Pneumatic tires are a primary and critical component of every over-the-road vehicle and most off-road vehicles which use tires. Although I have evaluated hundreds of tire failures over the 40-plus years I have been involved in forensic consulting and have been able to identify tire-factor contributions to collision causation in a few cases, I will not address tire failures in this issue but will rather provide a little background and history of rubber and of pneumatic tires and a little about manufacturing and tire types.

It is believed that the basic wheel was invented around 3500 B.C. Early wheels were solid, circular pieces of wood or wood-and-metal combinations. Two hundred years ago, rubber was being used for some applications, but it was not suitable for use over a wide range of temperatures: It would get sticky and possibly even melt on a hot day, and it would become very stiff in cold weather. Charles Goodyear is credited with discovering a process he called vulcanization. By adding sulfur to the rubber and heating the mixture, the rubber became a firm, pliable material that was stable over a wide temperature range.

Solid rubber tires were produced shortly after the development of the vulcanizing process; they were strong and durable, but they were heavy and rough-riding. Robert Thomson of Middlesex, England, invented and patented the air-inflated tire in 1845. However, that invention was before its time. In 1888, John Dunlop, a Scottish veterinarian, invented a pneumatic tire for his son's bicycle, apparently unaware of Thomson's invention or patent. John Dunlop patented his tire and formed a company to manufacture pneumatic tires. Although his patent was later deemed void by Thomson's earlier patent, the company he formed was a financial success.

Two French brothers, Andre and Edouard Michelin, pioneered the application of pneumatic tires for automobiles. Although their initial efforts were unsuccessful, they persevered, and the Michelin company is now one of the world's largest manufacturers of tires.

In 1910, carbon was added to tire compounding by B. F. Goodrich, increasing the durability of the rubber. That company also invented a synthetic rubber tire made of a patented substance called Chemigum in 1973.

Pneumatic tires based on bias-ply construction and incorporating an inner tube became standard for the first half of the 20th century. In 1948, Michelin produced the first radial-ply tire. It was significantly more costly, but it provided better handling and much longer tread life, offsetting the higher initial cost. But radial tires did not suit the suspension systems of American cars, which were designed for bias-ply tires, and retooling American plants to produce radial tires would have been very costly, so American car and tire manufacturers (for the most part) continued to design for and manufacture bias-ply tires. In 1973, when gasoline went from 30 cents a gallon to a dollar a gallon almost overnight, Americans began looking for ways to go farther on a gallon of gasoline; they began buying many foreign cars, which were designed to get much better gas mileage than most American cars, but those cars came equipped with radial tires. Firestone tried to get into the radial-tire market on the cheap by building radial tires on machines designed for assembling bias-ply tires; the resulting Firestone Steel Belted Radial 500 tires came apart in astronomical numbers, resulting in a recall of nine million tires between 1977 and 1980, and taking Firestone from a $110 million profit to a $106 million loss. In 1988, Bridgestone saved Firestone from collapse by purchasing it.

Goodyear, on the other hand, invested billions of dollars in radial technology, producing a commercially available and successful radial tire in 1977. By 1983, all American-made new cars had been designed for and factory-fitted with radial tires.

Tubeless tires were developed by manufacturing tires with a special interior layer (called the inner liner) designed to contain air and also designed to trap and seal around common objects which penetrate tires, like nails, screws, and other small, round objects, allowing a tire with a puncturing object of that type to be driven a substantial distance with very little air loss. Those of you who were around when tube-type tires were in use will remember that a puncture from any object resulted in immediate, complete deflation of the tire.

Radial-ply tires have cords which extend radially, from bead to bead, helping to keep the tread more evenly in contact with the surface over which the vehicle is being operated, increasing tread life and providing better traction, especially for cornering maneuvers. Passenger-car tires typically have two belts under the tread—sometimes three—giving the tire dent resistance and some additional resistance to penetration. Many higher-performing tires also include an extruded compound called cushion gum between the belt package and the tread to provide a smoother ride and to help isolate the tread from being internally worn by the (usually) steel-cord belts, which wear can produce tread-cap or tread-belt separations.

Each tire has two beads; inside each bead is a bundle of wires made of extremely high tensile strength steel. Bead wire bundles will typically comprise about five percent of tire's weight. Steel cords in the belts will typically be about ten percent of the tire's weight. Fabric cord in the sidewalls will typically be about three percent of the tire's weight. The tire will be approximately one-half rubber. The remainder of the tire's weight will be in compounding ingredients and rubber reinforcing fillers.

A typical tire gets about ten percent of its strength from the tire structure—the rest comes from the encased, pressurized air. The air gives the tire the ability to deform somewhat under applied forces, allowing it to maintain a better contact patch under various conditions of vertical and lateral loading and absorbing some of the impact shocks of irregularities in the surfaces over which a vehicle operates—it is a vehicle's first spring/shock absorber component.

For a particular tire, the load it can safely carry is related to its inflation pressure. When the inflation pressure falls substantially below the amount necessary to safely carry a given load, or when the applied load is substantially increased beyond the intended capacity, the tire flexes much more than normal during use. This condition is called overdeflection, and it causes heat to build up inside the components of the tire, often causing those components to separate from one another, which usually results in tire failure during otherwise normal vehicle operation. Of all the tire failures I have investigated, overdeflection was the cause of many, and the usual cause of the overdeflection was underinflation. Please keep your tires properly inflated! Your tire retailer is a good source of information on the proper inflation pressures for the tires on your vehicle.

I apologize for sending another newsletter without a photograph or other graphic—I realize that such graphics make a document more pleasant to read, but I didn't have any graphics which I felt would be appropriate to the topic, considering the limited space. Entire books have been written about pneumatic tires, and my goal was to summarize various aspects of the topic on one side of my newsletter.

With regard to crash data retrieval (CDR), in December of 2012 the White House OMB completed a review of the proposal to require event data recorder (EDR) capabilities in all cars and light trucks, allowing the National Highway Traffic Safety Administration (NHTSA) to publish a regulation on that topic. Recent Federal regulations did not require that all such manufacturers incorporate EDR technology in their airbag control modules (ACMs) or other on-board systems, but they specified that, if those recording capabilities existed, they would have to include a specified, minimum data set and be accessible with a commercially available system. Once the OMB cleared the way for the NHTSA to require EDR capabilities in all cars and light trucks sold in the United States, the NHTSA issued a Notice of Proposed Rulemaking to make EDRs mandatory for all such vehicles by September 2014. The public has 60 days to respond to such notices before the proposed rule is finalized; this final action could occur as early as March of 2013. Unless those public responses cause the NHTSA to change its intentions, it will change EDRs from a regulation under Part 563 to a Federal Motor Vehicle Safety Standard (FMVSS), requiring that feature on all applicable vehicles. One of the motivations for this action is to put all manufacturers on a level playing field with respect to allegations of privacy issues. If the FMVSS is established as proposed, it would essentially apply to all 2015-model-year vehicles. Bosch has released version 10 of the CDR software, which adds new manufacturers BMW, Rolls Royce, and Volvo, and it adds expanded coverage for many manufacturers already included, as well as coverage for some 2014 vehicles not yet available to buy. Along with version 10 are two new cables: one for directly accessing the ACM in BMW and Rolls Royce vehicles and the other for directly accessing the ACM in any covered Volvo. As I have written in the past, the NHTSA does not (currently) have authority to require that all manufacturers make their data accessible with the Bosch CDR Toolkit, but they are urging all manufacturers to work with Bosch toward that goal. The NHTSA has hundreds of investigators, and each team has a Bosch CDR Toolkit. For each manufacturer who develops and sells its own system for accessing crash data, the NHTSA will have to buy hundreds of those systems, adding tremendous cost and additional hardware and software for their investigators to carry into the field. I have been using the Bosch CDR Toolkit since 2002, and I have kept software and hardware updates current as soon as either became available. I, too, hope that all manufacturers work with Bosch to allow access with the Bosch system; I don't know if I could justify the cost of additional systems. Unlike the government, my funds are limited. ☺

Please call whenever you have need of an investigation into or evaluation of a motor-vehicle-related incident or allegation of failure.

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