Truck Tire Retreading

A guide for fleet owners, managers, and specifiers.

Prepared by Bandag, Incorporated.

Index

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Introduction

Everyone knows that a company must control costs to be profitable. Yet, every day, companies fail because they simply "can't afford to keep the doors open any longer."

Obviously, in today's competitive marketplace, effective cost management isn't just a sound business practice. It's critical to financial survival.

Which is why, as a fleet owner or manager, you should know more about truck tire retreading. Because through retreading, you can minimize your fleet's overall tire costs and get the most from your tire investment.

In fact, if you're not using retreads, you're losing money. Because only through retreading can you achieve the *lowest cost per mile* for your tire program.

Bandag has developed this booklet for your convenience as a single source of information on retreading to help you find new ways to reduce your fleet's tire costs and improve your company's bottom line.

Inside, you'll find a brief history of tires and retreading, and you'll learn why almost all commercial fleets are now recycling their casings.

You'll also find handy reference sections dealing with tire construction details, tire/tread design selection criteria and proper tire maintenance practices.

There is also a close-up look at the retreading process to demonstrate that retread performance is not only related to the kind of new tire you start with, but also to the materials, designs and techniques that go into the retread itself.

And, in a final section, we'll show you how the support of the Total Tire System™ can help you extend the life of your casings to provide the best tires for the money — at the lowest cost per mile.

That, in a nutshell, is what this booklet contains. We hope you find it interesting for the story it tells, valuable for its reference material and practical as an everyday guide to effective tire cost management.

Tire and Retread History

The first truck tires were solid rubber. Solid rubber had its drawbacks, not the least of which was a rough ride that took its toll on equipment and riders. And anything faster than 10 or 15 mph would cause the thick rubber mass to overheat and fail.

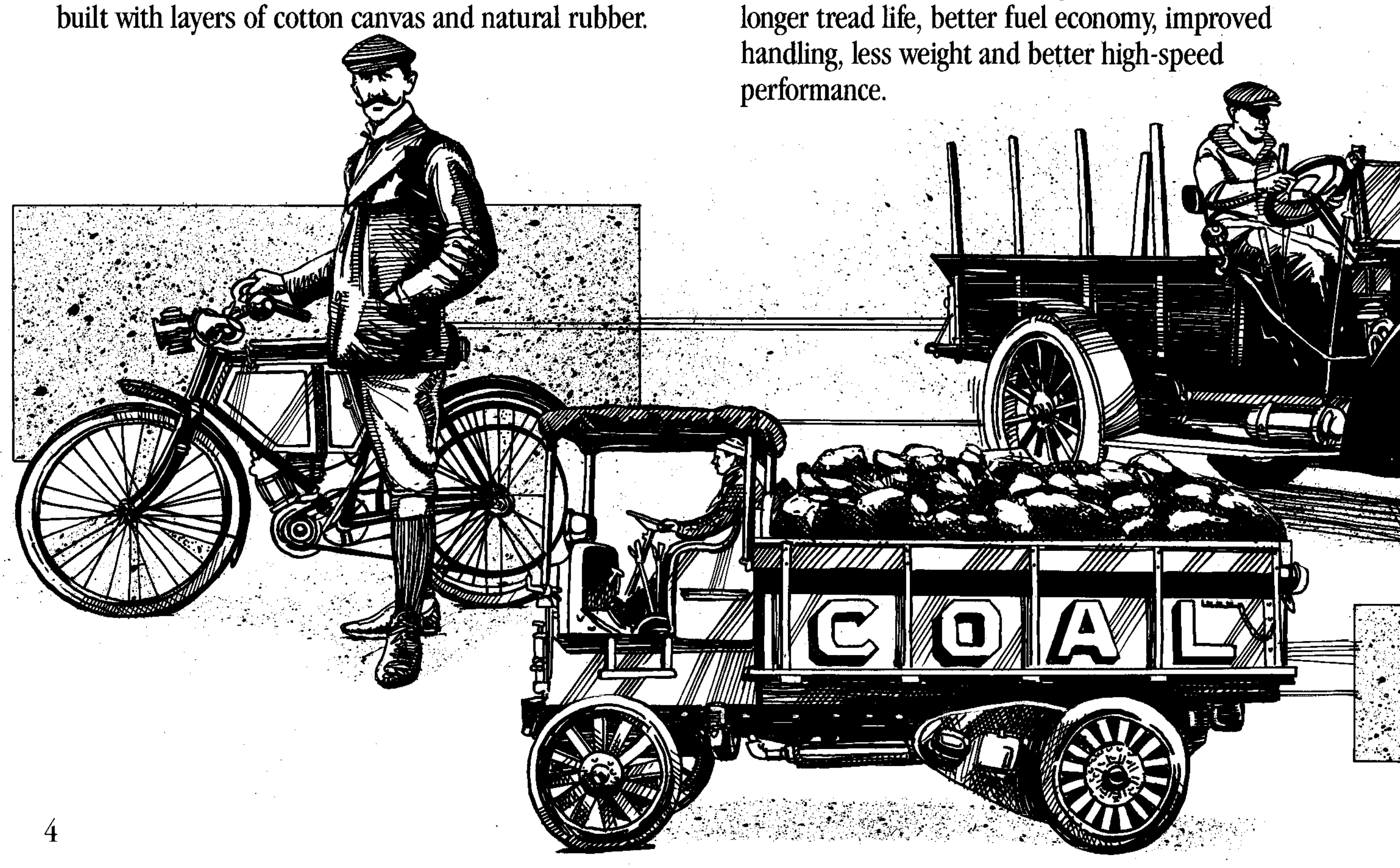
Help came when the pneumatic tire was invented in 1845. However, this new tire didn't see commercial use until John Dunlop put them on bicycles in 1888. And although the first automobiles used them, early pneumatic tires couldn't handle the load requirements of a heavy truck. Finally, in the early 20's, the invention of "high pressure pneumatics" allowed heavy trucks to convert to the "high speed," easy-riding pneumatic tires.

Pneumatic tires were actually a driving force in the evolution of the truck. Higher speed capability required more powerful trucks. Dual tires and tandem axles were developed to handle higher load capacities. In turn, better tires and trucks triggered the rapid development of the trucking industry.

The first pneumatic tires were canvas ply tires, built with layers of cotton canvas and natural rubber. Cotton cord then became popular and was the material of choice until World War II. Today's ply ratings reflect this cotton cord tradition — a 12 ply rated tire is a tire with strength equivalent to a 12 cotton ply tire. Rayon took the place of cotton, and nylon cord tires soon followed. Today steel is one of the more common tire cords.

In 1956, the first of three modern-day tire revolutions began when the tubeless tire came on the scene. This was followed in the 70's by the second tire revolution: radial tires. Radials were not a new concept — the first patent on radial tire design was awarded in 1913! Radials first gained acceptance in Europe, but it took an energy crisis to bring them overseas to the U.S. and Canada. Escalating fuel prices — and the need for better performance — made energy-saving radials necessary.

Tire evolution is continuing, and we are now in the midst of the third tire revolution. Tires are becoming lower and wider (low profile). This development takes radial advantages even further with longer tread life, better fuel economy, improved handling, less weight and better high-speed performance.



As you can see, a lot of engineering expertise has gone into the development of today's tires. Now let's look at retread evolution.

In 1915, the Gates Rubber Company strapped leather onto some worn out tires. These new "treads" gave tire owners a way to get longer tire life and more miles for their money. Retreading was born. The same principal — getting the most for your money — is behind retreading today.

A few years later, molds were invented to cure raw rubber onto an old casing. Tires were scraped down by hand, cement added, and new rubber was fixed in place. The casing was placed in a metal mold and cured over a charcoal fire. The process was slow — only one-third of a casing could be retreaded at once. Full-circle molding was developed about 1925.

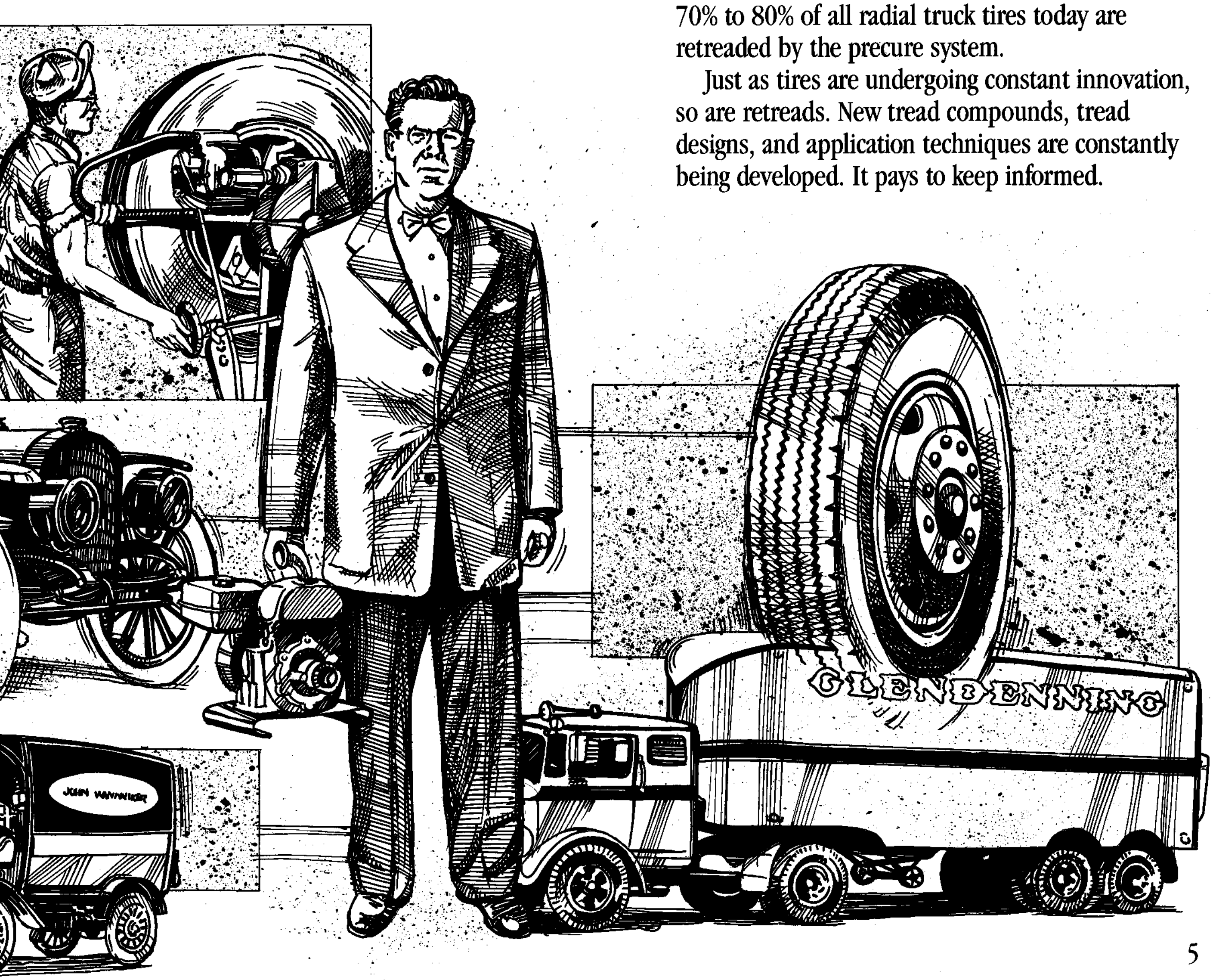
In 1957, an Iowa businessman, Roy Carver, discovered a new type of retread being built by a small shop in Germany. The new retread was "precured." The tread was molded separately from the casing during a manufacturing process. This precured tread could then be applied and bonded to casings later at a different location and at lower temperatures.

Carver brought this new retreading system to the U.S., improved it, named his company "Bandag," and a new era began.

Factory molding of tread has advantages because powerful presses and uniform heat can be used. This assures a very dense tread and consistency throughout the curing process, which means consistent performance. And it greatly reduces the heat the casing is exposed to — heat is a factor in premature tire failure.

One of the refinements Bandag made in the precure process was the development of the flexible curing envelope. This allowed the casing to be fitted with precured tread while it was in a relaxed position — eliminating the distortion necessary to conform to a rigid mold. This invention proved to be fortuitous. When radials came on the scene with steel belts that would not deform, the flexible precure system was perfect for retreading them. For that reason, 70% to 80% of all radial truck tires today are retreaded by the precure system.

Just as tires are undergoing constant innovation, so are retreads. New tread compounds, tread designs, and application techniques are constantly being developed. It pays to keep informed.



Why Retreads?

The reason for retreads is simple: money. Retreads save a lot of money, because retreading a worn tire costs far less than buying a new one.

On a fleet basis, the use of retreads can substantially reduce overall tire costs. And that can make a big difference on the bottom line. That's why almost all major commercial fleets today use retreads. And why there is at least one retread on the road for every new truck tire.

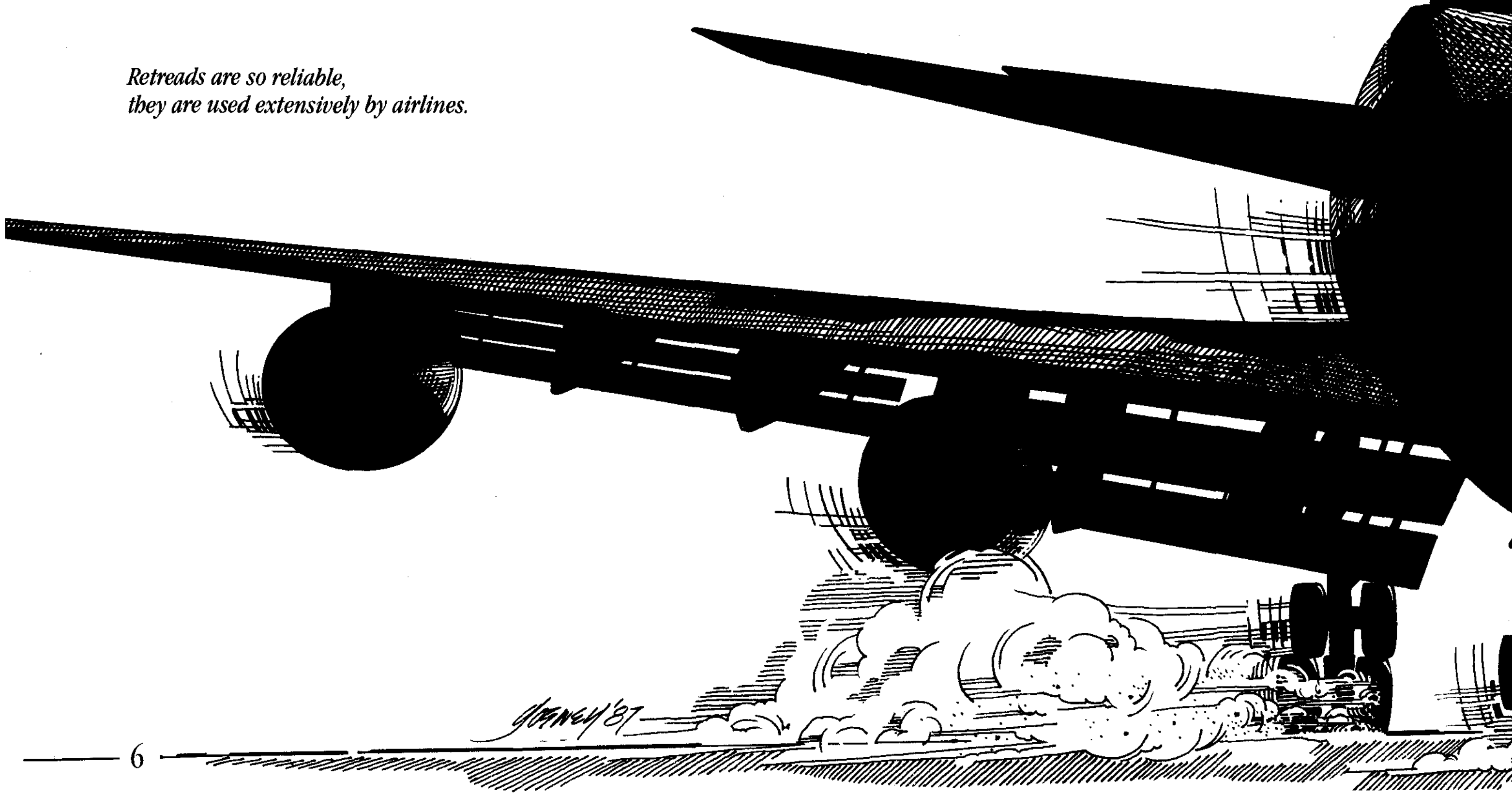
How much money can you save by specifying retreads? That amount depends on the unique characteristics of your fleet. But one thing is certain: if you aren't specifying retreads for your fleet, you're throwing away most of your new tire investment. Because when you discard a casing before its full life cycle is realized, it's like throwing away two, three, or even more tires.

When you think about it, it doesn't make much sense to spend $200 or more for a truck tire, wear off about 15% to 18% of it and throw the rest away. Not when more than 80% of your investment is still intact and is as good as new (maybe even **better** than new, as we shall see).

As good as new.

You may have heard that retreads aren't as safe as new tires. This old wive's tale got its start before the second World War. Then, when retreads were first being developed, some poor quality products gave inferior performance.

Today's quality retread is a different story. Retread dependability has been on a par with new tires for many years. In fact, today's retreads often have a better safety record than new tires.



Retreads are so reliable, they are used extensively by airlines.

Retreads are so dependable, all major airlines use them, and you can imagine the stress airplane tires receive during landing and takeoff. Many of those tires have been retreaded 8 to 10 times! Even high-tech, sophisticated jet fighters like the F-16 use retreads.

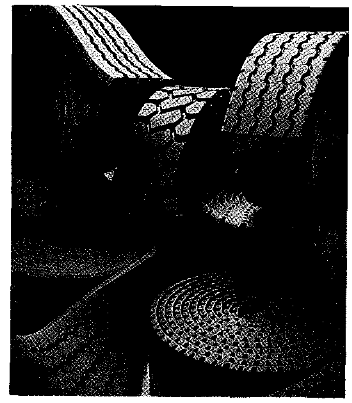
If that sounds incredible, consider a test performed for the Department of Transportation by the University of Michigan. This test compared the burst strengths of new truck tires against worn truck tire casings. The new tire casings averaged 511 psi before bursting. The worn tires averaged 526 psi. The worn tires were actually stronger! The reason? Loads placed on tire plies over their original life tend to equalize while running, actually improving strength as the tire wears.

A worn tire is a proven tire. If there is a weakness in a new tire, it invariably shows up early in the tire's first life. By the time it has run its original tread life, you know you have a good casing — one that could be retreaded once, twice, or even more times.

Many of today's retreads are outperforming the original new tire in wear, efficiency, and traction. So specify them with confidence.

And far more flexible..

Today, there are literally hundreds of tread designs and sizes available for retreads. There are treads specifically designed for almost any application — and new designs are being developed all the time.



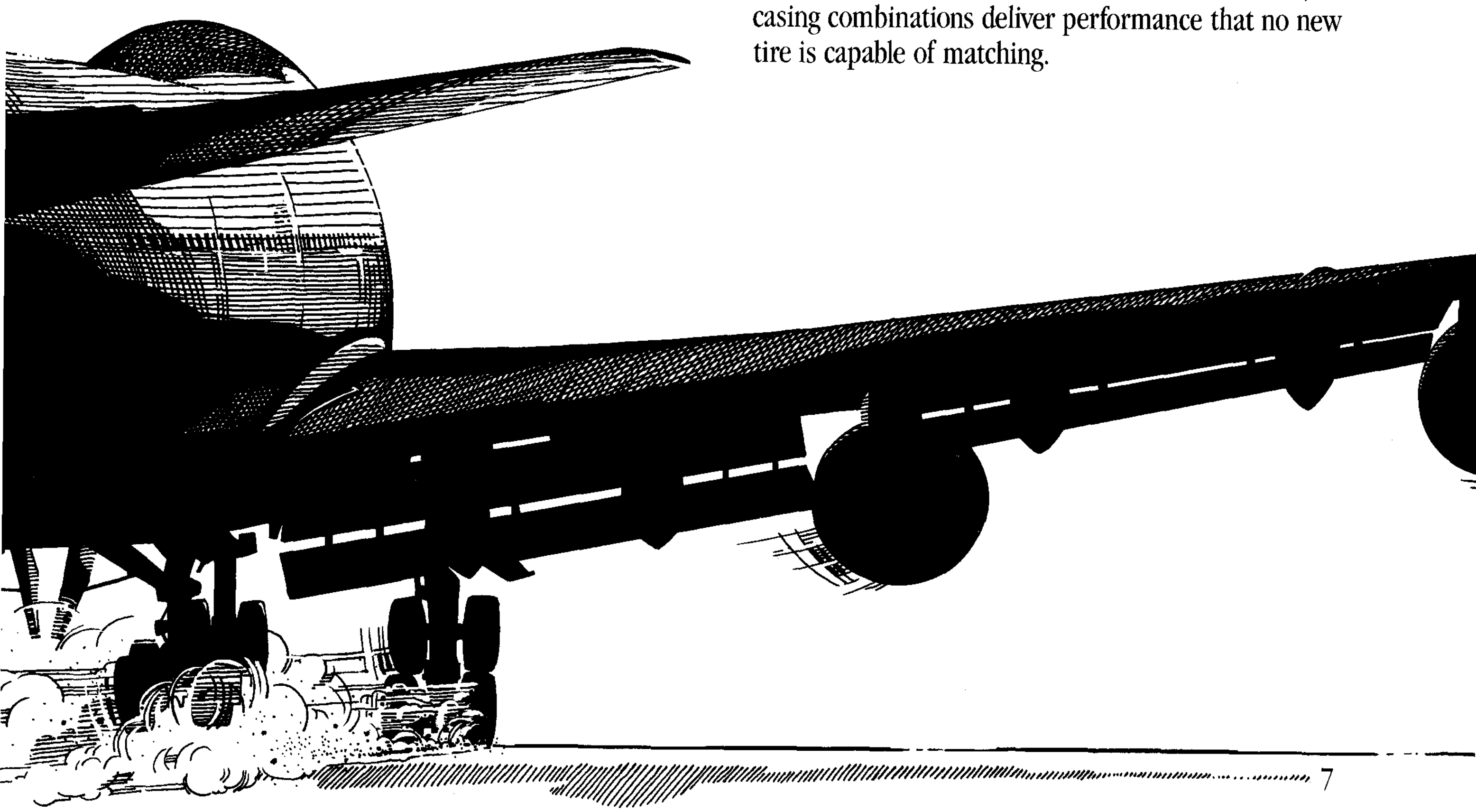
This tread variety enables fleet managers to have a far more flexible tire program than is possible using new tires alone.

For instance, you may find that a radial tire would have delivered better performance if a lighter weight tread had been used. Instead of buying a new tire, it's quite simple to specify a new tread design for the original casing.

In this way, it's possible to adapt your existing casings to meet your fleet's present and future requirements. Thus, you can enjoy the benefits of different tread designs without having to buy a warehouse full of new tires.

You can also avoid situations where, for example, you might be forced to use a linehaul new tire in a waste hauling application.

And you might even discover that certain tread/casing combinations deliver performance that no new tire is capable of matching.



Cutting life cycle cost.

A few figures tell the story. In the following example, the benefits of retreading are shown with a typical over-the-road fleet (11R22.5 tires). The chart below compares the life cycle costs of 100 tires, with and without retreading.

Allowances are made for the loss of tires that cannot be retreaded or sold for casing credit. You'll note that in the linehaul application, the retreaded tires give more miles than the original tires — not uncommon with quality retreads.

As the chart shows, retreading delivers more miles for the money. The linehaul fleet without retreading only gets 20,000,000 miles from its 100 new tires. Its net cost was $23,500 after it received an 80 casing credit. However, retreading those 80 casings and then retreading 40 of them again gave 44,000,000 miles from those original tires at a cost of $40,900.

To get the same mileage without retreading would cost $51,920, or 27% more! For easy comparison, these figures have been divided to achieve cost per tire mile, from which ultimate savings with retreading can be found.

Buying cheaper tires will not necessarily narrow the gap between a retreading and non-retreading program. Cheaper tires deliver less mileage, which drives cost per tire mile up again. What's more — and this is not shown on the chart — cheap tires have other costs such as extra mounting and demounting, labor, downtime and other factors. With new tires, you get what you pay for, as we will see in the next chapter.

As you can see, because the **life cycle cost** is lower, retreading can deliver some dramatic savings. And this is savings with no strings attached. With a quality retread, there is no loss in performance from the original tire.

In the final analysis, you owe it to your business to start a retreading program.

TYPICAL OVER-THE-ROAD FLEET

11R22.5 RADIAL TIRES	TIRES	PRICE	TOTAL COST	AVERAGE MILEAGE	TOTAL MILEAGE	COST PER MILE
Without retreading						
NEW	100	$295	$29,500	200,000	20,000,000	.148¢
CASING CREDIT	80	($75)	($6,000)	—	—	—
TOTAL			**$23,500**		**20,000,000**	**.118¢**
With retreading						
NEW	100	$295	$29,500	200,000	20,000,000	.148¢
RETREAD #1	80	$ 95	$ 7,600	200,000	16,000,000	.048¢
RETREAD #2	40	$ 95	$ 3,800	200,000	8,000,000	.048¢
TOTAL			**$40,900**		**44,000,000**	**.093¢**

100 VEHICLE FLEET

16 TIRE/COMBINATION (TRACTOR AND TRAILER)
100,000 MILES/YEAR/VEHICLE

COST PER MILE DIFFERENCE:	**.025¢**	**(.00118 − .00093)**
SAVINGS PER VEHICLE PER YEAR:	**$400**	**(.00025 × 16 × 100,000)**
SAVINGS PER FLEET PER YEAR:	**$40,000**	**(.00025 × 16 × 100,000 × 100)**

Tire Types/Constructions

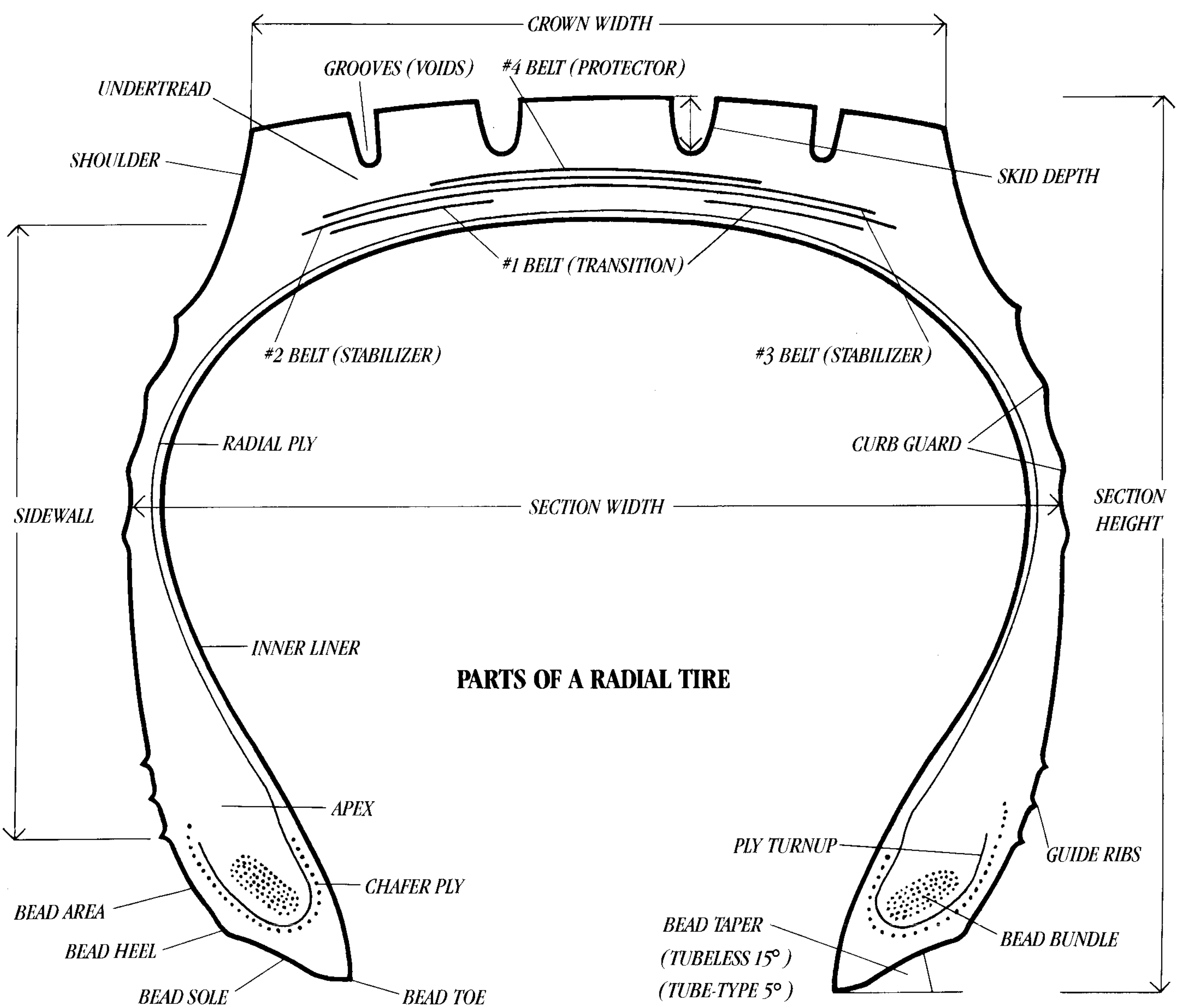
We take tires for granted, little appreciating the engineering marvel at work beneath our vehicle.

Here are some of the things we ask tires to do:

- Carry the load (actually, contain air which carries the load) and cushion bumps
- Provide necessary traction and braking force
- Supply cornering and road handling ability
- Give dimensional stability
- Consume minimum energy
- Run quietly, smoothly and safely
- Deliver tens of thousands of miles

If you're asking that much of a product you're buying, you should know a lot about it. What's more, the wise buying of new tires is at the heart of a good retreading program. Retreading cuts the need to buy new tires, but the ones that **are** bought should be quality products. A poorly made new tire will not only perform poorly during its original life, but also as a retread — **if** it makes it that far.

This chapter will help you become more knowledgeable about tire types and constructions.



PARTS OF A RADIAL TIRE

Tire types.

There are two basic types of truck tires today: tube-type and tubeless. Tube-type tires rely on a tube — a separate inner chamber — to contain compressed air. Tubeless tires have an integral inner liner that holds the air. There is no separate chamber.

Which is better? The tubeless tire has numerous advantages over the tube-type tire. Most of these advantages stem from a tubeless tire needing only two components, while a tube-type tire needs as many as six. And the tubeless tire can run with a bigger rim and lower profile than a tube-type tire.

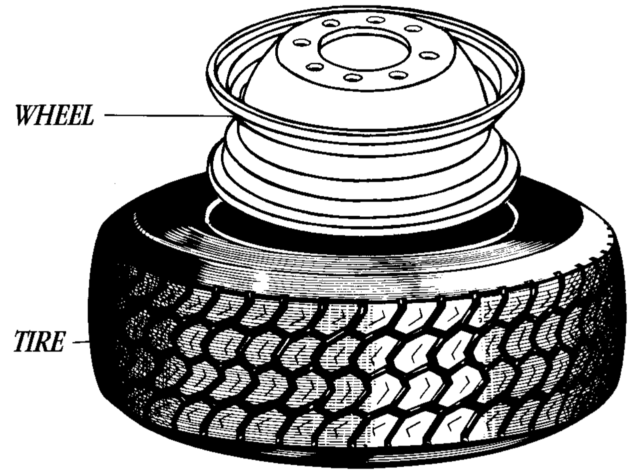
This adds up to easier mounting, less chance of failure due to mismatched components and reduced inventory and labor costs. It means a better balanced assembly that can give smoother riding and increased mileage. It means weight savings of several pounds per tire which reduces strain on the suspension, allows several hundred pounds more payload and creates less rolling resistance to save fuel. And, because tube-against-tire friction is eliminated and a bigger wheel with increased air flow is used, the tubeless tire runs cooler — improving mileage, economy and casing life.

What's more, there are less flats and downtime with a tubeless tire. The tubeless liner clings to penetrating objects to slow loss of air, and there is less chance of losing air around the valve on a tubeless tire.

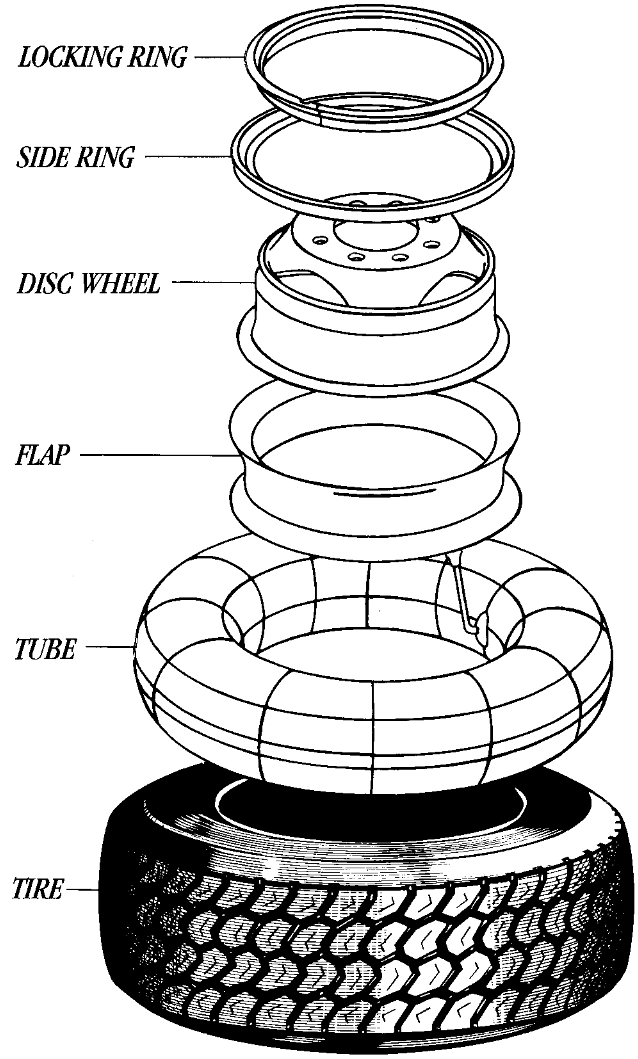
The lower profile also improves stability and road handling. No wonder the majority of truck tires sold today are tubeless.

TUBE-TYPE AND TUBELESS COMPONENTS

TUBELESS



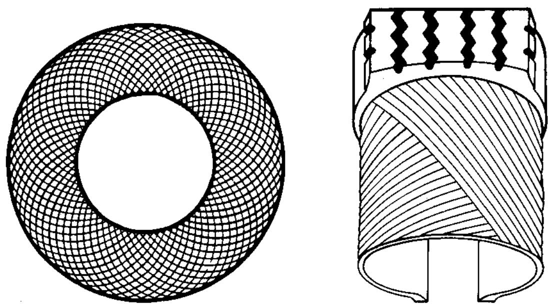
TUBE-TYPE



Tire constructions.

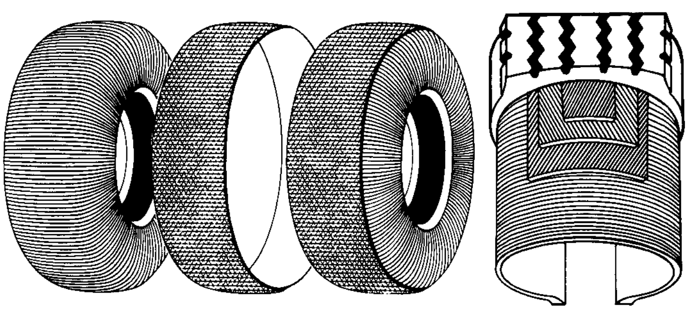
Today's truck tires are available in two basic constructions: bias and radial.

BIAS CONSTRUCTION



Bias body ply cords run diagonally from bead to bead — each layer criss-crossing the other. These tires may also have narrow belt-like plies, called breakers, which lie under the tread. These breakers have cords that lie diagonally to the bead.

RADIAL CONSTRUCTION

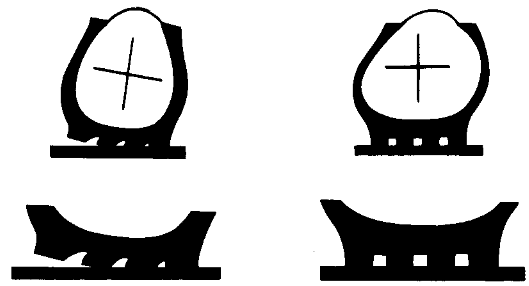


Radial body ply cords run straight across the tire from bead to bead. This construction permits easier flexing in the sidewall area. In addition, belt plies encircle the tire under the tread. These belts (there may be three or four) constrict the radial plies and add strength and rigidity.

Almost every major fleet today is on radial tires and for good reason. Radial construction gives a tire the best of two worlds: flexibility and strength. That combination generates a very impressive set of benefits:

- **Longer tread life.** Sidewall flexing allows the tread to hug the road while the belts keep it flat, reducing wear.
- **Improved fuel efficiency.** Easy-flexing radial plies put up less rolling resistance than stiffer bias plies.
- **Increased load.** Radial construction is stronger and can handle more load.
- **Less downtime.** Radial belts provide better protection against punctures for fewer flats.
- **Better performance, comfort.** Easy-flexing side-walls and strong belts give road-hugging traction. Flexible sidewalls give a better ride.

BIAS VS. RADIAL FLEXING



BIAS RADIAL

The stiffer sidewalls on a bias tire don't allow the tread to conform to the road surface which leads to increased wear. Flexible radial sidewalls free the tread to stay flat on the road and give better mileage.

As important as these benefits are, perhaps the most important one economically is that radial casings give longer casing life. Radial plies generate less heat than bias plies, and heat can shorten tire life. Therefore a radial casing gives more retread potential and ultimately more miles for the money than a bias tire.

Tire materials.

Both bias and radial tires will have body plies and breakers or belts made of polyester, rayon, nylon, fiberglass, steel, or aramid. Often a tire will have a combination of these materials.

Rubber ingredients are similar for both new tires and retreads. Some of these ingredients are:

- Rubber (natural and synthetic)
- Carbon black (for abrasion resistance)
- Zinc oxide, stearic acid, sulfur, accelerators (to promote rubber elasticity)
- Antiozonants and antioxidants (to slow aging)
- Process oil (for easier mixing)

While the basic rubber ingredients may be similar, the quality of these ingredients, and how they are compounded vary widely among tire and retread manufacturers. That is why there is such a wide variance in performance.

The best way to assure a quality product is to deal exclusively with reputable suppliers, whether you're purchasing new tires or specifying retreads.

Selecting the Right Tire

A tire must be matched to its application. Running a tire in an application for which it wasn't designed can shorten its life and reduce its retreading potential.

Finding the proper tire can be a tough job. There are over 4,000 different sizes, types, constructions and designs to choose from! The original equipment tires can be used as a guide, but often a vehicle is doing work that requires a different tire than the one it was equipped with.

Some of the things you must consider in selecting a tire which will deliver the best performance have already been discussed: **tire type** and **tire construction.** Other considerations are **tire size, casing strength, life cycle cost** and **tread design** which will be explored in this and the following chapter.

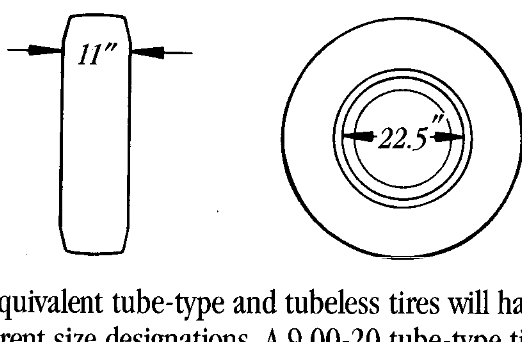
Tire size.

Truck tire sizes are indicated by a number molded into the sidewall. It is usually a two-part number giving the section width of the tire in inches followed by the rim or wheel diameter in inches.

TYPICAL SIZE DESIGNATION

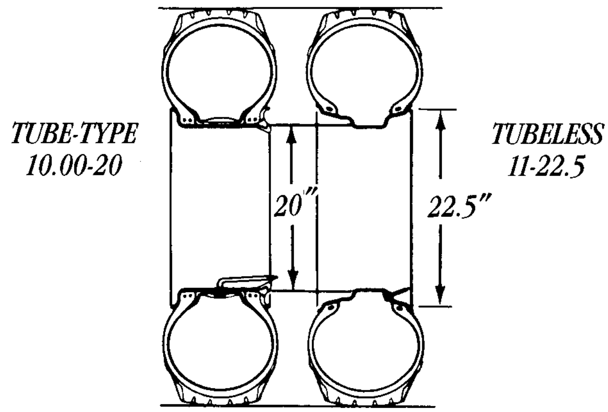
11 - 22.5

11 = section width in inches
22.5 = rim or wheel diameter in inches



Equivalent tube-type and tubeless tires will have different size designations. A 9.00-20 tube-type tire is equal to a 10-22.5 tubeless. A 10.00-22 tube-type is equal to an 11-24.5 tubeless. That's because a tubeless tire has a lower profile and a larger rim than a tube-type tire. The chart above right compares tube-type and tubeless tires.

DIFFERENCES IN WHEEL DIAMETERS



A rule of thumb for converting a tube-type size designation to a tubeless is to take the section width and remove all figures after the decimal point. Then add one (1) to the section width and two-point-five (2.5) to the rim diameter.

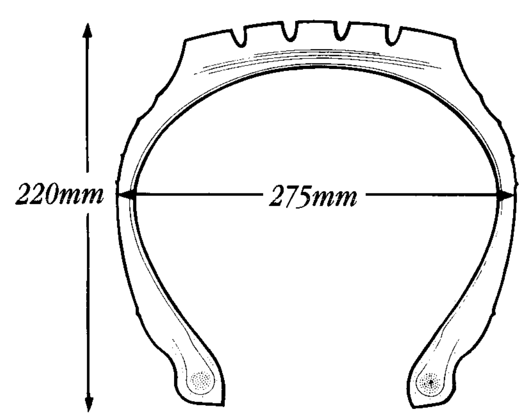
Low-profile markings are a different breed. Here a three-part designation is used. The first number is the cross section in millimeters, the second is the aspect ratio (see below). The third number is the rim size in inches.

LOW PROFILE SIZE DESIGNATION

275/80R24.5

275 = section width in mm
80 = aspect ratio
R = radial
24.5 = rim or wheel diameter in inches

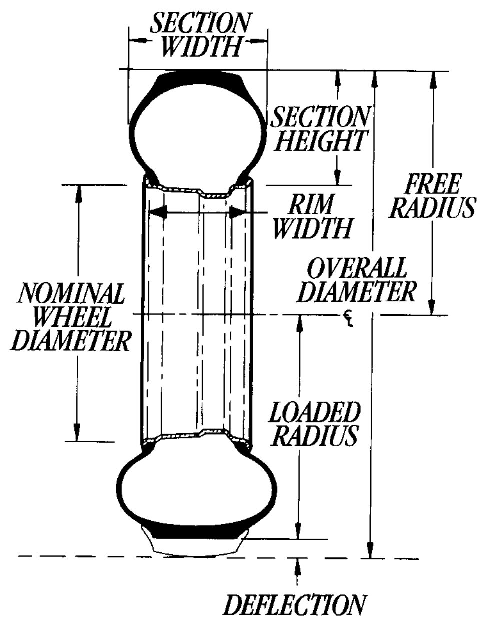
ASPECT RATIO



Aspect ratio is the ratio of tire height to width. In the example above, the tire height is 80% of its width for a low profile.

Size designations give basic information about tire dimensions. More comprehensive specifications can be obtained from the tire manufacturer. The illustration below shows some of the dimensions that may be of concern to you. You may also want to know the revolutions per mile and rolling circumference of the tire.

OTHER TIRE DIMENSIONS



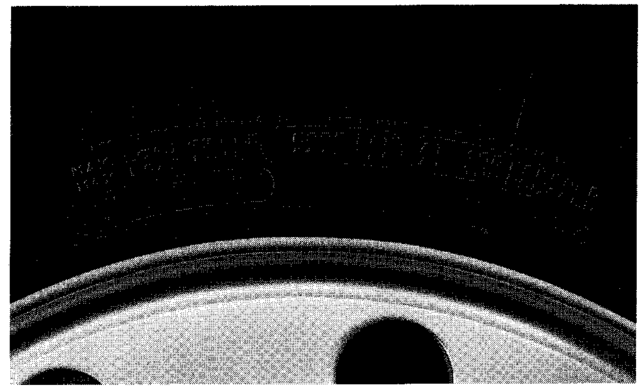
Casing strength.

The strength of a tire casing is expressed as ply rating or load range. A ply rating is given as a number (10, 12, 14, etc.) while load range is a letter (E, F, G, etc.). These designations give an indication of load carrying capacity — the higher the ply rating the more load the tire can carry. Actually, ply rating or load range relates to the tire's ability to hold air pressure and volume. It is the air that carries the load.

The load carrying ability of the tire varies with inflation pressure. The Rubber Manufacturers Association provides detailed load and inflation tables to aid in determining the load limits of a tire at various inflation pressures.

The load per tire must not exceed the capacity of the tire, rim, wheel or other vehicle components. The vehicle's capacity for load is given in its Gross Axle Weight Rating or Gross Vehicle Weight Rating. The tire load capacity is stamped on the sidewall of all truck tires manufactured after March, 1975.

TYPICAL LOAD DESIGNATION



An example of load information on a sidewall. This tire is rated for both dual and single use. The designation is the minimum inflation pressure required to carry the maximum load this tire can handle. It is also an indication of the maximum air pressure for the tire. It is **not** *the pressure to run at all the time. With lighter loads, this tire would be overinflated at 100 psi.*

One way to prevent tire overload is to weigh each axle or tire when the vehicle is fully loaded. If an axle is weighed, the number of tires on the axle are divided into the weight to determine load per tire. If the maximum load-carrying capacity of the tire is below the scale weight, tires with greater capacity should be used.

When selecting a different size tire than original equipment, be sure the rims are suited for it and the vehicle geometry will accept it. Other factors in selecting the right tire for the job include **speed, distance, traction, mileage** or **road conditions.** Consult your tire dealer for assistance.

Casing life cycle.

The life cycle of the tire casing is important to any tire selection. Tires are usually the second largest expense (fuel is first) in any fleet of trucks, so it is crucial to get the maximum life out of them before they are scrapped. It is the only way to get the best return on your investment.

And that means buying a tire with good retread potential. You're not just buying a tire, you're also buying a casing — which is 80% of the tire cost to begin with. A well-chosen quality tire will not only give excellent performance and safety in its original life, but also in its second and subsequent lives as a retread.

Another way to maximize casing life cycle is to deal with a supplier that has the most up-to-date technology for repairing, inspecting and retreading.

Selecting the Right Tread Design

Just as matching a new tire to an application is important, so is matching a retread design to an application. Most major retreaders carry a wide variety of tread designs. These designs can be categorized as over-the-road, off-the-road, light truck, or specialty. Over-the-road treads may be all-wheel-position, trailer, or drive treads.

Over-the-road treads.

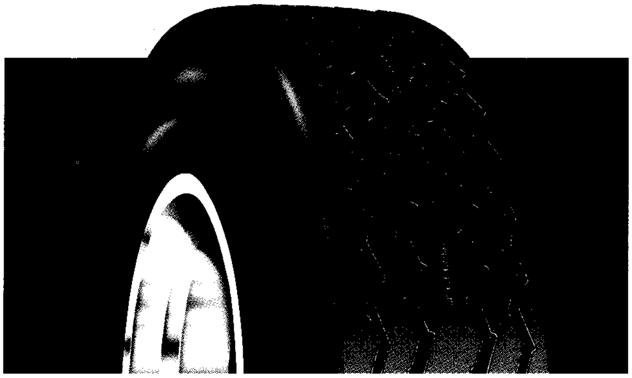
Built for highway use, these treads are designed to minimize the heat generated in a tire at high speeds over long distances.

All-wheel-position treads. These treads operate at any wheel position, including steering and drive axle positions. They are basically rib-type treads with tread grooves that provide maximum steering control (lateral traction), water channeling for wet road traction, and good skid resistance. All-wheel-position treads have patterns that are aggressive enough for drive axle use when maximum traction is not required.

Trailer treads. Built only for trailer use, these treads are usually lightweight and shallow to run cool and minimize irregular wear. They are rib-type treads which provide good stability, long mileage, and positive braking traction.

Drive treads. These treads are usually built with a rib-lug or lug-type design to provide greater traction and high mileage in high-torque service. Aggressiveness of the treads can vary greatly, and include all-weather treads and deep winter traction treads.

Specialty treads.



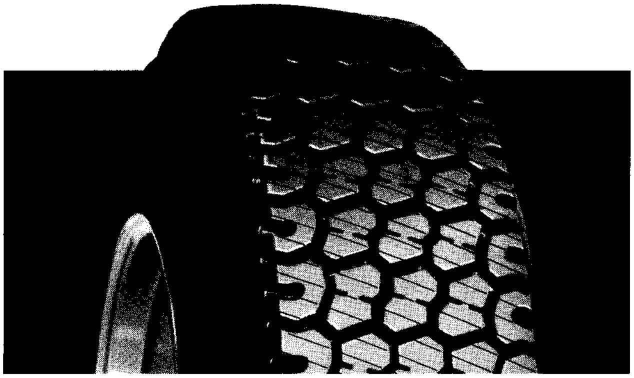
The designs of these treads run the gamut — from lightweight treads built to meet the needs of intermodal operations to massive lug treads designed to handle rocks. Wing treads are a recent addition to this category. They feature special shoulder extensions that provide extra strength along the bond line and give the finished retread a new tire appearance.

Available for either radial or bias tires, wing treads offer important performance advantages. They are often used, for example, on spread- and multi-axle trailers to prevent turning damage and extend the life of the retread.

Off-the-road treads.

Built to handle severe traction problems, these treads usually have very aggressive lug designs. They are heavy-duty treads built with very deep tread depths to ward off nails, glass, and other road hazards that might be encountered off the highway. Many of these treads are on-and-off-the-road treads — designed to handle severe off-the-road use, but also to handle short-haul, slow-speed highway use.

Light truck treads.



These treads are designed for light truck use — vehicles with tire rim diameters 17 inches or smaller. As with heavy trucks, a wide variety of tread designs give many combinations of traction and mileage options.

Fuel-efficient treads.

A new type of tread that has recently been introduced is a low-rolling resistance tread that saves fuel. Studies have shown the cost of tires and retreading is only one-quarter the cost of fuel. So even a small percentage improvement in fuel economy can have a major impact on costs.

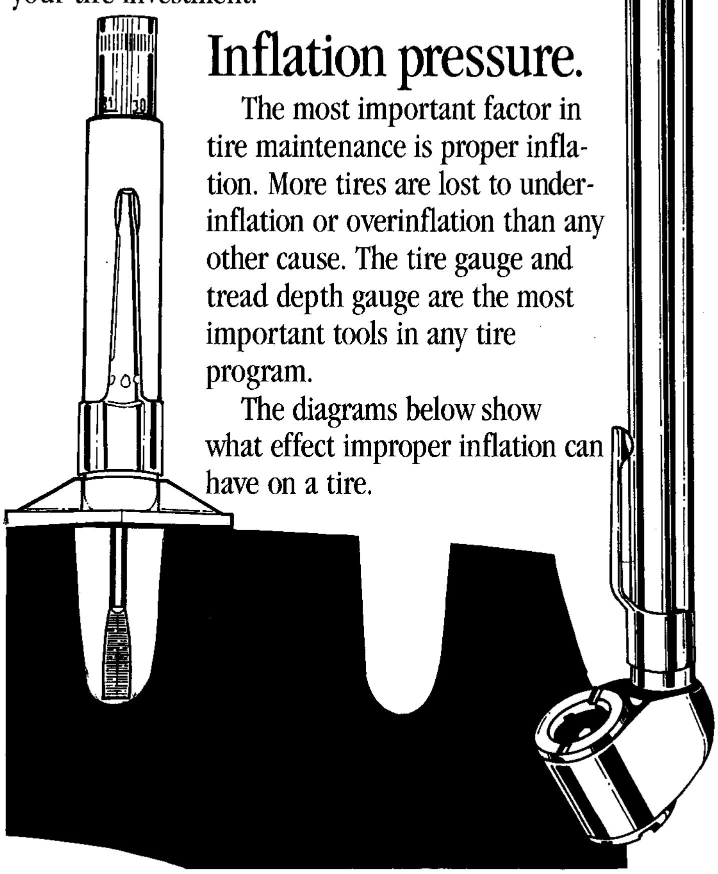
For that reason, you should definitely consider these treads. They are available in all-wheel-position, trailer and drive designs. Their efficiency is the highest when they are used with fuel-efficient tires.

Tread depth.

Besides tread design and characteristics, you should also be aware of tread depth (skid depth). The optimum tread depth varies by tire position and application — less-stressed trailer tires need less tread depth than a drive axle tire. An off-the-road tire, because of the hazards it may encounter, needs a deeper tread than a highway tire.

Preventive Maintenance.

If selecting the right tire is the crucial first step in a good retreading program, maintenance is the second. A tire that is not maintained will soon be ready for the scrap pile, and that's the end of the line for your tire investment.



Inflation pressure.

The most important factor in tire maintenance is proper inflation. More tires are lost to underinflation or overinflation than any other cause. The tire gauge and tread depth gauge are the most important tools in any tire program.

The diagrams below show what effect improper inflation can have on a tire.

The effect of overinflation.

Driving on tires that aren't properly inflated is unsafe, and can result in extensive tire damage. Let's first look at what overinflation can do to a tire.

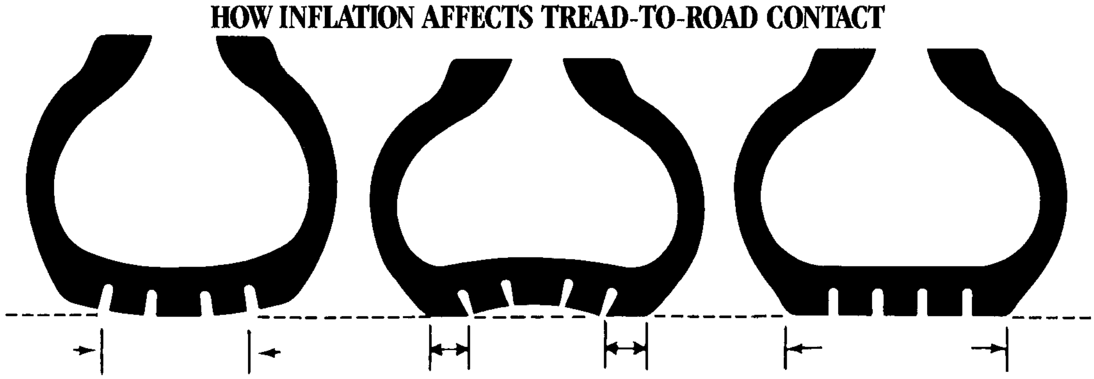
When a tire is overinflated, it's more rigid. The more rigid the tire, the less able it is to absorb road shock, and the more vulnerable it is to road hazards that can lead to cuts, snags, punctures and body breaks.

Overinflated tires also wear faster. Some truckers have experienced a 5% loss of tread mileage when running overinflated tires.

Many times, drivers overinflate tires on purpose, trying to compensate for overloading the vehicle. But the truth is no matter how much air you add to a tire, you'll never increase the tire's carrying capacity above the maximum rated load. The only way to effectively address the overloading issue is to use more tire, not more air.

The chart on the opposite page demonstrates the effect improper inflation has on tire service.

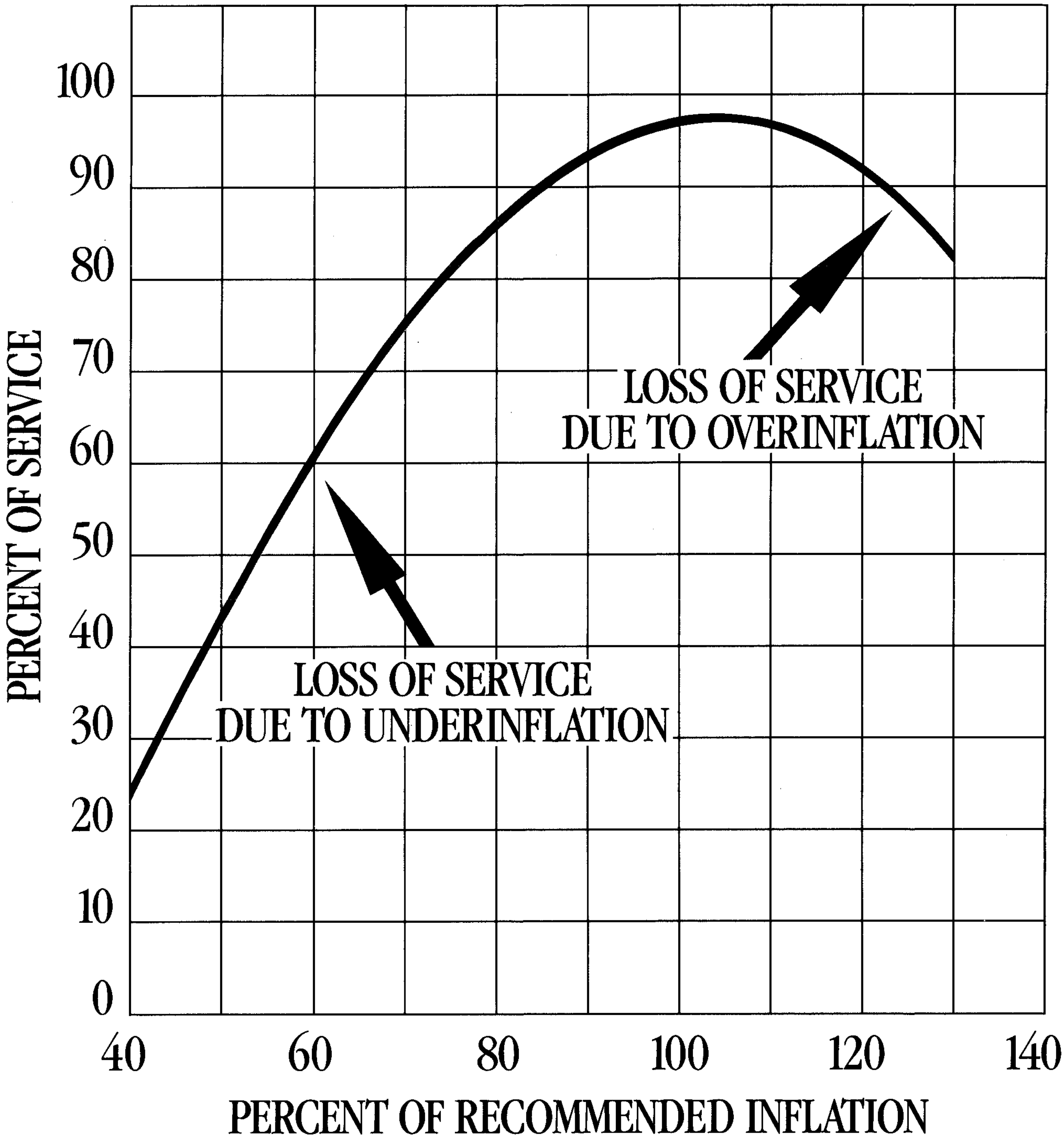
HOW INFLATION AFFECTS TREAD-TO-ROAD CONTACT



OVERINFLATION *UNDERINFLATION* *PROPER INFLATION*

Both overinflation and underinflation reduce tread contact with the road. Proper inflation assures maximum contact.

EFFECT OF INFLATION ON TIRE SERVICE



The effect of underinflation.

While overinflation is serious, underinflation is especially hazardous. It is the most common condition because no tire or tube is completely impervious to air loss. Sooner or later, air will have to be added.

The reason underinflation is devastating to a tire is heat. Abnormal deflection of an underinflated tire causes friction within tire components which elevates temperature. Heat is the primary cause of premature tire failure, and it doesn't take much of an increase to make a difference in the life cycle of the tire. The chart on the next page demonstrates this.

HEAT VS. TIRE LIFE

TIRE OPERATING TEMPERATURE	ESTIMATED LIFE CYCLE	ESTIMATED MILES AT 55 MPH
175 F	3600 HOURS	198,000 MILES
200 F	1090 HOURS	60,000 MILES
250 F	130 HOURS	7,150 MILES
275 F	50 HOURS	2,750 MILES
300 F	10 HOURS	550 MILES

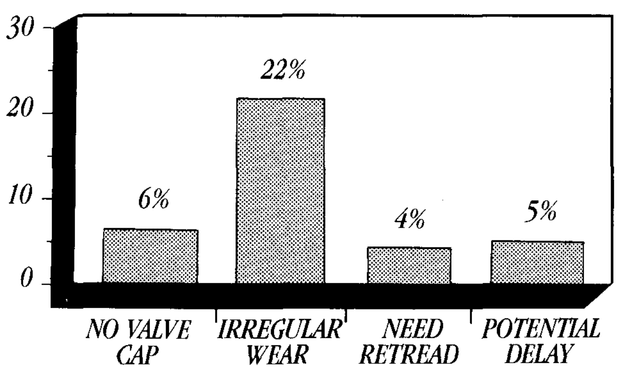
Once the correct pressure for the vehicle, load and speed is determined (use load and inflation tables in the RMA booklet) regular pressure checks should be carried out. Pressure should be checked at least once a week when tires are "cold," using an accurate pressure gauge.

Maintenance programs.

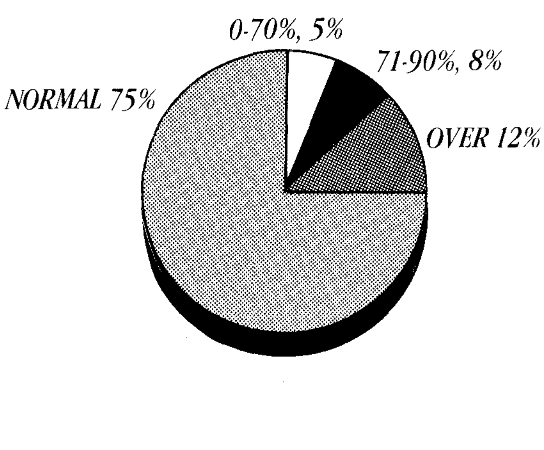
One of the best ways to begin a tire pressure maintenance program is to have a fleet survey done by your tire supplier. A thorough fleet survey will give you a wealth of information about your tires. It will give you a picture of conditions which need to be corrected to improve performance.

FLEET SURVEY ANALYSIS

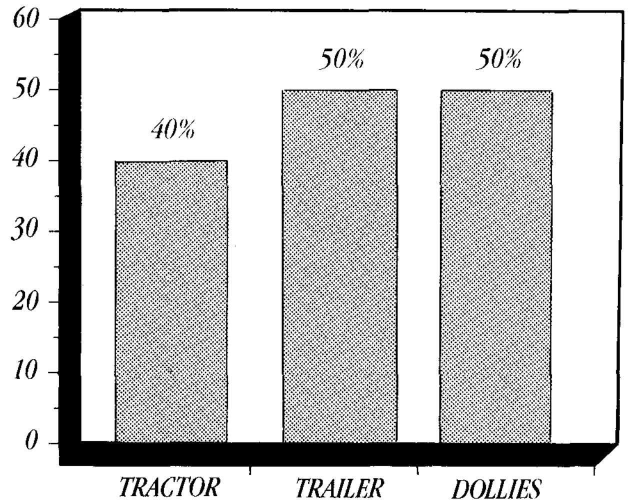
TIRE MAINTENANCE SUMMARY



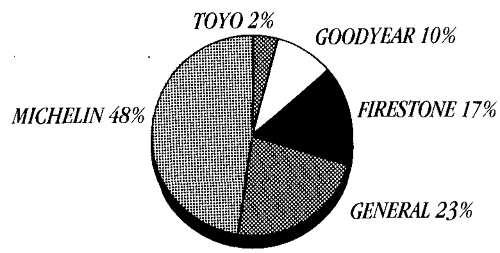
INFLATION SUMMARY



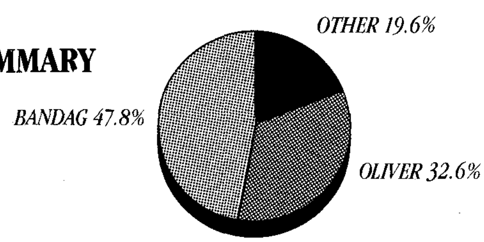
RETREAD USAGE SUMMARY



NEW TIRE USAGE SUMMARY



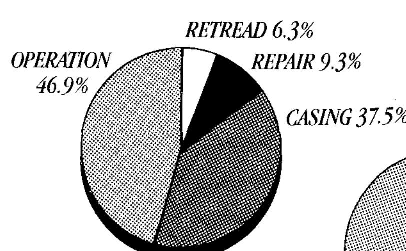
RETREAD USAGE SUMMARY



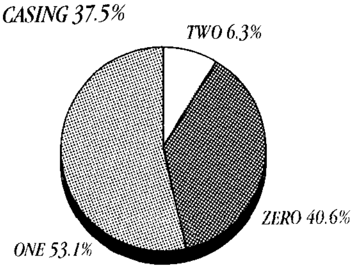
Additional valuable information can be obtained from a failed tire analysis, and a tire comparison test. The following graphs are examples of the kind of information that can be gleaned from this kind of research.

FAILED TIRE ANALYSIS

FAILURE AREA

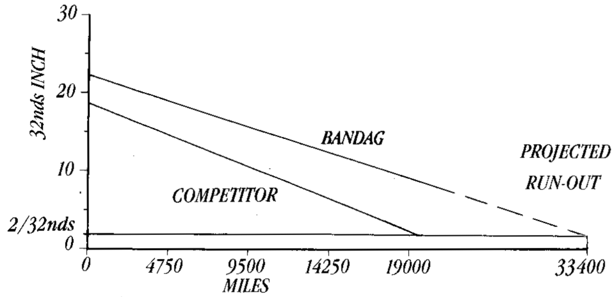


TIMES RETREADED

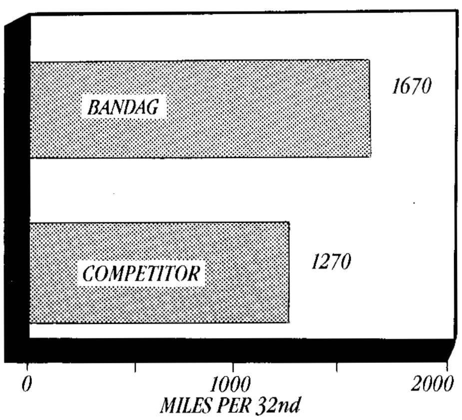


CHALLENGE TIRE TEST

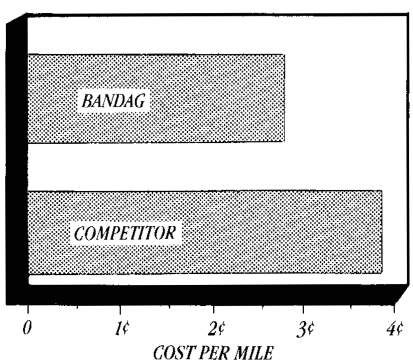
MILEAGE GRAPH



MILEAGE COMPARISON



COST COMPARISON



Maintaining duals.

Tires mounted in duals must be matched so that the maximum difference between the diameters of the tires does not exceed ¼″ or the circumferential difference exceed ¾.″ Mismatching will cause the tire with the larger diameter to carry a larger share of the load, resulting in overload and possible damage. The smaller tire, lacking proper road contact, wears faster and irregularly.

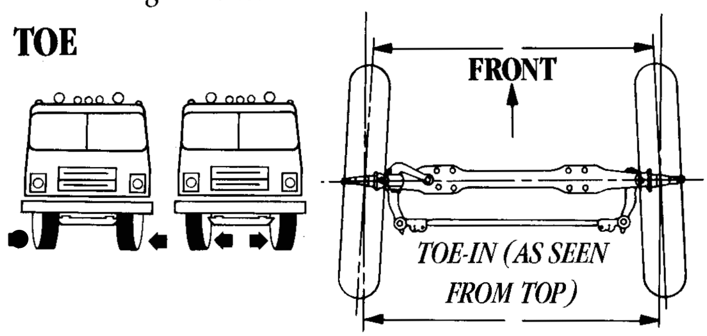
It is also important to make sure that sufficient space is provided between the duals to prevent the tires from rubbing against each other.

Maintaining the vehicle.

There are many vehicle factors which have a major effect on tire life, including the condition of the braking system, condition of the suspension system, and maintenance and placement of the 5th wheel. However, the vehicle factor that has the most direct effect on tread wear is axle alignment.

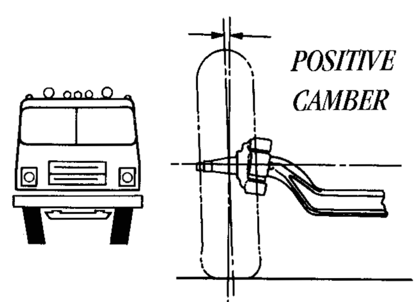
The importance of proper axle alignment can hardly be overstated. A national survey indicates as many as 80% of Class 8 trucks may have front wheel alignment problems, and 70% have problems with rear alignment. Proper axle alignment delivers three important benefits: reduced tread wear, better vehicle handling and control, and less fuel consumption. Alignment not only refers to the various angles of the steering axle geometry, but also to the tracking of all axles on the vehicle. A description of the main alignment settings follows.

TOE

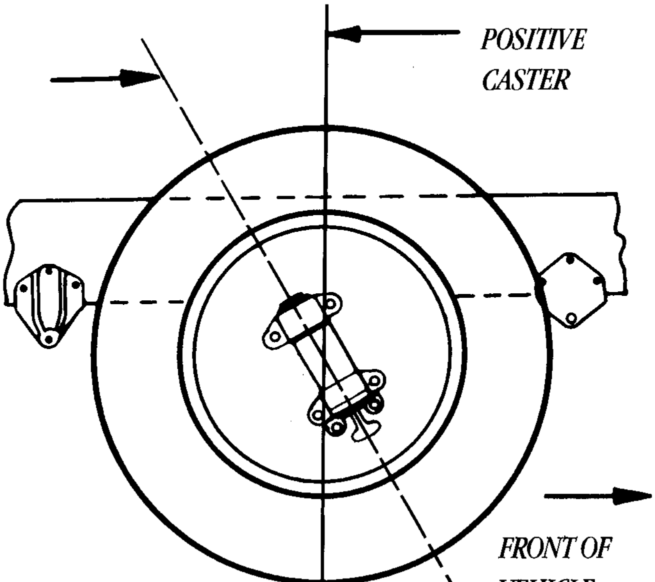


Toe determines how parallel steer axle tires are. It is the difference in distance between a measurement taken between the front of the tires and one taken between the rear of the tires. With toe-in, the fronts of the wheels are closer together than the backs. Toe-out is the opposite. New vehicle wheels are set with a slight toe-in to eliminate the tendency of wheels to weave from side to side. Excessive toe-in causes rapid wear on the outside shoulders of the tires. Toe-out causes rapid wear on the inside shoulders.

CAMBER



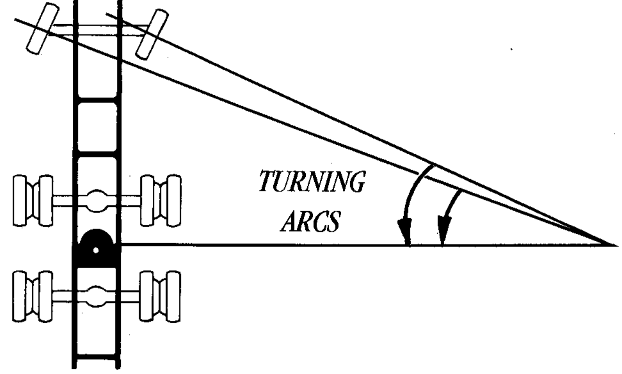
Camber is the angle the wheel tilts from the vertical. Positive camber is an outward tilt of the wheel, negative is inward tilt. Excessive camber results in rapid shoulder wear.



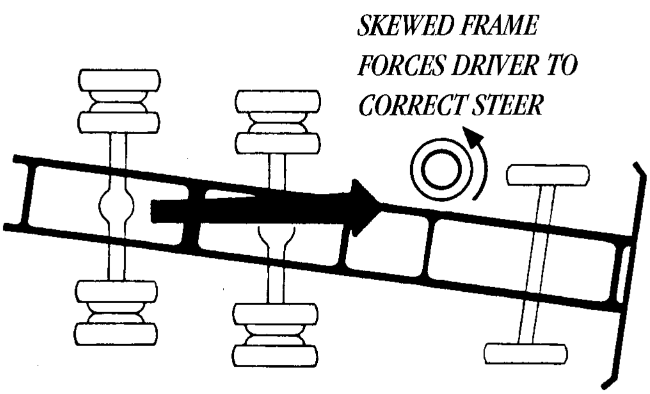
CASTER

Caster is the backward (positive) or forward (negative) tilt of the kingpin when viewed from the side. Insufficient caster reduces stability and can cause wander. Excessive caster increases steering effort and can cause shimmy.

TOE-OUT-ON-TURNS



Toe-out-on-turns is the difference in the arcs steering wheels make in a turn. This difference is necessary to prevent the inside tire from scrubbing around a turn. It is accomplished by setting the steering arm and tie rod so that an imaginary line drawn from each steering arm converges on the centerline of the rear axle. This setting is not adjustable.



TRACKING

Rear wheels should follow the front wheels on a parallel line when driven straight ahead. Out-of-track rear wheels will drive the vehicle off course, causing penalties in tire wear, fuel consumption, suspension wear, driver fatigue, and ultimately, safety.

Alignment is extremely important to the life cycle of your tires. It is another key to a good tire maintenance program. Complete alignment information and settings can be obtained from the vehicle manufacturer.

Preventive maintenance is an investment in the future. By taking care of your tires today, they may live to see tomorrow as a retread. And your life cycle cost will be lower.

The Retreading Process

In purchasing, knowledge is power. The better you know the product, the better decision you'll make in buying it. To help you understand the retreading process, this section will take you through the building of a retread.

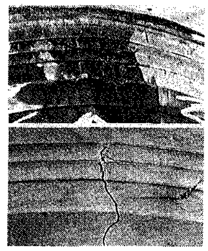
Initial inspection.

Initial inspection may be the most important part of the retread process. More than half of the failures of retreaded tires can be traced to poor initial inspection. Here the decision is made whether to retread or not. Expert inspection assures every casing that can be retreaded is, and every casing that can't be returned to service isn't. The first saves you money; the second, downtime.

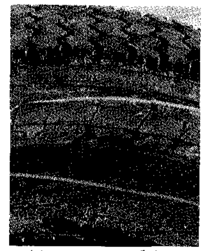
Often a knowledgeable inspector, backed by advanced repair techniques, can save a severely damaged casing by repairing it and downgrading it to less stressful service such as a trailer position.

Inspection begins when the tire is placed on a mechanical spreader and a drop-light is used to make the inside visible to the inspector. As the casing is rotated, the inspector checks inside and outside with his hands and eyes.

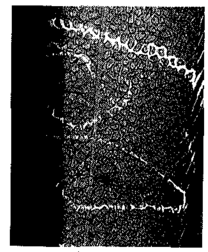
Some of the things an inspector looks for that could cause rejection of a casing are:



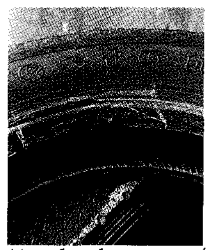
Cuts and snags



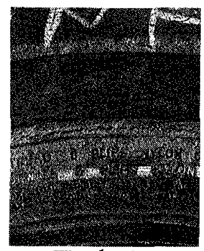
Torque cracking



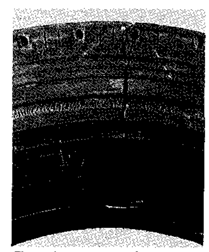
Inner liner cracking



Torn beads–mount/dismount damage



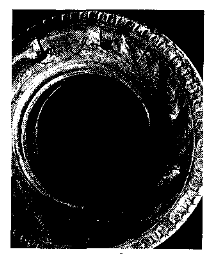
Weathering



Equipment damage

Sidewall separation

Stone drilling



Run flat

Repair failure

Tread separation

Impact break

Any of these problems could be reason for casing rejection, and these are just some of the ones that can be seen or felt.

Buffing.

Buffing is simply the removal of previous tread material and the shaping, sizing and texturing of the casing surface to receive the new tread. It is best performed on a lathe-type machine.

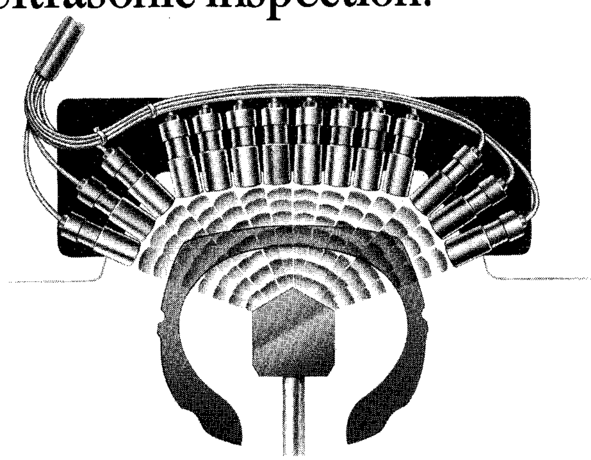
The casing is mounted on the machine, inflated, and rotated as it is worked on. A powered buffing rasp removes material.

The casing is buffed as flat as possible so there will be good tread-to-road contact. It is buffed to a predetermined crown width, radius and symmetrical profile. Often a buffed casing will end up more true and round than the original tire.

Tires that need repairs are marked for the kind of repair needed, or marked "RAR" (return as received — the casing is beyond repair) or "RAB" (repair after buffing). Nail holes can be repaired at this stage, other repairs are made after buffing.

Bias tires are "vented". Small holes are placed in the bead and shoulder areas to reduce buildup of air pressure within the tire cords while curing.

Ultrasonic inspection.



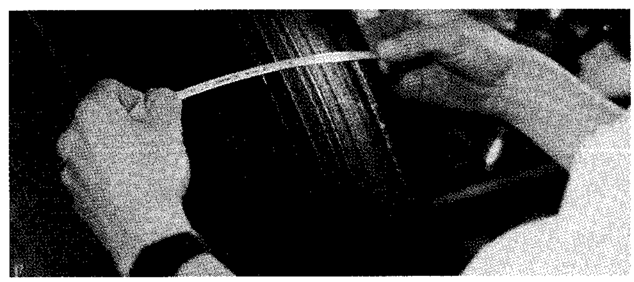
Bandag's NDI® tire casing analyzer uses ultrasonic waves to penetrate a casing and look for flaws.

For damage that cannot be seen, quality retreading shops today use sophisticated ultrasonic equipment to check for hidden flaws.

For example, Bandag's NDI® tire casing analyzer uses ultrasonic waves and electronic detectors to scan buffed casings for flaws. This state-of-the-art tool can find pinhole leaks, separations, and other damage hidden from visual inspection.

Measuring.

The casing is carefully measured either with an automatic device on the buffer, or with a steel tape. In the case of a mold cure operation, this is to determine the proper mold fit. In the case of a precure operation, it is used to determine the length and width of tread to be used.



Casing preparation.

Injuries remaining or uncovered after buffing are then repaired. This involves skiving or "buzz out" of the injury with a powered rasp. This is a crucial operation.

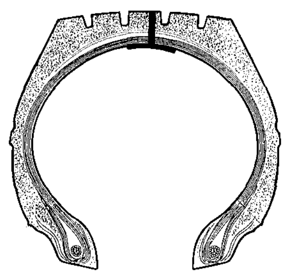
All exposed cords are trimmed, finished and coated with cement as soon as possible after buffing and skiving operations. This is to prevent oxidation of the material. Steel belt cord needs to be protected within 15 minutes.

Repair.

Repairing a casing is both an art and a science. It takes highly skilled people, proper equipment, and quality materials to do the job well. Basically, repairing involves the removal, filling, and reinforcing of the injury and surrounding area. Repairing is well worth the effort. There is such a wide difference between the cost of a new tire and a retread, even major repairs such as rebelting are cost efficient.

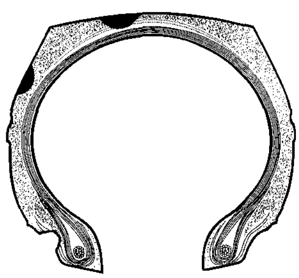
There are four basic types of repair: nail hole, spot repair, reinforcement repair, and section repair.

NAIL HOLE REPAIR



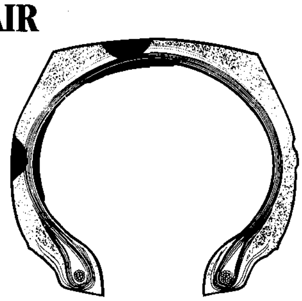
A nail hole repair is an injury ¼″ or less in diameter in the crown area (or 1/16″ or less in the sidewall) that penetrates 50% or more of the plies. Any number of nail holes in the crown or sidewall of a tire can be repaired as long as the repair patches do not overlap. Nail holes in the bead area of a tire cannot be repaired.

SPOT REPAIR



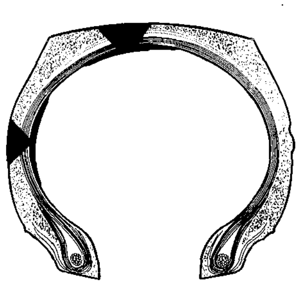
A spot repair is the removal and replacement of rubber in an injury that is larger than a nail hole, but involves less than 25% of the actual body plies. Any number of spot repairs can be made as long as the repairs do not involve body ply damage in the bead area.

REINFORCEMENT REPAIR



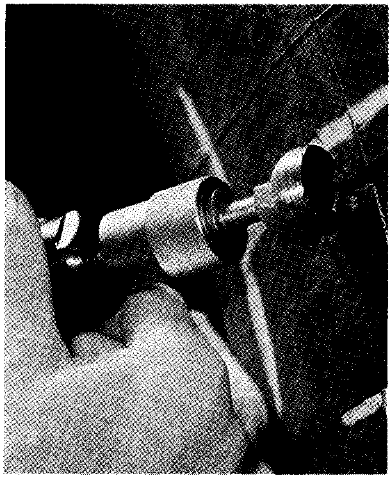
A reinforcement repair is repair of an injury through 25% but less than 75% of the body plies (in California, less than 50%). Over-the-road bias drive tires may not have more than one reinforcement repair in each quarter-section of the tire. Trailer or local service bias drive tires may have no more than two. No portion of a repair patch can overlap another. Reinforcement repairs are limited to bias tires.

SECTION REPAIR

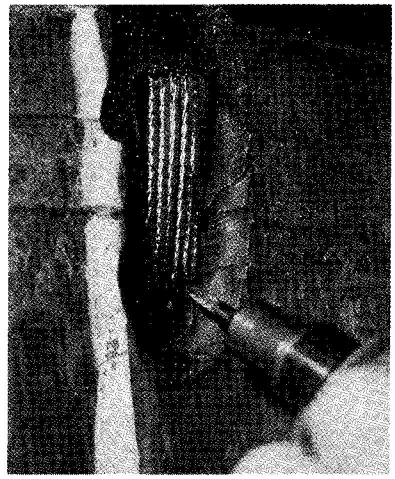


A section repair is a repair made when an injury extends through 75% (in California, 50%) or more of the body plies or completely through the casing in the tread and sidewall areas. Bias ply section repairs are limited to one per quadrant for over-the-road drive tires; two for trailer and local service drive tires. Radial section repairs are not limited by number, but no portion of a repair patch can overlap another.

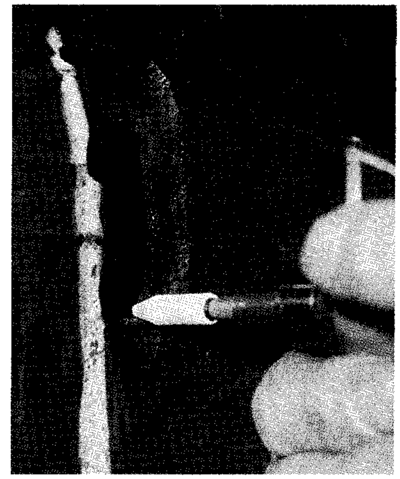
REPAIRING A SIDEWALL INJURY



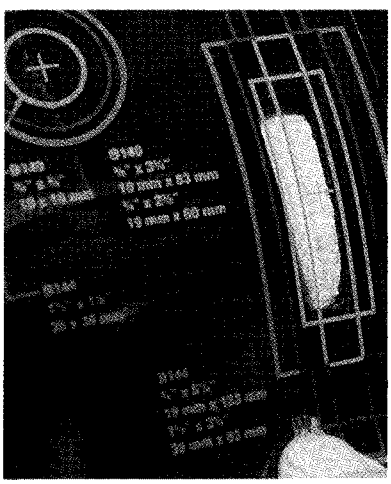
Skiving the injury.



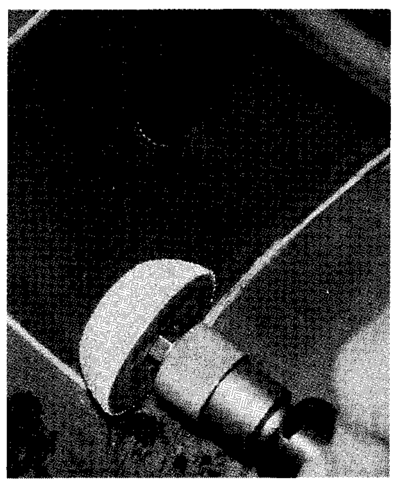
Removing damaged cords.



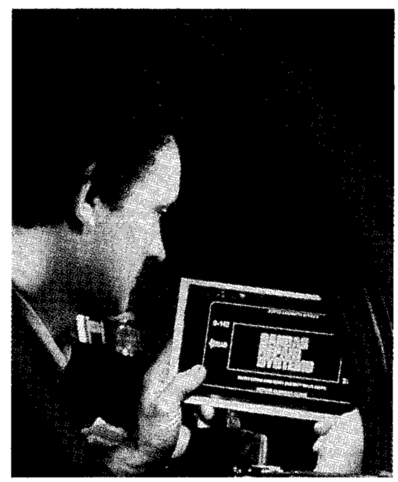
Cleaning the injury.



Measuring for repair.



Preparing liner for patch.

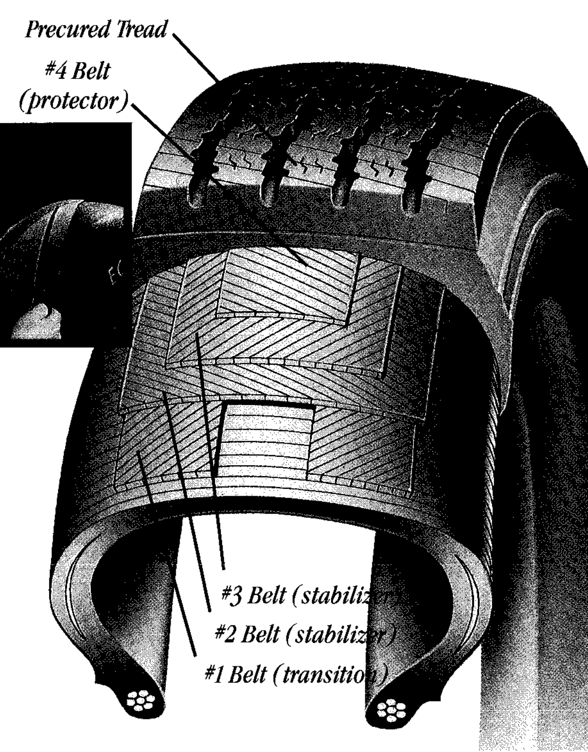


Installing the repair.

Rebelting.

Recent technology has made the replacement of the top two belts of a radial tire possible. This advanced procedure can make a big difference in the number of casings that can be saved. As many as 9 out of 25 rejected casings can be put back in service with rebelting.

A machine with a knife cuts under the belts and peels them off the casing. When the belts are removed, the casing is buffed, prepared, and cemented. Then two new belt assembly packages are added, followed by standard retreading procedures. In the precure process, a restraining ring is used to retain the shape while curing.



Tread application.

After repairs are made, the casing is then sprayed with cement to enhance adhesion between the new tread material and the casing. When the cement dries to a tacky consistency, it is ready for the tread.

At this stage, the new tread material is fitted to the casing. It must be the precise size and it must be centered on the casing.

In precure operations, the proper length of the precured tread is cut, and a layer of cushion gum is added to the back of the tread. The cushion gum is the bonding agent between tread and tire casing. That bond becomes the strongest part of the tire. It reduces the chances of tread separation and increases the reliability of the retread.

The tread is then applied to the casing in such a way as to distribute the tread evenly over the tire circumference. The tread may be applied manually or with the help of a machine. The ends of the cut tread are spliced together, temporarily stapled to hold them in place during curing, and then the tread is "stitched" to the casing to eliminate trapped air.

In mold cure operations, uncured rubber is added to the prepared casing.

Curing.

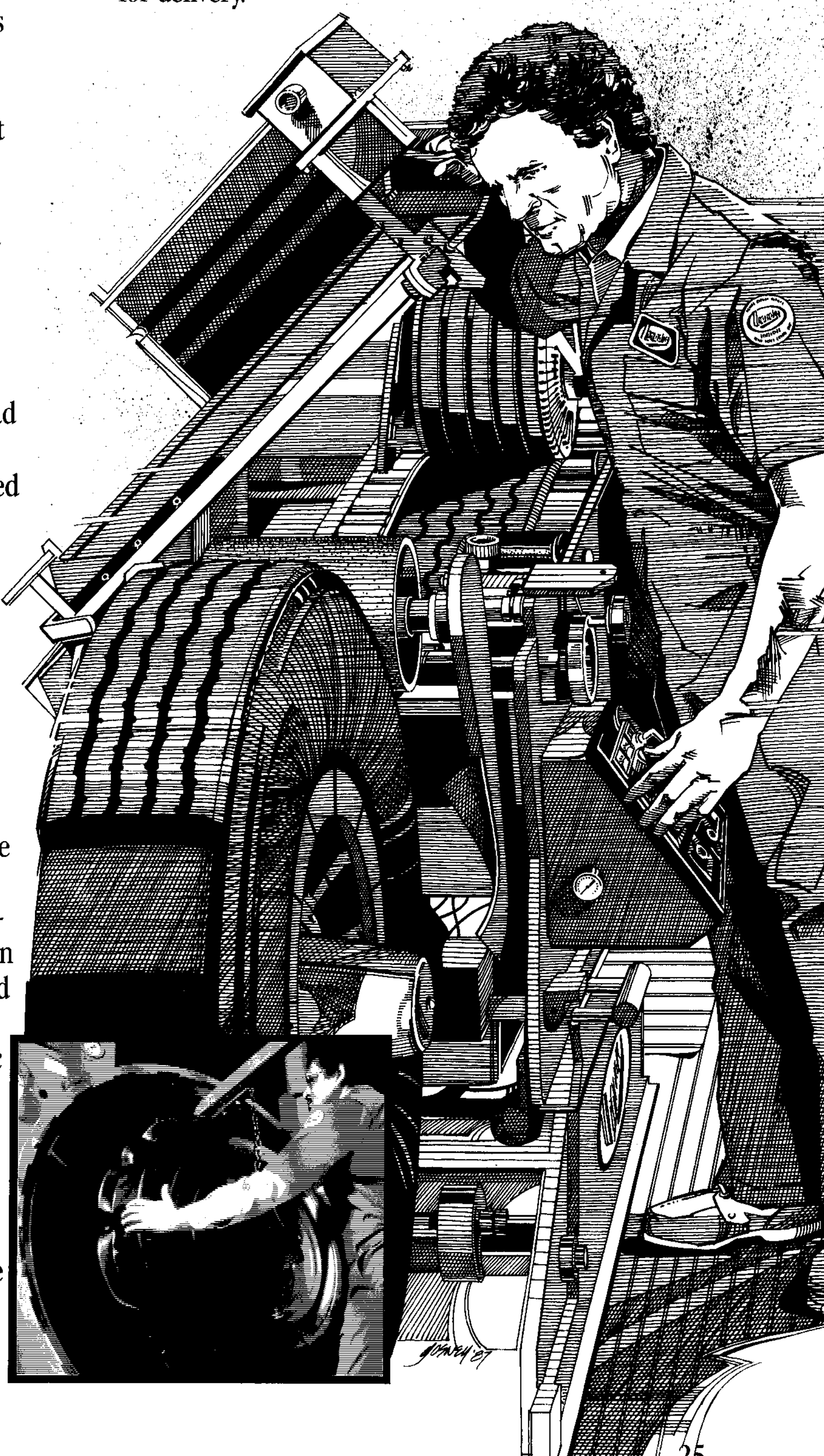
Time, temperature, and pressure are the keys to proper retread curing. Even small variations in the correct level of one of these could lead to poor retread performance or failure.

In the precure process, the prepared casing is covered with a flexible envelope fitted with an air exhaust valve, a curing tube is placed inside and the casing is then mounted on a curing rim. Some systems use a special curing ring that replaces the curing tube and curing rim. The casing is then placed in the curing chamber which is pressurized and heated while air is evacuated from between the tread and envelope, locking the tread in place. After a specific time and temperature (usually three to four hours at about 210° F) the tread becomes bonded to the casing — so well, in fact, this bond becomes the strongest part of the tire.

In the mold cure process, the casing and curing tube are placed in a mold. The curing tube pressure forces the raw tread rubber into the hot mold for a specific period of time and temperature. The tread rubber cures with the mold pattern imprint.

Final inspection.

A final inspection of the finished retread is then made. Inspection is made while the tire is hot — separations and other flaws are easier to see then. The inside is checked to make sure all patches are properly bonded. The DOT number is checked. The tire is then trimmed of rubber flashing or overflow, staples are removed, the tire is painted, and tagged for delivery.



The Advantages of a Total Tire System™

In the previous sections of this guide, we've tried to illustrate how retreading can reduce your tire costs. And we've talked about the many processes and techniques that go into a quality retread.

Now, we would like to show you what the support of a total retreading system can mean to your fleet's profitability.

In all honesty, we have to be a little self-serving at this point. Because Bandag is the only retreader to offer you a total system for tire cost management.

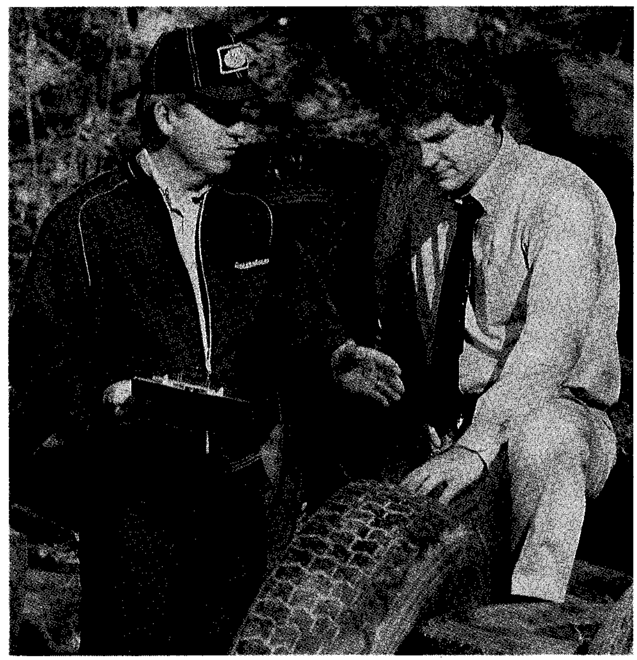
Total system capability requires a network of certified dealers. A full range of services to address the fleet manager's every need. Innovative new processes, materials and equipment that frequently enable our retreads to outperform new tires. And the widest possible range of tread designs and sizes.

It takes time to develop this capability. More than 30 years, in fact. That's how long Bandag has been working to reduce your overall tire costs. And that's why we can do a better job of it than anyone else.

The Bandag Dealer Network.

Perhaps the most important component of the Bandag system is our North American network of more than 500 professional dealers. Because it is our dealers who bring you all the benefits and capabilities our Total Tire System™ offers. That's why Bandag places such emphasis on reliability and consistent quality at the dealer level.

Every Bandag dealer is an independent businessman and a tire expert who has received advanced training and certification in all phases of tire management. Because he is generally a new tire dealer as well, he understands and can handle all your tire needs.



He has the technical knowledge to help you maximize your tire investment. And he is supported by processes, equipment and materials only Bandag offers, to ensure that you get the most from each of your casings.

While every fleet should have a tire expert on staff, no fleet should pay extra for one. Your Bandag dealer will provide you with total system expertise whenever you need it, and at no charge whatsoever.

For example, through computerized, on-site fleet analysis, he'll help you pinpoint tire maintenance problems, identify causes of tire failure, conduct mileage and cost comparisons... all to help you fine-tune your total tire management program.

Bandag Services.

Bandag also offers you a full range of services specifically designed to minimize downtime and help you manage your fleet more efficiently.

For instance, we've recently introduced **ETA**,™ a 24-hour emergency tire assistance program. Whenever or wherever a driver experiences tire problems, he can simply call 1-800-8-BANDAG (in Canada: 1-800-544-4142) and our ETA service fleet will respond quickly and expertly.

EMERGENCY TIRE ASSISTANCE
1-800-8-BANDAG
In Canada call 1-800-544-4142.

This dedication to meeting your fleet's needs is also evident in the Bandag Dealer National Warranty program. If a Bandag retread fails under warranty, it will be adjusted by a Bandag dealer. And with nearly 500 dealers at your service, that means you have coast-to-coast protection.

Fleet surveys and computerized analysis. Complete yard and road service. Emergency tire assistance and national warranty programs. These are just a few of the ways the Total Tire System™ from Bandag will help you get the most from your tire investment.

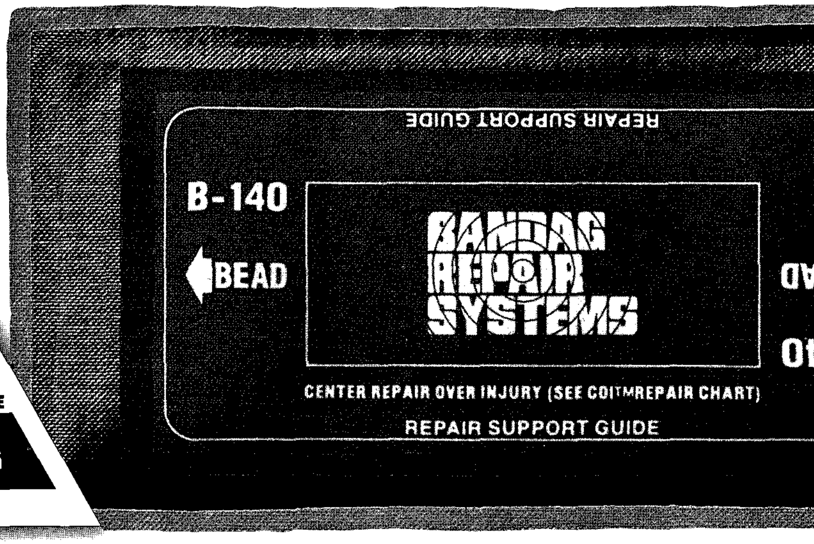
Extended Casing Life System™

The lowest end cost. That's how you measure the return on your tire investment. And that's why our exclusive casing-saving technology is so important.

Our total system approach enables you to get extra lives out of a casing other retreaders would simply send to the scrap pile. That can have a big impact on your tire replacement costs... and your bottom line.

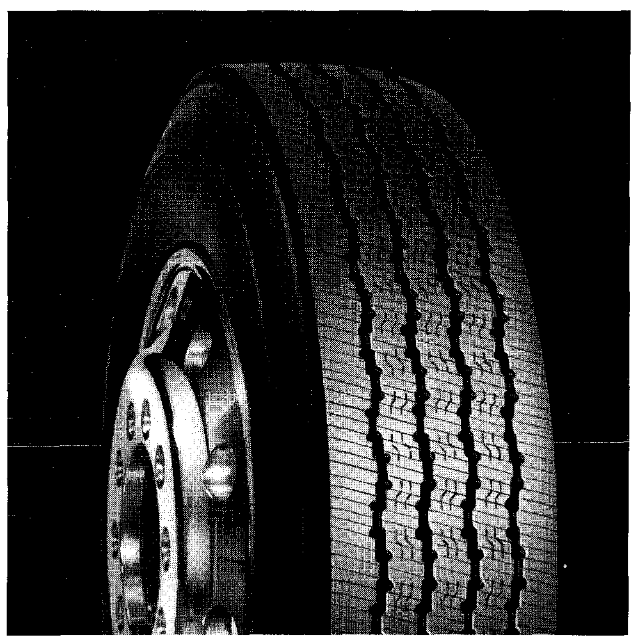
The secret is your Bandag dealer's thorough knowledge of every aspect of every make of casing, his repair expertise and the patented Bandag® rebelting and retreading equipment he uses.

To ensure only sound casings are retreaded, your Bandag dealer also uses state-of-the-art ultrasonic inspection equipment — such as our exclusive NDI® tire casing analyzer — to spot problems that can't be detected through routine visual inspection. This extra step means you'll have fewer downtime headaches due to casing failure.



The Bandag Process.

At Bandag, we have developed a totally integrated "cold" retreading system. The raw materials we begin with, the bonding process we employ and the manufacturing equipment we use have all been specially designed to work together as a whole. It's how we make sure each Bandag retread provides superior performance.



This approach pays dividends for our customers. In longer casing life. Better tread wear. Smoother running tires. Higher driver satisfaction. And greater reliability down the road.

We think it's safe to say no one takes as much care with each retread as Bandag. That's because no one is as concerned as Bandag with helping you reduce your overall tire costs.

Bandag® treads.

Bandag offers you more than 275 separate tread designs and sizes — far more than any other supplier.

This variety allows your Bandag dealer to retread any type of casing you use, from bias casings to steel-belted radials. He has the right tread for your needs, whether you're on a logging run to Seattle, hauling steel pipe over the Rockies or on a high speed linehaul to Chicago.

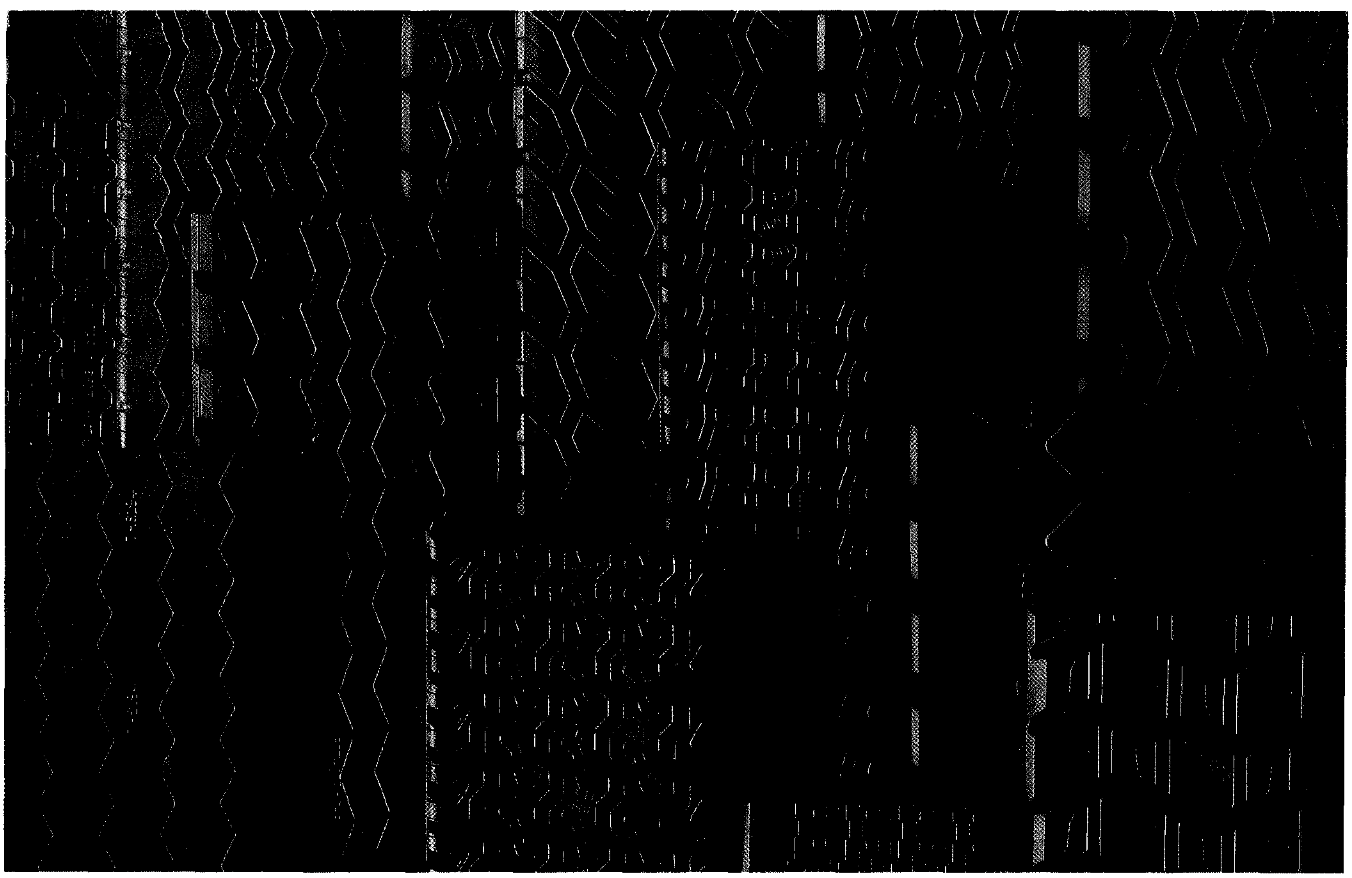
And we are continuing to develop new and improved tread designs. Our MilEdges® tread provides extended wear *and* maximum traction. Our Fuel Mizers™ tread offers optimum fuel economy. And our revolutionary HTR 4000™ tread series — specially designed for radial casings — not only wears longer and runs cooler, but is also fuel-efficient.

But there is more to Bandag treads than variety. Quality is always uppermost in our minds. That's why all Bandag tread rubber must pass *20 separate tests and inspections* before it can be shipped to Bandag dealers.

A North American network of tire specialists. A full range of tire management services. Innovative approaches to extending the lives of your casings. The most sophisticated repairing, rebelting and retreading process in the industry. And a variety of quality treads to meet any application.

If you're not getting all this from your retreader, we encourage you to talk to a Bandag dealer today.

Because when it comes to effective tire cost management, Bandag has the one and only system.



Glossary

ACCELERATOR
A chemical which speeds up the rate of vulcanization of tread rubber compounds.

AIR INJECTION
An inspection method using a high pressure air probe to detect separations.

ALL-PURPOSE TREAD
Tread design suitable for on- or off-highway use at any wheel position.

ASPECT RATIO
The ratio of tire height to tire width.

AWL
A pointed or flat tool used to probe nail holes and injuries.

BACKING
A removable protective material used on the application side of tread rubber and repair materials to preserve cleanliness and tackiness.

BALLAST, LIQUID
Liquid pumped into a tire to provide weight for added traction. Used with farm and some off-the-road tires.

BANDAG
A company using a proprietary method of applying and vulcanizing a precured tread to a tire casing.

BAND PLY
The first inner cord ply of a tire.

BEAD
That anchoring part of the tire which is shaped to fit the rim. Made of high tensile steel wires wrapped and reinforced by plies.

BEAD-TO-BEAD MEASUREMENT
The distance from the heel of one bead over the crown to the other bead.

BEAD SEAT
The flat part of the rim where the tire bead rests.

BEAD TOE
The part of the bead which faces inside the tire.

BELTED CONSTRUCTION
A tire construction with several belts of steel or fabric that encircle the tire.

BREAK
A crack extending into or through the fabric. An impact break is usually in the shape of an X or star and can be seen from the inside of the tire. A flex circumferential break runs parallel to the beads.

BREAKER STRIP/PLY
A band or strip of rubber-coated, bias-cut tire cord that encircles the tire between the top steel or fabric ply and the tread. Sometimes called the impact or shock ply.

BUFF CONTOUR
The shape of a buffed tire.

BUFF LINE
The dividing line in the tire cross section between the buffed surface of the original tire and the new retread rubber.

BUFFED SURFACE
The specially prepared surface of a tire casing which provides proper adhesion between it and the new rubber.

BUFFER
A machine used to rasp the old tread from the tire.

BUFFING RADIUS
The distance from the center or pivot point of the buffing rasp assembly and the arc it describes.

BUFFING TEMPLATE
A shaped guide used to determine the contour of a buffed tire.

BUILDER
A machine used to apply tread rubber to a casing.

BUILD-UP
Portion of tread covering the shoulder and blending into sidewall.

BUNCHING
A "wave" of tread rubber that forms in front of the tread contact point with the road. Occurs when tire is under load and moving.

BURRED WHEEL (INDUSTRIAL TIRES)
Steel or iron wheel with rough slivers or projections of metal around rim edges.

BUTTRESS (See BUILD-UP)

BUTYL RUBBER
A synthetic rubber made from 98-99% isobutylene and 2-1% isoprene. Noted for excellent weather and chemical resistance, and vibration absorption.

BUZZ-OUT
The removal of damaged material prior to repair.

CALCIUM CHLORIDE
Chemical added to water ballast in farm tires to prevent freezing.

CAP AND BASE CONSTRUCTION
A type of tread construction in which the cap or anti-skid compound differs from the base or subtread compound.

CASING
The tire structure, less tread and sidewall rubber.

CASING FACTOR
Load carried by the casing only, not including the load carried by the air pressure.

CASTER
Placement of an axle to locate the center of weight either ahead or behind the ground contact point of the tire to provide easier steering.

CEMENT
An adhesive rubber compound dissolved in solvent used to provide tack for building and adhesion for curing.

CENTERLINE
An inked line or indentation in the center of the tread rubber which aids in positioning.

CHAFER FABRIC
The layer of fabric covering the bead to eliminate friction and wear between bead and rim.

CHANNELING
Voids in the shoulder area between the tread and the buffed surface.

CHECKING
Minute cracking in the rubber caused by aging and oxidation.

CHECK VALVE
A one-way valve used to prevent pressure loss.

CHEMICAL CURE
Vulcanization activated by chemical agents without the application of heat.

CHUNKING
Separation of tread from the casing in particles that may range from a very small size to several square inches in area.

CIRCUMFERENTIAL CRACKS
Cracks in a tire running parallel to beads. Usually occur in the tread grooves.

COMPOUNDING
Chemical process that combines rubber components to achieve tire qualities such as wear, traction and density.

COMMERCIAL TIRES
Truck and industrial tires.

CORDS
The strands forming the tire plies.

COST PER MILE (also called Cost/Tire/1000 Miles)
Total cost, including any repairs and recaps, divided by total tire mileage. In some cases downtime may also be taken into consideration.

CROWN
Portion of the tire between one edge of the tread and the other.

CROWN RADIUS
The measurement of tire tread curvature between the shoulders. Expressed as a percentage, it indicates the "flatness" of the tire tread area.

CROSS SECTION
The maximum width of the tire.

CROWN WIDTH
The distance from shoulder to shoulder on the buffed contour.

CURB GUARD
A protrusion of rubber circling the tire to protect the cord body from scraping against curbs.

CURING
The process of heating or treating a rubber or plastic compound to convert it from a thermoplastic or fluid material into a solid, relatively heat-insensitive state. When heat is employed, the process is called vulcanization.

CURE TIME
The time required at a certain temperature for a compound to reach optimum physical properties.

CURING RIM
The rim used to support the tire and keep the curing tube in place while curing.

CURING TUBE
Special, heavy-duty tube placed within the tire during curing.

CUSHION GUM
A tacky rubber compound used for adhesion, under-tread repair, and build-up.

DEFLECTION
Difference in radius between a loaded and unloaded tire.

DELUGGER
A machine used to cut the lugs from tires prior to buffing.

DIAGONAL BREAK
A fabric break which follows the path of the ply cords.

DIAPHRAGM
A flexible sheet used to enclose the tire during precure retreading.

DIE SIZE
A coded description of tread rubber dimensions.

DIRECTIONAL TREAD
Tread design which is effective in only one direction of rotation (rear farm tractor tires for example).

DOWNTIME
The vehicle operating time lost due to maintenance difficulties and tire or tube failures.

DUAL-BEAD TIRES
Heavy service tires using two or more sets of bead wires in each bead.

DYNAMIC BALANCE
Balancing a tire while it is spinning.

ENVELOPE (See DIAPHRAGM)

EXTRUDER
A machine that shapes a rubber compound into a desired form by extruding.

FABRIC FATIGUE
Fabric degradation and resultant tire cord breakdown due to repeated flexing.

FILLER STRIP
A free flowing rubber used under the tread when added thickness is needed.

FLOTATION
Ability of a tire to support a load on soft, yielding terrain.

FOOTPRINT
Tread area that actually touches the road.

F.O.B.
Denotes the point at which the transfer of title takes place. F.O.B. point of origin means freight collect from the shipping point. F.O.B. point of destination means freight prepaid from the original shipping point to the destination.

FREE CAPPING
One-half the overall diameter of an unloaded new tire.

FULL CAPPING
Application of new rubber to the tread area and some distance down the sidewall of a casing.

GROOVE
Space between two adjacent tread ribs.

GROOVE CRACKING
Cracking which occurs at the bottom of a tread groove.

GUIDE RIB
Protruding rubber rib located over the bead. Serves as a guideline for mounting the tire on the rim.

IMPACT BREAK (See BREAK)

LINER/INNER LINER
The layer of rubber which is laminated to the inside of a tubeless tire to insure the air retention quality.

LOAD RANGE
A letter designation which indicates maximum permissible load on a tire. Also referred to as ply rating (i.e. load rating G = 14 ply rating).

LOADED RADIUS
Distance from wheel axle centerline to the ground on a properly inflated, loaded tire.

LOW PRESSURE TIRES
Larger cross-section tires for operation at lower pressure. Increased air capacity permits lower pressure.

LOW PROFILE TIRE
A tire in which the cross-section has a squat appearance. While most tires have cross-section widths that are about the same as their heights, low profile tires have heights only about 85% of the widths.

LUG
An aggressive tread pattern feature used to improve traction.

LUG TEARING
Rupture of the lug resulting from violent operation or mechanical interference.

MANDREL
A curved support inserted in a tire to prevent the casing from collapsing while repairing.

MATRIX
Aluminum or steel rings or segments which form the cavity in which the tire is cured by hot capping and which forms the tread design.

NU-LINER
A liquid of very thin viscosity used in both tubeless and tube-type tires to seal porosity and rim leaks, reduce liner oxidation, and decrease tire operating temperature.

NON-DIRECTIONAL TREAD
Tread design which is equally effective in either direction of rotation.

OFF-THE-ROAD TIRES
Tires designed primarily for use over unpaved roads or where no roads exist. Built for ruggedness and traction rather than speed.

OPEN SPLICE
A retread tire defect caused by failure of the rubber to knit together properly at the tread splice.

OPTIMUM CURE
The state of cure when the rubber compound exhibits the best physical properties. Usually expressed in minutes curing time at a specified temperature.

OVERALL DIAMETER (O.D.)
The diameter of a buffed tire or the diameter of an unloaded new tire. Usually made on an inflated tire using calipers or a diameter type rule.

OVERALL WIDTH
Maximum width in cross section of an unloaded tire.

OVERCURE
Vulcanizing longer than necessary. Can result in deterioration of physical properties.

OVERFLOW
Spew-out of tread compound at the mold parting line or at the edge of the matrix skirt. Should be trimmed or buffed off the finished product.

PEAKING
A condition, usually in the cushion, resulting from local material starvation and excessive flow from adjacent areas.

PLY
A layer of rubber-coated parallel cords.

PLY RATING
Strength of tire in terms of cotton ply strength. Does not necessarily indicate actual number of plies.

PLY SEPARATION
A parting of rubber compound between adjacent plies.

PRESSURE SEAL
A liner spray used in both tubeless and tube-type tires to seal porosity and rim leaks and reduce liner oxidation.

PRODUCTION RETREAD SHOP
A shop which schedules its production not on the basis of day-to-day orders but rather on long runs of purchased casings in order to secure the lowest cost per unit.

PROFILE
Shoulder-to-shoulder area of tread cross section.

RADIAL PLY
Refers to the ply or plies in which the cords run at right angles to the bead.

RADIAL CRACKING
Cracking, usually in or near a rib, resulting from underinflation or ozone exposure.

RASP
A tool with raised points used for removing rubber and roughening surfaces.

REDUCING VALVE
Pressure regulating device used for controlling steam or air pressure.

REGROOVING (RECUTTING)
The cutting of a tread design into worn down tread or cutting a deeper design in existing tread.

REINFORCEMENT REPAIR
Casing repairs that require both hole filling material and reinforcing patches when an injury has extended through more than 25% but less than 75% of the tire body. California standards define a reinforcement repair as a damage to more than 25% but less than 50% of the plies.

REPAIR GUM
Tire repair material used for filling voids, or covering reinforcing material.

REPAIRED TIRE
Any tire with punctures, cuts or other types of injuries that has been reconditioned to provide additional safe service life.

REPAIR PATCH
Reinforcing material used to strengthen the area around a tire injury.

REPAIR PLUG
Rubber material that fills the cavity of a tire injury.

RETREAD TIRE
A tire built of a used casing and new tread which extends its usable life.

REVERSION
Excessive heating of a cured rubber compound leading to deterioration of physical properties.

REVOLUTIONS PER MILE
The number of tire revolutions in a mile. Varies with speed, load and inflation.

RIM DIAMETER
The diameter of the rim corresponding to the tire bead heel.

RIM FLANGE
That part of the rim that supports the bead heel and resists lateral internal pressure.

RIM TAPER
The slanting of the rim bead seat area.

ROLLING CIRCUMFERENCE
Calculated from the revolutions per mile. 63,360 Revs per mile = Rolling Circumference in inches.

SECTION HEIGHT
Distance from rim seat to outer tread surface of an unloaded tire.

SECTION REPAIR
Casing repairs made when an injury has extended through 75% or more of the plies or completely through the casing in the tread or sidewall areas. California standards define a section repair as damage to 50% or more of the plies.

SECTION WIDTH
Distance between outside surfaces of sidewalls of a inflated tire.

SELF-CLEANING TREAD
A tread pattern that stays open when running in dirt and slush.

SELF-VULCANIZATION
Vulcanization activated by chemical agents without the application of heat.

SET-UP
Premature vulcanization of a rubber compound during processing or storage.

SEPARATION
Pulling apart, such as ply separation (from each other) or tread separation (from plies).

SHELF LIFE
Refers to the length of time that a perishable product may remain in stock before serious deterioration takes place.

SHOULDER
The outer edges of tread.

SIDEWALL
That portion of a tire between the tread and bead.

SIPE
Any of the small, often hook or bracket-shaped grooves in the tread of tire that provides extra traction and skid prevention.

SIZE FACTOR
The sum of a tire's section width at the rim and its overall diameter.

SKID DEPTH (See TREAD DEPTH)

SKIVING (See BUZZ-OUT)

SPECIAL MILEAGE TIRE
A tire with an extra layer of rubber between the cords and the tread for the purpose of recutting and regrooving.

SPLICE
The line where two ends of a precure tread are joined.

SPOT REPAIR
The replacement of rubber in an injury that penetrates less than 25% of the body plies.

SPREADER
A multi-arm device that spreads a tire at the bead area.

SRT-STEEL REINFORCED TREAD
A tread with an undertread and sidewall protective layer of thick tread rubber containing many short lengths of brass-coated, hardened steel filaments. Used in certain types of truck and industrial pneumatic tires.

SSS-SAFETY STEEL SHIELD
Strands of flexible steel sealed in rubber and positioned in a double layer in the tread area of a tire. Used in certain types of truck and industrial pneumatic tires.

STATIC BALANCE
Wheel balance on a non-rotating tire.

STANDARD RIM
A rim that has been calibrated and found to meet the precise measurements specified by Tire and Rim Association, Inc. or the European Tire & Rim Association.

STITCHING
A rolling method used to both remove trapped air and improve rubber contact for better adhesion.

STOCK ROTATION
The use of stock on a "first in, first out" basis so that the oldest stock is used first and inventories are kept fresh.

STRIPPING STOCK
A rubber stock used to extend the wing of tread rubber.

TACK
Tackiness.

TEMPLATE (See BUFFING TEMPLATE)

TIRE SIZE MARKINGS
Designations that appear on the side of a tire to indicate basic dimensions.

TIRE PAINT
A black paint, compatible to tire bodies, used to enhance appearance.

TOE-IN
Adjustment of front wheels so that they are closer together at the front than at the back.

TOE-OUT
Alignment of wheels so that they are closer together at back than at front.

TOP CAP (TOP TREADING)
A retread which covers the crown, or top, of a tire.

TREAD
That portion of a tire that comes in contact with the road.

TREAD DEPTH
The distance, measured near the center of the tread, from the base to the top of the tread.

TREAD DESIGN
The pattern of the tread.

TREAD RIB
A tread pattern section that encircles the tire.

TREAD GUM
A rubber compound used primarily to build up the tread when making a repair.

TREAD RADIUS
A measure of tread surface curvature from shoulder to shoulder.

TREAD ROLLER
A manual or power roller used to apply the tread rubber, remove trapped air and obtain adhesion.

TREAD RUBBER
Uncured rubber material which replaces the worn off tread portion of a tire.

TREAD SEPARATION
Pulling away of the tread from the tire casing.

TREAD TEARING
A tearing away of a portion of the tread design.

UNDERCURE
Incomplete vulcanization or curing.

UNDERTREAD
The rubber between the bottom of tread grooves and the casing.

VENTING
Perforating a tire above the beads to allow internal pressure in the cords to escape safely during curing.

VULCANIZATION
A chemical reaction which takes place under an appropriate temperature and pressure to develop tire characteristics and properties.

WEATHER CHECKING
A condition that appears as fine cracks in the sidewall rubber.

WICKING
Either the capillary action of air escaping from a casing or the porous material used during curing that allows air to escape rather than build up within the casing body.

WING STOCK
Tread rubber that is tapered to a feathered edge on each side in order that it may be applied to the shoulder of the tire. Used only on a full retread.

WING TREADS
Treads with special shoulder extensions that wrap down onto the shoulder of the casing. These extensions provide extra strength along the bond line and give the finished retread a new tire appearance.