communications about tire aging. The current method of conveying the DOM to consumers needs to be changed. One potentially limiting factor is that tire manufacturers are currently required to give the DOT number as specified by law (NHTSA, 2009). At the same time, manufacturers have a responsibility to ensure that consumers are provided adequate information about its safe use. The current U.S. DOT requirement for DOM does not mean that manufacturers are prevented from other methods of communicating the DOM to consumers. Tire manufacturers could put the DOM in a clear format elsewhere on the tire, separate from the DOT number. There is no need to give the specific day of manufacture (as in month/day/year). However, manufacturers should have little difficulty giving the DOM in a month/year format directly on the tire in a way that is clear and understandable to consumers. Future research could examine whether DOM consisting of a text abbreviation (short name) of the month rather than numerically (e.g., JAN vs. 01) aids ease-of-use and accuracy.

As mentioned earlier, when tires are sold new, they come with removable paper labels on the tread. Consumers commonly never see these labels because they are removed when the tires are installed, or they are left on the tire and are worn off after some initial use. With some modest changes to the paper tire-tread label, communication of the DOM could be further improved. Once a tire is purchased, sellers or technicians could be instructed to remove a portion of a sticker from that tire’s tread label with the DOM and place the sticker on the door jam and/or on the bill of sale. These and other potential methods could be used to more effectively convey DOM to vehicle owners.

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