Conflicting Goals in Product Development: Learning From the Fatal Firestone Flaw

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Submitted to the Integrated Design & Management program in partial fulfillment of the requirements for the degree of Master of Science in Engineering and Management

Abstract

The human-centered design approach is a powerful methodology for developing products that are considerate of humanity. Yet, in spite of the proven success of empathetic design, we still see products that fail, amplify negative social behaviors, or take advantage of human tendencies for the sake of profit or competitive success. These outcomes are often the result of poor negotiation between conflicting organizational and value-driven goals. The purpose of this analysis is to consider how goal conflict inhibits the product development process and leads to suboptimal or destructive results.

This exploration seeks to learn from an analysis of the deadly product failure of Firestone ATX, ATX II, and Wilderness AT tires in the late 1990s. Drawing from Congressional testimony, expert evaluation, and depositions of relevant engineers, this analysis considers the impact of goal conflict on product design requirements and testing. Recommendations include methods for identifying goals and framing conflict to encourage balance between organizational goals and human wellbeing. This project is the beginning of a larger body of work that aims to equip "makers" with skills they need to reconcile conflicting goals in order to focus on making the world better by making better things.

Supervisor: David Niño
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First, to my parents and siblings: Thank you for being steady, continuously encouraging me to chase what I find meaningful, and for all the pancakes.

To the friends who have walked beside me while I did a really hard thing: You have taught me the meaning of belonging. Thank you, thank you, thank you.

To my IDM family: You guys are weird. My kind of weird. I'm so thankful for two years of adventures with y'all. Here's to many, many more!

To the wonderful faculty of MIT: I'm so grateful for all the lessons learned and stories shared. Thank you for making me part of this world. It's one of the coolest things that's ever happened to me.

There are two powerful stories that inspired my interest in conflicting goals. One is fiction, and one is history. I'd like to acknowledge these authors for their courage; It takes equal parts guts and wisdom to articulate the human tendency to get so caught up—in the circumstances, the exhilaration of creation, the potential of success—that you don't realize the impact of what you've made. To Michael Crichton, author of *Jurassic Park*, and Dr. Richard Feynman for sharing his experiences in his autobiography, *Surely You're Joking, Mr. Feynman*, thank you.

I love you all.

Be lifted high.

Dr. Ian Malcolm

You stood on the shoulders of geniuses to accomplish something as fast as you could, and before you even knew what you had, you patented it, and packaged it, and slapped it on a plastic lunchbox, and now you're selling it.

John Hammond

I don't think you're giving us our due credit. Our scientists have done things which nobody's ever done before…

Dr. Ian Malcolm

Yeah, yeah, but your scientists were so preoccupied with whether or not they could that they didn't stop to think if they should."[1]

Jurassic Park

[1] *Jurassic Park.* Dir. Steven Spielberg. Perf. Jeff Goldblum, Richard Attenborough. Universal Pictures, 1993.

After the thing went off, there was tremendous excitement at Los Alamos.[2] Everyone had parties, we all ran around. I sat on the end of a Jeep and beat drums and so on. But one man, I remember, Bob Wilson,[3] was just sitting there and moping.

I said, "What are you moping about?"

He said, "It's a terrible thing that we've made."

I said, "But you started it. You got us into it."

You see, what happened to me—what happened to the rest of us—is we started for a good reason, then you're working very hard to accomplish something and it's a pleasure, it's excitement. And you stop thinking, you know; you just *stop*. Bob Wilson was the only one who was still thinking about it, at that moment.[4]

Richard Feynman

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[2] Dr. Feynman is referring to the Manhattan Project, a WWII research effort that developed the first nuclear weapons.
[3] Robert Wilson was an American physicist who led the research efforts on the Manhattan Project.
[4] Richard P. Feynman, *"Surely You're Joking, Mr. Feynman!": Adventures of a Curious Character* (Bantam Books, 1989), 156-157.

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I. Introduction

Motivation

In 1964, a designer in London published a manifesto. The essay, titled *First Things First* and penned by Ken Garland, was a call to prioritize to consideration of humanity in the design profession.[5] It spoke out against projects with "trivial purposes," and challenged the belief that the most lucrative and influential career path for designers was the most worthy. Instead, it called for designers to spend their problem-solving abilities on the betterment of society. Twenty-two design legends, students, and up-and-coming professionals signed the manifesto. It was published independently, then reprinted in The Guardian, then featured on the BBC.

Now, anything labeled "manifesto" risks its emotionally charged composition style undercutting its credibility. However, *First Things First* was spot on in its analysis of how the design profession was evolving. Focus had shifted to persuasion—from solving well-formed problems to persuading consumers to spend their money and attention in a certain way. The 22 signatories felt that shift was harming both their profession and to society. The manifesto was a call for the design community to consider where they applied their skills, and how their work would impact society.

Just over 50 years later, the scope of the design profession has exploded. The list of professions responsible for design now includes developers, technologists, business designers, engineers, product managers, and entrepreneurs. These "makers," fueled by advancement in technology, have an incredible opportunity to make world-changing things. However, they face a similar conflict felt by those original 22 designers: left unchecked, history has shown that the professional climate will shift to prioritize profit and scale.

This is evidenced by products and services that have entered the market in recent years. The past few decades have brought about many incredible innovations. However, we have also seen a stream of undifferentiated apps driven by advertising, observed the impact of social platforms developed as a front for the sale of customer data, and discovered products that amplify negative

[5] Ken Garland. *First Things First.* (Self-published, 1964).

social behaviors. In this climate, all makers will face a time when they are asked to produce something redundant or destructive. So what do we do?

First, the human-centered design has built-in mechanisms to look out for the human. However, it is not foolproof. For example, makers are taught to look for three markers of a strong concept:

Do people want it?
Satisfy that, and you have got a **desirable** product.

Can you make it? Do you have reason to believe the technology suggested can be developed?
If so, then your idea is **feasible**.

Can you build a business around it?
Then it is **viable**.

Got all three? Greenlight.

Yet, there have been ideas that tick all three boxes that we've now come to question. Think about it: According to the CDC, 249 billion cigarettes were sold in the United States in 2017.[6] It's a 125 *billion* dollar market.[7] Arguably desirable, feasible, and viable. If we could go back to a point in time when someone was deciding to commercialize tobacco, what would we tell them? Would we inform them that smoking-related illnesses in the United States cost Americans more than $300 billion each year? Would we share that if someone they love smokes, there is a high chance that they will lose them to a related illness? Would that change anything? Should it?

Second, these makers work in a real world, with multiple often conflicting stakeholders. Competitive industries, budgets, lack of resources, time constraints—these are just a few examples of driving factors that compete to be top priority. I believe that most designers and engineers want to make "good" things. We want to make things that are ethical, sustainable, and enable people to be more connected and loved. We also want to be competitive in the market. We want to earn a profit. Make a name for ourselves. We want to design something breakthrough. There is a tension between what we believe and what we believe will bring success.

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[6] "Economic Trends in Tobacco | CDC." Centers for Disease Control and Prevention, 2017.
[7] "Tobacco: U.S. Market Value 2015-2020 | Statistic." Statista, 2015.

The phrase "First Things First" is used in situations where there is a clear priority in what needs be addressed. As we consider the new technologies on the horizon, we must understand our values and goals in creating successful products, services & platforms. This is not suggesting that all innovation should be strictly what some would describe as "functional." Entertainment improves lives. Beauty improves lives. Communities and networks improve lives. Experimentation is important. Doing work that is motivating and enjoyable is essential. The goal of this research is to explore how we can be competitive *and* compassionate, innovative *and* human-centered.

First things first, we need to innovate with humans in mind.

Goals & Scope

The human-centered design approach is a powerful methodology for developing products that are considerate of humanity. However, despite the success of empathetic design, consumer industries continue to produce products that negatively impact human health and happiness. These outcomes are often the result of conflict between organizational and human-centered goals.

The purpose of this analysis is to consider how conflicting goals inhibit a human-centered approach and lead to product failure. To achieve this objective, the analysis will address the following research questions:

Research Question 1: *How do conflicting goals manifest in product development?*

Research Question 2: *How do conflicting goals inhibit the product design process?*

The findings presented in this thesis aim to improve the outcomes of the design process by identifying gaps in design-driven methodologies. This leads to a third research objective:

Research Question 3: *How can the lessons learned from the case study influence the future of product development?*

In order to achieve these objectives, we seek to learn from a past product failure, the 2000-2001 Firestone tire recall. The analysis seeks to learn from the Firestone failure to improve the outcomes of the product development process in the future. The resulting work is organized into the following topics: Conflicting goals in product development; goal conflict and the inhibition of human-centered outcomes, with emphasis on case study learnings; and conclusions with comments on potential future work.

II. Developing New Ideas

Design is the most common way that consumers interact with the output of the creative process. Some interactions with design are tangible, such as transfering clothes from a washing machine to the dryer, opening a can of tomatoes, or using an app on a smartphone. Others are less overt, such as the design of an organizational structure or business strategy.

The process of creating new, discrete offerings to meet a the needs of consumers is know as Human-Centered Design. The design process, in its most basic form, is the scientific method that most learn in grade school: observe, hypothesize, experiment. Designers observe a phenomenon, often referred to as a "need," that leads to the development of a question and hypothesis. The resulting concepts are tested with users. The process is iterative, with the feedback from each test informing the next hypothesis and round of ideas.[8] This process leads to the creation of an output, from physical products to system design, that addresses the needs of its stakeholders.

Building a great product in a real-world context is exceedingly complex. In a competitive market, designers must consider multiple stakeholders, work within budget constraints, and often rely on external systems to manufacture and distribute their products, platforms, and services. And, while designers do their best, predicting how consumers will use and abuse a product is guessing at best. In addition to the uncertainty of development, the culture of innovation is fast. *Move fast* and break things.[9] Design *Sprint*. *24-hour* hacks. There is added pressure for decision makers to move quickly to keep up in a competitive market. This mindset is a badge of honor for many disruptive companies, and a reality for most working to remain competitive in a rapidly changing market.

As mentioned in the motivation for this research, design work does not take place in a vacuum. Real-world application of the process often encounters contradictory requirements from multiple stakeholders and challenging parameters. This work seeks to understand how these "conflicting goals" interfere with the product development process and inhibit prioritization of the human needs.

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[8] Karl T. Ulrich, Steven D. Eppinger, and Maria C. Yang. *Product Design and Development,* (McGraw-Hill Education, 2016).
[9] Mike Deerkoski, "Facebook CEO Mark Zuckerberg and His Company's Motto", (Wikimedia Commons, 2014)

Conflicting Goals in Human-Centered Design

Contradictory forces in business is not a new concept. They exist at an organizational level: Engineering hopes for technical superiority, business development wants a product they can price competitively, customer service wants consistency in quality. They can also exist within an individual: You want to advance your career, and you also want to be at home for dinner with your family. Goal conflict occurs when two equally worthy goals inhibit each other; the objective of one goal seems to interfere with the achievement of another goal.

In this case, we consider the conflict between organizational goals and value-driven goals. Value-driven goals are actionable ways that a company expresses its commitment to important values, for example, ethical practices, sustainability, or community contribution. Goals that stem from these values can be complex, such as "create a culture where all employees can express their opinion" or they can also involve so-called *wicked problems*, such as "reduce the use of single use plastic." The human-centered design process assumes a value-driven goal of creating an output that solves a user need.

However, the use of this approach does not guarantee a human-centered product—the goal of creating quality product must compete with other individual and organizational goals. Individual goals may stem from a wide-range of human motivations; these are highly personal and can range from concrete goals, such a desire to be promoted, to more complex, emotional goals, such as a need for control. Organizational goals are defined by a combination of internal factors, such as financial and human capital, and external factors, such as demand, competitors, and the state of the economy. For example, if a company is working to create a product that is safe and low cost, and they know that their competitor is also working to bring a product to market, they will face conflicting goals: build a high quality product, get there first.

Conflicting goals are present throughout the entire design process. For the purpose of this analysis, observations are focused on *organizational goals* at a critical stage of the process: defining design requirements.

Design Requirements

Before you can begin generating solutions, you must define the bounds of your exploration. These parameters, or design requirements, outline the important characteristics a design must possess

in order to be considered successful.[10] Design requirements are critical to product development; they represent stakeholder needs during concept generation and shape testing as concepts proceed to prototyping and production.

Human-centered design advises that design requirements are selected from three primary sources: research of user needs, engineering or technical limitations, and competitive analysis. Typically, a designer will map design requirements to observed and expressed customer needs and engineering considerations, and then prioritize requirements based on competitors or product-market fit.

The ideal design process considers what users desire a product to be. In an environment of conflicting goals, many other voices contribute to that description. Some examples of influences include:

- **Competition**: Presence of a competitor may present the need to drive down cost margins to be competitive in the market, or accelerate the timeline to be the first into production.
- **State of the company:** Related to competition, availability of financial and and human capital can influence design.
- **Partnerships, vendors, and customers**: For example, limitations from a prefered vendor or commitment to a long standing partnership.
- **Reputation and history**: Requirements may be limited by "what we've always done" or efforts to maintain an image or reputation.
- **Aspirations**: Developing a new technology is an exciting process, and can motivate a team to strive for a certain type of solution.
- **Company culture:** Standard practices and expectations communicated explicitly or implicitly to employees.

Goals stemming from these categories often present latent design requirements. I propose that design requirements are a product of both user needs *and* the relevant organizational goals.

It's important to note that none of these goals are inherently negative influences—A human-centered product can also aspire to be incredibly profitable or first to market. However, potential for negative outcomes is increased when conflicting goals are not recognized, or are

[10] Ulrich, Eppinger, Yang. *Product Design and Development, 94-103.*

prioritized to the detriment of product quality, viability, or safety. For example, a product driven by competition that doesn't consider the human needs, or a product focused on a virtuous goal, such as sustainability, that is unsuccessful because of high production costs or barriers to adoption.

To learn more about prioritization of design requirements due to conflicting goals, we look to the Firestone case.

III. Case Study: Firestone Tires

The Firestone case reveals several areas where product development, quality control, and product success teams failed to protect their consumer and produce the best possible product. However, reading page after page of testimony and internal communication drives home an important point: **none of the engineers or managers intended to do harm.** Instead, they were engaged in a process and environment rife with conflicting goals.

The objective of this chapter is to understand how a company committed to safety encountered such a tragic product failure. We focus in on the Design Requirements stage, and consider how goal conflict inhibited the design process and contributed to the failure of the affected tires. Following the background on the case, the analysis is divided into two sections: Analysis of the tire's design and defect and observations regarding the recall and Firestone's response.

Background

The investigative staff at KHOU collected evidence for two months before going to air. Where most had seen a random string of accidents caused by driver error or misuse, the Texas news station saw a correlation that was too strong to be a coincidence. The investigation began when Anna Werner, a journalist who (along with a producer and photojournalist) went on to win a Peabody Award[11] for the report, received a tip from a small claims lawyer. In the report, Werner described a connection between Bridgestone/Firestone tires failures and Ford Explorer rollovers, identifying 30 related fatalities. The viewer's response was overwhelming. After the report aired, the station was inundated with calls and emails from viewers who had similar problems with their vehicles. The report hit home, not only with viewers but within KHOU—many staffers drove vehicles with affected tires.[12]

In response to the investigative report, the U.S. Office of Defects Investigation (ODI) opened an official investigation. The response to the report, now being aired nationwide news, confirmed what KHOU had believed: an abnormal number of failures in Firestone Radial ATX, ATX II, and Wilderness tires manufactured after 1991. With 90 reported cases of tire failure at the time investigation, the tires subject to investigation had been involved in 33 crashes, 27 injuries, and 4

[11] "Treading on Danger?," *Peabody Awards*, 2000.
[12] Al Tompkins, "Breaking the Big One," *Poynter*, August 02, 2002.

fatalities.[13] [14] The ODI issued a consumer advisory, informing the public of the investigation, and asking consumers who were not covered by the initial recall to check their tires, wear seatbelts, and drive primarily on roads with low speed limits.[15] The ODI investigation eventually led to a recall of 14.4 million tires, with an estimated 6.5 million of those tires still in service at the time of recall.

A History of Recall

Unfortunately, the defect discussed in this work is not the first time that Firestone has encountered product failure with tragic consequences. 20 years before the recall of ATX, ATX II, and Wilderness AT tires, a catastrophic defect in the Firestone 500 led to the death of 41 Americans.[16]

Pneumatic radial tires were first introduced in Europe by the Michelin brothers in 1948. Over the next 20 years, radial tires became the standard for new vehicles outside the United States: Michelin, Bridgestone, Pirelli, and Continental became leaders in France, Japan, Italy, and Germany respectively.[17] However, U.S. tire companies resisted the new technology that would disrupt current design and manufacturing facilities. They created new versions of the older form of tires and advertised heavily against foreign technology, despite their improved durability and efficiency.

The 1970s brought about a gasoline crisis in the United States. Gas prices rose rapidly and with it, the number of Americans buying foreign-made vehicles equipped with radial tires. Having resisted the technology, the American manufacturers were utterly unprepared to supply drivers with replacement tires.[18]

When Firestone recognized that they couldn't resist the radial tire, they moved quickly to bring their own competitive product to market. The Firestone 500, the company's first radial offering,

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[13] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 1.
[14] ODI Investigation, See Appendix A
[15] ODI Consumer Advisory, See Appendix A
[16] Larry Kramer, "U.S. Seeks Firestone 500 Recalls," *The Washington Post*. July 09, 1978.
[17] Donald N. Sull, "The Dynamics of Standing Still: Firestone Tire & Rubber and the Radial Revolution." *Business History Review* 73, no. 03 (1999): 430-464.
[18] Richard S. Tedlow, *Denial: Why Business Leaders Fail to Look Facts in the Face--and What to Do about It*. (New York: Portfolio/Penguin, 2011).

was cobbled together on an assembly line designed to manufacture the older model bias-ply tires. Consequently, Firestone 500 tires failed at a 2.5x higher rate than any other previous Firestone products, leading to a recall of 9 million tires. The financial impact of the Firestone 500 failure led to massive layoffs and the company posting a $100 million loss. In order to stay afloat, Firestone was acquired by Bridgestone Corporation of Japan in 1988.[19]

Components of a Radial Tire

The Firestone 500 failure resulted from low quality components due to use of modified plant equipment that was not equipped to build the intricate radial designs. First introduced in Europe, pneumatic tires replaced solid rubber tires in the late 1800s. Over the next seventy years, radial tires design evolved to become the complex, engineered product that it is today. Typical radial tires are comprised of twenty or more physical and chemical components, including rubber compounds, wire, synthetic cord, and other chemical compounds, such as sulfur to assist in vulcanization. The design and combination of these components enable manufacturers to customize their product to specifications in order to achieve complex—and often contradictory—performance goals.[20]

Radial tires are assembled in layers or "plies." Key plies are as follows:

- **Inner ply:** an thin layer engineered to reduce the amount of air that can seep through the other layers. This layer makes the tire effectively air-tight.
- **Body ply:** a rubberized layer containing reinforcing cord. These cords are arranged radially from bead to bead, setting them at a 90° angle to the centerline of the tread. Both the inner and body plies are applied and spliced around a drum.
- **Bead:** bunched wires formed into hoops. The beads give the tire its structure inside the rim of the wheel. The beads are placed on either edge of the drum, and the outer edges of the inner and body plies are folded over, forming the tire's inner structure.
- **Side wall:** two sheets of thick, sidewall rubber are applied to the outer edges of the assembly.

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[19] Firestone's management remained in place, operating out of their headquarters in Akron, Ohio. For the purpose of this analysis, I will refer to Bridgestone/Firestone as "Firestone" unless clarification is necessary.
[20] Alan N. Gent, Joseph D. Walter. *The Pneumatic Tire.* (U.S. Department of Transportation, 2006), 2-10.

At this point, the edges of the tire are pneumatically brought toward each other and the assembly is filled with air. A roller placed at each edge rolls the sidewalls in. Next, the belt layers are applied. See Radial Tire Assembly figure below.

- **Inner belt:** brass-plated steel cords are coated with a thin layer of "skim rubber" to reduce corrosion and fatigue. The resulting sheet is cut into strips at an angle to form a belt.
- **Outer belt:** cut with the cords running in an opposite angle, a second belt is applied to the first. Belt widths and cord angles determine the tire's handling and the vehicle's performance and ride.[21] The inner-belt gauge is determined by thickness of the skim rubber that was applied to the belt cords.
- **Belt Wedge:** On some radial tires, a thin strip of rubber is placed under the edge of the outer belt to reduce interply friction at the belt edge.
- **Belt-edge insert:** contoured rubber strips under the edge of the inner belt to assist in belt contour and protect the body ply from friction from the belt edges.
- **Tread:** outermost layer that will receive the tread pattern during the vulcanization process. The tread is formulated to provide "a balance between wear, traction, handling and rolling resistance" to achieve the performance goals.
- Some tire designs also include additional layers, such as subtread, undertread, nylon cap plies or cap strips. These plies are not critical to this analysis.

Relationship With Ford

The 100-year Ford—Firestone relationship began as a friendship between Henry Ford and Harvey Firestone. The two men became close business associates as their professional endeavors grew, [22] with Firestone supplying tires for 40% of Ford's vehicle production at the time of the recall. According to Phil Pacsi, the director of brand and retail marketing for Bridgestone-Firestone consumer tires, Ford was Firestone's largest customer.[23]

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[21] Gent and Walter, *The Pneumatic Tire*, 9-10.
[22] James D. Newton, *Uncommon Friends: Life with Thomas Edison, Henry Ford, Harvey Firestone, Alexis Carrel, & Charles Lindbergh*, (Harcourt Brace Jovanovich, 1989).
[23] Tim Keenan, "Ford-Firestone Relationship 'tested' but Continues." *WardsAuto*, December 04, 2011.

NHTSA

It's also helpful to highlight the relationship between tire and vehicle manufacturers and the government agencies that handle safety standards. In 1966, Congress began addressing growing concerns about highway safety. This led to the creation of the U.S. Department of Transportation and the eventual establishment of the National Highway Traffic Safety Administration (NHTSA). NHTSA is a federal government agency that partners with local and state governments to define and enforce federal motor vehicle safety standards. One important part of NHTSA's responsibility is managing product recall.

According to testimony by Dr. Sue Bailey, administrator of NHTSA, "When the agency's screening process identifies a possible safety defect, our Office of Defects Investigations takes steps to open an investigation as a preliminary evaluation. We inform the manufacturer and the public at this time. If our review of the information at the end of a preliminary evaluation suggests that further evaluation is warranted, we move the investigation to a second stage, the engineering analysis." If warranted, NHTSA will inform consumers and mandate a product recall.[24]

Design & Defect of the ATX, ATX II and Wilderness Tires

The Radial ATX, ATX II, and Wilderness tires[25] were developed for use on Ford light trucks and sport utility vehicles. The ATX and ATX II tires were designed in the late-1980s and saw a slight redesign in 1994 to improve the rolling resistance of the tire. These tires were initially produced in Firestone's Joliette and Wilson plants. Following the redesign, Firestone's Decatur plant began producing the ATX tires, ramping up production to provide 84% of the ATX tires by 1996. Firestone also designed the Wilderness tire, which replaced the ATX tires for Ford Explorers beginning in 1996.[26]

Firestone manufactured both standard-load and extra-load versions of these tires for Ford. Typically, trucks were equipped with extra-load tires and passenger vehicles were fitted with standard-load tires. Ford's newest SUV straddled both categories. The vehicle manufacturer

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[24] U.S. Senate. *Firestone Tire Recall.* Sept. 12, 2000. 106th Cong., Testimony of Dr. Sue Bailey, Administrator of NHTSA.
[25] Hereinafter referred to as affected tires.
[26] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 3.

ultimately chose a standard-load, passenger tire to be factory-standard on the Explorer. Standard load tires required a lower inflation pressure, which helped provide a softer ride for passengers. The meteoric success of the Ford Explorer drove production of the ATX, ATX II, and Wilderness AT tires throughout the 1990s.[27]

When Ford approached Firestone to design a tire for the Explorer, they shared specifications of the vehicle as well as tire specifications for speed, durability, ride and handling. It's important to note that Ford, following industry standard practice, considers these to be performance specifications, rather than design specifications. Ford President, John Nasser testified to this fact, stating that "tire manufacturers have complete control and responsibilities for the design, construction, composition and workmanship and materials."[28]

Product Failure

The affected tires suffered from belt-leaving-belt tread separations.[29] This causes the outer belt and tread to separate and "peel" off, exposing the underlying belt structure. When this occurs, the tire is no longer able to apply sufficient friction to the road surface, and the vehicle becomes extremely difficult to control. This defect is particularly deadly for two reasons: First, the separation most commonly occurs at highway speeds, when the tires are subject to high centrifugal forces.[30] Second, these tires were primarily installed as OEM tires on sport utility vehicles, which are prone to rollover accidents in situations involving a loss of control due to tire failure.

Engineering analysis of the affected tires was conducted by Dr. Sanjay Govindjee, an outside expert hired by Firestone, as well as independently by NHTSA. Both reports were used as evidence to identify the following factors that contributed to the failure.

Belt wedge & inner-belt gauge

Radial tires gain their structure from the two-belt structure within the rubber of the tread. These two belts are divided at each sidewall by a thin strip or "wedge" of rubber. Belt wedges are used to

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[27] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Opening statement, Rep. Edward J. Markey.
[28] Ibid., Testimony of John Nasser, CEO of Ford Motor Company. (171)
[29] Hereinafter referred to as "tread separation."
[30] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 8.

distribute the shearing forces to surrounding components and reduce heat from belt friction. Tread separation occurs when cracks propagate in the belt wedge and allow the skim rubber of the two belts to separate. The aforementioned cracks and separation allow air and moisture to seep through and create a gap between the two belt layers.

Both Firestone's and NHTSA's expert analysis found differences in these components based on where they were manufactured. It's also concerning that Firestone set the standard for the wedge gauge dimension in the "green" tire phase, or a tire that has not been cured, despite the fact that the curing process has an effect on the final thickness.[31]

The aforementioned reports also indicate that the wedge gauge and the inter-belt gauge of the affected tires was consistently thinner than those of competitor tires.[32] In 1995, a Ford Dealer's report shows that Ford began to pressure Firestone to produce lighter tires. The weight reduction was necessitated by an increased rolling resistance due to lowered inflation, to be discussed in the coming pages. James Burdette testified in a deposition that he was given the task of lowering the rolling resistance, which negatively impacts fuel efficiency. His investigation ruled out the possibility of modifying the rubber compound or increasing the inflation, due to stability issues with the Explorer. The remaining option was to reduce the weight of the tire.[33] The only way to do so is to reduce the amount of rubber and steel used in the tire's design.

News outlets hypothesize that Firestone was aware of the impact of thinning out the rubber of wedge and inter-belt gauge. Evidence shows that Firestone made slight modifications to the design, increasing the gauge of the belt wedge in the spring of 1998 and the inter-belt gauge in August of 1999. These modifications may have increased the tires ability to resist catastrophic failure. However, because the tires do not typically fail before 3 years of use, the 2000 recall took these modified tires off the road before they aged to the point of exhibiting signs of failure. All tires that were analyzed by Firestone, Ford and NHTSA were manufactured before the modifications in 1998.[34]

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[31] Sanjay Govindjee, *Firestone Tire Failure Analysis*, (2001), 33.
[32] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 19.
[33] Deposition of James Burdette, Ford Fuel Efficiency Engineer.
[34] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), iv.

Shoulder pocket design

Gaps in the tread pattern where the tread meets the sidewall are referred to as shoulder pockets or shoulder slots. The size and orientation of these gaps determine traction, wet-road handling and tire weight. When Ford approached Firestone about a factory tire for the Explorer, they specifically asked for a modified version of the existing ATX tire. The shoulder pocket design on ATX and Wilderness tires was significantly different than other comparable tires, with large gaps in the tread at the tire's shoulder. This tire was designed with completely different specifications: it had a wide footprint and reinforced sidewalls to enable use as a "flotation tire" on RVs.[35] This design was optimized to run at a lowered inflation, which expands the section of tread that is in contact with the ground. This enables the tire to "float" over loose dirt and sand in off-road and farming conditions.

Ford "liked the look" of the tire, with its aggressive looking tread design and wide footprint, and believed that it would help sell the image of the Explorer.[36] The use of this aggressive tread pattern meant that the shoulder pockets were wider than is normally expected for a passenger tire. Firestone's analysis found that this design may have contributed to the propagation of belt wedge cracks. Further investigation by ODI confirmed that belt-wedge cracks initiated at regular intervals corresponding to the shoulder pockets around the circumference of the affected tires.[37]

Manufacturing facility

Tire manufacturing is a complex process. Former Bridgestone/Firestone CEO Masatoshi Ono is quoted in a company press release saying, "A typical tire can have more than 26 components, 14 different rubber compounds and require 29 separate steps to manufacture"[38]The manufacturing process also varies from plant to plant, with some plants utilizing different levels of automation. The affected tires were produced in three plants: Wilson, North Carolina, Joliette, Quebec, and Decatur, Illinois. During the investigation, Firestone submitted production and claims data to the court. The provided data indicated that production of the affected tires was split evenly between

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[35] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Robert J. Wyant, Vice President, Quality Assurance for Firestone, 138.
[36] James Gardner Deposition, Firestone Product Analysis Engineer. 50:8-18.
[37] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 22.
[38] Krueger and Mas, "Strikes, Scabs, and Tread Separations: Labor Strife and the Production of Defective Bridgestone/Firestone Tires," 260.

the three plants, but the claims data suggested that quality varied from plant to plant. Tires built in the Decatur plant failed twice as often as those built in the Wilson plant, and seven times more often than product from the Joliette plant.[39]

Issues in Decatur

Research has indicated three potential issues that may have contributed to the higher incidence of defective tires produced in Decatur, Illinois: labor strikes, inconsistent manufacturing processes, and use of outdated materials.

Union

Union issues at the Decatur plant affected the workforce that produced the affected tires. Strike from mid-1994 through 1996. In 1994, Bridgestone/Firestone proposed changes to the union agreement, insisting that the plant move to 12-hour hour rotating shifts, with the plant open 24-hours, 7 days a week, as well as adjustments to pay rates, vacation time, and health care contributions. Plant workers refused to agree to the new terms but continued to work for three months without a contract. In July of 1994, the United Rubber Workers (URW) announced a strike. Bridgestone/Firestone immediately brought in replacement workers to operate the plant through the strike. By May of 1995, the plant employed 1,048 replacement workers and 371 of the permanent workers who had crossed the picket line to return to work.[40]

At the trial, Congressman Dingell from Michigan raised concerns about the areas within the plant that were staffed with replacement workers. In response, Firestone submitted a document to the record that shows replacement workers were used in all areas of the plant, supervised by salaried employees and permanent workers who crossed the picket lines. All replacement workers were trained using one-on-one supervised work, where an experienced worker would work with the trainee until he was satisfied with the quality of the work. The nature of this method is subjective, so the extent of the training is unknown.[41]

In of 1995, the union workers in Decatur agreed to return to work, unconditionally accepting the changes that Bridgestone/Firestone set in their April '94 agreement. This decision was driven by

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[39] Krueger and Mas, "Strikes, Scabs, and Tread Separations: Labor Strife and the Production of Defective Bridgestone/Firestone Tires," 256.
[40]Ibid., 258.
[41] Memo re: Decatur Replacement Workers, See Appendix A

the threat of a Decertification Election, in which workers could vote to remove the union, and a lack of funds to pay strike benefits to the workers who had been without a paycheck for almost a year.[42]

When workers returned to work, they came back to 12-hour shifts, changes to pay and benefits, and worked alongside non-union replacement workers and colleagues who had crossed the picket lines. Bridgestone/Firestone continued to encounter resistance around these changes and the decision to retain the temporary workers rather than bring back all of the workers involved in the strike.

Ford contracted an independent analysis of the claims data. The resulting report indicated a harsh spike in defective tire claims during the labor strike (1994-1996). This result was confirmed by the testimony of then-CEO of Firestone, Masatoshi Ono.[43] In addition to the data analysis, plant workers spoke to news sources throughout the labor dispute about quality concerns and working conditions.

William Newton, a retired tire builder told the New York times that it takes two years to become skilled at his craft. When he returned to work after the strike, he found himself working alongside "a lot of people who didn't know how to build tires"[44]

In an investigation in Texas, the Decatur plant manager testified that his plant "was not producing the volume of tires it was expected to produce ... and waste and scrap levels were higher than the company expected them to be"[45]

Manufacturing Quality Standards

During the period of time when ATX, ATX II, and Wilderness tires were produced, the Decatur plant relied on almost entirely on manual labor. The manual nature of the process, in addition to the issue of untrained workers, accounts for some of the variation that was discovered the product produced in Decatur. However, the court also called into question the standards and practices of

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[42] Michael H. Cimini, Monthly Labor Review, Vol. 119, No. 1/2 (January/February 1996), 25-46
[43] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony Of Masatoshi Ono, CEO, Bridgestone/Firestone, 109.
[44] David Barboza, "Firestone Workers Cite Lax Quality Control." *The New York Times*. September 15, 2000.
[45] Krueger and Mas, "Strikes, Scabs, and Tread Separations: Labor Strife and the Production of Defective Bridgestone/Firestone Tires," 261.

the Decatur plant. Firestone workers were deposed as part of the trial's investigation into production quality in the Decatur plant. They agreed to appear before court under subpoena pressure. These worker's testimony revealed issues with production process, plant conditions, and unreasonable production quotas.

One major issue was revealed by the deposition of Dareld Burke, who worked in the Decatur plant for almost 30 years. He testified that areas of the plant were not air conditioned, leading to high humidity. These conditions are thought to have caused problems with adhesion of the various layers of the tires and corrosion of the steel belts. In order to account for the humidity, workers were instructed to apply a solvent to the tire in order to "refreshen the adhesiveness."[46] This process was against policy, but Firestone officials told court reporters that the decision to "swab" tires was a judgement call and up to the plant management. The use of solvent introduced significant opportunity for human error. In order to apply the solvent to the entire surface, workers had to run a brush around the tire twice. Former employees reported that workers often missed areas of the rubber, or only took one pass in order to keep up with their production quotas.[47] Missed areas would not adhere to adjacent layers, leading to gaps that would initiate a separation.

Darrell Batson, who was an inspector in the Decatur plant, testified that he was expected to inspect 100 tires per hour. This made it difficult to give each tire a thorough inspection. As a result of what he perceived as a significant deterioration of quality in the product, Batson stopped buying Firestone tires from the Decatur plant, despite his employee discount. It's important to note that he made this decision in 1992, two years before the labor disputes that began in 1994.

Other workers testified about standard practices in the Decatur plant, including puncturing bubbles created in the manufacturing process, and storing "green" tires—tires still mid-production—on the floor, which led to debris being "baked" into the tires as they were finished. Many tires produced in the late 1990s were shipped without tire builder numbers identifying the worker that built the product. Alan Hogan, a former tire builder in the Wilson plant,

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[46] James V. Grimaldi, Caroline Mayer, "4 Former Firestone Workers Deposed." The Washington Post. August 24, 2000.
[47] Adam L. Penenberg, *Blood Highways: The True Story behind the Ford-Firestone Killing Machine*, (Wayzgoose Press, 2012), 66.

shared that it was common practice for a builder to leave off their identifier if they suspected the tire was bad.[48]

Materials

The Decatur plan also differed from the other plants in how the raw materials were treated at early mixing stages. In Decatur, the raw materials are mixed, extruded, and cut into pellets. These pellets are then coated in a lubricant to prevent the pellets from clumping. In Wilson and Joliette, the material is mixed and then calendered, a process that involves pressing the rubber compound into sheets by feeding headed material through counter-rotating rollers. The resulting sheets are then coated in a lubricant. The amount of lubricant introduced to the raw materials was significantly higher at the Decatur plant due to the form factor of the rubber compound at this stage.[49] This affects how the belt wedge and skim rubber compounds degrade over time, impacting the material's ability to resist crack formation and belt separation.[50]

One method of measuring the breakdown of these compounds is the peel adhesion test. To complete this test, one-inch samples are collected from returned tires. The surface tread is ground down to standardize the samples, and a razor is used to introduce a uniform "pre-crack" between the belts. A tensile testing machine is used to measure the force required to peel each sample apart. This test was performed by Dr. Govindjee and the results were confirmed by independent testing by the federal investigation.[51] The resulting data indicated:

- Samples from tires produced in the Decatur plant show lower adhesion strength
- Samples from Joliette and Wilson initially show stronger adhesion. However, as these tires age, the adhesion characteristics converge with those of the Decatur tires. This happens more rapidly in tires from hot climates. After 3-4 years, tires from all plants show peel adhesion characteristics similar to those from Decatur.
- Samples from a comparable peer, the Goodyear Wrangler RT/S, were also tested. The Goodyear tire at a given age maintained higher adhesion than all affected tires.

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[48] Adam L. Penenberg, *Blood Highways: The True Story behind the Ford-Firestone Killing Machine*, (Wayzgoose Press, 2012), 155.
[49] *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 28.
[50] Ibid., (23).
[51] Sanjay Govindjee, Firestone Tire Failure Analysis, (2001), 45-46.

Climate

The majority of tread separation claims were filed in southern states. This is due to greater degradation of materials in the belt-tread area of the affected tires. These materials degrade over time due to exposure to heat and oxidation, which are present in greater quantities in southern regions. In his investigation, Dr. Govindjee found that "materials from tires in southern climates have reduced ductility (extensibility) and higher stiffness." This observation held true regardless of the tested tire's condition or age; the same tests were performed on both in-service tires, and tires without any tread wear, such as a new, lightly used, or spare tires.[52]

This observation is supported by the failures reported in foreign markets with warm climates. These markets will be discussed further in a later section. The foreign market failures prompted Ford and Firestone to conduct a joint "Southwest Survey," collecting samples of the affected tires from four dealerships in the southwestern United States. The survey collected 243 tires from 63 vehicles to be inspected by Firestone representatives. Only seven of the 243 tires collected were cut open in order to inspect the belt-edge for separation. Of the seven tires inspected, six showed separation. In spite of this finding, Firestone sent a memo to Ford indicating that the survey did not reveal a defect.[53] This finding was reiterated by Ford president John Nasser in his testimony. Nasser testified that the survey was co-sponsored by both Ford and Firestone, and that no defect was found.[54] Four days before NHTSA launched their investigation, Robert Martin, Firestone VP for Quality Assurance sent a memo to Ford stating that "Examination of [tires collected as part of the Southwest Survey] revealed no deficiencies. Tires performed as expected."[55]

Operating Temperature — Overloading & Underinflation

A key specification of tire design is rolling resistance, the measure of the effort required to keep a tire rolling on a surface. Rolling resistance is best described as "the amount of energy consumed by a rolling tire." The energy consumed by the tire is converted to heat, increasing the operating temperature, specifically in the belt-edge region. Increased operating temperature accelerates the

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[52] Sanjay Govindjee, Firestone Tire Failure Analysis, (2001), 23-24.
[53] Summary of Firestone Tire Inspection Trip 6/8/99 to 6/17/99 as quoted in *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*, (U.S. DOT NHTSA Office of Defects Investigation, October 2001), 5.
[54] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of John Nasser, CEO of Ford Motor Company, 144.
[55] Ibid., 104.

degradation of the materials in the belt-tread area and reduces the material's ability to resist crack formation and propagation. In addition to the heat, increased resistance also affects fuel efficiency.[56] This resistance is affected by inflation pressure, tire load and speed of travel. The rate at which these factors increase the rolling resistance (and therefore operating temperature) is a result of tire design. In this investigation, the internal operating temperature was measured by an embedded thermocouple in the belt-edge region. This testing indicated that the affected tires were more sensitive to changes in inflation, load, and speed compared to peer tires.

Underinflation

There are two major questions about inflation of the affected tires. First, was the tire pressure selected by Ford a reasonable standard for Firestone to approve? Second, what was the expected consumer behavior regarding inflation?

The vehicle manufacturer is responsible for setting the cold tire inflation standard for their vehicle. This standard is a complex balance between the technical requirements of the vehicle such as stability and handling, and the desires of the consumer, such as ride and gas mileage. The tire manufacturer relies on the vehicle manufacturer to make a judgement based on the vehicle's overall performance.[57]

In the case of the affected tires, Firestone recommends up to 35 pounds per square inch (PSI). However, Ford recommends an inflation of 26 PSI. According to Firestone testimony, 26 PSI is an acceptable inflation, but it decreases the margin of safety.[58] Testing data and email correspondence indicate that Ford lowered the recommended PSI *after* they had selected the affected tires as factory standard equipment.[59] This change was recommended by the engineering team at Ford to compensate for shortcomings with the design of the early Explorer.[60] The lower PSI increased the driver's experience of understeer, which is a situation where a vehicle

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[56] Gent and Walter, *The Pneumatic Tire*, 477.
[57]U.S. Senate. *Firestone Tire Recall.* Sept. 12, 2000. 106th Cong., Testimony of John Lampe, EVP Bridgestone/Firestone, 1242.
[58] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Gary Crigger, EVP of Bus. Planning, Firestone, 115.
[59] Internal Emails at Ford, See Appendix A
[60] Internal memos between Ford engineers discussed issues with the Explorer's stability. In order to increase the stability and reduce the chance of a rollover, Ford had to either adjust the width of the axel and length of the wheelbase, or lower the vehicle with decreased inflation pressure. The former would have delayed production of the first run. Ford opted to decrease inflation pressure.

turns less sharply than intended, and decreased the "cornering confidence." Both changes were seen as ways to "discourage aggressive driving" that would put the Explorer at risk of rollover, and increase the likelihood that the Explorer would pass Consumer Union testing.[61] Ford viewed these adjustments as ways to increase the Explorer's stability. However, the lower tire pressure increased the rolling resistance of the the tire, leading to higher internal temperatures and compromised belt adhesion. James Gardner, Firestone's Director of Product Analysis from 1982-2000, testified that "running the tire at 26 psi will put more internal stress on the tire."[62] These adjustments lowered the factor of safety, making it more likely that consumer behavior would put the tires at risk for catastrophic failure.

The discrepancy between the two standards also affected safety testing. Documents show that standard safety testing was executed Firestone on the affected tires inflated to 30 PSI. Ford was responsible for more specific tests at their recommended load and inflation. However, their records indicate that many of these tests were run on a Ford F-150, rather than the Ford Explorer. [63] According to testimony, Ford conducted these tests on a "pickup truck that was modified to reflect the weight distribution" of an Explorer. However, there's some question about the validity of these tests, as it does not accurately represent the axel, wheel base, or center of gravity characteristics of the Explorer.[64]

Ford later requested Firestone perform high speed tests at their recommended inflation of 26 PSI. These computerized tests are conducted by placing the tire in question against a drum that would "step" up the speed of the tire spin ~6mph at a time. Once the speed reached mid-eighties, the test would remain at each speed setting for 10 minutes. Test results indicate that the affected tires fail after only 5-6 minutes at the top speed of 112mph.[65]

The importance of proper inflation was discussed throughout the September 2000 hearings. Both Ford and Firestone leadership expressed that opinion that underinflated tires will not perform as expected. It is known that consistent operation at lower inflation will increase the

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[61] Ford Explorer Stability Testing, See Appendix A
[62] James Gardner Deposition, Firestone Product Analysis Engineer.
[63] Ford Tire Test Report, See Appendix A
[64] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony Of Helen O.Petrauskas, VP, Environment And Safety Engineering, Ford Motor Company, 1273.
[65] Ford High Speed Testing, See Appendix A

operating temperature of the tires, causing them to age prematurely. This type of operation is recognized to be common consumer behavior, but is considered "misuse" by the manufacturer.

It's worth noting that Firestone testified that underinflation was a major contributing factor, and that the Southwest Survey indicated numerous tires in the "teens."[66] However, documentation of the survey shows that only 9 out of the 243 tires collected had an inflation pressure below 20 PSI. The average inflation of the collected tires was 26.6 PSI.[67]

Load & Speed

Beyond underinflation, the operating temperature for the affected tires was also affected by the load of the vehicle, and the speed of travel. For example, tires wear up to 30 percent faster when operated at 65mph rather than 55 miles per hour. The Ford explorer was designed to look like a truck and was classified as a Light Truck. Like many SUVs, the Explorer was advertised as a vehicle that could go from neighborhood to offroad. However, owners used it like a passenger vehicle, spending significant time fully loaded with family passengers and traveling at highway speeds.

Learning from Failure

Firestone executives testified over and over the Firestone's number one priority is to produce durable and dependable tires. They stated the critical importance of consumer safety. Yet, when their product failed their consistent explanation was *consumer misuse.*

Impact to design requirements

As discussed in previous sections, Firestone's position was that failure was caused by driving on underinflated tires, traveling in hot climates, or driving at highway speeds for long distances. If the tires failed due to the ways that is was used by the consumer, then who were they built for? Put plainly, when you consider the limitations of the tire, it seems like Firestone had the design requirements all wrong.

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[66]U.S. Senate. *Firestone Tire Recall.* Sept. 12, 2000. 106th Cong., Testimony of Robert J. Wyant, Vice President, Quality Assurance for Firestone, 109.
[67] Ford-Firestone Southwest Survey, See Appendix A

Based on my understanding of the tire's design, it seems like Firestone sourced the majority of design requirements from the following organizational goals:

Commitment to maintaining long-held relationships

Ford was Firestone's biggest customer, and the Ford Explorer was a major source of demand. As discussed beginning on page 20, Firestone complied with Ford's request for a hybrid design that looked like a truck tire, but performed in passenger-car conditions. This led to a design that featured an aggressive shoulder slot, wider footprint, and lowered inflation, all factors that later proved to contribute to unsafe operating conditions.

Firestone did not protest when Ford to set an inflation standard that was much lower than the ideal pressure for tire performance. However, proper inflation became a constant source of disagreement when the case went to trial. Firestone's response throughout testimony indicates that they may have known that 26 PSI was too low, but did not address the issue until the company was in crisis due to failing product.

Competition

Firestone was Ford's largest supplier, but they were not the only company providing tires for the Explorer. Firestone didn't have much of a profit margin on the tires, as evidenced by the Ford Dealer report mentioned on page 22, but they had much better margins on replacement tires. It's reasonable to believe that when a most drivers replaced their tires, they just asked to replace their tires with "whatever is currently on there." It was in Firestone's best interest to be the tire that rolled off the assembly line with the Ford Explorer.

Company Culture

Firestone had a formula for competitive success: they focused on their competitors and large customers. The result was a company culture that was biased toward action rather than analysis. Consequently, Firestone moved fast to design the tire that Ford wanted for the Explorer, rather than the tire the Explorer needed. Success was defined as "selling to Ford" rather than providing the end customer with a tire they could trust. Throughout the development of the affected tires, we observe Firestone making design changes and then *following up* with testing that proved the effectiveness of the change. For example, the belt wedge and skim rubber gauge, discussed on

page 21 and 22 was altered, but there's no evidence that this change was tested until the recall investigation demanded it.

Insufficient design requirements

The design of the ATX, ATX II, and Wilderness AT suggests that Firestone struggled to consider how the tires would be used by drivers. Firestone focused on Ford as the primary stakeholder, designing reactively to their individual change requests. This led to several design changes that contributed to the failure of the affected tires when real-world customer behavior was introduced. This situation could have been significantly improved by consideration of both the constraints provided by Ford and the constraints of providing a reasonable factor of safety. Ford asked for an off-road type tire, but consumers were driving Explorers like station wagons—for hundreds of miles at highway speeds. What would have changed if Firestone's engineers and management thought about their design in context of how their mother, boss, or teenage neighbor would use the product?

The conflict between what the organizational influences and user behavior indicate that the prioritization of design requirements led to a lower quality product and tragic loss of life.

Tolerances

In addition to the influence of goals on design requirements, it's worth considering how conflicting goals impacted the tire design's tolerances. A product or system's tolerance is the allowable amount of variation that a design can handle and still maintain quality and safety. Tolerances are a key consideration in design requirements, especially in an engineered product, such as a tire. Court records provide significant discussion of exact operating conditions that consumers should maintain for safe operation. Unfortunately, the design of the tire removed any margin for error in these areas. By accepting the constraints that Ford provided, Firestone passed those limitations on to the manufacturing plants and eventually, to the consumer.

Low tolerance for error and the Decatur plant

Firestone faced intense challenges in the Decatur plant. The 38-year-old facility was in desperate need of renovation. Without the upgrades, the facility itself introduced the likelihood of product defects. The building was not able to control heat and humidity, a key condition in the production of tires. The older facility also relied entirely on outdated process and manual labor, which

increased production time, opportunity for human error, and amounts of solvents introduced to the rubber. The plant condition and lack of production automation also introduced harsh working conditions for workers. This, along with hard-nosed union negotiations from Bridgestone headquarters, led to labor strikes and untrained replacement workers.

Deposition of Decatur employees, as referenced in the discussion beginning on page 24, indicated that production was highest priority, and leadership took the "path of least resistance" to maintain the number of tires coming off the line: pushing workers to produce more tires by any means necessary. This is highlighted by their stories about the transition to 12-hour shifts to increase production numbers of non-automated production line, and the use of solvents to account for humidity-induced adhesion issues. It's also supported by the testimony of former inspectors who were expected to approve approximately 100 tires per hour. During the 1994-1996 labor strikes, Firestone was not able to negotiate the union agreement—which was unlike any other plant producing similar product—and chose to bring in replacement workers. When the union offered to unconditionally come back to work in 1996, Firestone chose to keep many of the replacement workers. The replacement workers entered into employment under different contracts, and reinstating the experienced workers would force Firestone to pay large pensions upon their retirement.

The state of the Decatur plant should have influenced the design requirements. Firestone leadership was aware of the working conditions and difference in manufacturing methods. The design of a product should leave appropriate margin for error in consideration of manufacturing methods and variance in consumer use.

We now return to the case study, to consider how these design requirements influenced Firestone's response to the product recall.

Recall & Response

The American public became aware of the Firestone-Ford issue in 2000, beginning with the KHOU report in early February. Before going to air, reporters from KHOU spoke with representatives from Firestone, who expressed "full confidence in their tires" and Ford officials, who suggested that the issues "may be due to driver error." NHTSA told the station that they had no evidence of a disproportionate number of Firestone tires involved in Ford rollover accidents. KHOU went to air

anyway, feeling that the evidence was too strong to withhold the information from American drivers.[68] The report prompted Firestone to issue a statement to KHOU, stating that "no court or jury has ever found any deficiency in these tires"[69]

The report led to nationwide attention and a spike in consumer complaints to NHTSA. A month after the KHOU report, NHTSA launched an initial inquiry into the issue. A full investigation of 47 million ATX, ATX II, and Wilderness Firestone tires followed in May 2000.

Exposure of defect

The nature of the defect was internal—there are no external indicators of the likelihood of a belt-leaving-belt tread separation. The affected tires often looked just fine. The danger of this situation is illustrated by a Texas driver's recollection of a tread separation experience. The following was submitted as part of an accident report submitted to NHTSA in 1997:

"I heard about several accidents with [the affected tires] and had mine checked by a tire company and Firestone ... In late July, I had air conditioning work done at Penske and asked about the tires and was told they were fine. The tread appeared in good shape. As I was driving home, the tread came off and I lost control of the vehicle and hit an 18-wheeler ... From what I understand, the naked eye cannot detect the defective tire." [70]

However, this does not mean that Ford, Firestone, and regulatory agencies were not alerted to a potential problem long before the consumer complaints reached a critical level in the United States in 2000. The issue with the affected tires was brought into the public eye in February, but evidence suggests that the defect was discovered much earlier.

Problems Overseas

The Ford Explorer, equipped with Firestone tires, was involved in recall-like behavior in two other regions prior to the investigation in the United States: Saudi Arabia and Venezuela.

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[68] Kathy Brittain McKee, Marcie Hinton, Larry F. Lamb. *Applied Public Relations: Cases in Stakeholder Management*. Routledge, Taylor & Francis Group (2015).
[69] Firestone Statement to KHOU, See Appendix A
[70] Customer Complaint Letter, See Appendix A

Saudi Arabia

Engineers from both companies investigated an increased number of tread separations in the Saudi region in 1999. The report[71] concludes that tire use was significantly more extreme than typical driver behavior in the United States. Priority performance requirements in the United States include: weight, rolling resistance (a factor in fuel efficiency), ride, and handling on wet roads and snow. In the Saudi region, tires were subjected to harsher conditions and had an increased likelihood of failure. These conditions include:

- High ambient temperature
    - Sustained summer temperatures above 105° F
- Off-road/rough road use
    - 25% of inspected tires show evidence of exterior tire damage due to harsh terrain
    - Drivers were instructed to lower the inflation of their tires before driving off-road on heavy rock or soft sand. Engineers expressed concern that a typical driver may not remember to reinflate after returning to standard pavement.
- High speed
    - Virtually no speed constraints
    - Aggressive driving style, reports indicate that drivers regularly reached vehicle's max speed (116mph) in highway conditions

The observed use conditions called for more robust tire, and engineers recommend that Ford replace tires in this region with the Wilderness AT Special Service tire, with intent to upgrade to a special service tire with a higher speed rating once it became available. An interoffice memo at Ford's indicates that Ford, not Firestone, was ultimately responsible for supplying a North American tire to Saudi Arabia and other gulf countries.[72]

Engineers concluded that the failures in Saudi Arabia were due to misuse and poor maintenance, not a tire defect. As a result, the replacement action in the Saudi Region was classified as a "customer satisfaction" replacement, not a recall. According to testimony, "both companies

[71] Middle East Tire Survey, See Appendix A
[72] Chronology of Firestone/Ford Knowledge of Tire Safety Defect, See Appendix C

looked at the performance of the tire ... and the technicians concluded that it was not a tire defect that was involved here."[73]

Firestone testimony presented two reasons that they didn't feel a product recall was necessary:

- The affected tires in the Saudi region were 16-inch tires, compared to the 15-inch tires in the United States.
- The conditions that tires were subjected to in Saudi Arabia did not exist in the United States, therefore it was unnecessary to inform U.S. Agencies or the American public.

Firestone was not involved in the product replacement in Saudi Arabia; Firestone maintained the position that there was not a problem with the tire, despite letters from local dealerships reporting that tread separations on Ford Explorers were becoming "an epidemic."[74] Documents submitted to the court record revealed that Firestone was concerned about how a replacement action might be perceived in the region, as well as concern about "complications that it could create in North America." The memo references conversation with Ford, stating that they shared the hesitation to conduct replacement action.[75]

Despite that concern, Ford did move forward with a customer satisfaction replacement program. This took the form of an "owner notification program that allowed customers who were unhappy or felt that their tires might be unsafe, that they could have them replaced with Goodyear tires at no charge to the customer." This was done under recommendation of Ford's World Direct Market Operations (WDMO) to "maintain sales momentum in the region on the Explorer. Explorer's reputation was being tarnished by the performance of the Firestone tires.[76]

Venezuela

A similar issue was found in Venezuela. However, the majority of these tires were manufactured locally with different compounds and factory standards. Firestone officials considered the

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[73] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Gary Crigger, EVP of Bus Planning, Firestone, 101.
[74] Memo from Firestone Dubai re: Saudi Arabian tread separations, See Appendix A
[75] Firestone Memo re: Gulf Countries Recall, See Appendix A
[76] Tom Baughman deposition, Engineering Director for Ford's Light Truck Division. 140:1-4.

product in Venezuela to be a different tire, exposed to different use conditions including high speeds and high ambient temperatures.

When issues arose, Ford believed that the tires in Venezuela should be Firestone's responsibility.[77] Unlike the situation in Saudi Arabia where Ford made a decision to send a North American tire to Gulf countries, the tires in Venezuela were designed for that market. There is some indication that Ford waited to respond to the problem because they were waiting for Firestone to take action. Firestone conducted surveys to learn more about failures in Venezuela, including implementing programs designed to incentivize owners to come in to a dealership for a free inspection. Internal memos indicate that these programs were designed to allow for further inspection with informing owners of the potential issue at hand.[78]

As the investigation began in the United States, the situation also escalated in Venezuela. Under pressure from the Venezuelan Consumer protection agency (INDECU), Ford began recalling U.S.-made Firestone tires in May 2000. Three months later, after the issue in Venezuela started making headlines in the U.S., Firestone Joined Ford in replacing the affected tires. The same month, INDECU recommended that Ford and Firestone be prosecuted for the 46 deaths related to the affected tires on Ford Vehicles in Venezuela.[79] Ford and Firestone responded by recalling all Venezuelan and U.S.-made tires.

State Farm Claims Reports

Samuel Boyden worked as an Associate Research Administrator at State Farm Insurance Company in their corporate headquarters in Bloomington, Illinois. At the time of recall, Boyden's work for the Strategic Resources Office was focused on research to assist insurance claim agents in the field.[80] An agent would contact the corporate office to inquire about product failure. If Boyden had a record of similar claims being called into his office, the field agent would contact the manufacturer of the failed product in an attempt to be reimbursed for the compensation that State Farm sent to the insured. The primary objective of this research was related to compensation. However, if an individual in Mr. Boyden's position felt there was a significant trend,

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[77] Chronology of Firestone/Ford Knowledge of Tire Safety Defect, See Appendix C
[78] Memo re: Venezuelan Tire Survey, See Appendix A
[79] Anthony Depalma, "If It's Not One Thing, It's Another; Venezuela Asks Criminal Case Against Firestone and Ford." *The New York Times*. September 01, 2000.
[80] Devon Spurgeon, "State Farm Researcher's Sleuthing Helped Prompt Firestone Recall." *The Wall Street Journal*. September 01, 2000.

they had the ability to contact NHTSA. It's important to note that "State Farm does not report defects. Rather, it reports claims trends that may reflect the possibility of a product defect."[81] The corporate office did not have access to all claims data, only the claims that were reported by field agents.

NHTSA — Failure to respond

In 1998, Mr. Boyden received a call from a field agent about a tread separation. Looking into the issue, Boyden found a total of 21 cases of tread separations since 1992, all Firestone ATX tires, 14 of the cases involving Ford Explorers. He spoke with his contact at NHTSA and followed up with an email about the 21 cases.[82] To his knowledge, NHTSA did not act on the information. He followed up again several times between July 1998 and December 1999, reporting a total of 66 claims called in by field agents.

State Farm doesn't share policyholder information when it reports claims to NHTSA. The normal procedure would be for NHTSA to follow up with State Farm to get permission from policyholders to share information so that the agency could look into the issue. NHTSA did not follow up with Mr. Boyden, and the issue was not addressed. According to the NHTSA administrator, Dr. Bailey's testimony, the decision to follow up on issues such as this is often left to one individual within the agency.

The decision to trigger an investigation was not made until May 2000. According to Dr. Bailey, there is not a standard for when an investigation should be initiated. There are different standards for different types of products. For example, a fatality related to a tire failure would not be grounds to launch an investigation because some tire failure is expected and accepted. Failure of other products, such as a child seat or seat belt, where failure is not expected or acceptable, would trigger an investigation without significant reports.[83]

During the Firestone 500 recall in 1978, NHTSA had staff in contact with garages making repairs who were trained to recognize and report product failure. Due to budget cuts over the following

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[81] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Samuel K. Boyden, Associate Research Administrator, State Farm Insurance, 201.
[82] Email from Sam Boyden re: Tread Separation Claims made to State Farm, See Appendix A
[83] U.S. Senate. *Firestone Tire Recall.* Sept. 12, 2000. 106th Cong., Testimony of Dr. Sue Bailey, Administrator NHTSA, 36.

years, that formal position was eliminated. NHTSA relies on consumer reports to document failure,[84] and at time of trial were not able to indicate how many consumer reports regarding a tire issue would be enough to trigger an investigation. The number of complaints filed with NHTSA doubled after the KHOU report aired in Houston.[85] The report aired in February 2000, and an initial exploration of the issue began on March 6, 2000. The official investigation was initiated by NHTSA on May 2, 2000, requesting information from both Ford and Firestone be submitted by mid-June.

Critique of consumer report model

In his testimony, Mr. Boyden mentions that every vehicle's owner's manual contains a section about how to file a complaint with NHTSA, including guidance on what NHTSA is responsible for, and how to contact them. Recognizing what it would take for NHTSA to launch an investigation, to hopefully trigger a response from the manufacturer, both Mr. Boyden and the staff at KHOU encouraged consumers to file a complaint with NHTSA. In fact, In his testimony, Mr. Boyden outlines that if "Half of the individuals that own these vehicles and had these losses ... had contacted NHTSA, we wouldn't have to concern ourselves with my email or the news broadcast; NHTSA would have already been made aware of this."[86]

However, as Houses Representative Bart Stupak from Michigan mentioned in response to Mr. Boyden's testimony, "when you have an accident like this, the last person on your mind is probably NHTSA." Rather, consumers involved in an accident will contact their insurance company, vehicle manufacturer, or tire manufacturer. And, if there is not an accident involved, consumers typically just replace the tire, with some contacting Firestone for warranty replacement.[87] In light of this behavior, NHTSA's reliance on consumer complaints leaves considerable room for error.

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[84] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Rep. Bart Stupak.
[85] U.S. Senate. *Firestone Tire Recall.* Sept. 12, 2000. 106th Cong., Testimony of Dr. Sue Bailey, Administrator of NHTSA, 28.
[86] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Testimony of Samuel K. Boyden, Associate Research Administrator, State Farm Insurance, 203.
[87] Ibid., Testimony of Rep. Bart Stupak, 203.

Learning from Recall

In the years leading up to the investigation and recall, Firestone continually claimed that their product was without defect. We see this in the discussion of the situations in Saudi Arabia and Venezuela, as well as in the Southwest survey conducted in the United States. This point is further supported by Firestone testimony in early court cases. Throughout the congressional hearing, company executives—including the VP for Quality Assurance—claimed that they didn't see the pattern of tread separation until NHTSA opened an investigation.

Using design requirements to test for failure

The secondary use of design requirements is to drive rigorous testing. Design requirements represent the ideal performance of a product, therefore, they make fantastic guidelines for testing the product for failure.

When the tires began to separate, Firestone continuously reported that the failed tires were up to their standards—no defect. Based on the evidence analyzed in the case study, I believe the design requirements Firestone used as a measuring stick to be primarily focused on goals surrounding their relationship with vehicle manufacturers and competitors, rather than the consumers behind the wheel. Insufficient design requirements led to poor testing.

The Firestone considered the following factors when evaluating the success of a product:

- Performance Testing Info: Testing done at Firestone & Ford
- Tire Warranty Adjustments: Reports of tires replaced as part of a warranty claim
- Inspection in the field: Physical inspection of tires collected from customers

The limitation of this system lies in scope of information considered for signs of failure. Internal testing and field inspections were plagued by confirmation bias and dismissing test failure as "not real world." During the early reports of failure, Firestone was focused on warranty adjustment data.[88] However, warranty claims were typically associated with puncture, damage due to misuse, and other minor issues. When the affected tires failed, they did so spectacularly, coming apart at

[88] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Prepared Statement Of Masatoshi Ono, CEO of Bridgestone/Firestone, 90.

highway speeds and without any exterior warning signs. As a result, consumers were filing property insurance claims, rather than seeking warranty replacement.

Court-mandated analysis of the data indicated that property claims swelled from 200-300 claims per year in the mid-nineties to over 700 claims in 1999. Those numbers were not considered as a metric of product performance. An engineering report presented in the 1999 Firestone Quarterly Meeting indicated that reports of tire separations were up and internal separations (belt edge, belt-leaving-belt, and SW separation--rubber from casing) were up 11-64% for 1999 third quarter compared to 1998. Still, the company line was that there was not a defect with the tires. Tread separations, despite the climbing numbers, were attributed to consumer misuse.

Firestone's response to the defect was the most damaging aspect of the failure. They prioritized their reputation over the safety of drivers. The product defect was a design and engineering failure, but it was also a failure of leadership—Firestone lost sight of the consequences of their actions and tried to contain the impact to the company, rather than the impact to their customers. Despite the company mission to produce safe, high quality tires, Firestone often prioritized goals in ways that produced results in direct conflict with their values. See the following section for details on how the product failure and recall impacted company success and contributed to unnecessary loss of life.

Outcomes

In response to the NHTSA investigation, Firestone issued a recall of 14.4 million tires: ATX and ATX II tires manufactured after 1991, and Wilderness AT tires produced in the Decatur plant after 1996. In October 2001, NHTSA mandated that the recall be expanded to include an additional 3.5 million Wilderness AT tires produced in any plant before 1998.

Impact to Consumers

The loss of life resulting from the failure of the affected tires is a tragedy. NHTSA released a press release in 2001 stating that the affected tires had been involved in 271 fatalities and 823 injuries in the United States.[89] Other analysts have estimated that the fatality number can be as high as 476.[90] In addition, the author recognizes the possibility of individuals that were unable to pursue

[89] "Firestone Recalls," *National Highway Traffic Safety Administration*. October 4, 2001.
[90] Joseph Szczesny, "Carmakers' Tire Warranties Vary," Chicago Tribune, Sept. 29, 2002.

legal action, and are therefore not included in that number. No amount of shifting blame or legal penalties will restore the families and communities that were impacted by this product failure.

There was also a significant loss of trust. American drivers were hesitant to ride on Firestone tires while the staggering number of accidents was still fresh in their minds. Public opinion surveys indicate that 81% of Americans held Firestone accountable for the accident, compared to 8.5% that felt that Ford was to blame for the fatalities.[91]

Impact to Company

Firestone faced significant financial consequences. The company was responsible for the cost of implementing the recalls as well as litigation, settlements, and damages for those injured and the families of the deceased. These numbers are hard to estimate since many of the cases were settled in closed agreements. Below are estimates of some of the financial impact Firestone faced:

- August 2000: The initial recall of the affected tires cost 1.1 billion
- August 2000: Firestone set aside $800 million to pay for lawsuits involving the recalled tire. By late 2003, Firestone had settled 1,300+ lawsuits.
- March 2004, Firestone paid a $149 million settlement in a class-action suit. The money was dedicated to replacing remaining recalled tires, producing new tires with a higher speed rating, and a consumer education program, as well as legal fees, and a $2,500 payout to each of the 45 plaintiffs.
- Firestone settled state investigation for violated state laws for $41.5 million

In the months following the recall, the valuation of Bridgestone/Firestone fell from $16.7 billion to $7.5 billion. This was in part due to a drop in demand for replacement tires bearing the tarnished brand's name, and the result of a severed relationship with Ford. The 100-year relationship between Ford and Firestone was severed by the tiremaker under the strain of both companies trying to to pass the blame. In May of 2001, Ford accused Firestone of ignoring data that indicated a defect, and incoming CEO John Lampe, announced that Firestone would cease doing

[91] Robert Noggle, Daniel E. Palmer. "Radials, Rollovers and Responsibility: An Examination of the Ford-Firestone Case." *Journal of Business Ethics*, vol. 56, no. 2, (2005): 185–204.

business with the automaker. Ford responded by announcing that "due to safety concerns," they would recall the 13 million Wilderness AT tires[92] still in service at a cost of $3.3 billion.[93]

Many high-level management officials were replaced, including Bridgestone/Firestone CEO Masatoshi Ono, and the entire Firestone leadership team. The company underwent a restructuring that is estimated to have cost Firestone an additional $2 million.

In 2001, Firestone announced that they would close the plant in Decatur. Firestone vice president for manufacturing operations, John McQuade, claimed that the decision was driven by a drop in demand and the age of the Decatur, Illinois plant, rather than the 'quality or professionalism of our Decatur employees.'[94] Closing the plant and settling with the unions came with a $210 million dollar price tag, and cost the community of Decatur almost 2,000 jobs.

Impact to Legislation

Throughout the trials, members of congress and Department of Transportation decried the current process and authority given to NHTSA in product recall. Less than a month after the congressional hearings, lawmakers voted to pass the Transportation Recall Enhancement, Accountability and Documentation Act (TREAD). This legislation mandates the following:

- Manufacturers must notify NHTSA of any form of safety campaigns conducted overseas
- "Early Warning" reporting requirements, enabling NHTSA to collect data needed to warn consumers of trends that could indicate potential defects.
- Violation of the reporting requirements related to a defect that leads to death or serious injury has criminal consequences.

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[92] The initial recall did not include Wilderness AT tires produced in Wilson or Joliette.
[93] All costs gathered with direction from Kevin McDonald's article on the outcomes of the recall. Kevin M. McDonald, *Separations, Blow-outs, and Fallout: A Treadise on the Regulatory Aftermath of the Ford-Firestone Tire Recall*, 1077-1080.
[94]David Barboza, "Bridgestone/Firestone to Close Tire Plant at Center of Huge Recall." *The New York Times,* June 28, 2001.

Ceiling On Fines

The penalty for concealing a product defect was capped at $925,000 at time of trial. Clarence Ditlow[95], testified in the Firestone recall case that "Interestingly, the highest fines ever assessed have been against Firestone and Ford—$500,000 against Firestone in 1978 over the 500 steel-belted radial and $425,000 against Ford in 1999 over the defective ignition switches that started vehicle fires."[96] A highway safety bill passed in 2015 lifted this cap, raising the potential fine that automakers could face to $105 million.

[95] Mr. Ditlow is the Executive Director of the Center For Auto Safety, a non-profit organization focused on improving vehicle and highway safety.

[96] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Prepared Statement, Clarence Ditlow, Center for Auto Safety.

IV. Recommendations for Improved Outcomes

The Firestone case study presents strong evidence that conflicting goals inhibited the effectiveness of the product development process. Analysis of the process suggests that design and manufacturing of the ATX, ATX II, and Wilderness AT tires was driven by organizational goals to the detriment of the value-driven goal of producing a product that was safe for consumers.

The Firestone failure illustrates a need to improve product development in the presence of conflicting goals. Study of the interaction between Firestone's organizational goals and the desired outcome of the design process highlights an opportunity to improve how we prioritize goals in product development. To achieve this objective, we consider three areas for improvement: Investigating goals, framing goal conflict, and product evaluation.

Investigate goals

To begin, let's consider the contrast between the objective of the design process and what happened at Firestone. Design methodologies determine design requirements by identifying user needs and product-market fit in order to create human-centered products. The case study analysis indicates that Firestone sourced it's design requirements from the organizational goals of maintaining their relationship with Ford, while attempting to remain competitive and profitable. The established design process failed to provide a way to consider organizational goals and Firestone's approach lacked awareness of user needs. This suggests that the design process could be improved by incorporating methods to balance both types of goals.

The first objective is to identify the goals present. This begins with expanding the definition of stakeholders to include relevant company and industry pressures that drive organizational goals. For example, Firestone would consider both end users of the tires, as well as the company need to manage their relationship with Ford. The next step is to identify the potential goals stemming from these "stakeholders." It's critical to push this investigation beyond the surface level assumption of what is desired to understand the underlying *why*.

In negotiation training, understanding the "why" is represented by the distinction between positions and interests.[97] A *position* demands a certain outcome, an *interest* reveals why the

[97] "Negotiation Research on Mediation Techniques: Focus on Interests." *PON*. September 06, 2018.

stakeholder believes that achieving that position will make life better for them. As an example of interests versus positions, if someone demands that you give them 5 dollars (position), further questioning might reveal that they forgot their wallet and need some cash to take public transit home. Better understanding of their underlying *interests* enables a wider range of potential solutions: You could lend them a transit pass, give them a ride home, or offer a map and walking route.

The same methodology can be used to discover goals. In negotiation, interest discovery is done through open conversation and willingness to share your own interests. Identifying stakeholder goals can be achieved through individual interviews, discussions with groups of stakeholders, and brainstorming the goals that stem from more abstract conditions, such as company culture. In the case of the affected tires, it's important to address the organizational pressure of Firestone's relationship with other corporate partners. Firestone's organizational position was that they needed to maintain an amicable relationship with Ford. This position led to a design approach that effectively gave Ford "whatever they want." A deeper dive into the underlying motivation reveals that protecting their position as the factory tire drove replacement tires sales. As discussed in the case, the larger margin on replacement tires was a primary source of revenue for Firestone.

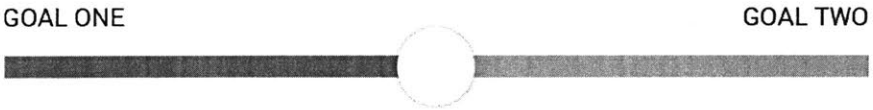
Frame goals as overlapping sets of constraints

Once goals are identified, the next step is to consider where goal conflict exists. There is a spectrum of ways that goals can conflict. For the purpose of this exploration, we focus in on the types of conflict observed in the research. The Firestone case study suggests that conflicting goals at Firestone were treated as *direct conflict* goals in situations where an *integrative* mindset was possible.

Goals in direct conflict seem to be mutually exclusive, or "win-lose." Focusing on one of these goals will negatively impact the other. Humans encounter conflicting goals all the time. Consider this example: You go to buy lunch, and you want something that is delicious (goal one) and very healthy (goal two). If you consider that one goal has to "win" at the cost of another, that's like saying that you have to choose either pizza or raw vegetables. Or, if you imagine those on a spectrum: pizza at one end and raw vegetables on the other, you might consider "splitting the difference" and select something moderately tasty and somewhat healthy. However, we know

from life experience that it is possible to have a meal that is fully satisfying from a taste perspective and also good for our bodies. It just takes a bit more consideration of the available options, and a willingness to address view both goals as important. This integrative mindset suggests an alternate way of framing conflicting goals.

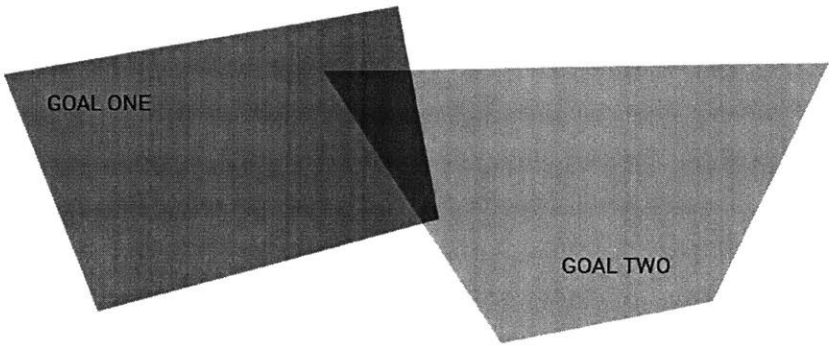
Looking at this through the lens of the case provides an example. When Ford approached Firestone about the Explorer, the tire manufacturer faced a conflict between the safety needs of drivers (value-driven goal) and satisfying Ford's demands (organizational goal). Ford requested that Firestone modify the rugged ATX tire to perform in passenger car conditions.[98] From that point on, the tire design was "anchored" on the design of the original ATX, an off-road tire that was never meant to be used in high-speed, highway conditions. Evidence suggests that Firestone compromised their value-driven goal of building a safe and efficient tire in order to satisfy Ford's requests; The aggressive ATX shoulder slot generated an destructive amount of heat in long-distance driving conditions and the wide footprint increased rolling resistance, decreasing fuel efficiency. Imagine this approach as two conflicting requirements on a single slider. To achieve the desired outcome of one goal negatively impacts the other: Keeping the characteristics that Ford requested meant building a tire that was not equipped for how it would be used by drivers.



Shifting from a direct conflict mindset to a more integrative approach suggests that both goals are equally important, and a creative solution that doesn't compromise either goal is possible. Imagining the slider mentioned before—if you can't slide left and you can't slide right, you must go up. You must innovate to solve for both goals.

[98] James Gardner Deposition, 50:8-18.

Shifting from a direct conflict mindset to an integrative mindset enables innovation by framing constraints as a complex venn diagram, rather than the aforementioned slider. Solutions under this type of conflict aim for pareto improvement; by generating solutions in the overlapping space, an innovative solution improves the outcome of one or both objectives without detriment to the other.



Continuing the example, Firestone faced the conflict between a design that met driver's needs and Ford's request for the ATX. Using the integrative approach, a deeper dive into Ford's request reveals that the motivation behind asking for the modified ATX was that Ford believed that it would have emotional appeal to customers. Understanding *why* Ford was asking for an altered off-road tire enables Firestone to generate more accurate design requirements. These design requirements are then posed as overlapping constraints, enabling engineers to innovate to provide a tire that is is technically sound for the use case and satisfies Ford's desire to enhance the rugged appearance of the explorer.

Extending to future work, an integrative approach to conflicting goals can help address common paradox characteristics. Through this lens, the following statements would be seen as in tension with each other, but not impossible to reconcile:

Competitive : Collaborative
Low cost : High quality
Stable : Nimble
Act Quickly : Think Long-Term
Reduce inventory : Reduce backlog
Decrease brick-and-mortar locations : Increase product adoption

Embracing goal conflict can also help to drive innovation. Research into creativity and problem solving indicates that encountering constraints encourages a global perspective,[99] which enables surprising connections and more creative solutions. In other words, conflicting goals trigger cognitive mechanisms for generating more original ideas.[100] Studies have also found that engaging with conflicting goals helps to reduce confirmation bias and anchoring. Studies from NYU and The Hebrew University illustrate that engaging with goal conflict "attenuate[s] the robust confirmatory thinking strategy that characterizes human thinking in numerous domains."[101]

Continuously evaluate

These constraints inform the third area of improvement. As discussed in the case study, goals are used to generate design requirements for concept development and testing. Giving voice to conflicting goals enables a more robust list of requirements, leading to stronger product offerings. It's important to note that a more robust list does not necessarily indicate a longer list, rather a more refined list. In engineering contexts, a project that has an inappropriate number of design requirements would be described as either over or underconstrained. Firestone had a long list of constraints, however, the constraints didn't adequately address safety. They were overconstrained, but not appropriately constrained. This led to insufficient testing and eventually, failure.

An integrative approach aims to frame goal conflict in a way that enables "makers" to continuously check back to make sure that important interests--human, technical and organizational—have a voice. A strong product needs advocates: a design-minded representative that speaks for the human needs, a technical mind that presents the engineering perspective, and an entrepreneurial strategist that is aware of the needs of the business.

Consider this practice through the lens of Firestone: the technical perspective provides the key knowledge that a misuse of a tire can cause a tread separation. The human perspective reminds engineers that the average human speeds on highways and probably checks their tire inflation once or twice a year. And, most critically, when a tire fails at highway speeds, people can be killed.

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[99] Matthew E. May, "How Intelligent Constraints Drive Creativity." *Harvard Business Review*. August 07, 2014.
[100] James Keith, Goal Conflict and Originality of Thinking, *Creativity Research Journal*, 8:3, (1995): 285-290.
[101] Tali Kleiman, Ran R. Hassin. "When Conflicts Are Good: Nonconscious Goal Conflicts Reduce Confirmatory Thinking." *Journal of Personality and Social Psychology* 105, no. 3 (2013): 374-87.

V. Future Work & Final Thoughts

This project sought to understand the impact of conflicting goals on the design process. As we continue to explore this topic, we should also consider "maker" responsibility. How do we improve our ability to predict how our work will be used in the future? What will we enable; and how much of the "ripple effect" are we responsible for? As we innovate and create new technologies, new ways to access data, and new methods of generating revenue, it's important to hold those opportunities in tension with our humanity. This reveals a few interesting areas for further consideration:

Cultivate responsibility driven by empathy

Perfect products are not the goal. The product development process is highly uncertain, and innovation requires risk. In light of that, companies should look for ways to consider the impact of their output. This can be facilitated by taking an empathetic view of the human. What you create is not for disembodied users, but for people with families; humans with strengths and weaknesses. It's common practice to discuss the need for empathy during the research stage of a project. The challenge for companies today is to find ways to stay in touch with those needs in all areas of product and business development. As Congressman Green stated during the Firestone trial, "we need to personalize this ... We need to realize the impact that it can have, even a small percentage of failure, on our ultimate customers."[102]

Communicate company values

Communicating organizational mission is also critical, particularly in large organizations. Without a clear understanding of what you stand for, there is potential for misunderstanding and assumption. In the Firestone case, action from the executive suite sent a message to employees about the importance of production and plausible deniability in the case of a failure. Although these "values" were not explicitly stated, the effect of the assumption is woven through employee decisions in design and testing, and in how the executives approached the recall.

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[102] U.S. House. *The Recent Firestone Tire Recall Action, Focusing On The Action As It Pertains To Relevant Ford Vehicles.* Sept. 6 & 21, 2000. 106th Cong., Opening Statement, Rep. Gene Green, 18.

This suggests two important objectives: First, be clear about your values. Don't leave room for assumptions, and be aware of what your actions are saying about company values. Goals are an active display of company values and can drive misdirected action if values are not clearly understood. Second, empower members of your team to speak up and applaud the presentation of an opposing view.

Identify Gaps in Education

Study of the Firestone failure reveals a need for expanded education that develops the skills needed to manage conflicting requests from multiple stakeholders and organizational needs. The Firestone case study primarily addresses the impact of goal conflict on design requirements. However, goal conflict occurs throughout the product development process. In future work, further study should consider how these conflicting goals impact other stages of product development. A brief look at other key stages of development offer the following insights:

Developing Empathy

The early stages of the human-centered design process is dedicated to developing empathy for the user. To understand stakeholders at this level, designers seek to immerse themselves in the world for whom they're designing. Going "native" with users not only provides an empathetic view of the need, but increases opportunities to get feedback on iterations. As research reveals more about the user, design requirements are adjusted to reflect new learnings. Successful products will take into account both physical and emotional needs and behaviors when defining and redefining the design requirements that guide the project. Successful stakeholder research requires designers to set aside what they already know about a group or environment. This is challenging: as humans, we listen for evidence that aligns with what we know, and we confirm what we already believe. The learnings from immersive field research can be especially tricky if they conflict with work that is already in progress, or if they bring to light a personal or organizational bias.

Concept Generation

After developing a strong understanding of problem and stakeholders, designers move into concept generation. This ideation generates potential solutions that consider everything unearthed by the process so far: design requirements, user needs, timeline, and scope of the

project. Each concept is evaluated against a set of criteria that indicate a "good" solution for the defined problem. This evaluation criteria is a critical touchpoint. Biased evaluation criteria leads to solutions that are inconsiderate of important goals.

Prototyping & Testing

Many design frameworks have built-in mechanisms to learn from users. The testing phase of product development may include bench level tests, prototyping, and looks-like/works-like models to prove the feasibility of a concept. Feedback is crucial in creating better products; consulting users not only catches places where you might be missing the mark on user needs but may also reveal tendencies to use your product in a way that interacts with other systems, amplifies negative behaviors, or causes harm. Successful designers will iterate between prototyping and getting feedback to learn from stakeholders. A common point of tension at this stage is retaining an open mind in observing how a product is used, rather than assuming compliance with instructions and best practices.

Final thoughts

Humans don't like ambiguity. Uncertainty fights against our innate need to comprehend and predict the world around us. Unfortunately, tackling tough problems—designing something new, handling a crisis, building a business, combating bias—are all jam-packed with ambiguity and uncertainty. In this environment, it's tempting to narrow your focus and forget about the wider implications. It takes courage to seek out opposition to your goals. It's not easy to thoughtfully consider seemingly incompatible goals, especially if you're short on resources.

These challenging contexts require both skills and strong vision. It's critical that those who lead the development of new products and services are also taught to thoughtfully consider their values and motivations. First, what skills are most helpful for defining and prioritizing goals? Second, as a leader—individually or as an organization— what are your best aspirations? How can you continue to stand for those values when there is pressure to conform or compromise? A healthy tension between the desire to build innovative, profitable product and innovating with strong principles can lead to breakthrough solutions. We should aspire to bring new technology and innovation to market, and we should resolve that solutions that put the wellbeing of humans at risk are simply not good enough.

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Appendix A

List of Exhibits

Note	Title
14	ODI Investigation
15	ODI Consumer Advisory
41	Memo re: Decatur Replacement Workers
59	Internal Emails at Ford
61	Ford Explorer Stability Testing
63	Ford Tire Test Report
65	Ford High Speed Testing
67	Ford-Firestone Southwest Survey
69	Firestone Statement to KHOU
70	Customer Complaint Letter
71	Middle East Tire Survey
74	Memo from Firestone Dubai re: Saudi Arabian tread separations
75	Firestone Memo re: Gulf Countries Recall
78	Memo re: Venezuelan Tire Survey
82	Email from Sam Boyden re: Tread Separation Claims made to State Farm

Appendix A

14 ODI Investigation

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

ODI RESUME

INVESTIGATION:	PE00-020 DATE OPENED: 2-MAY-00
SUBJECT:	Tire Tread Separation/Tire Failure
PROMPTED BY:	IE 00-024, Consumer complaints
PRINCIPAL ENGINEER:	Terri Droneburg (202) 366-6617
MANUFACTURER:	Firestone
TIRE MODEL(S):	ATX, ATX II, and Wilderness
TIRE MODEL YEAR(S):	To be determined
TIRE POPULATION:	To be determined
PROBLEM DESCRIPTION:	Consumers allege tire tread separation or failure while driving at highway speeds.

FAILURE REPORT SUMMARY

	ODI	MANUFACTURER	TOTAL
COMPLAINTS:	90	unknown	90
CRASHES:	33	unknown	33
# INJURY CRASHES:	17	unknown	17
# INJURIES:	27	unknown	27
# FATAL CRASHES:	4	unknown	4
# FATALITIES:	4	unknown	4

ACTION: Open a Preliminary Evaluation.

ENGINEER: _____ DIV CHF: Richard Boyd OFC DIR: _____

5/2/00 May 2, 2000 5/2/00

DATE DATE DATE

SUMMARY:

ODI is aware of 90 complaints on subject Firestone ATX, ATX II, and Wilderness tires alleging either tread separation or blowout. The details of most incidents have been identified; however, some specifics are still unknown. ODI is continuing to gather information about these, and other, incidents.

Most drivers report that they were driving at highway speeds when suddenly they lost control. Some drivers heard a loud noise seconds before the loss of control, but others heard nothing. Those that did hear a noise often reported that the loss of control occurred so quickly they were not able to avoid a collision. Over 30 percent of the drivers did not recover from the loss of control and crashed.

Appendix A

14 ODI Investigation

After analyzing complaints and contacting consumers, ODI knows of 65 consumers alleging a complete (61) or partial (4) tire tread separation occurred on a subject tire. An additional 17 allege a blow out occurred, which may or may not have been preceded by a tread separation. The remaining eight indicate unspecified tire failures. Twenty-eight of the drivers who experienced an alleged tread separation noted that the tire remained inflated, often after a subsequent crash. In fact, 22 of the 28 cases, resulted in a crash. In two of these crashes, the tread wrapped itself around the rear axle, allegedly causing a wheel lockup and the resultant crash.

Forty-one of the complainants reported a tire tread separated while traveling at speeds ranging from 50 to 75 mph, with 70 mph being the most commonly reported speed, cited by 18 drivers.

The subject tires were installed as original equipment (OEM) on certain Ford Explorer, Ranger, and F150 vehicles (among others) and were also available as replacement tires for these and other vehicles. Forty-one reports allege that an OEM tire failed and ten owners claim the failure involved a replacement tire.

ODI has documented 34 crashes with 21 resulting in an injury or death. In many cases, more than one occupant was injured in the crash (i.e., 27 injuries resulted from 17 of the crashes). Many of the injuries were relatively minor (i.e., lacerations, scrapes, and a bloody nose). However, 5 of the reports involved severe injuries including head trauma and broken bones. The remaining four crashes resulted in one occupant fatality each.

Finally, a strong geographical trend is noted at this time. Forty-three complaints are from Texas with over 80% of the balance involving Arizona, Florida, Alabama, Louisiana, South Carolina, Nevada, New Mexico, Oklahoma, Utah, and southern California.

Appendix A

15 ODI Consumer Advisory

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

400 Seventh Street, S.W.
Washington, D.C. 20590

CONSUMER ADVISORY

FOR IMMEDIATE RELEASE

NHTSA Rae Tyson
Contact: (202) 366-9550

The National Highway Traffic Safety Administration (NHTSA) is recommending that owners of vehicles with certain models and sizes of Firestone tires not already being recalled by Firestone take a number of actions to assure their safety, based on NHTSA's analysis of Firestone's data.

On May 2, 2000, NHTSA opened a defect investigation into approximately 47 million ATX, ATXII, and Wilderness tires manufactured by Bridgestone/Firestone, Inc. (Firestone). On August 9, Firestone announced that it was recalling 14.4 million of the tires under investigation. These include all Firestone ATX and ATXII tires of the P235/75R15 size manufactured since 1991 and all Wilderness AT tires of that same size manufactured at Firestone's Decatur, IL plant. Firestone has estimated that about 6.5 million of these tires were still in service as of that date.

NHTSA has continued its investigation into the remaining tires. As part of that investigation, NHTSA has reviewed data provided by Firestone on property damage claims, personal injury claims, and lawsuits regarding the tires under investigation. Although its investigation is not complete, that review indicated that the rate of tread separations for certain other tire models and sizes exceed those of the recalled tires, sometimes by a large margin. Therefore, NHTSA is concerned about the possible safety risk associated with those tires.

On August 30, 2000, NHTSA staff met with Firestone representatives in Washington and recommended that Firestone expand the recall to include these tire models. On August 31, Firestone advised NHTSA that it would not voluntarily expand the recall at this time. We are continuing our investigation, which may result in an order directing Firestone to recall these tires and any other defective tires. However, in view of the potential safety risk, NHTSA believes that it is important to alert the public of its concerns now.

The tire models with the high tread separation rates are set out in an Attachment to this advisory. A total of approximately 1.4 million of these tires were produced. However, since many of them were manufactured many years ago, it is likely that far fewer are currently on the road. Most of them were sold as replacement equipment and were not installed as original tires on new cars.

DOT AUTO SAFETY HOTLINE
888-DASH-2-DOT

Appendix A

15 ODI Consumer Advisory

Since Firestone has chosen not to expand the recall at this time, you may not be able to obtain free replacement tires from Firestone. However, in light of these concerns, NHTSA recommends that you consider replacing the tires in question and that you retain all documentation.

If you have one of these tires on your vehicle, you should take the following steps:

- Check your tires to be sure there are no visible signs of a problem.
- Be sure your tires are properly inflated.
- Do not drive at a high rate of speed, particularly in hot weather. If possible, choose roads with relatively low speed limits.
- Make sure your vehicle is not overloaded.
- Wear your seatbelt.

Please be aware that while these precautions are good general guidelines to tire safety, they may not prevent a tire failure.

NHTSA will be moving to rapidly complete its defect investigation into these particular tires as well as the remaining Firestone tires under investigation. If the agency concludes that other tires should be recalled, it will act promptly to assure that the public is protected.

Attached: List of Tires Included in 9/1/00 Consumer Advisory

Appendix A

41 Memo re: Decatur Replacement Workers

KING & SPALDING

1730 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20006-4706
TELEPHONE: 202/737-0500
FACSIMILE: 202/626-3737

DIRECT DIAL
202 626-2901

E-MAIL:
thester@kslaw.com

January 12, 2001

VIA COURIER

Tom DiLenge
Deputy Chief Counsel for Oversight and
Investigations
House Commerce Committee
2125 Rayburn House Office Bldg
Washington, DC 20515-6115

Dear Tom:

Per your request, on behalf of Bridgestone/Firestone, Inc. ("B/FS"), I am providing the following responses for the record from the September 6, 2000, hearing. This information was provided orally to Congressman Dingell's staff shortly after the hearing, but is now being submitted for the written record.

Congressman Dingell asked for certain information relating to the Decatur, IL, plant, and as you requested, we have summarized this response based on information provided to us by BFS. Let me know if you have questions or need additional information.

First, Congressman Dingell asked about the production numbers for Decatur for the periods before, during, and after the strike. The strike period lasted from July 12, 1994 - May 22, 1995. On May 22, the union offered an unconditional return to work notice, but the actual agreement was not ratified by the union membership until December 12, 1996. Permanent workers began to return to work on or around May 22, 1995. Because BFS has requested confidentiality and the Committee has granted this request, the information is being provided as a separate attachment

Congressman Dingell also inquired regarding the number of replacement workers during the strike and what kind of duties they performed, specifically whether or not replacement workers were used as inspectors or in quality control positions The following chart provides the numbers of employees at the plant during the period of the strike, other than managers, supervisors, and salaried workers:

Appendix A

41 Memo re: Decatur Replacement Workers

Date	Permanent Workers	Replacement Workers
July, 1994	24	49
August, 1994	24	49
September, 1994	24	49
October, 1994	28	175
November, 1994	45	227
December, 1994	75	308
January, 1995	261	923
February, 1995	308	935
March, 1995	310	952
April, 1995	310	952
May, 1995	371	1,048

BFS advises us that the replacement workers performed a variety of tasks and worked in all departments of the Decatur plant. All replacement employees went through specific job training, just as any permanent worker would. Training consisted of the new employee working with an experienced trainer, initially in a one-on-one basis. The duration of the training was based on the requirements of the job and the skills of the individual. The trainer would monitor the progress of the trainee until certified.

In the case of inspectors, the trainees would receive a formal training program with testing and follow-up. The program consisted of individualized instruction, observation, and a performance review. The review would be evaluated and signed by the instructor, trainee, and foreman. The inspector trainee would also be given a written test to assess the skills learned. Based on the results of the test, the inspector trainee was either certified or received additional training.

As noted above, during this period there were a substantial number of "permanent" workers who crossed the picket line, and the plant continued to be staffed by supervisors and

Appendix A

41 Memo re: Decatur Replacement Workers

Tom DiLenge
January 12, 2001
Page 3

salaried workers. The following chart lists the various departments and the occupations that replacement workers filled.

Department	Occupations within the Department
Compounding & Mixing	Pellet Tower Attendant, Banbury Operator; Utility or Service Worker; Power Trucker; Cement Mixer; Refiner Mill Operator; Refining Trucker; Slab Off Mill Wig-Wag Attendant
Calendering	Calender Operator; Helper; Mill Operator, Creel Room Attendant; Utility or Service Worker; Power Trucker
Stock Cutting	Slitter Operator, Stabilizer Ply Roll Certifier; Automatic Splicer & Hot Insert Cutter Operator; Fischer Cutter Operator; Off-line Innerliner/Sidewall Pre-assembly Operator; Battery Attendant; Bias Cutter Operator; Utility or Service Worker; Power Trucker
Bead Making	Wire Insulator Operator; Bead Assembly Operator; Programmed Wire Winder Operator; Cold Applied Dual Filler Bead Assembly Operator; Bead Filler Extrusion Line Operator; Utility or Service Worker; Power Trucker
Tubing	Dual Tube Machine Operator; Tube Machine Booker Trucker; Attendant, Helper; Dual Tube Machine Certifier; Triplex CFE Operator; Utility or Service Worker; Power Trucker
Tuber Die Making	Tube Machine
Curing	Curing Press Operator; Bladder Cure and Preparation Worker; Tire Doper and Sorter; Mold Cleaner and Changer; Mold Radial Runout Inspection-Correction Operator; Mold Equipment Inspector; Utility or Service Worker; Power Trucker
Final Finish	Final Finish Equipment Regulator; Tire Balancer; Tire Repairer; Tire Sorter; Tire Classifier and Repairer; Checker and Labeler; Module Operator; Module Loader; Utility or Service Worker; Power Trucker
Waste Control	Workaway Labor; Power Trucker
Receiving	Checker; Utility or Service Worker; Trucker Attendant

Appendix A

41 Memo re: Decatur Replacement Workers

Department	Occupations within the Department
Warehouse & Shipping	Warehouser; Truck Tube & Flap Inserter
Powerhouse	Engineer Level I; Engineer Level II
Stores	Storeroom Attendant; Battery Attendant
Maintenance	Mechanic; Multi-Mechanic; Machinist; Pipefitter; Head Painter; Painter; Lubricator-Inspector

I hope that this information is helpful. We will be glad to provide additional information if needed. Please let me know if we can be of further assistance.

Sincerely,

Theodore M. Hester

cc: Edith Holleman, Esq.

Appendix A

59 Internal Emails at Ford

From: RSTORNAN--DRBN001 Date and time 09/12/89 09:01:29
To: CWHITE --DRBN001

FROM: Roger F. Stornant
Subject: UN46 Steering Linkage Issue - Index Bars

UN46 with P225 tire on both 2 dr and 4 dr was literally "bullet-proof" (i.e., no 2 wheel lift on long or short course with "saturation" tendency similar to T-Blazer). The 4 dr with the P235 ATX tires was significantly better than BII, especially on the short course where it was impossible to generate 2 wheel lift (on the long course,"reserve" was 3 mph, better than BII's 0 mph reserve).

However, the 2 dr with P235 ATX tires performed similarly to the BII on both the short and long courses. Addition of the lowered front roll center gave the P235 tire performance similar to the P225 even without the increased track width. Based on the variability of the test, as demonstrated by our own drivers, it is possible to pass the CU test with the P235 tires; however, if we were using the CU test as sign-off requirement, we would not accept this combination (P235 ATX & 2dr).

In the "real world", tire size has not been demonstrated to be a significant factor; in fact, analysis of the FARS incidents would suggest that larger tires may be an advantage (reduced tendency for rim-road contact). Our analysis would indicate that the Explorer will have much better FARS performance than BII regardless of tire size due to it's longer wheelbase, increased understeer and slower dynamic response (also a WB effect).
Regards,
Roger F. Stornant
*** Forwarding note from CWHITE --DRBN001 09/11/89 16:01 ***
To: RSTORNAN--DRBN001 R. F. Stornant

FROM: Charles White
Subject: UN46 Steering Linkage Issue - Index Bars
Isn't is also true that the UN46 is better than BII in CU test even with P235?

Isn't it also true that UN46 with P235 is much better than BII with P205 in real world FARS analysis standpoint (longer wheelbase, etc.)?
*** Forwarding note from RSTORNAN--DRBN001 09/11/89 12:20 ***
To: CWHITE --DRBN001

FROM: Roger F. Stornant
Subject: UN46 Steering Linkage Issue - Index Bars
I believe my attached note to RRS will answer your question on "What tire issues?".
Regards,
Roger F. Stornant
*** Forwarding note from RSTORNAN--DRBN001 09/11/89 12:18 ***
To: RSIMPSO1--DRBN001

FROM: Roger F. Stornant
Subject: UN46 Steering Linkage Issue - Index Bars

Nothing new on tires. Our tests indicate a high confidence of passing CU with P225 tires and less confidence on the P235. All tires meet engineering J-Turn test. I believe new info is that our competitors are recognizing CU Test as a requirement and have designed their new utility vehicles to meet. OGC is concerned we will be only OEM with a vehicle that has a significant chance of failing the CU test. I believe that management is aware of the potential risk w/P235 tires and has accepted risk. CU test is generally unrepresentative of real world and I see no "real" risk in failing except

Appendix A

59 Internal Emails at Ford

what may result in way of spurious litigation.

From an engineering standpoint, I am not comfortable with the warning label approach to avoid use of an index bar. I do not believe we could even count on B&AO to orient correctly, much less service personnel; however, if you obtain ASO concurrence in this approach, I will go along.
Regards,
Roger F. Stornant
*** Forwarding note from RSIMPSO1--DRBN001 09/11/89 11:01 ***
To: RSTORNAN--DRBN001

*** Reply to note of 09/11/89 09:55
FROM: Roger R. Simpson
Subject: UN46 Steering Linkage Issue - Index Bars
IN MY MIND, THERE IS SUFFICIENT RATIONALE TO ELIMINATE ALL OF THE INDEX BARS IF A DECAL ON THE LINKAGE IS EMPLOYED. LET'S DISCUSS.

REGARDING TIRES, I THINK TRUCK SHOULD STAND ON IT'S ORIGINAL POSITION. IS THERE ANY NEW INFORMATION THAT WOULD CAUSE A CHANGE?

cc: WGILLIES--DRBN001 CWHITE --DRBN001

Regards,
Roger R. Simpson

cc: RCAMPBEL--DRBN001 DWOTTON --DRBN001
DHOUSTO1--DRBN004

Appendix A

61 Ford Explorer Stability Testing

Subject: UN46 Status

DRAFT/PRELIMINARY

Overview:
Current "strategies" for development of utility vehicle stability have changed over the past few years due the increased availability of rollover accident data and analyses. Previous strategies were partially driven by the Insurance Institute tests of the Jeep CJ7 in the early 80's which emphasized risk from rollovers caused by extreme (rate and magnitude) steering inputs in emergency maneuvers. Independent DOT, GM and Ford studies have confirmed that rollovers directly induced by extreme steering inputs are rare for any Utility vehicle (including the CJ7). The following quote from GM's recent SAE Paper (Reconstruction of Rollover Collisions, SAE 890857), summarizes current wisdom ... "A common pre-rollover maneuver is an off-road path by the car, followed by heavy steer correction back towards the road leading to a side slide, and, ultimately, a trip followed by the rollover". Based on this new information, the UN46 was developed using a handling philosophy notably different from the BII. A comparison of BII and UN46 handling strategies is summarized below:

Model	Response	Cornering Capacity	Body Roll
BII	"Quick" steering and moderate understeer for good response and minimal tire "squeal". Develop vehicle for high speed through lane change pylons.	Maximize for good accident avoidance capability and fast "lap times" on handling track.	Minimize for "flat" feel and high cornering confidence.
UN46	Reduce steering gain and increase understeer to slow steering response. This will increase driver feedback (more tire "squeal") and reduce sensitivity to driver over-correction (common with drivers "under the influence").	Not to exceed current BII levels. Limit cornering capacity with larger tires through suspension revisions and tire pressure reduction.	Increase body roll to reduce cornering confidence and thereby discourage aggressive driving.

Parametric Comparison:

Parameter	2 dr UN46 4x2	2 dr UN46 4x4	4 dr UN46 4x2	4 dr UN46 4x4	'89 BrII 4x2	'89 BrII 4x4	S-Blaz(4x4) Std	S-Blaz(4x4) Opt	Path/Fdr 4x4
Avg. Track Width	58.1	58.3	58.1	58.3	56.9	56.9	55.8	55.8	55.6
C.G. Height (curb)	26.9	26.8	27.1	27.1	27.5	26.7	25.7	25.7	26.3
Stability Index	2.16	2.17	2.14	2.15	2.07	2.13	2.17	2.17	2.11
Versace Metric 1/	.349	.348	.336	.336	.3760	.3650	.3459	.3459	.3447
Roll Gain (°/g)	TBD	5.6	TBD	5.7	N/A	3.7	6.9(e)	N/A	9.0
U/steer @ .3g (°/g)	TBD	6.5	TBD	TBD	N/A	4.4	4.2	N/A	3.2
U/steer @ .6g (°/g)	TBD	TBD	TBD	TBD	N/A	19.8	24.6	N/A	9.8
Overall Str Ratio	19:1	19:1	19:1	19:1	19:1	19:1	20:1	20:1	20:1
Wheelbase	102.1	102.1	111.9	111.9	94.0	94.0	100.5	100.5	104.3
WB/Tan(20°/SR) 2/	463.0	463.0	507.5	507.5	426.3	426.3	479.8	479.8	497.9
Engine Disp.	4.0L	4.0L	4.0L	4.0L	2.9L	2.9L	2.8L	4.3L	2.9L
Horsepower	170	170	170	170	140	140	125	160	139
Curb Weight	3576	3791	3719	3907	3278	3371	3217	3267	3715
HP/Weight 3/	.048	.045	.046	.044	.043	.042	.039	.049	.037

1/ This a measure of stability that shows high correlation with actual FARS rollover data. Unlike the "Stability Index", this measure includes wheelbase effects (important for "directional stability") ... lower is "better".
2/ This is an analytical measure of steering gain. The smaller the value, the "quicker" is the perceived steering response.
3/ High power/weight is believed to promote aggressive driving.

Appendix A

61 Ford Explorer Stability Testing

due to inconsistencies with the computer analysis program ADAMS, the UN46 2 Dr 4X4 will be signed-off for rollover stability by actual "limit" testing at the Arizona Proving Grounds (April 18th to 29th). Testing will include an '89 S-10 Blazer with 4.3L engine along with a current production BII 4x4. The BII provides an essential "baseline" for UN46 Rollover Stability sign-off because our analysis of the BII FARS data indicates almost no propensity for rollover during "handling" maneuvers. Testing will begin at relatively low speed (40 mph) and steer angles (90 deg.) and gradually increase to 55 mph and 360 deg. to establish the limit "threshold". The UN46 must at least be equivalent to the BII in these maneuvers to be considered acceptable for production.

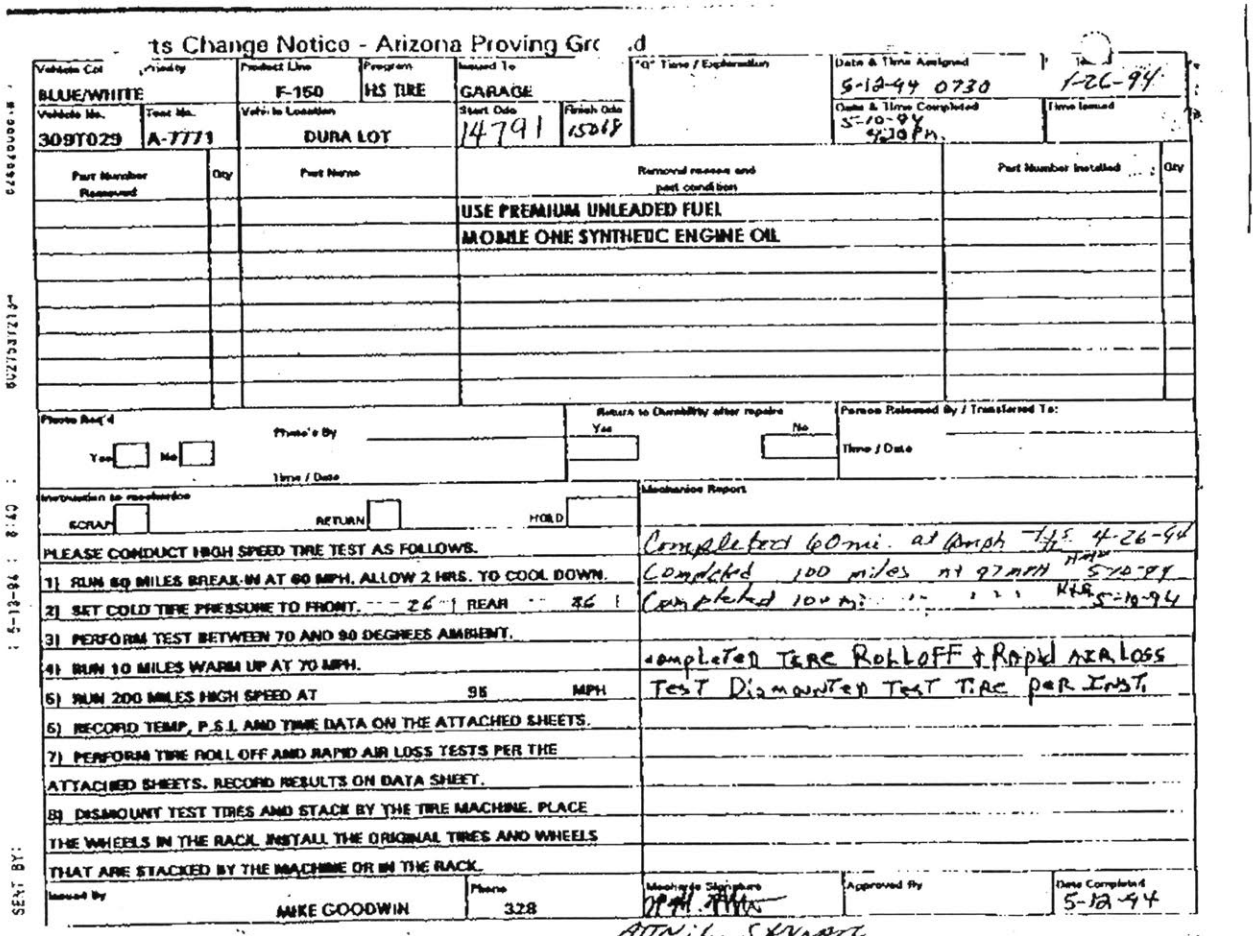
Track Handling (Non-limit Subjective):
The UN-46 2 door and 4 door models, both 4x2 and 4x4, exhibit track handling performance superior to the 1989 Bronco II models. Evaluations on the handling and serpentine courses demonstrate that the vehicle body roll induced during increasingly severe maneuvers provides ample feedback to the driver of impending limit conditions. Increased understeer during severe cornering reduces the lateral acceleration and enhances control. The UN-46 models are superior to the Bronco II for all available options, including tires currently released for the program. The UN-46 models have been rated superior to the Chevrolet S-10 Blazer and Nissan Pathfinder for overall subjective handling.

Tire Pressure Reduction:
Engineering has recommended use of tire pressures below maximum allowable inflation levels for all UN46 tires. As described previously, the reduced tire pressures increase understeer and reduce maximum cornering capacity (both "stabilizing" influences). This practice has been used routinely in heavy duty pick-up truck and car station wagon applications to assure adequate understeer under all loading conditions. Nissan (Pathfinder), Toyota, Chevrolet, and Dodge also reduce tire pressures for selected applications. While we cannot be sure of their reasons, similarities in vehicle loading suggest that maintaining a minimal level of understeer under rear-loaded conditions may be the compelling factor.

Summary:
Based on an analysis of FARS accident summaries and BII & Competitive handling characteristics, it is impossible to identify any type of vehicle "defect" that could explain the BII FARS performance. It is most likely that the handling strategy used during the development of the BII, which fully exploited the vehicles inherent quickness (due to its short wheelbase), encourages aggressive driving and makes the vehicle more sensitive to the large steering wheel "over-corrections" that seem to be part of most rollover scenarios. This sensitivity is aggravated by the fact the most operators in rollover accidents are either inexperienced drivers, under the influence of alcohol or both. The UN46, designed with the benefit of the FARS experience for all utility vehicles, has been intentionally developed to resolve these issues.

Appendix A

63 Ford Tire Test Report



'ts Change Notice - Arizona Proving Gro .d

Vehicle Col	Product Line	Program	Issued To	"Q" Time / Explanation	Date & Time Assigned
BLUE/WHITE	F-150	HS TIRE	GARAGE		5-12-94 0730

Vehicle No.	Test No.	Vehicle Location	Start Odo	Finish Odo	Date & Time Completed	Time Issued
309T029	A-7771	DURA LOT	14791	15018	5-10-94 4:30 PM	

Part Number Removed	Qty	Part Name	Removal reason and part condition	Part Number Installed	Qty
			USE PREMIUM UNLEADED FUEL		
			MOBILE ONE SYNTHETIC ENGINE OIL		

Photo Req'd Yes ☐ No ☐ — Photo's By — Time / Date

Return to Durability after repairs Yes ☐ No ☐

Person Released By / Transferred To: — Time / Date

Instruction to reworkers: SCRAP ☐ RETURN ☐ HOLD ☐

PLEASE CONDUCT HIGH SPEED TIRE TEST AS FOLLOWS.

1) RUN 60 MILES BREAK-IN AT 60 MPH. ALLOW 2 HRS. TO COOL DOWN.

2) SET COLD TIRE PRESSURE TO FRONT. -- 26 | REAR -- 36 |

3) PERFORM TEST BETWEEN 70 AND 90 DEGREES AMBIENT.

4) RUN 10 MILES WARM UP AT 70 MPH.

5) RUN 200 MILES HIGH SPEED AT 95 MPH

6) RECORD TEMP, P.S.I. AND TIME DATA ON THE ATTACHED SHEETS.

7) PERFORM TIRE ROLL OFF AND RAPID AIR LOSS TESTS PER THE ATTACHED SHEETS. RECORD RESULTS ON DATA SHEET.

8) DISMOUNT TEST TIRES AND STACK BY THE TIRE MACHINE. PLACE THE WHEELS IN THE RACK. INSTALL THE ORIGINAL TIRES AND WHEELS THAT ARE STACKED BY THE MACHINE OR IN THE RACK.

Mechanics Report

Completed 60 mi. at 60mph TH 4-26-94
Completed 100 miles at 97 MPH TH 5-10-94
Completed 100 Mi. RH 5-10-94
completed Tire Rolloff & Rapid Air Loss Test Dismounted Test Tire per Inst.

Issued By	Phone	Mechanic Signature	Approved By	Date Completed
MIKE GOODWIN	328			5-12-94

ATTN: L. SKYHAWK

BAAZ 1009

SENT BY:

Appendix A

63 Ford Tire Test Report

TIRE TEST DATA SHEET - TEST PROCEDURE
GEN. T - 4. 04 IVD AND GEN. T. 4. 04 IVD .2.8
TIRE ROLL - OFF TEST
RAPID AIR LOSS TEST

ATTN:L. SKYNAR
FAX 248-2606

Total Vehicle Weight : Front: 3064 Rear : 3186

Tire Size: P235/75R15 Const. No. SR897J Manufactor: FIRESTONE

Test Rim Part Numbers (Inspected by ________ Date ________

Tire Pressure RF 26 RR 26 Slave SAME

Did Tire complete High Speed Test Yes X No ____

Did tire roll into wheel well? Yes ____ No X

Did wheel rim contact ground? Yes ____ No X

Location on the circle where the failure occurred. DNA

Did tire pass test? Yes X No ____

RAPID AIR LOSS

Photo of Puncture Delve. (attached) IF requied.

10 minute arm - up at 60 mph. Yes X No ____

Rapid loss of Air? Yes X No ____

Was there evidence of air escaping from tire after stop. Yes ____ No X

Decelration Rate 13 to 15 F Yes X No ____

Position of tire on rim after loss of air inside flanges for entire 360 degree.
Yes X No ____

Driver's Name: [illegible] Date: 5-12-94

I participated in the above described tire test (Rapid Air Loss Test) and certify that all the above information is ture.

[illegible]

jro/B2

BAAZ 1010

SENT BY: : 5-13-94 : 8:42 : 6027537218→ 9248260266:# 4

Appendix A

63 Ford Tire Test Report

ATTN: LARRY
SKYNAR FAX 313-
248-2808

HIGH SPEED TIRE TEST REPORT

ENGINEER : LARRY SKYNAR
DATE:
VEHICLE: 308T029
TEST ORDER NO. A-7771
TIRE SIZE: P235/75R15
BRAND: FIRESTONE
TIRE CONST. NO. 9R697J
TRACK TEMP. 191
TIME-OUT:
AMB. TEMP.
TARGET TIME 190 SEC
TIME-IN:
WIND DIRECT :
MAX SPEED 98
BREAK-IN: 60 MILES @60 MPH
WIND VOL.
WARM-UP: 10 MILES @70 MPH
WEATHER COND.
WHEEL 15X8

TEST POSITION	LF	RF	LR	RR
TIRE ID				
HOT P.S.I.	30	31	35	35
SHLD. TEMP.	145	123	159	142

LOAD
FRONT: 3084
REAR: 3188
PRESSURE
FRONT: 26
REAR: 26

LAP	5 MILE LAP TIME IN SECONDS	ACTUAL MPH	REMARKS
2	189	97	
3	"	"	
4	190	"	
5	"	"	
6	"	"	
7	190	97	
8	"	"	
9	"	"	
10	"	"	
11	"	"	
12	190	97	
13	"	"	
14	"	"	
15	"	"	
16	"	"	
17	185	"	
18	"	"	
19	190	97	
	"	"	

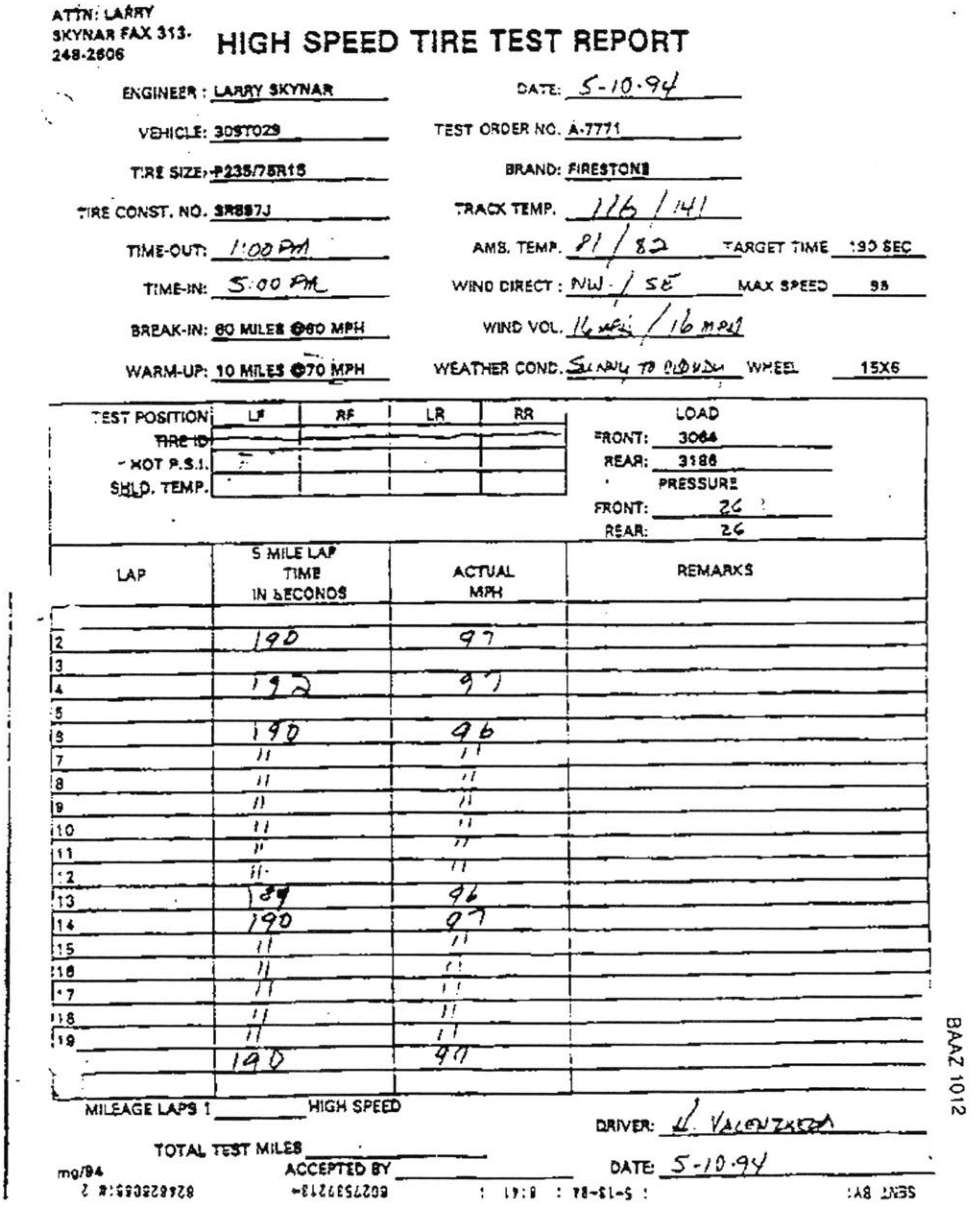
MILEAGE LAPS 1 HIGH SPEED
DRIVER: W. M. K.L. ELSWICK
TOTAL TEST MILES 216
ACCEPTED BY K.L. ELSWICK
DATE: 5-10-94

mg/94

8AAZ 1011

Appendix A

63 Ford Tire Test Report



ATTN: LARRY
SKYNAR FAX 313-
248-2606

HIGH SPEED TIRE TEST REPORT

ENGINEER : LARRY SKYNAR — DATE: 5-10-94

VEHICLE: 30ST029 — TEST ORDER NO. A-7771

TIRE SIZE: P235/75R15 — BRAND: FIRESTONE

TIRE CONST. NO. 3R887J — TRACK TEMP. 116 / 141

TIME-OUT: 1:00 PM — AMB. TEMP. 81 / 82 — TARGET TIME 190 SEC

TIME-IN: 5:00 PM — WIND DIRECT : NW / SE — MAX SPEED 98

BREAK-IN: 60 MILES @60 MPH — WIND VEL. 16 MPH / 16 MPH

WARM-UP: 10 MILES @70 MPH — WEATHER COND. SUNNY TO CLOUDY — WHEEL 15X6

TEST POSITION	LF	RF	LR	RR
TIRE ID				
HOT P.S.I.				
SHLD. TEMP.				

LOAD
FRONT: 3064
REAR: 3186

PRESSURE
FRONT: 26
REAR: 26

LAP	5 MILE LAP TIME IN SECONDS	ACTUAL MPH	REMARKS
1			
2	190	97	
3			
4	192	97	
5			
6	190	96	
7	"	"	
8	"	"	
9	"	"	
10	"	"	
11	"	"	
12	"	"	
13	189	96	
14	190	97	
15	"	"	
16	"	"	
17	"	"	
18	"	"	
19	"	"	
	190	97	

MILEAGE LAPS 1 — HIGH SPEED

DRIVER: L. VALENZUELA

TOTAL TEST MILES

ACCEPTED BY

DATE: 5-10-94

mg/94

BAAZ 1012

Appendix A

65 Ford High Speed Testing

TEST TYPE=> DUR — WAREHOUSE ORDER NO: JR-42

FORD HIGH SPEED

PROJECT NO. => 181M004 — NON STD TEST => Y — DATE => 2000-07-

TEST NO. => 445527 — NEED BY =>2000-07-10 — SERIAL =>

TEST CODE => U5 — SIZE => P235/75R15 — SPEED RATING=>

REV DATE =>0001-01-01 — REV TIME =>00:00:00 — DE CONST NO=>

SPEC NO => 280105 — DESIGN NO => P235AT1A1

INFL => 26.0 PSI — LOAD => 2028.0 LBS — REM => 7.00

INFL => 179 KPA — LOAD => 9020.0 (N) — NO. OF TIRES => 4

BREAKIN =>VARIES — POP =10 MIN — AMBIENT TEMP=>100F+ 5 I

TIRE DESCRIPTION => FIRESTONE WILDERNESS AT

GENERAL FEATURES => FIRESTONE WILDERNESS AT

USF DASH NO =>

SOURCE => TRA — GOAL/MAX SPEED =>

REMARKS => 'U01'S' WRITTEN ON SIDE

PRIORITY

MRD 7.7.00 55% 2ND BV

CUSTOMER => FORD — WHEEL MATERIAL => W2HLIPV 2100

REQUESTOR:TSOTOS4 T3 — ENGINEER: UNITSEP — PHONE: 4622

MACHINE: _____ — STATION: 1

DISPOSITION: INSPECTION RACES

END REMARKS: _____

DATE COMPLETE YR ____ MO __ DA __ — OPERATOR _____

STEP NO	LOAD LB	LOAD NUT	INFL PSI	INFL KPA	STEP + SPEED	CAF. REV	STEP MIN	DUR UNIT	STEP REF LOAD	STEP OFF END
1	1500	6670	26.0	179.2	14.00		2.00	MIN	2028	26.0
2	1500	6670	26.0	179.2	27.00		2.00	MIN	2028	26.0
3	1500	6670	26.0	179.2	41.00		2.00	MIN	2028	26.0
4	1500	6670	26.0	179.2	54.00		2.00	MIN	2028	26.0
5	1500	6670	26.0	179.2	67.00		2.00	MIN	2028	26.0
6	1500	6670	26.0	179.2	81.00		10.00	MIN	2028	26.0
7	1500	6670	26.0	179.2	87.00		10.00	MIN	2028	26.0
8	1500	6670	26.0	179.2	94.00		10.00	MIN	2028	26.0
9	1500	6670	26.0	179.2	100.00		10.00	MIN	2028	26.0
10	1500	6670	26.0	179.2	106.00		10.00	MIN	2028	26.0
11	1500	6670	26.0	179.2	112.00		10.00	MIN	2028	26.0
12	1500	6670	26.0	179.2	118.00		10.00	MIN	2028	26.0
13	1500	6670	26.0	179.2	125.00		10.00	MIN	2028	26.0
14	1500	6670	26.0	179.2	131.00		10.00	MIN	2028	26.0
15	1500	6670	26.0	179.2	137.00		10.00	MIN	2028	26.0
16	1500	6670	26.0	179.2	143.00		10.00	MIN	2028	26.0
17	1500	6670	26.0	179.2	149.00		10.00	MIN	2028	26.0
18	1500	6670	26.0	179.2	156.00		10.00	MIN	2028	26.0
19	1500	6670	26.0	179.2	162.00		10.00	MIN	2028	26.0
20	1500	6670	26.0	179.2	168.00		10.00	MIN	2028	26.0

SPT0000415

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Appendix A

65 Ford High Speed Testing

CLOCK TIME	DATE	ON OR OFF	OPER.	DRUM COUNTER	MILEAGE	DRUM R.P.M.	DRUM M.P.H.	LOAD	INFL.	R.T.	TOTAL HOURS
419 A	7 8	ON	BK	BC	0		14	1500	26	100	0
528 A	7 8	OFF	BK	BC	100.4		112	1500	32	105	68.43

8.40 min @ 112 MPH

OSS WALL SEP
32 PSI

POS.	SECTION NEW PSI		ARC NEW PSI		CHORD NEW PSI	
1						
2						
3						
4						
5						
6						
AVG.						

CUT GROWTH MEASUREMENTS

POS.	GROOVES - SS TO OSS 1	2	3	4
1				
2				
3				
4				

SERIAL SIZE MACHINE TB STATION 1 TEST NO.

TEST PROJ.

049-01091 3-85

SPT0000416

Appendix A

65 Ford High Speed Testing

TEST DATE:	07/08/2000
PROJECT NUMBER:	141FM001
TEST NUMBER:	J45527
TEST CODE:	US
SPEC NUMBER:	280105
DASH NUMBER:	27
D.O.T. NUMBER:	W2HLIPY2100
ENGINEER:	QUEISER
TIRE SIZE:	P235/75R15
RIM SIZE:	7.00
TIRE DESCRIPTION:	WILD.AT
DESIGN LOAD(LBS):	1500
TEST INFL.(PSI):	26
MACHINE I.D.:	T3
STATION NUMBER:	1
TEST OPERATOR:	BILL G.
TEST CODE:	US
START TIME:	04:19:50
STOP TIME:	05:28:16

STATION 1 TOTAL ELAPSED TEST TIME: 68.43 minutes

STEP NO.	STEP START TIME	STATION 1 *****STEP ELAPSED TIME*****	STEP MILEAGE	TOTAL MILEAGE	LOAD	TEMP
1	04:19:50	2.00 Minutes(s) @ 14.3 MPH	0.5	0.5	1501	99.5
2	04:21:50	2.00 Minutes(s) @ 27.3 MPH	0.9	1.4	1498	98.8
3	04:23:50	2.00 Minutes(s) @ 40.9 MPH	1.4	2.7	1496	98.5
4	04:25:50	2.00 Minutes(s) @ 54.2 MPH	1.8	4.5	1503	99.0
5	04:27:50	2.00 Minutes(s) @ 67.3 MPH	2.2	6.8	1499	99.1
6	04:29:50	10.00 Minutes(s) @ 81.1 MPH	13.5	20.3	1500	96.2
7	04:39:51	10.00 Minutes(s) @ 87.0 MPH	14.5	34.8	1499	101.0
8	04:49:51	10.00 Minutes(s) @ 93.9 MPH	15.7	50.4	1498	102.1
9	04:59:51	10.00 Minutes(s) @ 99.7 MPH	16.7	67.1	1499	101.3
10	05:09:52	10.00 Minutes(s) @105.9 MPH	17.7	84.8	1503	92.2
11	05:19:52	8.40 Minutes(s) @112.0 MPH	15.7	100.4	1500	105.3

OSS WALL STP
32 PSI

SPT0000417

Appendix A

65 Ford High Speed Testing

TEST TYPE => DUR OAKHOUSE ORDER NO: 35242
FORD HIGH SPEED
PROJECT NO. => 141FN091 NON STD TEST =>Y DATE => 2000-07-07
TEST NO. => J40530 NEED BY => 2000-07-10 SERIAL =>
TEST TIME => 05 SIZE => P205/75R15 S SPEED RATING=>
REV DATE =>0001-01-01 REV TIME =>00:00:00 OE CONST NO=>
SPEC NO => 2B0105-28 DESIGN NO => P125SA1101
INFL => 26.0 PSI LOAD => 1500.0 LBS. RIM => 6.00
INFL => 179 KPA LOAD => 6670.0 NWT NO. OF TIRES => 1
SPEED => VARIES TIME => 10 MIN AMBIENT TEMP=>100 +5 F
TEST DESCRIPTION => FIRESTONE WILDERNESS AT
SPECIAL FEATURES => FIRESTONE WILDERNESS AT
OE BASE NO =>
SOURCE => RG TOTAL TEST SPEED => 105.00
REMARKS => "SPECIFIC" WRITTEN ON SIDE

M107.7.00 2ND 45# BV W2HLJPY 2100 PRIORITY

CUSTOMER => FORD WHEEL ACCEPTANCE =>

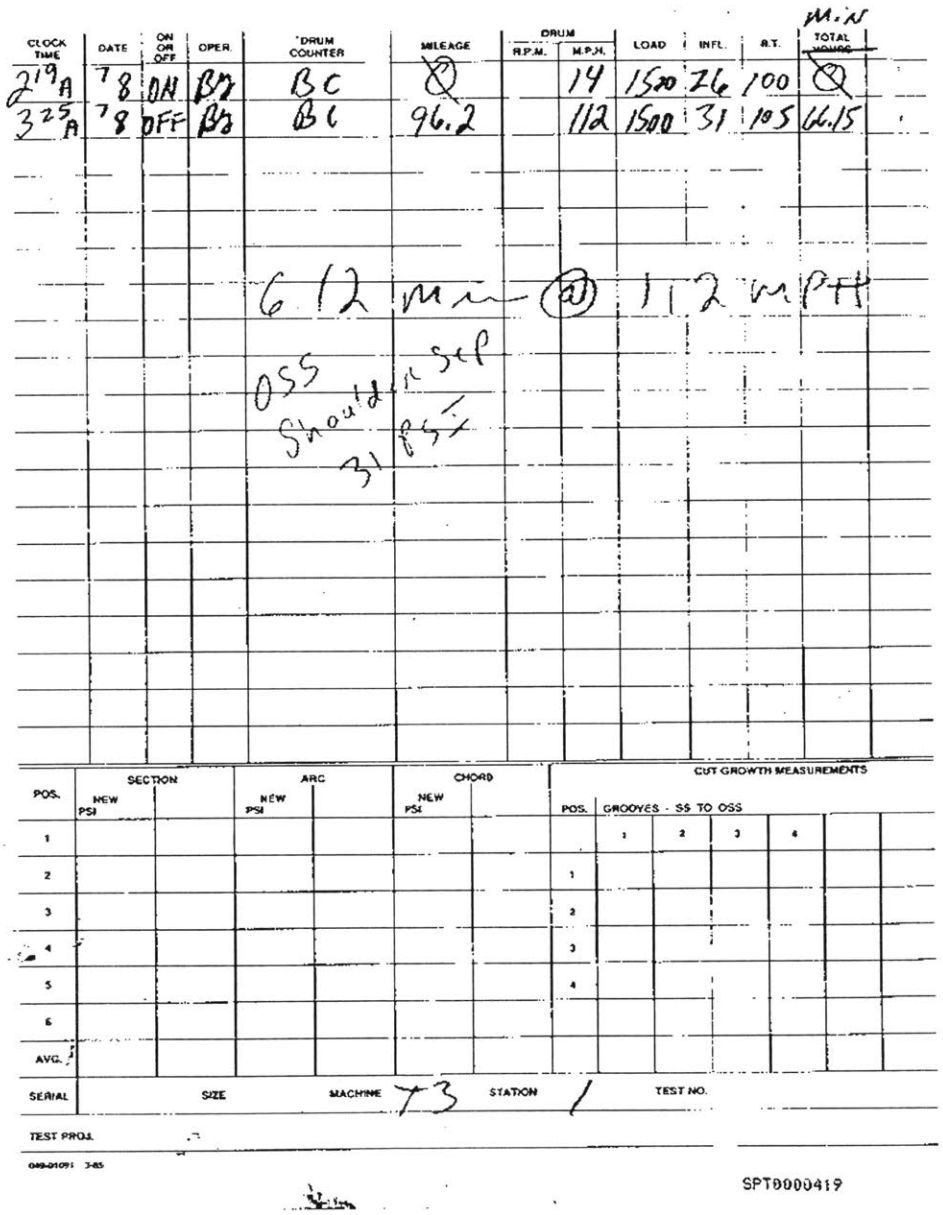
REMILSTOR:1501094 T3 ENGINEER: QUEISER PHONE: 6602
MACHINE:_____ STATION:_1__
DISPOSITION: INSP. RACKS
END REMARKS:
DATE COMPLETE YR __ MO __ DA OPERATOR

STEP NO	LOAD LC	LOAD NWT	INFL PSI	INFL KPA	STEP SPEED	CAP% MPS	STEP DUR	DUR UNIT	STEP REF LOAD	STEP REF INFL
1	1500	6670	26.0	179.2	74.00		2.00	MIN	2028	26.0
2	1500	6670	26.0	179.2	77.00		2.00	MIN	2028	26.0
3	1500	6670	26.0	179.2	81.00		2.00	MIN	2028	26.0
4	1500	6670	26.0	179.2	84.00		2.00	MIN	2028	26.0
5	1500	6670	26.0	179.2	87.00		2.00	MIN	2028	26.0
6	1500	6670	26.0	179.2	91.00		10.00	MIN	2028	26.0
7	1500	6670	26.0	179.2	97.00		10.00	MIN	2028	26.0
8	1500	6670	26.0	179.2	94.00		10.00	MIN	2028	26.0
9	1500	6670	26.0	179.2	100.00		10.00	MIN	2028	26.0
10	1500	6670	26.0	179.2	106.00		10.00	MIN	2028	26.0
11	1500	6670	26.0	179.2	112.00		10.00	MIN	2028	26.0
12	1500	6670	26.0	179.2	118.00		10.00	MIN	2028	26.0
13	1500	6670	26.0	179.2	125.00		10.00	MIN	2028	26.0
14	1500	6670	26.0	179.2	131.00		10.00	MIN	2028	26.0
15	1500	6670	26.0	179.2	137.00		10.00	MIN	2028	26.0
16	1500	6670	26.0	179.2	143.00		10.00	MIN	2028	26.0
17	1500	6670	26.0	179.2	149.00		10.00	MIN	2028	26.0
18	1500	6670	26.0	179.2	156.00		10.00	MIN	2028	26.0
19	1500	6670	26.0	179.2	162.00		10.00	MIN	2028	26.0
20	1500	6670	26.0	179.2	168.00		10.00	MIN	2028	26.0

SPT0000418

Appendix A

65 Ford High Speed Testing



CLOCK TIME	DATE	ON OR OFF	OPER.	DRUM COUNTER	MILEAGE	DRUM R.P.M.	DRUM M.P.H.	LOAD	INFL.	R.T.	TOTAL HOURS
219A	7 8	ON	BJ	BC	Ø		14	1520	26	100	Ø
325A	7 8	OFF	BJ	BC	96.2		112	1500	31	105	66.15

6 12 min @ 112 mph

OSS Should be set 31 psi

POS.	SECTION NEW PSI		ARC NEW PSI		CHORD NEW PSI	
1						
2						
3						
4						
5						
6						
AVG.						

CUT GROWTH MEASUREMENTS

POS.	GROOVES - SS TO OSS 1	2	3	4		
1						
2						
3						
4						

SERIAL SIZE MACHINE T3 STATION 1 TEST NO.

TEST PROJ.

049-01091 3-85

SPT0000419

Appendix A

65 Ford High Speed Testing

TEST DATE:	07/08/2000
PROJECT NUMBER:	141FM001
TEST NUMBER:	J45528
TEST CODE:	U5
SPEC NUMBER:	280105
DASH NUMBER:	28
D.O.T. NUMBER:	W2HLIPY2100
ENGINEER:	QUEISER
TIRE SIZE:	P235/75R15
RIM SIZE:	7.00
TIRE DESCRIPTION:	WILD AT
DESIGN LOAD(LBS):	1500
TEST INFL.(PSI):	26
MACHINE I.D.:	T3
STATION NUMBER:	1
TEST OPERATOR:	BILL G.
TEST CODE:	U5
START TIME:	02:19:27
STOP TIME:	03:25:36

STATION 1 TOTAL ELAPSED TEST TIME: 66.15 minutes

STEP NO.	STEP START TIME	STATION 1 *****STEP ELAPSED TIME*****	STEP MILEAGE	TOTAL MILEAGE	LOAD	TEMP
1	02:19:27	2.00 Minutes(s) @ 14.3 MPH	0.5	0.5	1499	100.1
2	02:21:27	2.00 Minutes(s) @ 27.3 MPH	0.9	1.4	1497	100.2
3	02:23:27	2.00 Minutes(s) @ 40.8 MPH	1.4	2.7	1502	99.6
4	02:25:27	2.00 Minutes(s) @ 54.3 MPH	1.8	4.5	1502	99.8
5	02:27:27	2.00 Minutes(s) @ 67.4 MPH	2.2	6.8	1502	101.0
6	02:29:27	10.00 Minutes(s) @ 80.9 MPH	13.5	20.3	1501	103.4
7	02:39:27	10.00 Minutes(s) @ 87.1 MPH	14.5	34.8	1499	104.0
8	02:49:28	10.00 Minutes(s) @ 94.1 MPH	15.7	50.4	1498	91.4
9	02:59:28	10.00 Minutes(s) @ 99.9 MPH	16.7	67.1	1498	104.4
10	03:09:28	10.00 Minutes(s) @105.9 MPH	17.7	84.8	1499	95.9
11	03:19:29	6.12 Minutes(s) @112.0 MPH	11.4	96.2	1500	105.0

OSS Shoulder Sep

31 PSI

SPT0000420

Appendix A

65 Ford High Speed Testing

TEST TYPE-> [illegible] WAREHOUSE ORDER NO: [illegible]
FORD HIGH SPEED
PROJECT NO. -> [illegible] NON STD TEST -> [illegible] DATE -> 200[illegible]
TEST NO. -> [illegible] MFG BY -> [illegible] SERIAL -> [illegible]
TEST CODE -> [illegible] SIZE -> [illegible] S SPEED RATING : [illegible]
REV DATE ->0001-01-01 REV TIME ->00:00:00 DL CONST NO -> [illegible]
SPEC NO -> 28010[illegible]-29 DESIGN NO -> [illegible]
INFL -> [illegible] PSI LOAD -> [illegible] LBS RIM -> [illegible]
INFL -> [illegible] KPA LOAD -> [illegible] NM NO. OF TIRES [illegible]
BREAKIN ->VARIES FORM->10 [illegible] AMBIENT TEMP=100F+ [illegible]
TIRE DESCRIPTION -> FIRESTONE WILDERNESS AT
GENERAL FEATURES -> FIRESTONE WILDERNESS AT

PRIORITY

USE DASH NO -> [illegible]
SOURCE -> [illegible] GOAL/MAX SPEED -> [illegible]
REMARKS -> [illegible] WRITTEN ON [illegible]

MTD 7-7-00 5% 2ND DV

CUSTOMER -> FORD WHEEL MATERIAL [illegible] W2HL PY 2100

REQUESTOR:TSOTDSA 13 ENGINEER: [illegible] PHONE: [illegible]
MACHINE:________ STATION: 3
DISPOSITION: INSP. [illegible]
END REMARKS: ________
DATE COMPLETE. YR ___- MO _ -DA _ OPERATOR______

STEP NO	LOAD LB	LOAD NM	INFL PSI	INFL KPA	STEP SPEED	LOAD REG	STEP DUR	DUR UNIT	STEP REF LOAD	STEP REF INFL
1	1500	6670	26.0	179.2	14.00		2.00	MIN	2028	26.0
2	1500	6670	26.0	179.2	27.00		2.00	MIN	2028	26.0
3	1500	6670	26.0	179.2	41.00		2.00	MIN	2028	26.0
4	1500	6670	26.0	179.2	54.00		2.00	MIN	2028	26.0
5	1500	6670	26.0	179.2	67.00		2.00	MIN	2028	26.0
6	1500	6670	26.0	179.2	81.00		10.00	MIN	2028	26.0
7	1500	6670	26.0	179.2	87.00		10.00	MIN	2028	26.0
8	1500	6670	26.0	179.2	94.00		10.00	MIN	2028	26.0
9	1500	6670	26.0	179.2	100.00		10.00	MIN	2028	26.0
10	1500	6670	26.0	179.2	106.00		10.00	MIN	2028	26.0
11	1500	6670	26.0	179.2	112.00		10.00	MIN	2028	26.0
12	1500	6670	26.0	179.2	118.00		10.00	MIN	2028	26.0
13	1500	6670	26.0	179.2	125.00		10.00	MIN	2028	26.0
14	1500	6670	26.0	179.2	131.00		10.00	MIN	2028	26.0
15	1500	6670	26.0	179.2	137.00		10.00	MIN	2028	26.0
16	1500	6670	26.0	179.2	143.00		10.00	MIN	2028	26.0
17	1500	6670	26.0	179.2	149.00		10.00	MIN	2028	26.0
18	1500	6670	26.0	179.2	156.00		10.00	MIN	2028	26.0
19	1500	6670	26.0	179.2	162.00		10.00	MIN	2028	26.0
20	1500	6670	26.0	179.2	168.00		10.00	MIN	2028	26.0

SFT0000421

Appendix A

65 Ford High Speed Testing

CLOCK TIME	DATE	ON OR OFF	OPER.	DRUM COUNTER	MILEAGE	DRUM R.P.M.	DRUM M.P.H.	LOAD	INFL.	R.T.	TOTAL MINUTES
719 A	7 8	ON	BS	BC	0		14	1500	26	100	0
325 A	7 8	OFF	BS	BC	95.8		112	1500	31	102	65.95

5.92 Min @ 112 MPH

OSS Shoulder Sup

31 psi

POS.	SECTION NEW PSI	ARC NEW PSI	CHORD NEW PSI
1			
2			
3			
4			
5			
6			
AVG.			

CUT GROWTH MEASUREMENTS

POS.	GROOVES - SS TO OSS					
	1	2	3	4		
1						
2						
3						
4						

SERIAL SIZE MACHINE T3 STATION 3 TEST NO.

TEST PROJ.

040-01095 3-85

SPT0000422

Appendix A

65 Ford High Speed Testing

TEST DATE:	07/08/2000
PROJECT NUMBER:	141FM001
TEST NUMBER:	J45529
TEST CODE:	U5
SPEC NUMBER:	280105
DASH NUMBER:	29
D.O.T. NUMBER:	W2HLIPY2100
ENGINEER:	QUEISER
TIRE SIZE:	P235/75R15
RIM SIZE:	7.00
TIRE DESCRIPTION:	WILD.AT
DESIGN LOAD(LBS):	1500
TEST INFL. (PSI):	26
MACHINE I.D.:	T3
STATION NUMBER:	3
TEST OPERATOR:	BILL G.
TEST CODE:	U5
START TIME:	02:19:27
STOP TIME:	03:25:24

STATION 3 TOTAL ELAPSED TEST TIME: 65.95 minutes

STEP NO.	STEP START TIME	STATION 3 *****STEP ELAPSED TIME*****	STEP MILEAGE	TOTAL MILEAGE	LOAD	TEMP
1	02:19:27	2.00 Minutes(s) @ 14.3 MPH	0.5	0.5	1497	97.0
2	02:21:27	2.00 Minutes(s) @ 27.3 MPH	0.9	1.4	1501	97.1
3	02:23:27	2.00 Minutes(s) @ 40.8 MPH	1.4	2.7	1503	97.2
4	02:25:27	2.00 Minutes(s) @ 54.3 MPH	1.8	4.5	1499	97.6
5	02:27:27	2.00 Minutes(s) @ 67.4 MPH	2.2	6.8	1501	98.0
6	02:29:27	10.00 Minutes(s) @ 80.9 MPH	13.5	20.3	1501	99.7
7	02:39:27	10.00 Minutes(s) @ 87.1 MPH	14.5	34.8	1499	101.0
8	02:49:28	10.00 Minutes(s) @ 94.1 MPH	15.7	50.4	1502	92.4
9	02:59:28	10.00 Minutes(s) @ 99.9 MPH	16.7	67.1	1501	101.6
10	03:09:28	10.00 Minutes(s) @105.9 MPH	17.7	84.8	1499	95.6
11	03:19:29	5.92 Minutes(s) @112.0 MPH	11.1	95.8	1500	102.4

OSS Shoulder Sep

31 PSI

SPT0000423

Appendix A

65 Ford High Speed Testing

TEST TYPE=> DUR
FORD HIGH SPEED
PROJECT NO. => 141[illegible]
TEST NO. => 145530
TEST CODE => US
REV DATE =>0001-01-01
SPEC NO => 280105 -30
INFL => 26.0 PSI
INFL => 179 KPA
BREAKIN =>VARIES
TIRE DESCRIPTION => FIRESTONE WILDERNESS AT
GENERAL FEATURES => FIRESTONE WILDERNESS AT
USR BASE NO =>
SOURCE => TKO
REMARKS => '98105.1' WRITTEN ON 4WHL

DOM STD TEST =>Y
DEEP BY =>2000-07-10
SIZE => P235/75R16
REV TIME =>00:00:00
DESIGN NO => P1255A1141
LOAD => 2038.0 LBS.
LOAD => 9070.0 NWT
DUR=>10 MIN

DATE => 2000-07-07
SPEED =>
SPEC B RATING=>
OE CONST NO=>
PLY => 1.00
NO OF TIRES => 1

PRIORITY

CUSTOMER => FORD
REQUESTOR: YSOTRS4
MACHINE: _____
DISPOSITION: INSP. BACKS
END REMARKS: _____
DATE COMPLETE YR ____ MO __ DA __

WHEEL MATERIAL => W2HL VP: 2/00
ENGINEER: GREASER
LOCATION: 3
PHONE: 4422
OPERATOR: _____

STEP NO	LOAD LB	LOAD NWT	INFL PSI	INFL KPA	STEP SPEED	CAP/ REG	STEP DUR	DUR UNIT	STEP REF LOAD	STEP REF INFL
1	1500	6670	26.0	179.2	14.00		2.00	MIN	2028	26.0
2	1500	6670	26.0	179.2	27.00		2.00	MIN	2028	26.0
3	1500	6670	26.0	179.2	41.00		2.00	MIN	2028	26.0
4	1500	6670	26.0	179.2	54.00		2.00	MIN	2028	26.0
5	1500	6670	26.0	179.2	67.00		2.00	MIN	2028	26.0
6	1500	6670	26.0	179.2	81.00		10.00	MIN	2028	26.0
7	1500	6670	26.0	179.2	87.00		10.00	MIN	2028	26.0
8	1500	6670	26.0	179.2	94.00		10.00	MIN	2028	26.0
9	1500	6670	26.0	179.2	100.00		10.00	MIN	2028	26.0
10	1500	6670	26.0	179.2	106.00		10.00	MIN	2028	26.0
11	1500	6670	26.0	179.2	112.00		10.00	MIN	2028	26.0
12	1500	6670	26.0	179.2	118.00		10.00	MIN	2028	26.0
13	1500	6670	26.0	179.2	125.00		10.00	MIN	2028	26.0
14	1500	6670	26.0	179.2	131.00		10.00	MIN	2028	26.0
15	1500	6670	26.0	179.2	137.00		10.00	MIN	2028	26.0
16	1500	6670	26.0	179.2	143.00		10.00	MIN	2028	26.0
17	1500	6670	26.0	179.2	149.00		10.00	MIN	2028	26.0
18	1500	6670	26.0	179.2	156.00		10.00	MIN	2028	26.0
19	1500	6670	26.0	179.2	162.00		10.00	MIN	2028	26.0
20	1500	6670	26.0	179.2	168.00		10.00	MIN	2028	26.0

SPT0000424

Appendix A

65 Ford High Speed Testing

min

CLOCK TIME	DATE	ON OR OFF	OPER.	DRUM COUNTER	MILEAGE	DRUM R.P.M.	DRUM M.P.H.	LOAD	INFL.	A.T.	TOTAL HOURS
4:19 A	9	ON	BB	BC	0		14	1500	26	100	0
5:26 A	18	OFF	BB	BC	96.7		112	1500	31	101	66.40
				6.37	MIN	@	112	MPH			
				OSS Wall Skip							
					31 PSI						

POS.	SECTION NEW PSI		ARC NEW PSI		CHORD NEW PSI	
1						
2						
3						
4						
5						
6						
AVG.						

CUT GROWTH MEASUREMENTS

POS.	GROOVES - SS TO OSS 1	2	3	4		
1						
2						
3						
4						

SERIAL SIZE MACHINE T3 STATION 3 TEST NO.

TEST PROJ.

040-01091 3-88

SPT0000425

Appendix A

65 Ford High Speed Testing

TEST DATE:	07/08/2000
PROJECT NUMBER:	141FM003
TEST NUMBER:	J45530
TEST CODE:	U5
SPEC NUMBER:	280105
DASH NUMBER:	30
D.O.T. NUMBER:	W2HLIPY2100
ENGINEER:	QUEISER
TIRE SIZE:	P235/75R15
RIM SIZE:	7.00
TIRE DESCRIPTION:	WILD.AT
DESIGN LOAD(LBS):	1500
TEST INFL.(PSI):	26
MACHINE I.D.:	T3
STATION NUMBER:	3
TEST OPERATOR:	BILL G.
TEST CODE:	U5
START TIME:	04:19:50
STOP TIME:	05:26:14

STATION 3 TOTAL ELAPSED TEST TIME: 66.40 minutes

STEP NO.	STEP START TIME	STATION 3 *****STEP ELAPSED TIME*****	STEP MILEAGE	TOTAL MILEAGE	LOAD	TEMP
1	04:19:50	2.00 Minutes(s) @ 14.3 MPH	0.5	0.5	1503	97.9
2	04:21:50	2.00 Minutes(s) @ 27.3 MPH	0.9	1.4	1498	97.7
3	04:23:50	2.00 Minutes(s) @ 40.9 MPH	1.4	2.7	1501	98.0
4	04:25:50	2.00 Minutes(s) @ 54.2 MPH	1.8	4.5	1498	98.1
5	04:27:50	2.00 Minutes(s) @ 67.3 MPH	2.2	6.8	1498	98.6
6	04:29:50	10.00 Minutes(s) @ 81.1 MPH	13.5	20.3	1497	97.2
7	04:39:51	10.00 Minutes(s) @ 87.0 MPH	14.5	34.8	1504	100.1
8	04:49:51	10.00 Minutes(s) @ 93.9 MPH	15.7	50.4	1496	101.0
9	04:59:51	10.00 Minutes(s) @ 99.7 MPH	16.7	67.1	1504	100.7
10	05:09:52	10.00 Minutes(s) @105.9 MPH	17.7	84.8	1500	92.8
11	05:19:52	6.37 Minutes(s) @112.0 MPH	11.9	96.7	1500	101.5

OSS WALL SEP
31 PSI

SPT0000426

Appendix A

67 Ford-Firestone Southwest Survey

BRIDGESTONE/FIRESTONE, INC.

To	MEMO TO FILE
From	ROBERT O. MARTIN
Date	April 28, 2000
Reference	
Security Class	
Subject	TIRE SURVEY

Ford requested a survey of Firestone Ford Explorers and Ford dealers in Dallas, Las Vegas, Phoenix, and Tucson were selected to remove tires from trade-in or lease return vehicles. The tires removed were P235/75R15 and P255/70R16 Firestone Wilderness AT tires. The tires were returned to Bridgestone/Firestone's Akron Technical Center for analysis by Bridgestone/Firestone and Ford. Before removing the tires, the dealers recorded the inflation pressure, the VIN Number, the position, and the odometer mileage. A total of 243 tires from 63 vehicles were returned.

The returned tires ranged in mileage from 11320 to 76092. Examination of the tires revealed no tire deficiencies and that the tires performed as expected.

Bridgestone/Firestone appreciates the efforts of the Ford Motor Company for coordinating the return of these tires from the dealers and for the time spent by Ford's engineering staff reviewing tires with us.

Robert O. Martin
Vice President, Corporate Quality Assurance

cc: Deepak Parekh - Ford
Jerry Metters - Ford

0S00150

Appendix A

67 Ford-Firestone Southwest Survey

SW Tire Survey: 243-Tire/63-Vehicle Summary

LOCATION STATS:

Dealer	City	Total	P235/75R15 ST381J	P255/70R16 ST358J	P255/70R18 ST369J	Trade
Click	Tucson	36	28		8	
Earnhardt	Phoenix	32	20	4	8	
Friendly	Las Vegas	64	32		32	
Gaudin	Las Vegas	61	32		29	
Leadership	Dallas	15	14			1
Tuttle	Tucson	34	26		8	
unknown	unknown	1	1			
	Total	243	153	4	85	1

City	Total	P235/75R15 ST381J	P255/70R18 ST358J	P255/70R16 ST369J	Trade
Dallas	15	14			1
Las Vegas	125	64		61	
Phoenix	32	20	4	8	
Tucson	70	54		16	
unknown	1	1			
Total	243	153	4	85	1

Jerry Van. 1150 mtg to review SW survey results
2VT
1152
Maybe Nick Kazan

0500157

Appendix A

67 Ford-Firestone Southwest Survey

SW Tire Survey: 243-Tire/63-Vehicle Summary

MILEAGE STATS:

Vehicle:

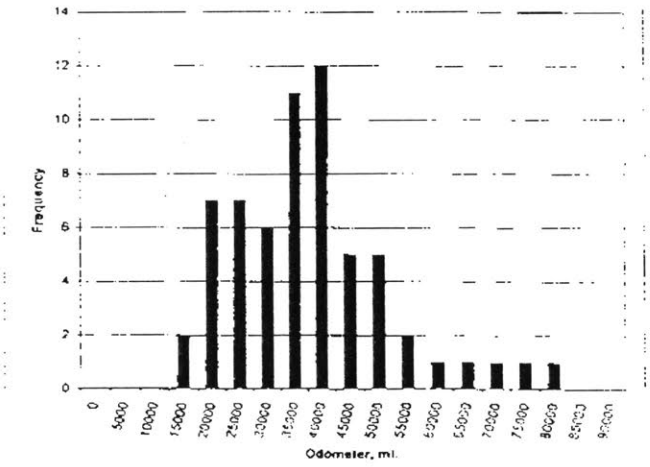
Model Year	Tires	Vehicles	Vehicle Avg. Mi
1995	4	1	72096
1996	9	2	68144
1997	86	22	36381
1998	135	35	29776
1999	4	1	16078
unknown	5	1	47731
Total	243	63	
		34649	=avg all vehicles

Tires:

	All Tires	P235/75R15 ST381J	P265/70R16 ST358J	P255/70R16 ST369J	Trade
Average	32967	29547	60062	37734	unk
Projected	72101	62693	77961	88781	unk
N	220	139	4	77	0
Excluded	23	14	0	8	1

→ Year/mileage of these vehicles

Vehicle Mileage Histogram:



0500158

Appendix A

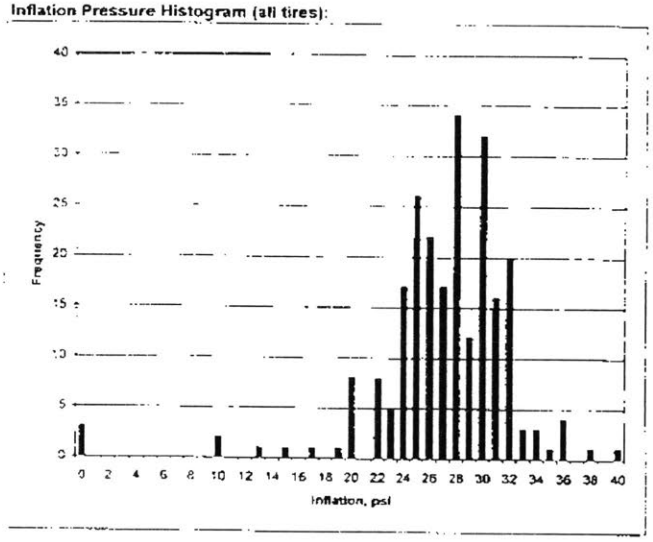
67 Ford-Firestone Southwest Survey

SW Tire Survey: 243-Tire/63-Vehicle Summary

TIRE INFLATION STATS:

	All	P235/75R15 ST381J	P255/70R16 ST358J	P255/70R16 ST369J	Trade
Avg Psi	27.1	26.6	26	28.1	30
N	240	152	4	83	1
N < 20 psi	9	4		5	

Inflation Pressure Histogram (all tires):



Notes:
- ST381J vehicle inflation = 26/26 psi
- ST358J and ST369J vehicle inflation = 30/30 psi
- 48 (31%) ST381J tires were < 26 psi
- 45 (51%) ST358J and ST369J tires were < 30 psi
- 9 tires were < 20 psi

0500159

Appendix A

67 Ford-Firestone Southwest Survey

SW Tire Survey: 243-Tire/63-Vehicle Summary

INSPECTION STATS:

	Plug	Patch	Patch & Plug	Object Thru	Object Not Thru	Off Road
Total No. Tires	7	42	14	14	11	16
% of Tires	2.5%	13.6%	5.3%	5.8%	4.5%	6.6%

Breakdown of repair by dealer

Plug = Improper, exterior application cord repair
Patch = Internal tire patch
Patch & Plug = Internal patch with integral or separate hole plug
Object Thru = Usually nail/screw/staple with penetration completely through tire
Object Not Thru = Usually nail/screw/staple with penetration not completely through tire
Off Road = Tires with some indication of unimproved road use, i.e. gravel
Tread Cuts = Tires with deep cuts in tread area

Notes:
- Some tires had more than one of, or a combination of, each item above
- 159 tires (65.4%) had none of the above
- 52 tires (21.4%) had repair(s)
- In most cases, objects through the tread (14 tires) were probably leaking
- In some cases, objects stuck in tread but not through, will eventually penetrate
- In 3 tires, repairs were made in the shoulder/buttress of the tire (improper area)
- In 1 tire, an internal patch was loose and probably permitting inflation loss
- 8 tires were worn out or almost worn out, some with shoulder wipe
- 1 tire was worn completely through the top steel belt in the shoulder

No Tires showed any indication of tread seps

0500160

Appendix A

69 Firestone Statement to KHOU

Statement From Bridgestone/Firestone, Inc
February 4, 2000

"We at Bridgestone/Firestone, Inc. take great pride in the quality and durability of our products and we stand behind all of them. We work hard every day to earn and maintain the loyalty and trust of our customers, and we have full confidence in the performance of our Firestone Radial ATX tires.

Firestone has manufactured more than 12 million Radial ATX tires- nearly 6.8 million of which were original equipment on virtually all of the millions of Explorers produced by the Ford Motor Company from 1990 to 1996. The Radial ATX has proven to be a reliable workhorse for U.S. consumers. Our experience with the Radial ATX indicates high consumer satisfaction with the quality and reliability of these tires. No court or jury has ever found any deficiency in these tires.

KHOU inquired about Firestone's investigation of three incidents involving Radial ATX tires on Ford Explorers. That investigation exemplifies the kinds of tire damage that Firestone has found in investigating Radial ATX incidents. One tire had a puncture, which the owner unsuccessfully attempted to repair with aerosol flat fixer. The second tire had severe road hazard damage. The third tire had multiple punctures, one of which was left unrepaired. Out of respect for the persons involved, Firestone took no steps to publicize the results of its investigation of the incidents.

KHOU also asked about a theory advanced by some in tire product liability lawsuits that nylon cap plies prevent tread/belt separation. Nylon cap plies are used almost exclusively on high speed rated tires. There is no scientific data or study that shows a durability advantage to tires with nylon cap plies at normal highway speeds.

For the 1997 model year, Ford chose the new Firestone Wilderness AT tire line for use as original equipment on most Explorers. Ford's selection was in no way related to the reliability of the Firestone Radial ATX. In fact, the Firestone Radial ATX continues to be produced and remains one of Firestone's most popular and successful aftermarket tires.

We monitor the performance of all of our tires and, having manufactured more than 12 million Radial ATX tires, we have full confidence in them. Bridgestone/Firestone wants its customers to be fully satisfied with all of our products and services. If any customer would like to have additional assurance about the quality of his or her tires, we invite them to visit a local Firestone store where we will be pleased to check their tires.

Appendix A

70 Customer Complaint Letter

September 7, 1997

Mr. Trevor C. Hoskins
Sr. Vice President - Public Affairs Department
Bridgestone/Firestone, Inc.
50 Century Blvd.
Nashville, TN 37214

Dear Mr. Hoskins:

It has taken me over a month to write this letter. I have been so upset and angry that I had to wait until I was able to control my emotions and express my feelings in a responsible manner.

On August 4, 1997, I was driving home from work, outbound on Highway 288, when suddenly I lost control of my 1992 Ford Explorer. I hit an 18 wheeler and bounced off of his truck - twice. I then crossed the median of Highway 288 toward oncoming traffic and somehow managed to control the vehicle in the median and ended up on the shoulder parallel with the inbound lanes. I don't know how, but the vehicle did not flip over. When I got out of the car, my front driver side tire had blown and I thought that was the cause of the accident. When all of the witnesses stopped to see if I was alive, it was apparent that the front tire was not the problem. It was my rear passenger side tire that had lost the tread and caused the accident.

It was really ironic because I had been concerned over the Firestone ATX tires since November, 1996 when the local news aired several stories about accidents with these tires and the number of fatalities that had occurred. I was so scared of the tires that I had them inspected at Strouhalls in November, 1996 and was told they had plenty of tread and did not need to be replaced. Still concerned, I went to the Firestone store at 5800 Westheimer, Houston, Texas on November 22, 1996 and had them inspected again. A copy of the invoice is enclosed. Again I was told they were fine, had plenty of tread and did not need to be replaced. Both inspections were done at tire dealers who could have easily sold me new tires if they had thought there was a problem.

My car was inspected for the state inspection sticker in January, 1997 and again there was no problem with the tires. On July 24, 1997, I had $540 air conditioning work done on the vehicle at Penske and again was told the tires were fine and did not need to be replaced. A copy of the invoice is enclosed, which shows I had 56,128 miles on the vehicle. Then on August 4, 1997, the

Appendix A

70 Customer Complaint Letter

tire fell apart. Everyone at the scene of the accident was horrified at what could have happened. No one thought I should be alive and could not believe that the vehicle did not flip over and kill me.

I do not understand why Firestone has not recalled these tires. I have talked with several attorneys who believe I have a lawsuit against Firestone for what happened. I do not want to pursue that option but do want to prevent other people from experiencing what happened to me. My insurance company, State Farm, is investigating the tire and the accident. I received $10,800 for my vehicle and it cost me $24,000 for a new car. I was not very happy! Because of your tires, I was forced to buy a new vehicle. I will tell you that my new Ford Explorer does not have Firestone tires at my insistence.

I have and will continue to tell everyone I can, that these tires are a hazard and should be recalled. I truly believe that Firestone knows there is a problem and refuses to acknowledge the problem because of your liability. I cannot believe that the people at Firestone will not take responsibility for the problems associated with these tires. I would not want the blood on my hand if I were an employee of your company.

I would appreciate your response in writing and what action your company will take with regard to this problem. If I do not receive a reasonable response and action from Firestone, I will be forced to take legal action and pursue my options with additional media coverage. I am out $13,200 and many hours of pain and agony from this accident which could have been prevented if Firestone had taken the proper action. I still have problems driving and am paranoid of all the other vehicle on the road that have these Firestone ATX tires. It was very fortunate that my accident did not cause damage or death to the people and vehicles around me.

I have enclosed pictures of my totaled vehicle. As you can see, the tires do not reflect any problems except the tire that fell apart. I have pieces of the tread that came off and the tire was confiscated by the insurance company for analysis.

Your prompt response is requested.

Sincerely,

Appendix A

71 Middle East Tire Survey

MIDDLE EAST TIRE SURVEY: Ford Explorer / P255/70R16 109S Firestone Wilderness AT

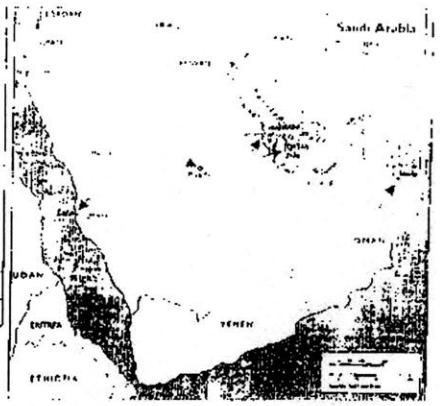
TRIP SUMMARY AND REPORT

Team: Ford: Jim Johnson, Technical Service Manager, WDMO, Dearborn
Amir Al Orabi, Field Service Manager, MidEast/Africa, Dubai

BFS: Bruce Halverson, Manager, Market Quality Assurance, Nashville
Brian Queisser, Proj. Engineer, OE Pass LT Development, Akron

Itinerary:

June	Location	Dealer/Contact	Veh.
9	Jeddah, Saudi	Al Jazirah	11
10	Jeddah, Saudi	Haji Hussein Alireza	7
11	Travel		
12	Riyadh, Saudi	Al Jazirah Auto World	12
13	Riyadh, Saudi	Haji Hussein Alireza	7
14	Al Khobar, Saudi	Al Jazirah	4
15	Al Khobar, Saudi	Tamimi Co. Haji Hussein Alireza	7
16	Doha, Qatar	Almana Motors	6
17	Muscat, Oman	Arabian Car Mktg	13
		total:	67



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Appendix A

71 Middle East Tire Survey

MIDDLE EAST TIRE SURVEY: Ford Explorer / P255/70R16 109S Firestone Wilderness AT

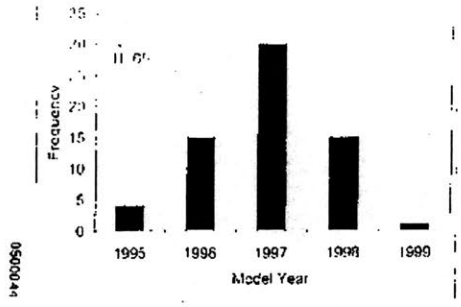
Overview of Inspections:

➢ Total Vehicles and Tires:

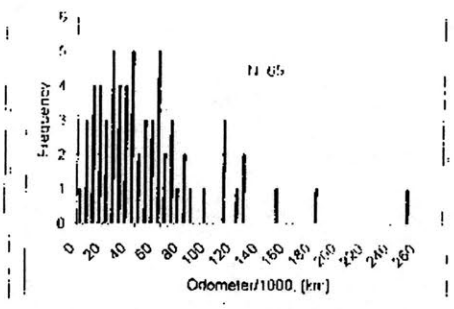
- (67) Explorers [VIN, odometer]
- (268) tires [DOT, groove depth, inflation, chip/tear rating, repairs, cuts/punctures]

➢ All vehicles, except new, at the visited dealers were checked (most were in for repair/maintenance)

Model Year Histogram:



Odometer Histogram:



Appendix A

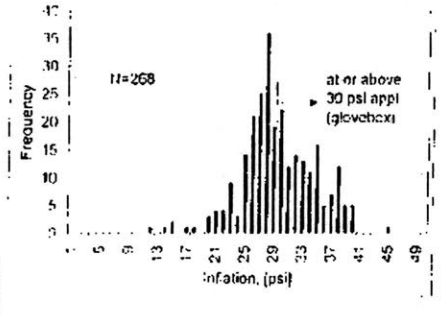
71 Middle East Tire Survey

MIDDLE EAST TIRE SURVEY: Ford Explorer / P255/70R16 109S Firestone Wilderness A/T

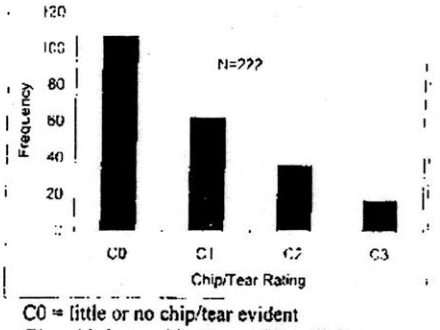
Overview of Inspections (continued):

- Tire inflation recorded for all tires (including non-Firestone) on every Explorer examined.
  - 54% of tires below 30 psi (Ford recommended inflation setting 30/30 psi F/R)
  - 9% tires at or below 20 psi
- Chip/Tear ratings only for Firestone brand tires (new tires excluded)
  - 25% of tires exhibited moderate to heavy chip/tear

Tire Inflation Histogram:



Chip/Tear Rating Histogram:



C0 = little or no chip/tear evident
C1 = chip/tear evident to engineer (light)
C2 = chip/tear evident to consumer (moderate)
C3 = chip/tear objectionable to consumer (heavy)

Bridgestone/Firestone, Inc July 7, 1999

Appendix A

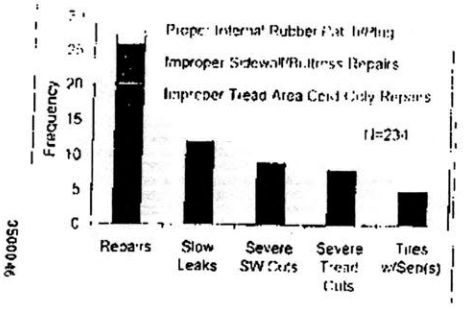
71 Middle East Tire Survey

MIDDLE EAST TIRE SURVEY: Ford Explorer / P255/70R16 109S Firestone Wilderness AT

Overview of Inspections (continued):

- Individual repairs, leaks, cuts, etc. data recorded for only Firestone brand tires
  - Improper repairs found in 11% of Firestone tires inspected
    - (6) Improper sidewall buttress repairs
    - (20) Improper cord-only repairs in tread area
  - Slow leaks, causing a run-low condition, can result in internal tire damage
  - Severe cuts can be indicators of additional damage
  - Firestone North American policy: improperly repaired tires are not warranted and any repair damage nullifies the tire speed rating
- During the tire survey, all cases of safety concerns were reported to the dealership service manager

Tire Anomalies Histogram



Appendix A

71 Middle East Tire Survey

MIDDLE EAST TIRE SURVEY: Ford Explorer / P255/70R16 109S Firestone Wilderness AT

Overview of Inspections (continued):

- Other General Observations
  - Service Conditions:
    - Highway tarmac conditions are very good; often 6+ lanes with high speed capability
    - City streets are similar configuration to NA Europe, except more roundabouts
    - Speed is virtually unrestrained in all areas
      Driving habits are aggressive: testimonials indicate max vehicle speed regularly attained on Highway
    - Testimonials indicate off-road use is common. Reducing tire inflation to operate in soft sand and heavy rock is usual practice – increasing before returning to highway is not 100%.
    - Sustained summer heat is very high, well over 105°F during day – hotter inland
  - Vehicles:
    Many vehicles exhibited witness marks of moderate off-road use (front and rear wheel housing shroud damage scrapes, rocker damage, etc.); some more than others
    - Many vehicles equipped with 3rd row seats – fully loaded with passengers, Explorers are near GVW
  - Tires Wheels:
    - Projected avg wearout (based on this survey) of the OE tires is 139,000 km (86,060 mi)
    - Roughly 50% or more wheels were missing valve caps (potential leakage)
    - Upper sidewall and shoulder area rubber cracking was more common on tires in the eastern, Persian Gulf cities
    - Tire anomalies appeared worse and more often on the outboard side (direct sun, ozone)

Appendix A

74 Memo from Firestone Dubai re: Saudi Arabian tread separations

بسم الله الرحمن الرحيم

AL JAZIRAH VEHICLES Agencies Co. شركة تهوكيلات الجزيرة للسيارات

Limited Liabilities Co.
Capital SR. 5,000,000 Fully Paid
C. R. 1010064047 - C. C. 165

شركة ذات مسئولية محدودة
رأس المال ٥٠٠٠٠٠٠ ريال مدفوع بالكامل
س.ت : ١٠١٠٠٦٤٠٤٧ - غرفة ١٦٥

Ford LINCOLN

Date: February 25, 1999 التاريخ
No. NSDD/0075/99 الرقم

TO: MR. KESHAV DAS
Technical Service Department
Firestone - Dubai

SUBJECT: FORD EXPLORER FIRESTONE TYRES

Sir,

Thanks for your letter of the 23-02-99 regarding the above subject in response to my letter of the 20-02-99 and 14-02-99.

I consider the contents of your letter to be no more than an attempt to create a smoke screen over the issue. Taking these point by point I would comment as follows:

1) Tyre Thread Separation

I agree that thread separation may not indicate a manufacturing defect in the tyre, however it can be equally argued that if an inbuilt defect exists it does not mean that this will become apparent early in the tyre life. The fact that this particular tyre thread separated at 54,305 km is irrelevant to the core issue which is not when it occurred, but why it occurred.

With regards to your comment on tyre pressure maintenance. I agree that the proper maintenance of tyre pressures is an important factor. However as stated just because the left front tyre was at 26 psi when inspected this does not under any circumstances mean that the pressures were not checked every 2 weeks or that this tyre was at the correct pressure at the time of the accident, also your reference to this point is totally irrelevant to the issue at hand. The left front tyre is not in question at this time.

The fact that Firestone Wilderness P255/70/R16 A/T tyres have been accepted by Ford as original equipment again is irrelevant to this particular incident.

Appendix A

74 Memo from Firestone Dubai re: Saudi Arabian tread separations

I am in close communication with Ford, Dubai on this issue and Glen Drake wishes me to retain the wheel and tyre in untouched condition for forward shipment to Ford, U.S.A..

You should be aware that we have another case of complete thread separation which has been involved in a very serious accident that arrived to our Branch early this very day. Once again a 1996 Explorer fitted with the same tyres. I have investigated this vehicle and find that the right rear tyre tread has separated in exactly the same area as the previous one. These incidents involving Firestone P255/70/R16 tyres is beginning to become an epidemic. At this time I do not have details of injury of fatalities in this latest case, but be sure that I will keep you informed of developments.

Nothing in your reply has done anything to re-assure me that there may not exist a defect in a particular batch of your product and I note that you did not answer the three simple questions I asked of you in my letter of February 20th 1999. Al Jazirah is firmly committed to customer satisfaction and safety therefore, please be very aware that I will continue to pursue this issue until I have a satisfactory solution.

Yours sincerely,

JOHN GARTHWAITE
NATIONAL SERVICE DIRECTOR

Cc: President
Vice-President
General Manager
Marketing Director
Glen Drake – Ford, Dubai

Firestone
26/2/99 1137

PE00-020 3643

Appendix A

75 Firestone Memo re: Gulf Countries Recall

BRIDGESTONE Firestone

ORIGINAL EQUIPMENT TIRE SALES COMPANY

One Towne Square, Suite 1470
Southfield, MI 48076-3708
Phone: 248-208-3600 Fax: 248-208-3636

A DIVISION OF BRIDGESTONE/FIRESTONE, INC.

March 11, 1999

To: S. Katsura, Dubai Office
Y. Tomiyasu, BSJ GSC
D. R. Saurer, PLTD (Akron)
R. O. Martin, QA (Nashville)
H. B. Horton, Law Dept. (Akron)

Subject: **EXPLORER SITUATION – MIDDLE EAST**

I had another meeting today with Chuck Seilnacht from Ford's Worldwide Direct Marketing Operations group with respect to the P235/70R16. I provided him with photographs of the current P255/70R16 Wilderness AT OWL, the H-rated European tire, and the Australian Special Service tire. I also advised him that our adjustment rate on the subject tire in the U.S. from 1995 through 1998 is less than 0.1% (1/10th of 1%), on total production of just under 1.75 million tires. Furthermore, of that small percentage, nearly half of those adjustments were for vibration.

Mr. Seilnacht then provided me with the attached write-up that he put together. As indicated, the write-up confirms his belief that the tire is not at fault. Interestingly, Ford conducted a search of their data files on this same tire in the U.S., as indicated in the second bullet point. That search revealed only a handful of tire "failures" reported by dealers and/or customers, out of approximately 300,000 Explorers and Mountaineers equipped with this tire. That's contrasts dramatically with the reports of seven incidents already in Saudi Arabia, where Ford estimates there are only 2,000 Explorers/Mountaineers in service.

The rest of the meeting focused on Ford's proposed customer notification program, which Mr. Seilnacht details at the bottom of his write-up. I advised him of our concerns with that type of program, both with respect to the perception it might convey in Saudi, as well as related complications that it could create in North America. Fortunately, he had received similar responses from his own people, none of whom favored that type of program.

It's really unknown as to where we go from here. Mr. Seilnacht and I did agree that any additional tires that come in to Ford be immediately sent to Akron for analysis. Further to that, he asked if we could provide a listing of who our contacts are for Al Jazirah (Ford) and Haji Hussain Alireza (Mercury) at each of their locations. Those distributorships have one outlet each in Dammam, Riyadh, and Jeddah. Shingo, could you please advise me the name and phone number for our contacts in those locations. Furthermore, he asked that our people contact each dealership, and advise them that all tires involved in any further incidents be turned over to us. Those tires are then to be sent to Akron via airfreight for analysis (attn: Jim Gardner).

Appendix A

75 Firestone Memo re: Gulf Countries Recall

Ford plans to proceed with the change to the H-rated European tire for newly built Explorers destined for the Middle East, as soon as possible. Unfortunately, there is still concern that if punctures, and run-low conditions, are the ultimate cause of the concern, as is suspected, neither this tire, nor the Special Service tire, will totally resolve the situation. I further advised Mr. Seilnacht that we are working with the Ford U152 people (2002 Explorer) on a ROW (rest-of-world) tire that would be a compromise of attributes (chip tear, puncture resistance, high speed/heat resistance, etc.) for Explorers going to various parts of the world, including the Middle East. While he commends those efforts, he further recognizes that this will not provide any immediate help.

Lastly, with respect to GSC's question on changing to a white letter tire, it is generally felt that the H-rated tire is the best alternative at this time. The rest-of-world tire being proposed to Ford will be white letter, but until (and if) that tire is approved, Ford is proceeding with the change to the BSW H-rated tire for the Middle East.

Yours truly,

John E. Behr
Account Executive

cc: A. W. Stuart
J. Ujiyama / P. Hoda
J. Saruwatari (BSJ GSC)
D. Candido (ATC)

letter-c.doc

Appendix A

78 Memo re: Venezuelan Tire Survey

BRIDGESTONE FIRESTONE VENEZOLANA C.A.
RIF J-00071467-0

Carretera Nacional Valencia - Los Guayos
Apdo. 194 - Valencia 2001 - A
E-Mail [illegible]
Telef. 0041 [illegible]
Fax. 0041 [illegible]
Valencia, Edo. Carabobo
Venezuela

JAG312/99
Valencia, August 24, 1999

Mr. E. Cassingena
President
Ford Motor de Venezuela, S.A.
Valencia

Dear Mr. Cassingena:

As agreed during the meeting held on July 29, 1999, we have proceeded to fully investigate the use of the tire Wilderness, sizes P235/75R15a and P255/70R16 in order to determine which actions are needed and establish a plan to meet our customer's needs.

Reports, documents, conclusions and recommendations regarding the inspections made, follow:

1. Document #1 contains a report by Messrs. Bruce Halverson and Roger Marble regarding the visits made to Ford Dealers in the Maracaibo, Cabimas, Punto Fijo and Barquisimeto Areas. Oscar Romero, Roselia Moreno and Edivia Caballero from Ford Venezuela and Luis Abreu and Pedro Martinez from BFVZ also participated in these visits.

2. Document #2: Summary of the main issues, possible causes and effects of the findings by BFVZ's Technical Department and recommendations after said evaluations.

3. Document #3: Summary of the survey made by BFVZ with the owners of Ford Explorer.

4. Based on the findings we are recommending a program as attached under "Document 4", Training program to Ford Dealers, and special work in conjunction with BFVZ dealers and BFVZ personnel.

Appendix A

78 Memo re: Venezuelan Tire Survey

BRIDGESTONE FIRESTONE VENEZOLANA C.A.
RIF: J-00014879-0

Carretera Nacional Valencia - Los Cuevos
Apdo. 154 - Valencia 2003 - A
E-Mail: [illegible]
Telef. [illegible]
Fax: (041) 36 55 77 - 32 15 51 - 33 82 73
Valencia, Edo. Carabobo
Venezuela

In addition to the above mentioned subjects and in particular to carry out an intensive program to identify if there are any problems which were not detected in the inspections, we have prepared a promotion for owners of Sports Utility Vehicles, offering a very interesting incentive to visit our service centers.

We are also in the process of preparing a brochure on the correct use and maintenance of the tires, which will be delivered to all Ford and BFVZ dealers to be distributed to Ford customers.

Through these programs we continue making all possible efforts to meet all the requests not only of Ford but also of all our customers. Should you require additional information regarding these reports, please do not hesitate in contacting us.

Sincerely,

Jorge A. González
President & Managing Director

cc: Sres. H. Rodríguez – Ford de Venezuela
O. Romero – Ford de Venezuela
A. Da Silva – Ford de Venezuela
G. Pereira – Ford de Venezuela
C. Marón – Ford de Venezuela
A. Stuart – BFOE, Southfield
H. Horton – BFS, Akron
R. Martin – BFS, Nashville
O. Rodriguez – BFVZ
L. Abreu – BFVZ
P. Martinez – BFVZ

"Free Translation"
Document 2

(PRELIMINARY REPORT)

SUMMARY OF THE EXPLORER SURVEY

Source of Information	Problem	Observations or possible Causes	Result or possible Effects
TIRE EVALUATION IN EXPLORER VEHICLES BEING SERVICED IN FORD DEALERS LOCATED AT: MARACAIBO, CABIMAS, PUNTO FIJO AND BARQUISIMETO 132 TIRES INSPECTED	Low Inflation pressure 8 Tires - 6%	1) Punctures with nails, screws, glass and others metallic objects. Repairs may not be adequate 4 Tires - 3%	Steelcord corrosion which may result in Tire separation and tread belt leaving belt and casing
		2) Protruded weld spots on rim surface - Valve failures - Poor maintenance of Inflation pressure	Progressive air leak, which favors the heat generation, flexion and fatigue of the tire inducing tread separation and tire failure
	Tread Cuts to Tire Steelbelt	3) Impact with metallic objects, glass and others sharp edge objects	Same as item 1
	Low inflation pressure in Explorer vehicles in FORD Showroom	4) Protruded weld spots on rim surface - Tires coming with low inflation pressure from OEM. Plant	Same as item 2
BFVZ Survey to Explorer users Total contacted customers: 2,183 Satisfied Customers = 1,703 78% Reporting Incidence = 480 22%	Punctures (159)	- With nails, screws and others objects in the driveways	Same as item 1
	Sidewall undulations (64)	- Wide sidewall splices	Visual effects
	Vibrations (63)	- High tire/rim run-out - Unbalance of rim/tire set or wheel mounting chuck	Vehicle vibration vertically and horizontally
	Irregular tread wear (38)	- Unbalance of tire/rim set or wheel mounting chuck - Vehicle wheel miss allignment - Tire are not being rotated periodically	Premature and irregular tread wear
	Tire slips in wet surface (16)	Need to be investigated by BFS and FORD Technical Areas	
	Impact breaks (34)	Impacts with objects in the driveways	Body ply breakage and tire must be scrapped
	Tread separations (31)	Same as item 1, 2, 3, and 4	
	OTHERS (75)		
L.E. ABREU's visit to El Tigre, Anzoategui	Explorer vehicle roll over due to tread leaving casing	- Excessive speed 173 Km/Hr (26 Km in 9 Minutes) - Heavy load, 8 passengers plus luggage - High pavement temperature (55°C at 1.20 p.m)	Tire fatigue and separations

Appendix A

82 Email from Sam Boyden re: Tread Separation Claims made to State Farm

From: samuel.k.boyden.b1p9@statefarm.com
To: Duckwitz, William <NHTSA>
Date: Wed, Jul 22, 1998 2:48 PM
Subject: Firestone ATX Tires

Bill,

We noticed we have 21 failure inquiries regarding P235 / 75R15 Firestone ATX tires in our data.

14 of the 21 inquiries are mounted on 1991-95 Ford Explorers. I have attached a table and an Adobe attachment below for your review. I have made the attachment to include the inquiries all the way back to 1992, however, if you would like the disclosure form to go out, we would send them out to only losses occurring during the most recent year.

	Calendar Year				
Inquiry Received	1998	1997	1996	1995	1994
Firestone ATX 235/75R15	4	6	3	2	4

*Two inquiries from 1992

(See attached file: Firestone ATX.PDF)

Thanks
Sam

Appendix B

NHTSA ODI Initial Findings

As Published by the U.S. DOT in *Engineering Analysis Report and Initial Decision Regarding EA00-023: Firestone Wilderness AT Tires*

1. Belt-leaving-belt tread separation failures of Firestone ATX and Wilderness AT tires manufactured for use on Ford vehicles have led to numerous deaths and injuries.

2. Most of these failures, deaths, and injuries involved ATX tires that were recalled by Firestone in August 2000. However, several different analytical methodologies demonstrate that, on a plant-by-plant basis, the tread separation claims experience of the focus Wilderness AT tires is similar to that of the recalled ATX tires after the same period of time in service.

3. The recalled ATX and Wilderness AT tires manufactured at Decatur began to fail in significant numbers after between one and two years in service; this period was 2-3 years for the recalled ATX and focus Wilderness AT tires manufactured at Wilson and 3-4 years for the recalled ATX and focus Wilderness AT tires manufactured at Joliette.

4. The tread separation failure experience of the focus tires is far worse than that of their peers, especially the Goodyear Wrangler RT/S tires used as original equipment on numerous Ford Explorers.

5. The belt wedge thickness, or gauge, in the ATX tires and the Wilderness AT tires produced prior to May 1998 is generally narrower than the wedge gauge in the peer tires tested by ODI, and the wedge gauge in cured tires was often less Firestone's target. The tires with this wedge did not adequately resist the initiation and propagation of belt-edge cracks between the steel belts.

6. Firestone increased the dimensions of the belt wedge in the focus tires and improved its material properties in March and April 1998. In general, this increase brought the wedge gauge of the focus tires within the range of the tested peers.

7. The inter-belt gauge initially specified by Firestone for the focus tires is generally narrower than the gauges in peer tires, and the actual measured gauge under the tread grooves in several of the cured tires measured by ODI was far less than Firestone's minimum design specification.

8. The design of the shoulder pocket in the focus tires can cause high stresses at the belt edge and lead to a narrowing of the wedge gauge at the pocket. The focus tires exhibit a series of weak spots around the tire's circumference, leading to the initiation and growth of cracks in these tires earlier than in competitor tires and in other Firestone tires produced for similar applications.

9. Some of the focus tires exhibited shoulder pocket cracking similar to that which Firestone identified as a significant contributor to the risk of tread detachment in the recalled ATX tires.

10. Material properties testing indicated that the peel adhesion characteristics of the focus tires reached the low level exhibited by the Decatur tires after 3-4 years and were worse than the adhesion characteristics of the Goodyear Wrangler RT/S tires. Also, the rubber in the focus tires exhibited deterioration due to aging that was similar to that of the Decatur tires and that was more severe than that of the Goodyear Wrangler RT/S tires.

11. As reflected by shearography performed on randomly collected focus tires and peer tires from southern states, where most of the failures have occurred, the cracks and separations between the belts were far more prevalent and severe in the focus tires than in peer tires. Many of the focus tires were in the later stages of failure progression prior to complete separation of the upper belt. The shearography results for tires manufactured at Wilson were essentially the same as for those manufactured at Joliette. Although ODI did not test any tires manufactured at Oklahoma City, the design of those tires is identical to those made at Wilson and Joliette.

12. Belt-leaving-belt tread separations, whether or not accompanied by a loss of air from the tire, reduce the ability of a driver to control the vehicle, particularly when the failure occurs on a rear tire and at high speeds. Such a loss of control can lead to a crash. The likelihood of a crash, and of injuries or fatalities from such a crash, is far greater when the tread separation occurs on a SUV than when it occurs on a pickup truck.

13. Tread separation claims included in the Firestone claims database involving the recalled and focus tires have been associated with numerous crashes, which have led to 74 deaths and over 350 injuries. Tread separation complaints reported from all sources included in the ODI consumer complaint database that have been identified as involving these tires have reportedly led to 192 deaths and over 500 injuries.

14. Although there have been more failures and casualties associated with failures of the recalled tires than the focus tires to date (17 deaths and 41 injuries involving focus tires in the Firestone claims database), the fact that the plant-by-plant failure trends for the focus tires are very similar to those of the recalled ATX tires demonstrates that, if they are not removed from service, the focus tires – at least those manufactured before Firestone modified the wedge --will experience a similar increase in tread separation failures over the next few years, leading to numerous future crashes, injuries, and deaths.

15. The rate of tread separation failures on Ranger pickups is lower that the rate of such failures on Explorers for a variety of reasons, including the fact that the Explorer generally carries higher loads and is a more demanding application, and the tires on the Explorer had a significantly lower recommended inflation pressure (especially on the rear wheels). The risk of such a separation on Rangers remains a cause for possible concern. Nevertheless, because the likelihood of a crash due to a tread separation, and of deaths and injuries resulting from such a crash, is substantially lower when the separation occurs on a pickup than on a SUV, NHTSA's initial defect decision does not apply to focus tires installed on pickup trucks.

16. Almost all of the tread separation failures of the focus tires that led to claims occurred after the tires were in service for at least three years and involved tires manufactured before May 1998, when Firestone improved the wedge. In theory, Firestone's modifications to the wedge would tend to inhibit the initiation and propagation of the belt-edge cracks that can lead to belt-leaving-belt tread separations. If these modifications actually improved the resistance of the focus tires to belt-edge separations, the historical failure trends described above may not predict the future performance of the newer tires. However, because tread separation failures rarely occur in the focus tires until at least three years of use, it is not now possible to ascertain from field experience whether their actual performance has improved significantly.

17. The record of this investigation supports a determination that the focus tires manufactured by Firestone prior to its 1998 modifications to the belt wedge that are installed on SUVs contain a safety-related defect. Although the agency has concerns about the possibility of future tread separations in focus tires manufactured after the wedge change, the evidence at this time does not clearly demonstrate that a safety-related defect exists in the focus tires manufactured with the improved wedge.

Appendix C

Chronology of Firestone/Ford Knowledge of Tire Safety Defect

As compiled by Public Citizen and Joan Claybrook, former administrator of NHTSA. Submitted to Congress, September 2000.

1987

May 1, 1987
A Ford internal memo states that the stability of the Explorer [UN46] is worse than Bronco II and that it can be improved by widening, lowering and using a smaller P215 tire.

June 11, 1987
Ford internal memo on a meeting with Firestone reports that the ATX design is approved by Ford.

1988

Fall 1988
Ford ADAMS reports states that the Explorer demonstrated ``performance issues'' at 35 psi but that they expected more favorable results at 26 psi.

1989

February 20, 1989
In an internal Ford memo, Ford engineers recommend use of 26/26 psi along with various other spring changes due to stability testing showing two wheel lift with 35 psi.

March 2, 1989
Internal Firestone memo to Ford states that ``in light of Ford's decision to specify 26 psi in the P245 tire for the Explorer, Firestone has tested the vehicle at 26 psi front and 35 psi rear'' . . . ``Calspan testing showed severe tread separation, but our testing used a more realistic procedure and we don't think it will be a problem.'

September 12, 1989
In an internal Ford email to Charles White, Roger F. Stornant expresses that OGC is concerned that the UN46 [Explorer] would fail Consumers Union tests with the P235 tires.

December 1989
Internal memo states that Explorer with 235 tires set at 26 psi passed the rollover test.

1990

February 1990
In order to meet the production deadline, Ford officials rejected some proposals to improve the stability of the Explorer (i.e. widening the track width).

March 1990
JOB 1: '91-'94 Explorer

May 1, 1990
Ford asks Firestone in a letter from Jim Avouris to issue a dealer bulletin regarding tire replacement, emphasizing the importance of using the correct size tire and the correct air pressures on the Explorer [due to rollover sensitivity].

1991

February 12, 1991
FILED: Woodburn v. Firestone Tire and Rubber Co.; et al. [injuries unknown]

1992

March 24, 1992
FILED: Johnson v. Nissan, et al. [injuries unknown]

April 23, 1992
FILED: Cherinka v. Ford; et al [Explorer/ATX tread separation; injuries unknown]

April 29, 1992
FILED: Roberston v. Firestone/Bridgestone, Inc.; et al. [injuries unknown]

1993

December 22, 1993
FILED: Blackaller v. Ford; Firestone; et al. [2 injuries, 2 deaths]

1994

April 12, 1994
Ford Light Truck Operations Tire Construction Detail Sheet specifies the P235/75R15 tire at a maximum psi of 35.

September 9, 1994
FILED: Dreher v. Ford, et al. [injuries unknown]

1995
Ford/Firestone begins shipping 16" Wilderness tire to Saudi Arabia.

February 23, 1995
FILED: Greenwald v. Bridgestone/Firestone, Inc.; Ford; et al. [Explorer/ATX separation; injuries unknown]

August 7, 1995
FILED: Ellis v. Bridgestone/Firestone, Inc.; Ford; et al. [Explorer/ATX; injuries unknown]

August 7, 1995
FILED: Dickson v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation from Wilson, NC plant; injuries unknown]

1996

January 4, 1996
FILED: Combs v. Ford [Bronco II/ATX separation; 1 fatality]

March 13, 1996
FILED: Welch v. Ford; et al. [Explorer/ATX separation; 3 injuries]

July 1996
FILED: Rogers v. Ford; et al. [Explorer/ATX separation; 1 injury, 1 fatality]

July 12, 1996
A memo from Deputy Yuma County (Arizona) Attorney John K. White regarding Firestone Firehawk ATX tires reported

July 22, 1996
Letter from Robert J. Descheemaker at the Arizona State Procurement Office to Roger Abrams of Bridgestone/Firestone requesting replacement of all Firehawk ATX tires bought under state contracts.

August 19, 1996
Ford CQIS computer report on Explorer with 20k miles--Colonial Ford dealer in Danbury, Connecticut has 16 Explorers with distorted tires like this--belt is obviously distorted and about to separate

August 26, 1996
FILED: Gauvain v. Bridgestone Corporation; et al. [Explorer/ATX separation; 1 fatality]

September 23, 1996
FILED: Brizendine v. So. New. T.B.A. Supply Co., et al. [injuries unknown]

December 27, 1996
FILED: Guara v. Ford, et al [Bronco II/ATX separation; injuries unknown]

1997

January 17, 1997
FILED: Kehm v. Bridgestone/Firestone, Inc.; et al. [Bronco/ATX separation; 3 injuries]

February 21, 1997
FILED: Spivak v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

June 1997
Speed rating on tires in Venezuela changed from R [106 mph] to S [112 mph], with tires to be made in Venezuela.

June 1997
FILED: State Farm Mutual Automobile Insurance Company v. Bridgestone/Firestone, Inc. [injuries unknown]

June 2, 1997
FILED: Stephens v. Catherine A. Broome and Christopher D. Kehm; Bridgestone/Firestone; et al. [Bronco/ATX separation; 3 injuries]

July 28, 1997
FILED: Jackson v. Bridgestone/Firestone, Inc.; Ford; et al. [Explorer/ATX separation; 3 injuries, 1 fatality]

August 1997
An undated memo states Ford and Firestone are notified of tire problems in Saudi Arabia

August 7, 1997
FILED: Lazarus v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

September 16, 1997
FILED: Silva v. Ford; et al. [Explorer/ATX separation; injuries unknown]

September 22, 1997
FILED: Carrillo v. Bridgestone/Firestone, Inc.; et al. [Blazer/ATX separation; 2 fatalities]

October 7, 1997
FILED: Flores v. Ford; Bridgestone/Firestone, et al. [Explorer/ATX separation; injuries unknown]

October 21, 1997
FILED: Chinichian v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

December 1, 1997
FILED: Ortiz v. Bridgestone/Firestone, Inc.; Ford; et al. [Explorer/ATX separation; 1 fatality]

1998

January 1998
Marketing manager in the UAE for Ford expresses concern about Firestone's response to the tire problems in an email to other Ford executives: "If this was a single case, I would accept Firestone's response as they are the experts in the tire business, case closed. However, we now have three cases and it is possible that Firestone is not telling us the whole story to protect them from a recall or a lawsuit."

January 9, 1998
FILED: Haffey v. Ford; et al. [Explorer/ATX separation; 2 injuries, 1 fatality]

January 22, 1998
FILED: Huffman v. Ford; et al [Explorer/ATX separation; 2 injuries, 1 fatality]

January 28, 1998
FILED: Bragg v. Bridgestone/Firestone, Inc.; et al. [1 injury]

April 23, 1998
FILED: Van Etten v. Bridgestone/Firestone, Inc.; Ford [Explorer/ATX separation; 3 injuries, 1 fatality]

April 24, 1998
FILED: Parra v. Ford; et al. [Explorer/Wilderness HT; 2 injuries]

May 15, 1998
FILED: Kim v. Ford; et al. [Explorer/ATX separation; 2 injuries, 2 fatalities]

June 24, 1998
In an internal Bridgestone/Firestone memo to acknowledges that P235/75R15 ATX II separation is 92.8% of all ATX II claims and 53.6% of all Firestone light truck claims for the year of 1997. Additionally, warranty claims on ATX II tires jumped from 42 in 1995 to 279 in 1997, a sixfold increase. 1998 light truck claims are 469 for separations and 8 for road hazards.

July 13, 1998
FILED: Simmons v. Ford; et al [Explorer/ATX separation; 2 injuries]

July 22, 1998
In an email to William Duckwitz at NHTSA from State Farm Associate Research Administrator Samuel Boyden, Boyden advises NHTSA of 21 Firestone ATX P235/75R15 tire failures causing injuries. Fourteen cases were in 1991-1995 Ford Explorers. The problem was dismissed as ``unremarkable" by NHTSA.

July 31, 1998
FILED: Gutierrez v. Bridgestone/Firestone [Explorer/ATX separation; injuries unknown]

August 27, 1998
FILED: Lockwood v. Bridgestone/Firestone, Inc.; Ford; et al. [Explorer/ATX separation; 1 fatality]

September 17, 1998
FILED: Alvarez v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

October 24, 1998
Saudi Arabian Ford Dealer, Al Jazirah Vehicles, expresses concern and frustrations that despite his warning about the safety of the tires, he did not receive a response and was being ``kept in the dark to what is happening."

1999
Federal data from the Fatal Accident Reporting System for 1995-98 was available to Ford, Firestone, and NHTSA showing that Explorer fatalities were almost three times as likely to be tire related as those with other SUVs or cars and that Explorer crashes increased significantly in the late 1990s compared with other SUVs.

January 12, 1999
FILED: Hill v. Bridgestone/Firestone, Inc. [5 injuries]

January 19, 1999
FILED: Wieters v. Bridgestone/Firestone, Inc.; et al. [injuries unknown]
January 22, 1999
An email from D.J. Candido, to Firestone colleagues concluded that for countries prone to heat induced separation, the Wilderness HT, with European specs, was the best application choice. However, they also acknowledged that this model is more prone to chip and tear. The best choice is to develop a new tire with similar heat specs to the European model and similar chip/tear specs to the Australian model.

January 27, 1999
In an interoffice Bridgestone/Firestone memo entitled P255/79R16 Wilderness AT Adjustment Data to Bruce Halverson, Market Quality Engineer, Nashville, Luis E. Abreu, Technical Service Manager, Firestone Venezuela, indicates that 47 tires in Venezuela had tread or belt separation. Of these 47, 34 had international serial codes and 13 had DOT (U.S.A.) code.

January 28, 1999
In an email to Melanie Gumz, Glenn Drake of Ford questions the durability of the product and the fact that Ford is about to change the tire on all Explorers and Mountaineers to a tire that has better high speed durability. Drake recommends that Ford conduct its own analysis in order to protect Ford and give the dealers and customers an independent opinion. ``[W]e owe it to our customers and our shareholders to investigate this for our own peace of mind."

January 1999
In a memo to Firestone Distribution entitled Ford Explorer--Concerns in the Middle East (P255/70R16), John E. Behr, Account Executive for Original Equipment Tire Sales, reported, ``I attempted to assure the Ford people that we are not aware of any defect with these tires, and that we've supplied over 1.1 million of the same tires to Ford over the past three years (1996 thru 1998) for usage in North America, with excellent field performances.''

January 29, 1999
In a memo to Bridgestone/Firestone Distribution, John E. Behr, OE Sales, expresses that Ford is concerned that the tires in the Middle East are defective.

February 8, 1999
FILED: Menendez v. Ford, Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

February 14, 1999
In a letter to Keshav Das, Technical Service Department of Firestone at Dubai,
John Garthwaite, Ford National Service Director, Al Jazirah Vehicles (Ford Dealer in the Middle East), warns Bridgestone/Firestone of the serious nature of the problem with P255/70/R16 AT tires. Garthwaite indicates that an accident occurred with a tire at 30 psi. The tread separated completely and the tire remained inflated. Garthwiate expressed his strong conviction that there is a ``distinct problem with all or at least a certain production run of this particular tyre.''

February 25, 1999
Garthwaite continues to question the safety of the P255/70/R16 tire in a subsequent letter to Keshav Das. ``These incidents involving Firestone P255/70/ R16 tyres is beginning to become an epidemic.'' He further states that ``Nothing in your reply has done anything to re-assure me that there may not exist a defect in a particular batch of your product . . .''

March 11, 1999

An internal Bridgestone/Firestone Letter to S. Katsura, et. al. from Firestone Account Executive, John E. Behr expresses concern over the result of Ford's proposed consumer notification program and its potential effects and ``perception'' it would convey in Saudi Arabia as well as ``complications it could create in North America.'' The letter also indicates that other Ford people also disfavored the notification program.

April 27, 1999
FILED: Glick v. Firestone Tire and Service Center, et al. [Explorer/ATX separation; injuries unknown]
April 28, 1999
Ford memo on Firestone Tire Tread Separations states that Ford will ``address the issues related to the rollovers on a case-by-case basis.''

May 4, 1999
FILED: Healy v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; 1 injury]

May 4, 1999
FILED: Patterson (Elroy) v. Bridgestone/Firestone [injuries unknown]

May 4, 1999
In a fax from Arabian Car Marketing to Ford Middle East and North Africa Company, Oman Ford advises Ford Middle East that it is replacing Firestone tires with Michelin tires prior to delivery because Explorer users are becoming aware of (through the internet) the off-road limitations of the Explorer.

June 24, 1999
FILED: Jenkins v. Bridgestone/Firestone, Inc. [injuries unknown]

June 30, 1999
Fax labeled ``Top Urgent & Very Important'' to Ford Middle East from Arabian Car Marketing Company warns Ford Middle East and North Africa that the tires are failing: "The tire problem has already resulted in a severe decline in Explorer sales.''
July 2, 1999

FILED: Jenkins v. Bridgestone/Firestone, Inc. [injuries unknown]

July 7, 1999
FILED: Meza v. McCombs HFC Limited D/B/A Red, et al. [Explorer/ATX separation; injuries unknown]

July 16, 1999
FILED: Progressive County Mutual Insurance Company v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; injuries unknown]

July 28, 1999
FILED: Jarvis v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; injuries unknown]

July 30, 1999
FILED: Taylor v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; injuries unknown]

August 2-5, 1999
Teams from Ford and Bridgestone/Firestone recognize Ford Explorer rollover due to tread leaving casing in the Venezuelan Tire Survey of problem tires. Suggested possible causes are excessive speed (173 Km/hr (26 Km in 9 minutes)), heavy load (8 passengers plus luggage), and high pavement temperature (55 degrees Celsius at 1:20 pm). Suggested possible results were tire fatigue and separations. 132 tires inspected at dealers in 4 locations revealed 8 underinflated tires (Wilderness P255/70R/16AT and P235/75R/15ATX)

August 6, 1999
FILED: Aoyagi v. Bridgestone/Firestone, Inc.; et al. [injuries unknown]

August 9, 1999
Letter from B.V. Halverson to Mr. J. Gonzalez of Bridgestone Firestone acknowledges that "sustained high speed driving must be considered as a normal input in the performance of vehicles and tires in Venezuela."

August 12, 1999
FILED: Romero v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

August 13, 1999
FILED: Jimenez v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; injuries unknown]

August 17, 1999
Ford begins replacing tires on Saudi Explorers through a ``customer notification enhancement action'' and not a ``recall.''

August 19, 1999
FILED: De Leon v. Bridgestone/Firestone, Inc.; et al. [injuries unknown]

August 23, 1999
In a letter to owners of light truck vehicles, Bridgestone/Firestone offers free tire inspection and free rotation service as a special offer to Venezuelan owners of light truck vehicles.

August 27, 1999
In a letter to C.E. Mazzorin, Ford's L.A. Klein indicates that the tire problems in the Middle East are largely due to the fact that the tire was not designed for the Middle Eastern market. The tire's speed rating is ``S'' which allows for speeds up to 112 mph. The Middle East requires higher speed ratings.

September 1999
In a letter to it's GCC dealers, Ford stated: ``Ford and Firestone have been working to identify a Firestone tire that we can recommend that may offer a greater margin of resistance to puncture and or tread separation for the conditions unique to the GCC region than the current tire. That tire has been identified as the `special service' tire currently available only in the Saudi Arabian market. This tire is more puncture resistant than the current production tire.''

Fall 1999
Ford began replacing Firestone tires on Explorers in ten Middle East countries.

September 1, 1999

FILED: Hendricks v. Bridgestone/Firestone, Inc. [Explorer/ATX separation; injuries unknown]

September 3, 1999
FILED: Bean v. Bridgestone/Firestone, Inc.; et al. [Explorer/ATX separation; injuries unknown]

September 9, 1999
FILED: Porsche v. Ford, Bridgestone/Firestone, Inc. [3 injuries]

September 12, 1999
In a letter from John Garthwaite, National Service Director, Al Jazirah Vehicles, Saudi Arabia, to David MacKinnon, Director of Ford Customer Service, Dubai, Garthwaite once again advises of tread separation problems in Saudi Arabia. He suggests an in-depth Firestone tire investigation. ``I am afraid that I can see a pattern emerging here. The tyre in this second case is totally destroyed but it is clear to me that the body damage is indicative of tread separation in the first instance.''

September 13, 1999
FILED: Smith v. Bridgestone/Firestone, Inc.; et al. [injuries unknown]

September 14, 1999
Ford memo entitled ``1995/99 Explorer/Mountaineer Firestone P255/70R16 Tire Separation in the United States'' states:

September 15, 1999
Internal Ford memo from Carlos Mazzorin to Jac Nasser and others:

September 17, 1999
FILED: Douglas v. Ford; Bridgestone/Firestone; et al. [Explorer/ATX separation; injuries unknown]

October 1, 1999
Ford interoffice memo containing Ford's admission that it was responsible for use of a NA tire in the GCC market and determines the tire was not suitable for this area. Firestone was not part of that decision.

October 19, 1999
Report entitled 1999 Firestone Quarterly Meeting: Critical Performance Issues, Aiken, SC indicates that tire separations were up to 3365 from 2929. Belt edge separation up 18.3%, belt leaving belt was up 10.1%, and SW separation--rubber from casing was up 63.6% for 1999 third quarter compared to 1998. This report does not separate out the individual tires.

October 19, 1999
The Radial ATXII also experienced a 5.2% increase in belt edge separation.

November 10, 1999
FILED: Guillen v. Bridgestone/Firestone, Inc., et al. [injuries unknown]

December 21, 1999
FILED: Gilmore v. Bridgestone/Firestone; et al. [injuries unknown]

2000

2000
1999 vs. 1998 Adjustments data, Firestone revealed that Wilderness tire separations increased 194% and Wilderness adjustments are ``growing quickly.''

2000 est.
In a Firestone document ``Explorer Tire DNP'' giving status report: ``In July 1997 FoV representatives were called to a meeting in Caracas with a group of independent lawyers representing four (4) customers. The objective of this meeting as expressed by these lawyers, was to draw Ford attention to a situation related to their customers, but that they felt could be greater.''

January 1, 2000

In a Bridgestone/Firestone 1999 Year End Minor Profit Loss Report from William Thomas to Dave Laubie, attached charts show 1998 and 1999 data on tire tread separations by tire type and plant indicating large numbers of tread separations in tires manufactured at Decatur plant and with 235/75R15 tire. Also shows increasing claims for SXR4S Tire in 1999. Overall separation are up 10 in 1999 over 1998. 25% of total separations in 1999 were ATX II.

February 2000
Ford offers free replacement tires for vehicles in Malaysia and Thailand.

February 2000
Officials from Bridgestone/Firestone were briefed as early as February about rising warranty costs for the now recalled tires according to internal Bridgestone/Firestone documents including a series of charts distributed at a sales meeting in February, 2000. One chart tracking ``separations increasing'' revealed that the number of warranty claims for tread separation had risen from 4,200 in 1998 to 4,694 in 1999 (an increase of 11.8 percent). Another chart stated that ``Wilderness AT needs improvement.'' While still other charts analyzed patterns in tread separations emphasizing tires for light trucks. These charts revealed that the number of tread separations involving Wilderness tires had risen 144 percent from 1998 to 1999.

February 7, 2000 & Feb. 10, 2000
KHOU, CBS affiliate station in Houston, breaks story of significant numbers of deaths and lawsuits with Firestone tires on Ford Explorers. Firestone Statement on February 4 before the programs aired says: ``The Radial ATX has proved to be a reliable workhorse for U.S. consumers. Our experience with the Radial ATX indicates high consumer satisfaction with the quality and reliability of these tires. No court or jury has ever found any deficiency in these tires.''

February 10, 2000
In a letter from Christine Karbowiak, Vice President, Public Affairs, Firestone, to Robert Decherd, Chairman, President and CEO of A.H. Belo Corp., and Peter Diaz, President and General Manager of KHOU-TV, Firestone states that KHOU-TV's broadcast series regarding its tires, ``contains falsehoods and misrepresentations that improperly disparage Firestone and its product, the Radial ATX tire.'' It further asserts, ``This series has unmistakably delivered the false messages that Radial ATX tires are dangerous, that they threaten the safety of anyone using them, and that they should be removed from every vehicle on which they are installed. Each of these messages is simply untrue.''

February 25, 2000
Bridgestone/Firestone report indicates that separations in Wilderness tires are on the rise, but ATX are decreasing.

March 5, 2000
NHTSA ODI resume (IE00-016=different from current investigation file number) indicates 22 complaints, 8 crashes, and 4 fatalities due to tire tread separation. (All ODI complaints are sent to company when received.)

March 6, 2000
NHTSA opens preliminary inquiry after KHOU-TV programs prompted consumer complaints.

March 22, 2000
Firestone survey of 243 tires on 63 vehicles that were trade-ins or lease return vehicles shows that 31% of the 15'' tires were under-inflated and 51% of the 16'' tires were under-inflated and at total of 9 tires had less than 20 psi.

April 25, 2000
In response to a request from NHTSA, Samuel Boyden, State Farm Associate Research Administrator, emailed a breakdown by calendar year and tire type (Firestone ATX, ATX II, and Wilderness tires) for the period covering 1996 to April 2000. This contained information on 70 reports.

May 2000
Ford offers to replace tires for customers in Colombia, Ecuador and Venezuela. Ford shifts to Goodyear tires in Venezuela as it waits for a U.S. Firestone response. Ford's action covers about 39,800 vehicles.

May 2, 2000
NHTSA opens investigation of 47 million ATX, ATX II, and Wilderness Firestone tires (investigation number PE00-020) with 90 complaints reporting 33 crashes including 4 fatal crashes and 17 injury crashes resulting in 27 injuries and 4 fatalities.

May 8, 2000
NHTSA sends a list of interrogatories to Bridgestone/Firestone as part of its investigation of the tire failures. NHTSA requests that Firestone respond by June 19th.

May 10, 2000
NHTSA sends a list of interrogatories to Ford as part of its investigation of the tire failures. NHTSA requests that Ford respond by June 23rd.

June 6, 2000
Internal Ford Memo lists 21 vehicles sold in Gulf Countries. Lists Explorer (in Venezuela) psi at 28/28 for the 15" tire. The new 15" tires are listed at 30/30.

July 25, 2000
After a story aired on KCBS regarding Ford Explorers and ATX tires, Firestone instructed dealers to replace tires with Bridgestone or Firestone tires of the customer's choice. However, ``[t]his sale should be a regular sales ticket. Do not use an adjustment ticket.''

July 31, 2000
Public learns of Ford's replacement of Firestone tires on Explorers overseas.

August 2, 2000
NHTSA reports it is probing 21 deaths in crashes of pickup trucks and SUVs where tire failure may have played a role.

August 4, 2000
Sears, Roebuck & Co., the No. 1 tire retailer, stops selling certain Firestone tires.

August 6, 2000
Firestone announces a ``customer information notice'' in Venezuela in which certain models of tires would be replaced.

August 7, 2000
NHTSA announces investigation of 46 deaths related to the Firestone tires.

August 9, 2000
Firestone/Bridgestone voluntarily recalls 6.5 million 15" ATX, ATX II, and Wilderness AT from the Decatur plant. (14.4 manufactured)

August 15, 2000
NHTSA raises the number of traffic deaths linked to Firestone tires from 46 to 62. It is also looking into reports of 100 injuries.

August 28, 2000
Bridgestone announces a boost in replacement production to 650,000.

August 31, 2000
Venezuela's consumer protection agency asked prosecutors to bring criminal charges against both Bridgestone/Firestone and Ford. Venezuelan authorities contend that Ford and Firestone held secret meetings to determine what was wrong following the first reports of incidents in 1998. Instead of instituting a recall, officials allege that Ford asked Firestone to redesign the Wilderness tire.

August 31, 2000
NHTSA raises to 88 from 62 the number of deaths associated with the Firestone tires.

September 1, 2000
Firestone declines NHTSA's request to voluntarily expand recall to 1.4 million tires not included in the original recall.

September 4, 2000
Bridgestone/Firestone issues a recall in Venezuela of 62,000 Venezuelan-made 15-inch and 16-inch Wilderness tires. Previously, only U.S.-manufactured tires were being replaced.

September 4, 2000
Bridgestone/Firestone reaches agreement with union to settle labor disputes and avert a strike at nine U.S. plants.

September 6, 2000
The Senate Appropriations Committee and House Commerce Sub Committees conduct separate hearings on the Bridgestone/Firestone-Ford tire recall.

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