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Pneumatic Tires

This letter has been prepared to answer the many inquiries relating to pneumatic tires.

An automobile tire is a complex product and many factors determine its overall performance. A tire manufacturer designs his tires to obtain in his judgment the best balance of the properties affecting performance. As a consequence, one manufacturer is likely to make tires that excel in tread wear, another in low power loss on flexing, and still another in high strength of carcass. Any rating of various brands of tires is, therefore, dependent on the particular emphasis placed on the several factors used to judge overall performance.

The more important features that should be considered in judging the performance of a tire are the following:

1. Carcass strength and resistance to fatigue. From a safety standpoint, this feature is perhaps the most important in judging tire performance. A tire must have bruise resistance and a carcass strong enough to withstand the severe impacts it will receive in service without blowing out. During the life of a tire, the strength of the carcass usually decreases because of fatigue from flexing and therefore becomes more susceptible to failure. Although there are exceptions, it is generally true that tires made with rayon cords retain their strength better than those made with cotton cords. A well-made tire with rayon cords can usually be recapped or retreaded several times and still retain sufficient carcass strength. On the other hand it is necessary to consider the type of service a tire made with cotton cords has been and will be subjected to before a recommendation regarding recapping can be made.

2. Tread life.- The consumer is generally more interested in the tread life of a tire than in any other feature. A long wearing tread is of little value however, if the tire blows out or fails because of an inferior carcass long before the tread is worn smooth. The tread life of a tire is generally considered to be the mileage at which one or more of the grooves in the tread disappear and is frequently referred to as "non-skid" mileage. This mileage is dependent on many factors such as type of roads, climatic conditions, speed, condition of the vehicle, wheel balance, inflation of tires, load, and driving habits in addition to the quality of the tire. In this connection, a sudden stop that results in black streaks on a pavement may cause the loss of more rubber from the tire tread than many hundreds of miles of driving on a smooth and straight highway. Tread life cannot be estimated solely from the depth of the tread grooves. Some brands of tires have a relatively thin tread of a highly wear resistant rubber compound that will outwear other tires with a thick tread of a more rapidly wearing rubber compound. The only satisfactory method at present for judging tread life is a road test under controlled conditions. Such tests are necessarily expensive and, therefore, are seldom found in tire specifications.

3. Power loss.- In each revolution of a tire, the entire tread and carcass is flexed. It is not generally realized that an appreciable part of the gasoline consumed goes to provide the energy required to flex the tires. This energy of flexing is converted into heat, and a tire after running on the road becomes warm or even hot to the touch. At the same time, the air pressure increases which acts to reduce the amount of flexing and the power loss. At 60 miles per hour, the air pressure may increase from 28 to 37 pounds or more in a 6.00-16 tire. It is for this reason that tire inflation should be checked when the tires are at atmospheric temperature and no air should be bled from the tires when they are hot from running.

4. Tread and side-wall cracking.- Flexing of the tire may cause cracks in the tread grooves or in the side-walls of the tires. If these cracks continue to increase in size, they may crack through to the carcass and cause tread separation and tire failure.

5. Skid resistance.- A tire should be designed to minimize skidding, particularly in a sidewise direction. A manufacturer utilizes the tread design for this purpose. On the other hand, he must be careful that the tread design does not cause an excessive increase in the rate of wear, in the amount of cracking, or in the amount of noise and tire squeal. Most tire manufacturers make a special tread for use in mud and snow. These treads give additional traction and skid resistance for this type of service but offer little or no advantage over regular treads on icy pavements or packed snow. Considerable money has been spent by manufacturers to develop a tire that will have good skid-resistance on ice but thus far such a tire has not appeared on the market. Consequently, it is necessary to drive slowly and with caution when the pavement is covered with ice or packed snow. The most hazardous condition exists when the temperature is near the freezing point of water.

6. Aging.- Tires begin to deteriorate soon after they are made. Some, however, deteriorate uniformly with time; whereas, others deteriorate very slowly at first and after some time at a greatly increased rate. High temperature and light accelerate the deterioration process. If a car is driven less than 10,000 miles per year, the aging characteristics of the tires become an important consideration in judging performance. This deterioration on aging occurs even during shelf-storage so that tires should not be purchased until ready to be used. Millions of miles of tire life could be lost because of deterioration on aging if tires are hoarded.

7. Beads and other features.- The manufacturer must consider other things in the design of his tires such as beads and chafer strips. The beads hold the tire on the rim and transmit the stresses between the tire and the rim.

The National Bureau of Standards does not have any lists rating the various brands of tires. Such list would have very limited usefulness since the ratings of different sizes of the same brand would differ and they would change frequently with time so that within a six-month period a list might be obsolete.

The Government purchases tires on specification. The current Federal Specification is ZZ-T-381e which can be obtained from the Superintendent of Documents, Washington, 25, D. C. for 15 cents (stamps not accepted). Of the items mentioned heretofore, this specification has requirements only for carcass strength and resistance to flexing fatigue. As methods are developed for the other items affecting performance, they are incorporated in revisions of the Federal Specification.

During emergency conditions, such as the present one, the Government permits the manufacturers to make only one line of tires. In normal times, however, many manufacturers make several lines. This division of tires into lines is based on price and commercial practice and not on any well-defined technical standards or specifications. A first-line tire is often called a "100-level" tire and serves as a reference for the other tires which a manufacturer makes. Premium tires are higher in price than first-line tires; and second, third and fourth line tires are lower in price. In the absence of recognized standards, however, there is no assurance that first-line tires of different manufacturers are of comparable quality and there is no way to relate the quality of first-line tires to that of other lines.

Another thing that concerns consumers is the relative quality of tires made from natural and synthetic rubbers. Insofar as passenger car tires are concerned, some synthetic rubber has been used in these tires ever since 1943. Passenger car tires made today are equal or superior to tires made prior to 1943 in tread life but tend to be somewhat inferior in regard to power loss and tread cracking. If cotton cord is used, the resistance of the carcass to flexing fatigue is decreased because synthetic rubber tends to make the tires run hotter. For large size truck and bus tires, it is still necessary to use natural rubber because of the excessive power loss and high running temperatures in tires made from synthetic rubbers. The minimum amount of synthetic rubber in tires is specified in Government regulations with which the tire manufacturer must comply.

A tire that is worn smooth can be safely recapped or retreaded if the carcass is in good condition and it is economical to do so. On many bus and truck fleets, the tires are rented from the tire manufacturer on a mileage basis. These tires are recapped by the manufacturer several times. The rubber compound used to recap or retread a tire is known as "Camelback." A first grade camelback which contains no reclaim rubber has wear characteristics after recapping essentially equivalent to those of the original tread. It is generally more economical to use a first grade camelback than an inferior grade since the labor costs are the same and there is only a small difference in the material costs.

In regard to maintenance, the consumer can get the maximum life from his tires if he is careful to see that the tires are kept properly inflated, the car is in good condition and rapid starts and stops are avoided. Both under-and over-inflation will decrease tire life, although under-inflation is much more serious. The center of the tread will wear fastest in an over-inflated tire and the outside edges of the tread will wear fastest in an under-inflated tire. The Butyl synthetic rubber inner tube has helped considerably in maintaining proper inflation pressures, but even with these tubes the pressure should be checked at least once per month. A 5 or 10 percent over-inflation is preferable to an under-inflation. The tire should be at atmospheric temperature when checked and no air should be let out of the tire when the tire is warm from running.

The vehicle should be kept in good condition to obtain maximum tire mileage. The wheels should be in alinement and all bearings kept tight. The wheels should also be balanced to avoid wearing flat spots on the tires. The front wheels particularly should be periodically checked for uneven wear and the condition corrected whenever any such wear is seen.

Finally, the driver must avoid rapid starts and stops if maximum tire life is to be achieved. Remember that a sudden stop may wear off more rubber than several hundred miles of travel on smooth open highway.