Preventing Deaths from Tire Explosions Caused by Known Design Defects

By Richard Alexander

It is a strong but true statement that tires are designed to explode when being installed on wheels and for that reason, every tire explosion that occurs during the installation process, whether a passenger or light truck tire, is a predictable and preventable result of a known design defect.

This design defect has been known since 1955 when Firestone engineers publicly confirmed that the failure of the bead during mounting of the tire commonly occurs in a predictable location and recommended a simple method to avoid failure.

The tire industry has vigorously litigated explosion claims and industry lawyers have succeeded in defeating cases of serious injuries and wrongful deaths caused by defective tires by overwhelming inexperienced tire litigators.

The history of this fraud on the American public is important for consumers and their lawyers to understand.

Tire Bead Design

The traditional manufacturing process imbeds five parallel steel piano wires in a continuous rubber tape or ribbon, which loosely secures the wires in a soft insulating rubber. The ribbon is wound into a hoop, commonly made of five courses. The end result is a grommet composed of a bundle or stack of wires. A cross-cut view of the bead grommet shows a stacking of wires, five high and five wires across, also known as a five by five stack.

The key to understanding this foundation for the automobile tire carcass and the role it plays in explosions, is that this bead bundle or grommet has ten cut wire ends:

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five at the inside cut edge, or at the beginning of the bead wrap, and five on the outside cut edge, at the end of the bead wrap. Assuming the inside cut edge, or starting of the bead bundle, to be positioned at the twelve o'clock position, a clockwise wrap of the bead ribbon would result in the outside cut edge being found at the one o'clock position. This area of overlap between the twelve and one o'clock position is called the bead splice.

Identical Failure Modes

Virtually every tire bead failure occurs in the location of bead splice at the inside cut edge of the five wires that start the bead.

Each of these strong wires, commonly .037 inches in diameter, is individually capable of holding 300 pounds and separated into two well-constructed beads, these wires can easily hold 7 tons of air pressure, providing they are all carrying an equal load.

But when the wires in the grommet become unstabilized and distorted, the combined strength of the bead grommet is lost. Preventable distortion can occur when the bead is being seated onto the rim of a drop center wheel. The drop center, or smaller interior portion of the wheel, is the feature which allows a tire to be button-holed over the outer rim flange. Drop centers are found on every passenger and light truck wheel. (Heavy duty truck tires, which because of their extreme stiffness, cannot be button-holed and these style tires use split or multi-rim wheels in which the outer rim flange on one side of the wheel is detachable. In mounting these tires, the rim flange is detached, the tire placed on the wheel, the outer rim is re-attached and then the tire is inflated. There is no button-holing in this process.)

When a tire is mounted on a drop center wheel, its beads are forced on by inflationary air pressure within the tire from the drop center well of the wheel onto and against the vertical surfaces of the rim flanges by proceeding outward and sliding up a 5° ramp where the beads are said to "seat" in their final resting position against the rim flange. Distortion in the bead grommet naturally occurs in this process if the area of the bead splice happens to be the last portion of the bead to seat. One explanation for this is that a splice by definition is always a weakest point and prone to separation and distortion.

In the process, the grommet of wires, or bead bundle, will separate into a configuration where not all 25 wires in the bead bundle are carrying an equal load. The wires forming the grommet then can become separated and only one wire may end up carrying the full inflation load of the pressurized tire.

If by chance the unstabilized location happens to be in the area of the splice at the inside cut edge of the five wires where the bead bundle begins, the tensile strength of the wire carrying the full load of the inflating air is exceeded and it fails. At the instant when the first wire breaks, the load is immediately transferred to the next wire which breaks and in rapid succession all of the wires in the bead bundle rupture. But note that a bead will not break *unless*

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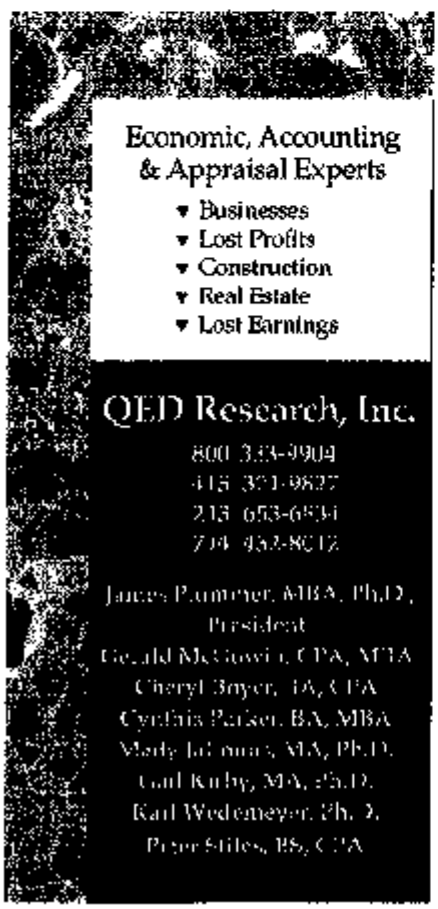

the beginning of the bead wrap, splice, or area of overlap, is trapped and is the last to seat.

No Secret to the Tire Industry

The tragedy is that the tire industry has known this fact for years and, in fact, a Firestone engineer has acknowledged that when beads rupture in mounting "the rupture frequently occurs at the ends of ribbon" and bead breakage occurs when the area of the bead splice is the "last to pass upon the rim." This same official admits that "if the end of the ribbon on the radial inside of the grommet was not in the last portion of the bead to seat on the rim, no breakage occurred."

Since the ends of the ribbon cannot be determined after the bead grommet is built into the tire, whether or not the area of the splice is the last to seat on the rim is completely a matter of chance.

Another major tire manufacturer's chief of engineering, while declining to speculate why the beginning of the inside cut edge was the known place of failure, was forced to admit that the fact of breakage at this point is "accepted by the tire industry and most of the tire engineers" with whom he had been in contact.

Common Defenses

Manufacturers have known for decades why beads fracture and tires explode in the mounting process, but have been unwilling to invest in machinery that would produce an explosion-proof bead. Bead failure arises as a direct result of the refusal to invest in new bead forming machinery and to put aside technology that is 50 years old. In short, the old way of making beads, on old equipment, gains the industry the most profits and there is a refusal to replace old equipment on an as needed basis with upgraded technology because new fail-proof beads would constitute a severe indictment of the old design and an admission of industry misconduct. The industry finds it cheaper to allow predictable and preventable deaths and injuries to occur and pay for the damages in cases where their standard defenses do not succeed in defeating valid claims.

A main defense is over-inflation, notwithstanding that it is impossible to explode a properly mounted tire with a fully seated bead tire by overfilling it with air. The primary reason is that air compression pressure at local service stations do not provide sufficient pressure to explode a tire. The tires on passenger vehicles and light trucks can be filled to 175 p.s.i. and they will not explode. The only way to explode a tire is to charge it to more than 250 pounds, at which time it will fracture into many pieces. This pressure level is not available at service stations, tire service islands or in commercial tire shops. Suffice it to say that the only tires that explode while being mounted are those in which the area of the splice or overlap hangs up in the bead seating process and the bead fails at the inside cut edge of the bead grommet.

Blaming the victim for pinching the bead in the mounting process is common when there are external marks on the tire. As a practical matter, most tires can be easily button-holed onto the rim by hand and require few tools. Rarely does the bead break in any location other than the inside cut edge of the grommet ribbon. When the bead fractures at the inside cut edge of the splice, any external marks on the tire itself have nothing to do with the failure.

In cases where the victim installs a 16 inch tire onto a 16.5 inch wheel the comparative negligence defense is bogus. Surprisingly, when 16 inch and 16.5 inch wheels are placed side by side, it is *extremely* difficult to tell the difference between the two because they are virtually identical in overall height. The deception is so dangerous and pregnant with major injuries and death that the 16.5 inch wheel is banned in Europe.

Even more startling is the very well-kept secret that a 16.5 inch wheel uses a *completely different* engineering system for securing the tire to the wheel.

The conventional drop center wheel (14 inch, 15 inch, 16 inch, etc.) holds the tire in place on the rim by air pressing the *side* of the bead *against the inside portion of the rim flange.*

In comparison, with the newer 16.5 inch wheel system, the tire is not held in place by the side of the bead against the flange. Rather, the wheel is designed very much like a jeweler's gauge for measuring the diameter of a ring and air pressure causes the bead to slide outboard and

upward along a 15° ramp from the center of the wheel, *until such time as the bottom* of the tire bead is *restrained by the upward ramp of the wheel and the downward compression of bead grommet.* The rim flange plays virtually no roll in holding the tire onto the wheel. All the actual forces are at the base of the bead.

Preventing Bead Failure

One solution to preventing bead failure at the inside cut edge was publicly proclaimed by another Firestone engineer in 1958 who proposed moving "the beginning-end of the bead ribbon from the inside surface of the grommet" by folding it around the bead and having it come to rest on the outer surface. He also suggested anchoring the inside cut edge by stapling or taping during fabrication, all of which "does not require complicated machinery to mechanically build the grommet."

Unfortunately, since 1958, no manufacturer has adopted this approach and the problem has continued.

One of the leading manufacturers of bead forming machines, National Standard Corporation of Niles, Michigan, directly addressed the problem in March 1976. National Standard introduced a solid-state programmable single-wire bead machine capable of making 12 inch through 24.5 inch diameter beads. A single-wire bead, designed by computer program, can form, for example, a bead composing of 72 single wires that has the strength of a cable but *with only two cut ends* (as opposed to 10) which *can be placed on the final bead in a position where the inner edge of the bead grommet will not be harmed.* The advantages with this product are greater efficiency and strength. In addition, as National Standard employees have honestly admitted,

> *the failure point of a conventional bead is almost always at the under lap or starting point of the ribbon. A single wire bead does not have this "weak point";* it has only two wire ends, the leading end and trailing end. When subjected to burst tests, single wire beads failed at random circumferential points. (Emphasis added.)

A second solution involves strengthening the bead wire. Bead wire is commonly .037 inches thick. Most bead wires could be easily replaced with .050 inch diameter wire. Because strength increases by the square of the diameter, this modest increase in diameter results in a wire that has 180 percent of the strength of the .037 inch wire.

Conclusion

Bead fractures and tire explosions during the mounting process cause serious injuries and death. Identical breakage occurs in mounting standard tires and rims and in so called "mis-match" cases involving odd sized rims. The size of the bead bundle is academic. Bead fractures universally occur at the location of the inside cut edge, or starting edge of the ribbon forming the bead grommet which fortuitously catches during the normal seating process. The entire phenomenon depends on the distortion of the bead bundle and the final loading of a single wire, which fails and causes a domino rupture of the balance of the wires in the bead grommet, resulting in an explosion. In every action for damages the industry continues to conceal its knowledge and always blames the innocent victim of a defect known to be inherent in the design and manufacture of a tire since the 1950's. While readily correctable, tire bead manufacturing techniques have not changed and manufacturers continue to make and sell defective beads.

Plaintiff's attorneys interested in networking on tire explosion cases should write the author at P.O. Box 1330, San Jose, CA 95109-1330. ■