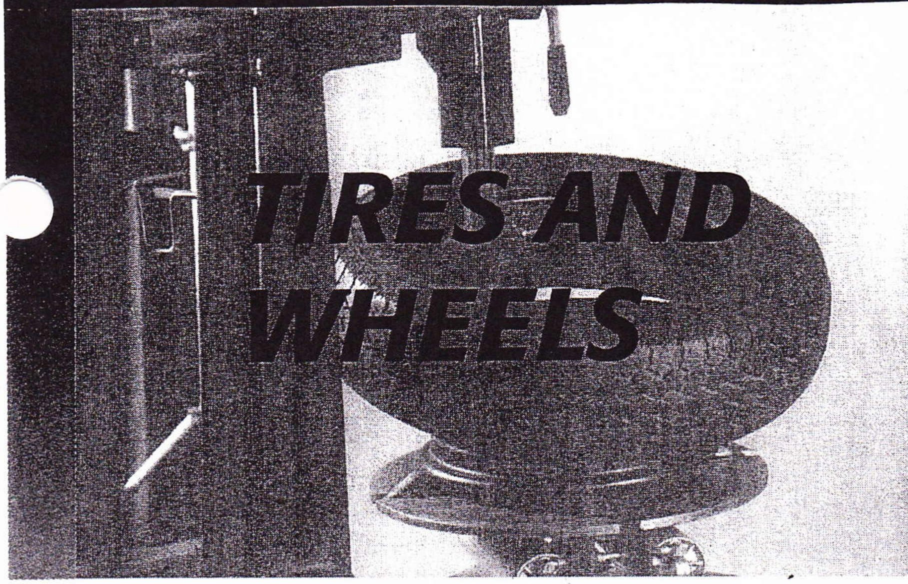
Tires and Wheels



35 TIRES AND WHEELS

OBJECTIVES

◆ Describe basic wheel and hub design. ◆ Recognize the basic parts of a tubeless tire. ◆ Explain the differences between the three types of tire construction in use today. ◆ Explain the tire ratings and designations in use today. ◆ Describe why certain factors affect tire performance, including inflation pressure, tire rotation, and tread wear. ◆ Remove and install a wheel and tire assembly. ◆ Dismount and remount a tire. ◆ Repair a damaged tire. ◆ Describe the differences between static balance and dynamic balance. ◆ Balance wheels both on and off a vehicle. ◆ Describe the three popular types of wheel hub bearings.

Tire and wheel assemblies provide the only connection between the road and the vehicle. Tire design has improved dramatically during the past few years and modern tires require increased attention to achieve their full potential of extended service and correct ride control. Tire wear that is uneven or premature is usually a good indicator of problems in the steering and suspension system. Tires, therefore, become not only a good diagnostic aid to a technician, but they can also be clear evidence to the customer of the need to service the front-end.

WHEELS

Wheels are made of either stamped or pressed steel discs riveted or welded together. They are also available in the form of aluminum or magnesium rims that are die-cast or forged. Magnesium wheels are commonly referred to as mag wheels, although they are commonly made of an aluminum alloy. Aluminum wheels are lighter in weight when compared with the stamped steel type.

Near the center of the wheel are mounting holes that are designed to fit tapered mounting nuts (**lug nuts**) that center the wheel over the hub. The rim has a hole for the **valve stem** and a **drop center** area designed to allow easy tire removal and installation. **Wheel offset** is the vertical distance between the centerline of the rim and the mounting face of the disc. The offset is considered positive if the centerline of the rim is inboard of the mounting face and negative if outboard of the mounting face. The amount and type of offset is critical because changing the wheel offset changes the loading on the front suspension loading as well as the scrub radius.

The wheel is bolted to a **hub**, either by lug bolts that pass through the wheel and thread into the hub, or by studs that protrude from the hub. In the case of studs, special lug nuts are required. Some vehicles employ left-hand threads (which turn counterclockwise to tighten) on the driver's side, and right-hand threads (which turn clockwise to tighten) on the passenger's side. Other cars use right-hand threads on both sides.

Wheel size is designated by rim width and rim diameter (Figure 35–1). Rim width is determined by measuring across the rim between the flanges. Rim

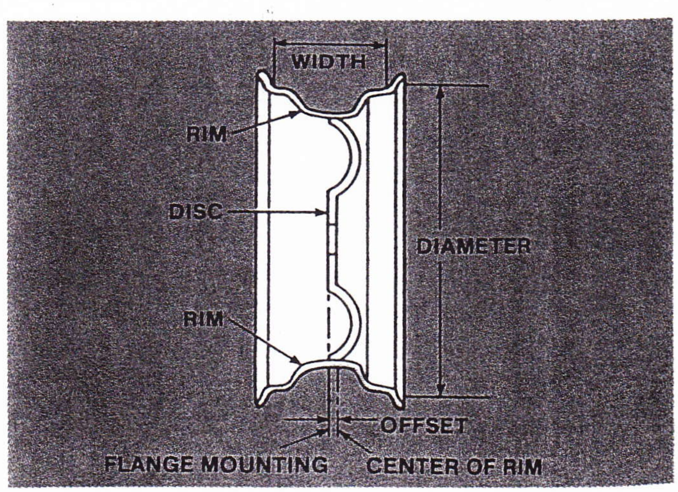


FIGURE 35–1 Wheel dimensions important to tire replacement.

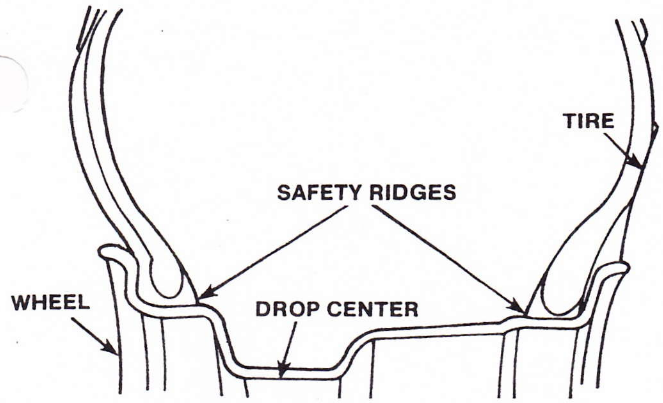


FIGURE 35–2 Safety rim. Note safety ridge on each side of wheel that retains tire in case of a flat or blowout (ruptured tire). *Courtesy of Chrysler Corporation*

diameter is measured across the bead seating areas from the top to the bottom of the wheel. Some rims have safety ridges near their lips. In the event of a tire blowout, these ridges tend to keep the tire from moving into the dropped center and from coming off the wheel (Figure 35–2).

Replacement wheels must be equal to the original equipment wheels in load capacity, diameter, width, offset, and mounting configuration. An incorrect wheel can affect wheel and bearing life, ground and tire clearance, or speedometer and odometer calibrations.

TIRES

The primary purpose of tires is to provide traction. Tires also help the suspension absorb road shocks, but this is a side benefit. They must perform under a variety of conditions. The road might be wet or dry; paved with asphalt, concrete, or gravel; or there might be no road at all. The car might be traveling slowly on a straight road, or moving quickly through curves or over hills. All of these conditions call for special requirements that must be present, at least to some degree, in all tires.

In addition to providing good traction, tires are also designed to carry the weight of the vehicle, withstand side thrust over varying speeds and conditions, and transfer braking and driving torque to the road.

Tube and Tubeless Tires

Early vehicle tires were solid rubber. These were replaced with pneumatic tires, which are filled with air.

There are two basic types of pneumatic tires: those that use inner tubes and those that do not. The latter are called **tubeless tires** and are about the only type used on passenger cars today. A tubeless tire has a soft inner lining that keeps air from leaking between the tire and rim (Figure 35–3). This inner lining can often form a seal around a nail or other object that punctures the tread. A self-sealing tire holds in air even after the object is removed. A tubeless tire air valve has a central core that is spring-loaded to allow air to pass inward only, unless the pin is depressed. If the core becomes defective, it can be unscrewed and replaced. The airtight cap on the end of the valve provides extra protection against valve leakage. A tubeless tire is mounted on a special rim that retains air between the rim and the tire casing when the tire is inflated.

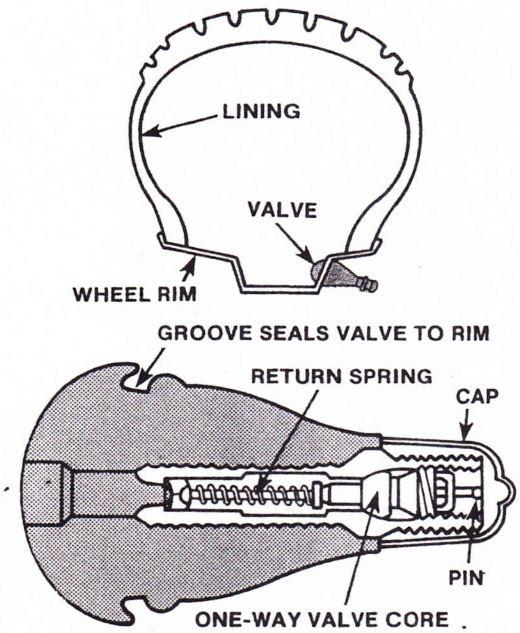
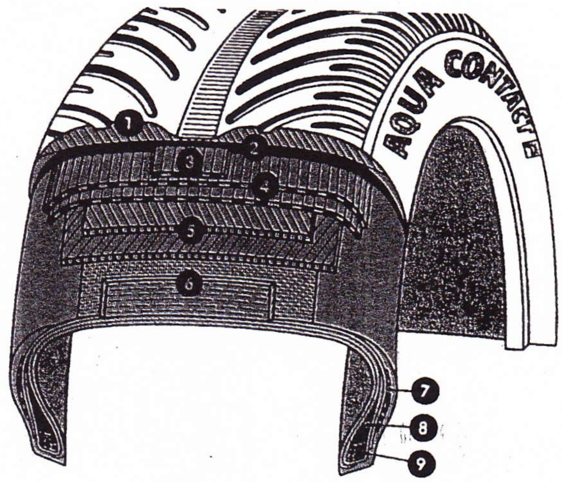


FIGURE 35–3 Typical tubeless tire installation and valve. *Courtesy of Chrysler Corporation*

Figure 35–4 shows a cutaway view of a typical tubeless tire. The basic parts are shown. The cord body or casing consists of layers of rubber-impregnated cords, called **plies**, that are bonded into a solid unit. Typically tires are made of 2, 4, or 8 plies; thus, the reference to 2-, 4-, and 8-ply tires. The character of the plies determines a tire's strength, handling, ride, amount of road noise, traction, and resistance to fatigue, heat, and bruises. The **bead** is the portion of the tire that helps keep it in contact with the rim of the wheel. It also provides the air seal on tubeless tires. The bead is constructed of a heavy band of steel wire wrapped into the inner circumference of the tire's ply structure. The **tread**, or crown, is the portion of the tire that comes in contact with the road surface. It is a pattern of grooves and ribs that provides traction. The grooves are designed to drain off water, while the ribs grip the road surface. Tread thickness varies with tire quality. On some tires, small cuts, called **sipes**, are molded into the ribs of



1. CAP tread
2. Tread base
3. Nylon wound aquachannel breaker
4. Two-ply nylon wound breaker
5. Two steel-cord plies
6. Two rayon-carcass plies
7. Double nylon bead reinforcement
8. Bead filler
9. Bead core

FIGURE 35–4 Typical tubeless tire. *Courtesy of SAE International*

the tread. These sipes open as the tire flexes on the road, offering additional gripping action, especially on wet road surfaces. The **sidewalls** are the sides of the tire body. They are constructed of thinner material than the tread to offer greater flexibility.

The tire body and belt material can be made of rayon, nylon, polyester, fiberglass, steel, or the newest synthetics—amarid or kevlar. Each has its advantages and disadvantages. For instance, rayon and cord tires are low in cost and give a good ride but do not have the inherent strength needed to cope with long high-speed runs or extended periods of abusive use on rough roads. Nylon cord tires generally give a slightly harder ride than rayon, especially for the first few miles after the car has been parked, but offer greater toughness and resistance to road damage. Polyester and fiberglass tires offer many of the best qualities of rayon and nylon but without the disadvantages. They run as smoothly as rayon tires but are much tougher. They are almost as tough as nylon but give a much smoother ride. Steel is tougher than fiberglass or polyester, but it gives a slightly rougher ride because the steel cord does not give under impact as do fabric plies. Amarid and kevlar cords are lighter than steel cords and, pound for pound, stronger than steel.

Types of Tire Construction

There are three types of tire construction in use today (Figure 35–5). They are bias ply, belted bias ply, and radial ply tires.

BIAS PLY TIRES The oldest tire currently in use is the **bias ply**. It has a body of fabric plies that runs alternatively at opposite angles to form a crisscross design. The angle varies from 30 to 38 degrees with the centerline of the tire and has an effect on high-speed stability, ride harshness, and handling. Generally speaking, the lower the cord angle, the better the high-speed stability but also the harsher the ride. Bias ply tires usually are available in 2- or 4-ply.

BELTED BIAS PLY TIRES **Belted bias ply** tires are similar to the bias ply, except two or more belts run the circumference of the tire under the tread. This construction gives strength to the sidewall and greater stability to the tread. The belts reduce tread motion during contact with the road, thus improving tread life. Plies and belts of various combinations of rayon,

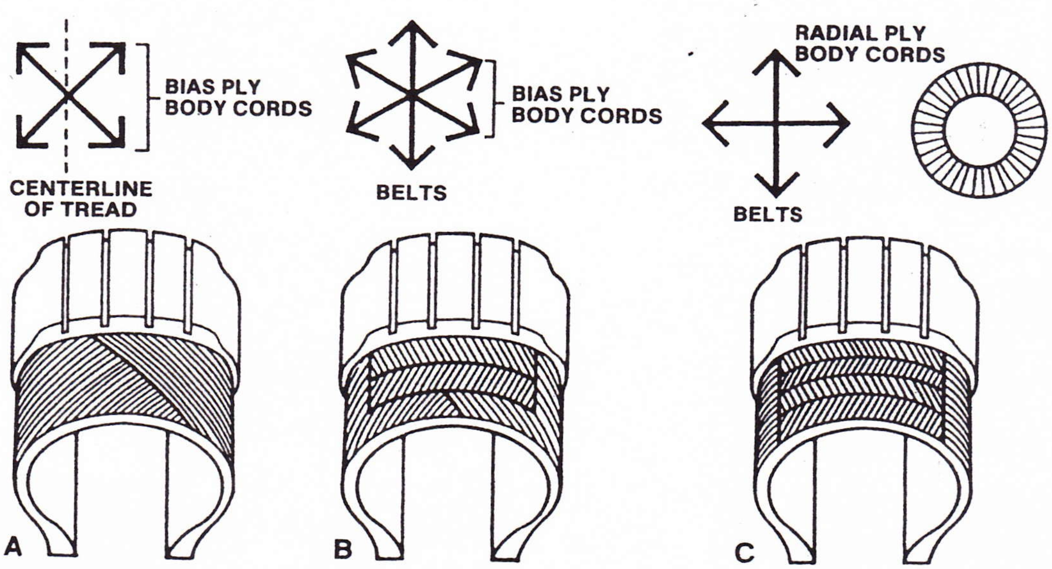


FIGURE 35–5 Three types of tire construction: (A) bias ply; (B) belted bias ply; and (C) radial ply.

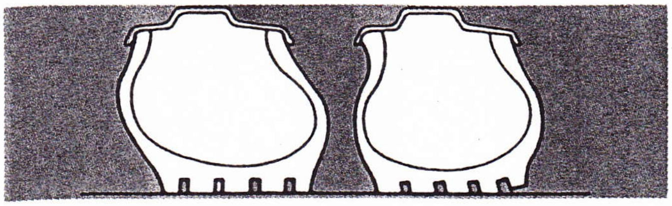


FIGURE 35–6 A radial tire's highly flexible sidewalls give maximum tread contact area during fast, hard turning.

nylon, polyester, fiberglass, and steel are used with belted bias construction. Belted bias ply tires generally cost more than conventional bias ply tires but last up to 40 percent longer.

RADIAL PLY TIRES **Radial ply** tires have body cords that extend from bead to bead at an angle of about 90 degrees—"radial" to the tire circumferential centerline—plus two or more layers of relatively inflexible belts under the tread. This construction of various combinations of rayon, nylon, fiberglass, and steel gives greater strength to the tread area and flexibility to the sidewall (Figure 35–6). The belts restrict tread motion during contact with the road, thus improving tread life and traction. Radial ply tires also offer greater fuel economy, increased skid resistance, and more positive braking.

Although the newer synthetics are being used more frequently in radial tires, steel is still the most popular belt material. Bias ply and belted bias are available in all cord materials mentioned earlier, except amarid and kevlar. Nonradial belts are usually of the same material as the sidewalls.

Specialty Tires

Specialty tires reflect the advances made in the conventional tire field. Special snow and mud tires are available in all three construction types. Studded tires provide superior traction on ice; however, they are slowly disappearing from the tire market because their performance in dry weather is poor. In addition, in the last few years many states have outlawed their use because they damage roads.

The present trend in specialty tire manufacturing is toward all-season or all-weather tires. The all-season tire, however, is a compromise and might not perform as well as specialty tires under certain circumstances. Their use has not eliminated the twice-a-year tire change for many northern motorists.

CUSTOMER CARE

Advise your customer that the use of tire chains is not recommended by most tire manufacturers. In case of emergency, or where required by law, chains can be used if they are the proper size for the tires and are installed tightly (no slack) with their ends securely restrained. Follow the chain manufacturer's instructions. Drive slowly. If any contact of the chains against the vehicle is heard, stop and retighten the chains. Use only SAE Class C tire chains. Use of other chains can damage the vehicle. ■

Compact Spare Tires A compact spare tire is designed to reduce weight and provide more luggage room. There are several types used today.

HIGH-PRESSURE MINI SPARE The high pressure (60 psi) mini-spare tire is the one most commonly used. This small, temporary tire should not be used for extended mileage or for speeds above 50 mph. Check the pressure in the spare tire at least monthly. If it is in use, check the pressure when the vehicle has been stopped at least 3 hours and driven less than 1 mile. Do not reduce the pressure when the tire is hot. Use a tire gauge to check the pressure and maintain 60 psi.

SPACE-SAVER SPARE This type of tire must be blown up with a special compressor that operates off the cigarette lighter electrical unit. Inflate the tire to 35 psi. Before installing it on the vehicle, make sure it looks like a road tire with no folds in the sidewalls.

LIGHTWEIGHT SKIN SPARE The skin spare is designed to provide additional luggage room and a lightweight, easy-to-use spare tire. This type of spare is a normal type bias ply with a reduced tread depth to provide an estimated tread life of 2,000 miles. It is for emergency use only and has a maximum speed capability of 50 mph. Maintain the cold inflation pressure as specified on the vehicle's tire pressure decal.

CUSTOMER CARE

Be sure to warn your customer that the mini, space-saver, skin, or similar type of compact spare should be used only temporarily for an emergency. It should never be used as a regular tire. Any continuous load use of the temporary compact spare might result in tire failure, loss of vehicle control, and injury to the vehicle's occupants. ■

High-Performance (Speed-Rated) Tires In recent years, the so-called high-performance tire has made an increasing appearance on cars driven in the United States. Many drivers do not care if they actually use

TABLE 35–1 SPEED RATINGS

Symbol	Maximum Speed
F	50 mph
G	56 mph
J	62 mph
K	68 mph
L	75 mph
M	81 mph
N	87 mph
P	93 mph
Q	100 mph
R	106 mph
S	112 mph
T	118 mph
U	124 mph
H	130 mph
V	149 mph
Z	+149 mph

the speed capabilities of the tire, just as long as the performance is there. In fact, many of their cars are not capable of these higher speeds. A comparison of the Porsche 928S4 and Ford Probe GT points this out.

The Porsche has a top speed of 165 mph. The Probe GT tops out at 120 mph. Yet, both are equipped with V-rated tires (up to 149 mph; see Table 35–1). While the Porsche can certainly use the V-rated tire, the Probe is using it strictly for handling, and, of course, image.

High-performance tires, like all tires, eventually have to be replaced. In some European countries, the replacement tire must have, by law, the same speed rating as the OE tire. Although it is not the law in the United States, trading down in speed ratings would probably not be a good idea. Optimum performance and, perhaps, even safe handling might be sacrificed.

The speed ratings are currently set by the Economic Commission using the European passenger car tire regulation R-30. While United States tire makers use the testing procedures established by this association, there are no minimum standards to which they must comply.

Tire Ratings and Designations

Tires are rated by their profile, ratio, size, and load range. **Tire profile** is the relation of its cross-section height (from tread to bead) compared to the cross-section width (from sidewall to sidewall). Today, this ratio is also known as **series**.

For many years, the accepted profile ratio for standard bias ply passenger car tires was approximately 83. This meant the tire was 83 percent as high as it was wide. Since the introduction of bias belted and radial ply construction, lower profile tires and ratios of 78, 70, 60, or even 50 have become popular (Figure 35–7). The lower the number, the wider the tire. For instance, a 50-series tire is quite low and fat, being only 50 percent as high as it is wide. Most new cars are equipped with 80-, 78-, 75-, or 70-series tires.

Prior to 1967, tire sizes were designated by a series of numbers, such as 7.75–15 or 9.50–15. The first number (9.50) referred to the cross-section width, in

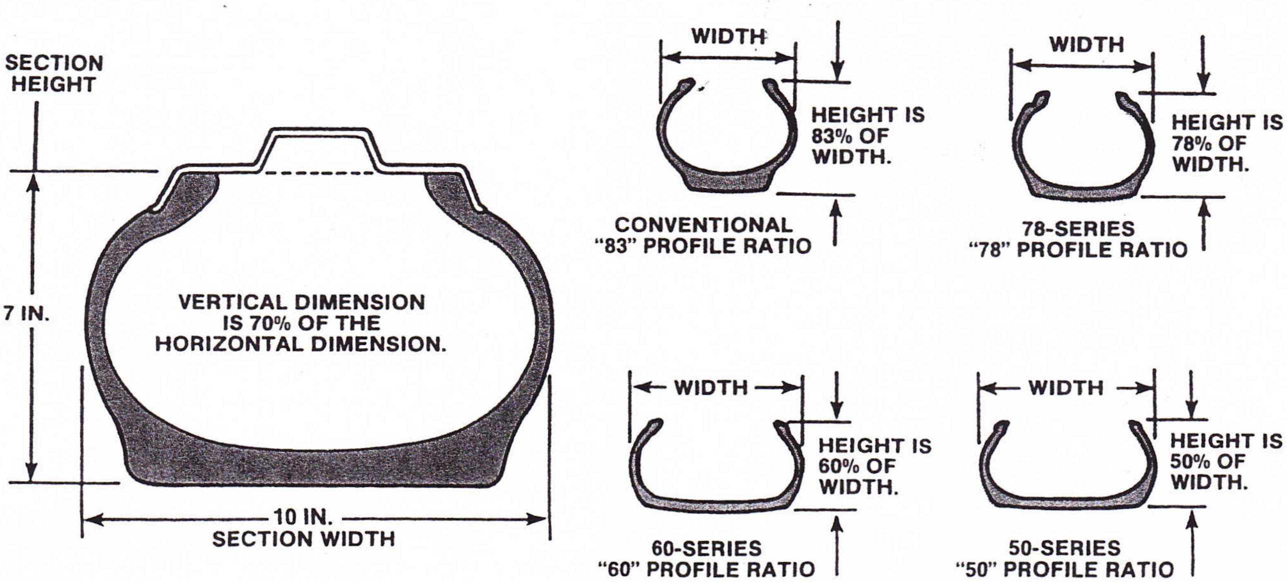


FIGURE 35–7 The aspect ratio (profile ratio) of a tire is its cross-sectional height compared to its cross-sectional width expressed in percentage figures.

TABLE 35–2 WIDTH/LOAD LETTER STANDARDS

V—650 pounds
W—710 pounds
Y—770 pounds
Z—830 pounds
A—900 pounds
B—980 pounds
C—1050 pounds
D—1120 pounds
E—1190 pounds
F—1280 pounds
G—1380 pounds
H—1510 pounds
J—1580 pounds
K—1620 pounds
L—1680 pounds
M—1780 pounds
N—1880 pounds

inches, of an inflated tire, and the second number (15) was the rim diameter. Then tire sizes were noted by alpha-numerics.

In the standard alpha-numeric system, the width/load letter scale starts at *V* and runs through *Z*, then takes up with *A* and runs through *N*. Typically the wider the tire, the more weight it is designed to carry. Table 35–2 shows the maximum weight each tire size can carry when inflated to 24 psi. As inflation is increased, so is the tire's carrying capacity up to a usual maximum of 35 psi.

In the alpha-numeric system, the tire letter size is followed by a number to indicate the tire's approximate profile ratio, followed by the rim diameter. For example, a tire designated as F78-15 means it belongs to the 78 series and fits a 15-inch rim. Radial ply tires use the same designation but have an *R* inserted in the number, such as FR78-14.

The half alpha-numeric, half metric system gives the tire's width in millimeters but gives its rim diameter in inches, such as 195R-15. Although the profile ratio is usually omitted in part-metric designations, a few manufacturers designate the tire series, such as 185-70-14. The *70* stands for a 70-series tire. In 1977, *P* metric tires were introduced.

In P195/75R14, *P* identifies passenger car tire. If this designation is followed by *M*, *S*, or *MS*, the tire's tread is rated for use in mud, snow, or both. The width in millimeters is 195. The height-to-width ratio is 75. *R* identifies radial construction. The rim diameter is 14.

All metric system measurements are now being given along with a standard translation. A typical

TABLE 35–3 LOAD RANGES

Rating	Ply Rating	Maximum psi
B	4	32
C	6	36
D	8	40

metric tire shows its width in millimeters, its inflation pressure in kilopascals (kPa), and its load capacity in kilograms (kg). One kilopascal equals 6.895 psi. A typical all-metric radial size is 190/65R-390. It fits a 390-mm diameter wheel.

Additionally, the letters *B*, *C*, or *D*, might appear on the sidewall, separate from the tire designation coding. These are holdovers from the old load-rating system, which replaced the still older ply system (Table 35–3). Load range B is the lightest design, suited to passenger car use. Load range C is in between, while load range D is heavy-duty. It is best for trucks and off-road vehicles.

The newer tires have abandoned the load range system replacing it with SL and XL for standard load and extra load. Standard load falls between load ranges B and C. XL is a little heavier duty than load range D.

Federal law requires that all tires carry designations (Figure 35–8) indicating size, load range, maximum load, maximum inflation pressure in pounds per square inch, number of plies under the tread and the sidewalls, manufacturer's name, tubeless or tube construction, radial construction (if a radial tire), and United States Department of Transportation (DOT) symbol indicating confirmation to applicable federal standards. Adjacent to the DOT symbol is a tire identification number. The first two characters identify the tire manufacturer. The remaining characters identify size, type, date of manufacture, and whether the tires are tubeless or tube-type.

In addition, DOT requirements mandate that tires must have the uniform tire quality grading system (UTQGS) molded into their sidewalls. As shown in Figure 35–9, this consumer comparison information includes tread wear, traction, temperature, and the tire performance criteria (**TPC**) specification number.

TREADWEAR The **treadwear grade** is a comparative rating based on the wear rate of the tire when tested under controlled conditions on a specified government test course. For example, a tire graded 160 would wear twice as well on the government course as a tire graded 80.

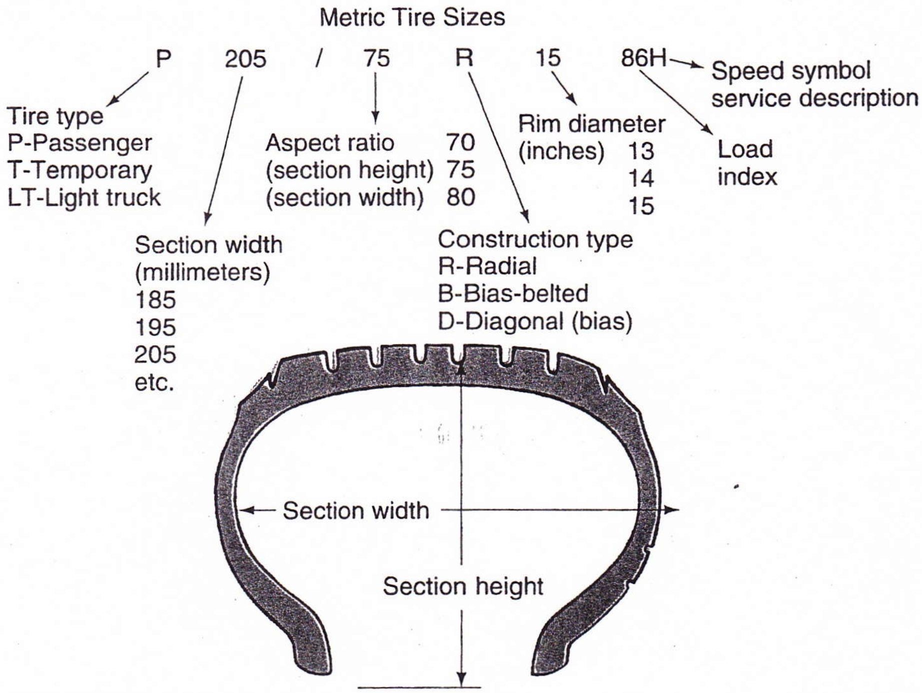


FIGURE 35–8 All tire sidewalls carry this information. *Courtesy of Oldsmobile Division, General Motors Corporation*

TRACTION The wet-weather traction grades are, from highest to lowest, A, B, and C. These represent the tire's ability to stop on wet pavement as measured under controlled conditions on specified government test surfaces of asphalt and concrete. The federal government warns consumers not to choose tires that earn only a C traction rating, no matter what other ratings they have. They have poor traction on wet roads.

TEMPERATURE The resistance to a high-temperature grading system also uses an A, B, and C rating. The C grade indicates the tire meets DOT's present standards for temperature resistance and is acceptable. Tires that earn A and B temperature resistance ratings are still better.

TPC SPECIFICATION NUMBER On most vehicles equipped with radial tires, a TPC specification number is molded into the sidewall. This indicates the tire meets rigid size and performance standards developed for that particular automobile. It ensures the combination of endurance, handling, load capacity, ride, and traction on wet, dry, and snow-covered surfaces.

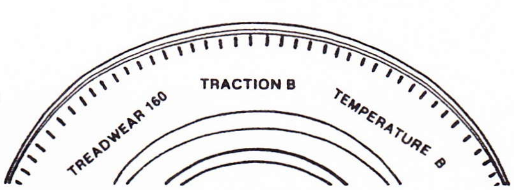


FIGURE 35–9 Uniform tire quality grading system.

Tire Placard

The tire placard, or safety compliance certification label, is generally found on the driver's door jamb. It includes recommended maximum vehicle load, tire size (including spare), and correct cold tire inflation for the specific vehicle (Figure 35–10). Never use this information for other cars.

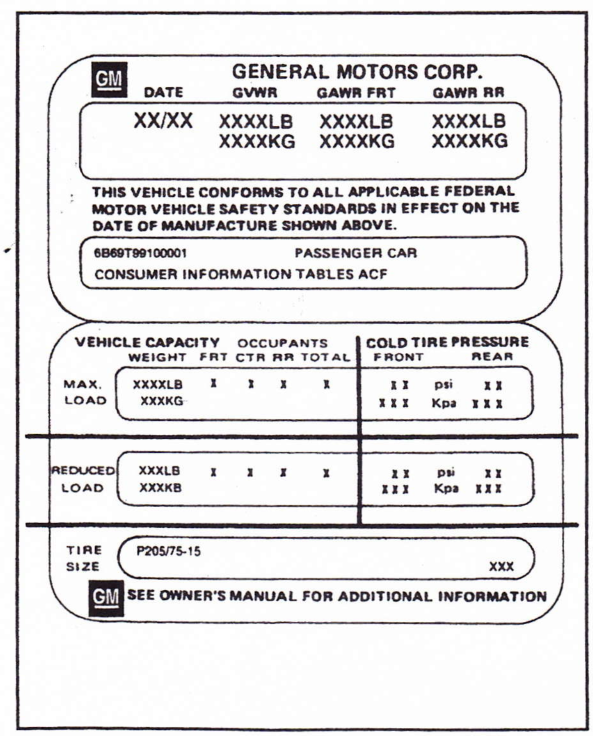


FIGURE 35–10 Typical tire placard. *Courtesy of Cadillac Motor Car Division, General Motors Corporation*

CUSTOMER CARE

Be sure to tell your customer to stay within the gross vehicle weight rating (**GVWR**) and the front and rear gross axle weight rating (**GAWR**) when loading a vehicle. The GVWR and GAWR are shown on the safety compliance certification label or tie placard. These limits represent the designed capacity of the vehicle, not merely of the tires. When towing a trailer, the allowable passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch. Station wagon loads should be distributed as far forward as possible. Vehicles equipped with luggage racks do not have a vehicle load capacity greater than specified on the tire placard. When carrying heavier-than-normal loads, the tire pressure should be increased but never to an extent greater than load range. ■

Combining Tire Types

As a general rule, tires should be replaced with the same size designation or an approved optional size as recommended by the auto or tire manufacturer. In addition to following the vehicle manufacturer's recommendations for tire size, type, inflation pressures, and rotation patterns, the following points should be observed.

1. Never mix size or construction types on the same axle.
2. Tires on the same axle should be of approximately equal tread depth.
3. All tires on station wagons and all other vehicles used for trailer towing should be of the same size, type, and load rating.
4. New tires should be installed in pairs on the same axle. When replacing only one tire, it should be paired with the tire having the most tread to equalize braking traction.
5. If radial tires are used on the car, combine them with radial snow tires on the driving wheels.
6. Snow tires should be of a size and type equivalent to the other tires on the vehicle; otherwise, the safety and handling of the vehicle might be adversely affected.
7. If any doubt exists as to combining tires on the same vehicle, use Table 35–4 as a guide.

TABLE 35–4 TIRE COMBINATIONS

Construction		Bias on Front (Read down for rear)			Belted Bias on Front (Read down for rear)			Radial on Front (Read down for rear)			
	Series (Profile)	78 Series	70 Series	60/50 Series	78 Series	70 Series	60/50 Series	Metric	78 Series	70 Series	60/50 Series
Bias on Rear (Read across for front)	Conventional (83 Series)	A	NO	NO	A	NO	NO	NO	NO	NO	NO
	78 Series	P	A	NO	A	NO	NO	NO	NO	NO	NO
	70 Series	A	P	NO	A	A	NO	NO	NO	NO	NO
	60/50 Series	A	A	P	A	A	A	NO	NO	NO	NO
Belted Bias on Rear (Read across for front)	78 Series	A	A	NO	P	A	NO	NO	NO	NO	NO
	70 Series	A	A	NO	A	P	NO	NO	NO	NO	NO
	60/50 Series	A	A	A	A	A	P	NO	NO	NO	NO
Radial on Rear (Read across for front)	Metric	A	A	NO	A	A	NO	P	A	A	NO
	78 Series	A	A	NO	A	A	NO	A	P	A	NO
	70 Series	A	A	NO	A	A	NO	A	A	P	NO
	60/50 Series	A	A	A	A	A	A	A	A	A	P

P: Preferred applications. For best all-around car handling, performance tires of the same size and construction should be used on all wheel positions.

A: Acceptable but not preferred applications. Consult the car owner's manual and do not apply if vehicle manufacturer recommends against this application.

NO: Not recommended.

SHOP TALK

Tires larger or smaller than originally installed might affect the accuracy of the speedometer calibration. It might be necessary to change the speedometer drive gears when tire size has been changed. Check the vehicle's service manual for details. ■

Tire Care

To maximize tire performance, inspect for signs of improper inflation and uneven wear, which can indicate a need for balancing, rotation, or front suspension alignment. Tires should also be checked frequently for cuts, stone bruises, abrasions, blisters, and objects that might have become imbedded in the tread. More frequent inspections are recommended when rapid or extreme temperature changes occur, or where road surfaces are rough or occasionally littered with debris.

To clean tires, use a mild soap and water solution only. Rinse thoroughly with clear water. Do not use any caustic solutions or abrasive materials. Never use steel wool or wire brushes. Avoid gasoline, paint thinner, and similar materials having a mineral oil base. These materials are harmful to the tires and eventually discolor the whitewalls and raised letters.

Inflation Pressure A properly inflated tire (Figure 35–11A) gives the best tire life, riding comfort, handling stability, and gas mileage for normal driving conditions. Too little air pressure can result in tire squeal, hard steering, excessive tire heat, abnormal tire wear, and increased fuel consumption by as much as 10 percent. An underinflated tire (Figure 35–11B) shows maximum wear on the outside edges of the tread. There is little or no wear in the center. Conversely, an overinflated tire (Figure 35–11C) shows its wear in the center of the tread and little wear on the outside edges. A higher tire inflation pressure than recommended can cause a hard ride, tire bruising, and rapid wear at the center of the tire.

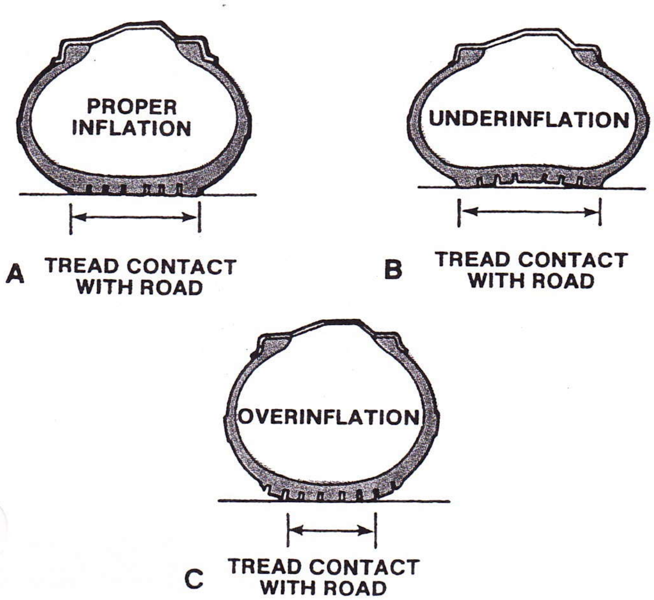


FIGURE 35–11 Effects of inflation on tires.

TABLE 35–5 INFLATION PRESSURE CONVERSION (KILOPASCALS TO psi)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60

Conversion: 6.9 kPa = 1 psi

Many inflation pressures given on OE import vehicles use kilopascals (kPa) rather than psi. Table 35–5 converts kPa to psi.

CUSTOMER CARE

Be sure to tell your customer that radial tires have a distinctive bulge (Figure 35–12) that gives the appearance of an underinflated tire. This is normal and air should not be added to make a radial tire look as inflated as a bias or bias-belted tire. Inflate a radial to the recommended pressure only. Do not overinflate. ■

Tire Rotation To equalize tire wear, most car and tire manufacturers recommend the tires be rotated. Remember that front and rear tires perform different

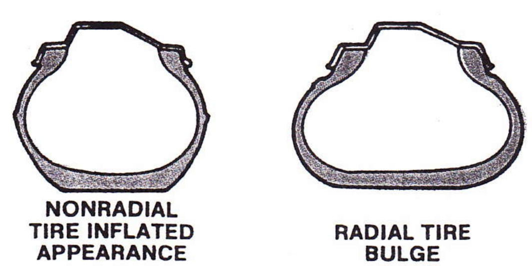


FIGURE 35–12 Tire profile on a nonradial tire as compared to a radial tire.

jobs and can wear differently, depending on driving habits and the type of vehicle. In a RWD vehicle, for instance, the front tires usually wear along the outer edges, primarily because of the scuffing and slippage encountered in cornering. The rear tires wear in the center because of acceleration thrusts. To equalize wear, it is recommended that tires be rotated as illustrated in Figure 35–13. Bias ply and bias-belted tires should be rotated about every 6,000 miles. Radial tires should be initially rotated at 7,500 miles and then at least every 15,000 miles thereafter. Many auto shops keep a record of tire rotation periods so they can notify their customers when it should be done next.

When snow tires are installed, the regular tread tires on the rear should be moved to the front and the front tires stored. When snow tires are removed, install the stored tires on the rear. Do not rotate studded tires. Always remount them in their original positions.

When storing tires, lay them flat on a clean, dry, oil-free floor. Keep them away from ozone, which comes from the electrical sparking frequently produced by electric motors. Store them in the dark. Direct sunlight is hard on tires.

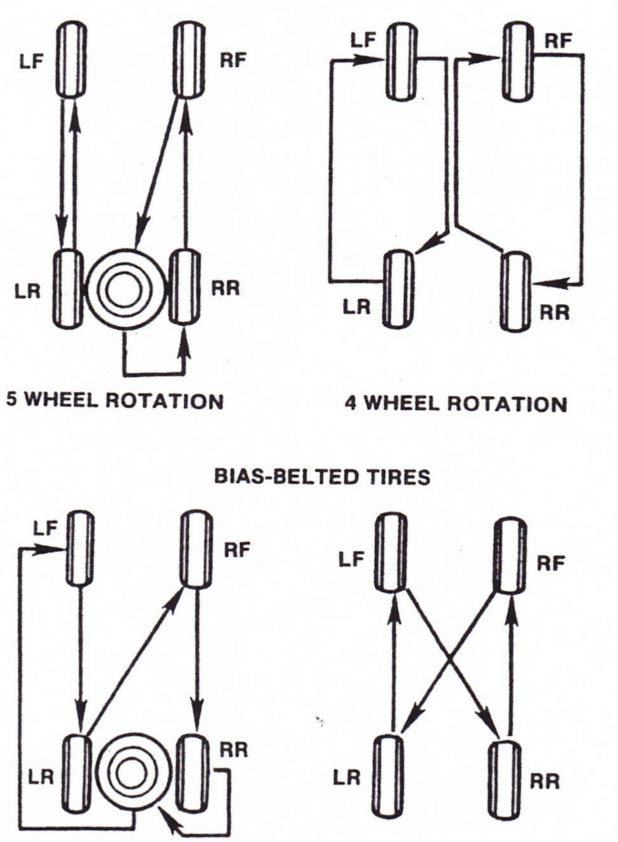


FIGURE 35–13 Rotation for radial and bias-belted tires.

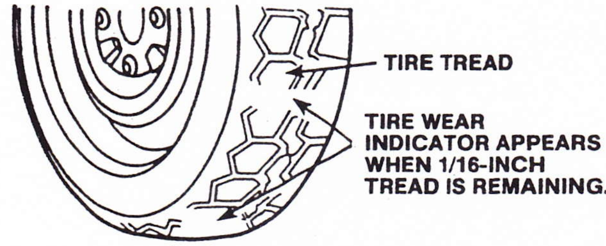


FIGURE 35–14 Tread wear indicators.

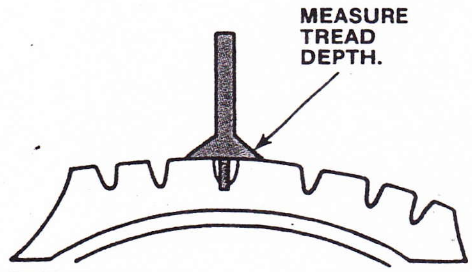


FIGURE 35–15 Checking tread depth.

Tread Wear Most tires used today have built-in tread wear indicators to show when they need replacement. These indicators appear as 1/2-inch wide bands when the tire tread depth wears to 1/16 inch (Figure 35–14). When the indicators appear in two or more adjacent grooves, at three locations around the tire, or when cord or fabric is exposed, tire replacement is recommended.

If the tires do not have tread wear indicators, a tread depth indicator (Figure 35–15) quickly shows in 32nds of an inch how much tire tread is left. When only 2/32 inch is left, it is time to replace the tire.

CUSTOMER CARE

It is good public relations to explain or, better still, to show a customer how to remove the tire/wheel assembly. This is especially true in the case of wheelcovers equipped with an antitheft locking system. The lock bolt for each wheelcover is located behind the hub ornament. A special key wrench is required to pry off the center hub ornament and remove the lock bolt (Figure 35–16). To allow for service in the event the customer's key has been misplaced, a master key set is available at the new car dealership.

In recent years more and more wheels are being equipped with antitheft wheel lugs (one per wheel). The key has a circular keyway that is matched to the female slot in the antitheft wheel lug nut (Figure 35–17). To remove or install the antitheft wheel lug nut, insert the special key into the slot of the lug nut. Place the lug nut wrench on the key. While applying pressure on the key, remove or install the lug nut. ■

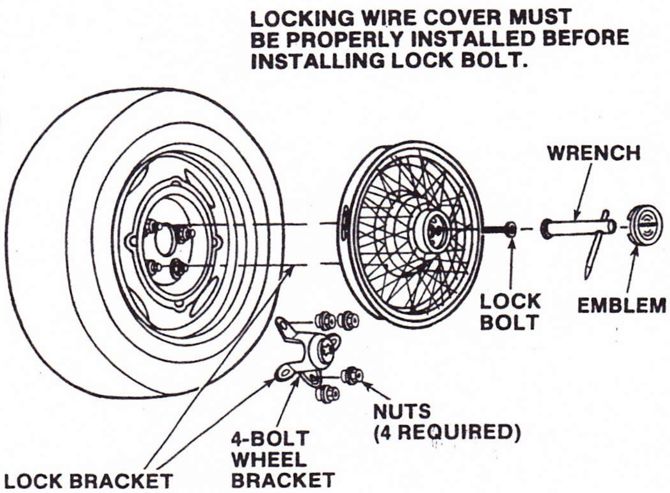


FIGURE 35–16 Antitheft wire wheelcovers. *Courtesy of Ford Motor Company*

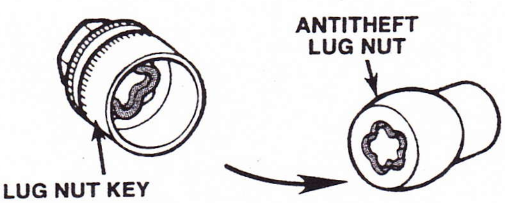


FIGURE 35–17 Circular keyway fits female slot of antitheft wheel lug nut. *Courtesy of Ford Motor Company*

Tire Repair The most common tire repair problem is a puncture. When properly done, a repaired tire can be put back in service safely and without fear of the leak recurring. Service punctures in the tread area only (Figure 35–18). Never attempt to service punctures in the tire's shoulders or sidewalls. In addition, do not service any tire that has sustained the following damage.

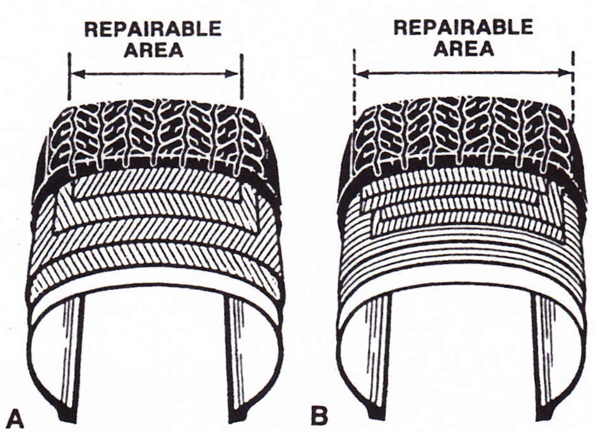


FIGURE 35–18 Repair areas of (A) bias and belted bias, and (B) radial tires.

- Bulges or blisters
- Ply separation
- Broken or cracked beads
- Fabric cracks or cuts
- Wear to the fabric or visible wear indicators
- Punctures larger and 1/4-inch diameter

WARNING!

Tire sealants injected through the valve stem can produce wheel rust and tire imbalance. ■

To locate a puncture in a tire, inflate it to the maximum inflation pressure marked on the tire. Then, submerge the tire/wheel assembly in a tank of water or sponge it with a soapy water solution. The water bubbles at the exact spot of the leak.

Mark the location of the leak with a crayon so it can be easily found once the tire is removed from the wheel. Also place a crayon mark to identify the valve stem location so the original tire balance and tire runout can be maintained when the tire is remounted.

The proper procedure for dismounting and remounting a tire is illustrated in Photo Sequence 21. Do not use hand tools or tire irons alone to change a tire because they might damage the beads or wheel rim. When mounting or dismounting tires on vehicles using aluminum or wire spoke wheels, contact the tire changer manufacturer about the accessories required to protect the wheel's finish.

Once the tire is off the wheel and the cause of the puncture is removed, the tire can be permanently serviced from the inside using a combination service plug and vulcanized patch. While the service kit manufacturer's instructions should always be followed, there are some general procedures that help to make a good, permanent patch. (Since so few vehicles still use tube-type tires, their repair is not covered in this book.)

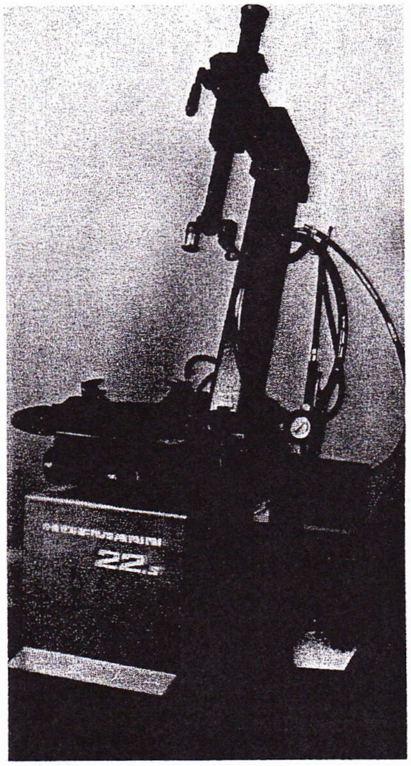
The following methods are the most popular types of tire repair.

PLUG REPAIR The head-type plug (Figure 35–19) is the most popular method. Place a plug slightly larger than the size of the puncture hole in the eye of the insertion tool. Wet both the plug and insertion tool with vulcanizing fluid.

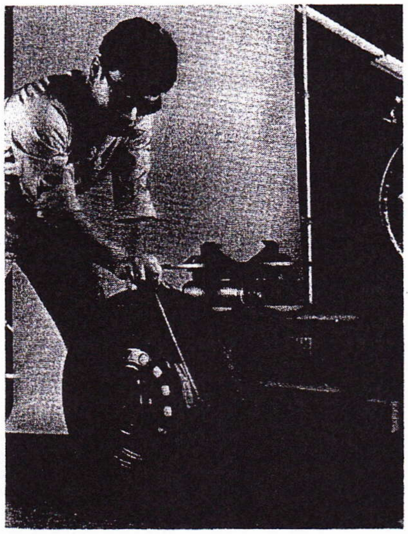
While holding and stretching the long end of the plug, insert it into the puncture hole from inside the tire. The plug must extend above both the tread and inner liner surface. If the plug pops through, discard it and repeat the insertion procedure. Once the insertion tool has been removed, trim off the plug 1/32

PHOTO SEQUENCE 21

DISMOUNTING AND MOUNTING A TIRE ON A WHEEL ASSEMBLY



P21–1 A typical tire changer.



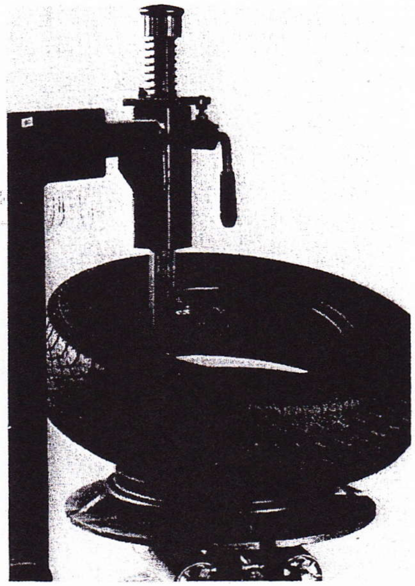
P21–2 Dismounting the tire from the wheel begins with releasing the air, removing the air valve core, and unseating the tire from the rim. The machine does the unseating. The technician merely guides the operating lever.

P21–3 Once both sides of the tire are unseated, place the assembly onto the machine.

P21–4 Depress the pedal that clamps the wheel to the tire machine.

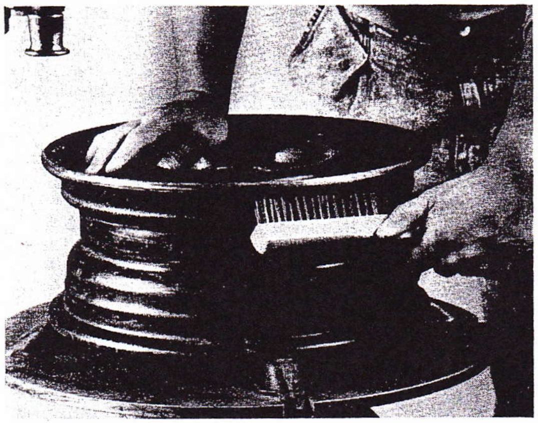
P21–5 Lower the machine's arm into position on the tire and wheel assembly.

P21–6 Insert the tire iron between the tire and wheel. Depress the pedal that causes the wheel to rotate. This will free the tire from the wheel.

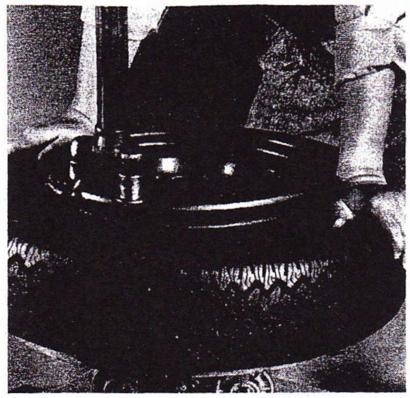


P21–7 After the tire is totally free from the rim, remove the tire.

(continued)

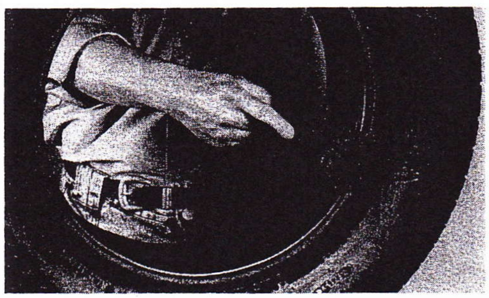


P21–8 To prepare the wheel for the mounting of a new tire, use a wire brush to remove all of the dirt and rust from the sealing surface.



P21–10 Place the tire onto the wheel assembly and lower the arm onto the assembly. As the wheel rotatês, the tire will be forced over the rim.

P21–12 Reinstall the air valve core and inflate the tire to the recommended pressure.



P21–9 Rubber compound should be liberally applied to the bead area of the new tire.

P21–11 After the tire is completely over the rim, install the air ring over the tire. Activate this to seat the tire against the wheel.

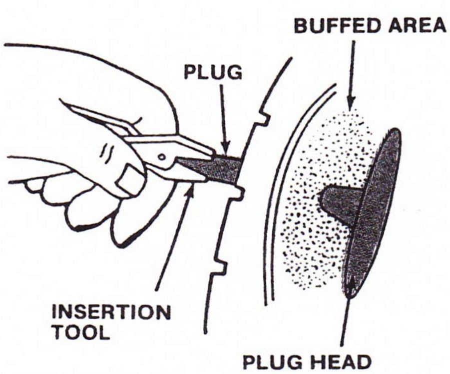


FIGURE 35–19 Plug for a radial tire.

inch above the inner liner surface. Do not pull on the plug while cutting.

COLD PATCH REPAIR When using a cold patch, carefully remove the backing from the patch. Spread vulcanizing fluid on the punctured area. Let it dry, then center the patch base over the punctured area. Run a stitching tool over the patch to help bind it to the tire.

WARNING!

When repairing radial tires, use only a patch specially approved for that application. These special patches have arrows that must be lined up parallel to the radial plies. ■

HOT PATCH REPAIR A hot tire patch application is similar to a cold patch. The difference is that the hot patch is clamped over the puncture and heat is applied to the patch to make it adhere.

SHOP TALK

When mounting new tires, always install new valve stems. The life of tire rubber is close to the life of the valve stem rubber. Most stems are the snap-in type. These are installed from inside the wheel with a pulling tool. Make sure the stem is properly seated. Another style of stem has a retaining nut that must be removed when pulling off the old stem. Be sure to completely tighten the new nut. ■

Installation of Tire/Wheel Assembly on the Vehicle

A wheel should be carefully inspected each time a tire is to be mounted on it. The major causes of wheel failure are improper maintenance, overloading, age, and accidents, including pot hole damage. Wheels must be replaced when they are bent, dented, or heavily rusted, have leaks or elongated bolt holes, and have excessive **lateral** or **radial runout**. Wheels with a lateral or radial runout greater than the recommended specification can cause high-speed vehicle vibration. Stones wedged between the wheel and disc brake rotor or drum can unbalance the wheel. Remember that wobble or shimmy caused by a damaged wheel eventually damages the wheel bearings. Also, check the lug nuts to be sure they are set according to the torque given in the vehicle's service manual. Loose lug nuts can cause shimmy and vibration and can also distort the stud holes in the wheels.

WARNING!

Steel wheel repairs that use welding, heating, or peening are not approved. The use of an inner tube is not an acceptable repair for leaky wheels or tubeless tires. ■

Before reinstalling a tire/wheel assembly on a vehicle, inspect the wheel bearings as described later in this chapter, then clean the axle/rotor flange and wheel bore with a wire brush or steel wool. Coat the axle pilot flange with disc brake caliper slide crease or an equivalent. Place the wheel on the hub. Install the locking wheelcover pedestal (if used) and lug nuts, and tighten them alternately to draw the wheel evenly against the hub. They should be tightened to a specified torque and sequence (Figure 35–20) to avoid distortion. Many tire technicians snug up the lug nuts. Then when the car is lowered to the floor, they use a torque wrench for the final tightening.

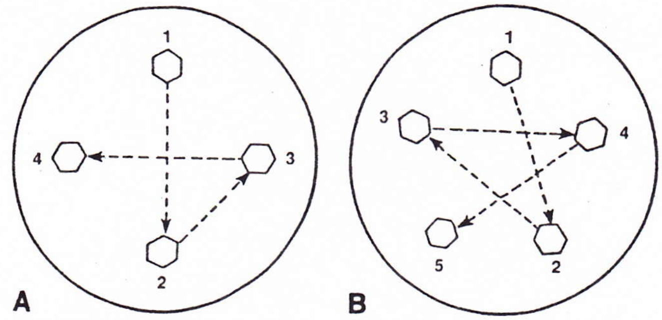


FIGURE 35–20 Lug nut tightening sequence for (A) four-bolt wheel and (B) five-bolt wheel.

WARNING!

Overtorqueing of the lug nuts is the most common cause of disc brake rotor distortion. Also, an overtorqued lug distorts the threads of the lug and could lead to premature failure. ■

Be sure the wheels and hub are clean. To clean aluminum wheels, use a mild soap and water solution and rinse thoroughly with clear water. Do not use a steel wool abrasive cleaner or strong detergent containing high alkaline or caustic agents because they might damage the protective coating and cause discoloration. Once the vehicle is on the ground, check and adjust the air pressure in all tires.

TIRE/WHEEL RUNOUT

A tire that is off center is said to run out. This is known as radial runout or eccentricity. One that wobbles side to side is said to have lateral runout. If a tire with some built-in runout is mismatched with a wheel's runout, the resulting total runout can exceed the ability of the balance weights to correct the problem. For this reason, part of a wheel balance check should be a check for excessive runout. Sometimes tires or wheels can be remounted to lessen or correct runout problems.

To avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven. Visually inspect the tire for abnormal bulges or distortions. The extent of runout should be measured with a dial indicator. All measurements should be made on the vehicle with the tires inflated to recommended load inflation pressures and with the wheel bearing adjusted to specification.

Measure tire radial runout at the center and outside ribs of the tread face (Figure 35–21). Measure tire lateral runout just above the buffing rib on the sidewall. Mark the high points of lateral and radial runout for future references. On bias or belted bias

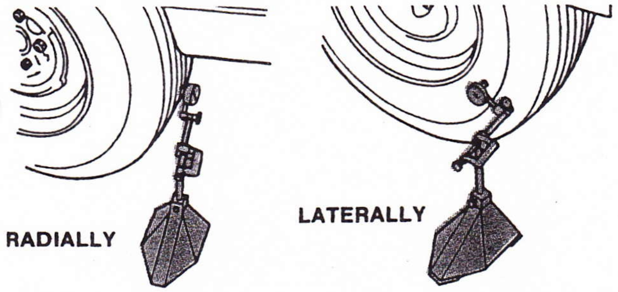


FIGURE 35–21 Using a dial indicator to measure tire runout.

tires, radial runout must not exceed 0.104 inch and lateral runout must not exceed 0.099 inch. On radial ply tires, radial runout must not exceed 0.081 inch and lateral runout must not exceed 0.099 inch.

If total radial or lateral runout of the tire exceeds specified limits, it is necessary to check wheel runout to determine whether the wheel or tire is at fault. Wheel radial runout is measured at the wheel rim just inside the wheelcover retaining nibs. Wheel lateral runout is measured at the wheel rim bead flange just inside the curved lip of the flange. Wheel radial runout should not exceed 0.035 inch and wheel lateral runout should not exceed 0.040 inch. Mark the high points of radial and lateral runout for future reference.

If total tire runout, either lateral or radial, exceeds the specified limit but wheel runout is within the specified limit, it might be possible to reduce runout to an acceptable level. This is done by changing the position of the tire on the wheel so the previously marked high points are 180 degrees apart.

If an air leak is suspected due to wheel damage, use the following procedure before considering wheel replacement.

Procedures 1. 2. 3.

PROCEDURES

Repairing Air Leaks

1. Remove the tire and wheel assembly, and inspect the wheel for structural damage. If none exists, go on to step 2. If the wheel is damaged, replace it.
2. With the tire mounted on the wheel, locate the leak as described earlier. Mark the location. Check the complete wheel for possible additional leaks. After all leaks are marked, dismount the tire.
3. On the inside of the rim, use about #80 grit sandpaper on the area of the leak to thoroughly remove all contamination. Score the surface of the wheel to improve sealer adhesion.
4. Use a clean rag to remove all sanding dust.
5. With the wheel at room temperature, apply a generous portion of silicone rubber sealer to the leak area.
6. Use a spatula or similar tool and spread the sealer over the entire area, forming a thin coat.
7. Allow to cure for approximately 6 hours before remounting the tire.

TIRE/WHEEL ASSEMBLY SERVICE

For most tire/wheel service, the assembly must first be removed from the vehicle. The wheel and the tire must be separated whenever tires are placed or repaired. The rear wheel drum or disc brake rotor is usually attached to studs on the rear axle shaft hub flange. The wheel and tire mounts on the same rear axle shaft flange studs and is held against the hub and drum or rotor by the wheel nuts.

Tire/Wheel Balance

Proper front-end alignment allows the tires to roll straight without excessive tread wear. The wheels can go out of alignment from striking raised objects or pot holes. Misalignment subjects the tires to uneven and/or irregular wear. An out-of-balance condition can also cause increased wear on the ball joints, as well as deterioration of shock absorbers and other suspension components.

Should an inspection show uneven or irregular tire wear, wheel alignment and balance service is a must. Wheel balancing distributes weights along the wheel rim that counteract heavy spots in the wheels and tires and allow them to roll smoothly without vibration. There are two types of wheel imbalance: static and dynamic.

Static Balance **Static balance** is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called **wheel tramp**. This condition eventually causes uneven tire wear. As the name implies, static balance is balancing a wheel at rest. This is done by adding a compensating weight. Static balance is achieved when the wheel does not rotate by itself regardless of the position in which it is placed on its axis. This is true whether the wheel is mounted vertically, as on a spindle or balancer shaft, or horizontally, as on a bubble-type balancer.

A statically unbalanced wheel tends to rotate by itself until the heavy portion is down. To balance against the heavy portion, a weight is attached to the wheel directly opposite the heavy area. Some technicians place the weight on the inside of the wheel. Others place the weight on the outside of the wheel. Still others recommend placing two equal weights, one on each side of the wheel, opposite the heavy area.

There are many static balancers commonly used. The simplest is the bubble balancer. This design features a movable flange that rests on a point. A round sight glass filled with liquid containing a bubble rides with the flange. The bubble indicates whether the flange is level. When the tire/wheel assembly is placed on the flange, any static imbalance makes it tilt and moves the bubble off center. Lead wheel balance weights are then placed on the wheel where the bubble points to counteract the imbalance and center the bubble on the sight glass. When balance weights are used in pairs, the total balance-correcting weight is divided in half. One half is installed on the back of the wheel, the other half on the front. This weight-splitting method leaves the wheel's dynamic balance or imbalance unchanged. Many equipment manufacturers recommend static balancing a wheel at equal distances from the center of the light area. The balance weights are normally hammered on with their holding tabs between the tire head and rim. Mag wheels require the use of tape weights to balance them.

Dynamic Balance **Dynamic balance** is the equal distribution of weight on each side of the centerline. When the tire spins, there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced can cause **wheel shimmy** and a wear pattern (Figure 35–22). Dynamic balance, simply stated, is balancing a wheel in motion. Once a wheel starts to rotate and is in motion, the static weights try to reach the true plane of rotation of the wheel because of the action of centrifugal force. In an attempt to reach the true plane of rotation when there is an imbalance, the static weights force the spindle to one side.

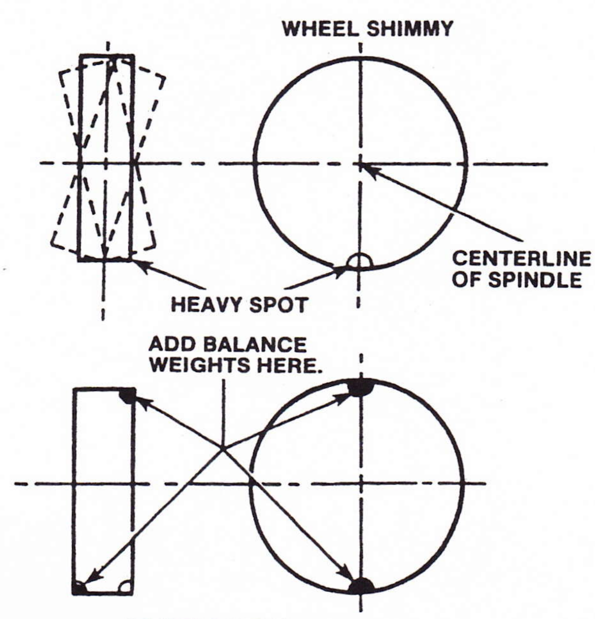


FIGURE 35–22 Dynamic unbalance causes wheel shimmy.

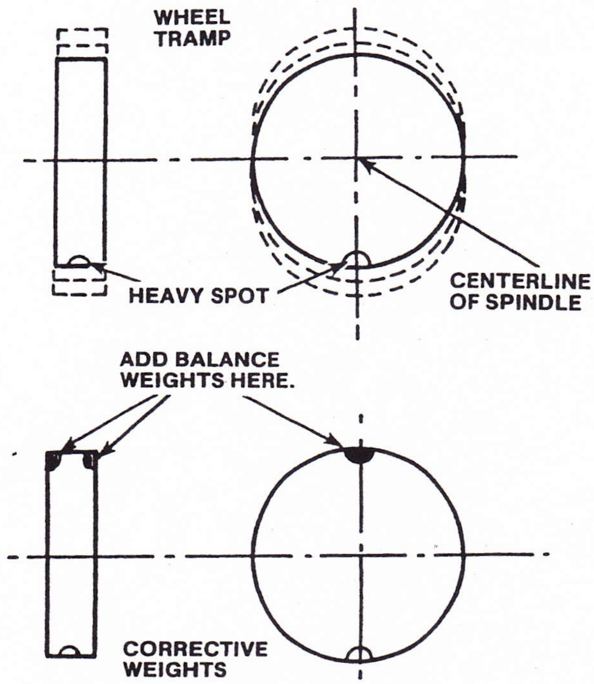


FIGURE 35–23 Static unbalance causes wheel tramp.

At 180 degrees of wheel rotation, static weights kick the spindle in the opposite direction. The resultant side thrusts cause the wheel assembly to wobble or wiggle (Figure 35–23). When severe enough, as already mentioned, it causes vibration and front-wheel shimmy.

To correct dynamic unbalance, equal weights are placed 180 degrees opposite each other, one on the inside of the wheel and one on the outside, at the point of unbalance. This corrects the couple action or wiggle of the wheel assembly. Also, note that dynamic balance is obtained, while static balance remains unaffected.

The most commonly used dynamic wheel balancer requires that the tire/wheel assembly be taken off and mounted on the balancer's spindle (Figure 35–24). The machine spins the entire assembly to indicate the heavy spot with a strobe light or other device. Two tests must be done, one for static and one for dynamic imbalance. One set of weights is placed to correct for static imbalance, and others are placed to correct for dynamic imbalance. Sometimes proper positioning of the static balance weights also corrects dynamic imbalance.

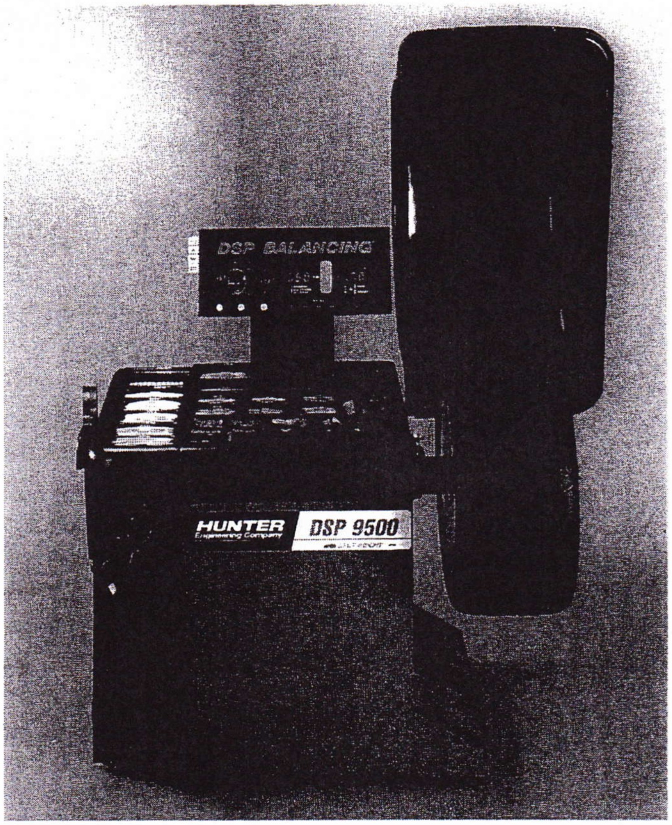


FIGURE 35–24 Tire/wheel assembly mounted on balancer's spindle. *Courtesy of Hunter Engineering Company*

There are several electronic dynamic/static balancer units available that will permit balancing while the wheel and tire are on the car. A switch on the console sets the machine for either static or dynamic balancing. When the wheel balancing assembly is mounted for static balancing, it rotates until the heavy spot falls to the bottom. Weights are added to balance the assembly.

In the dynamic balance mode, the wheel assembly is rotated at high speed. Observing the balance scale, the operator reads out the amount of weight that has to be added and the location where the weights should be placed.

Wheel Bearings

There are several types of wheel bearing arrangements for both driving and nondriving wheels.

Front Wheel Hubs Traditionally, the front wheel hub bearing for driven and nondriven wheels incorporated two bearings (Figure 35–25). They were usually of the separable type and, therefore, were comprised of four components. This arrangement required periodic bearing lubrication and adjustment.

In the early 1970s, the automotive industry began to show more interest in compactness and reduced mass. To meet future demands, especially

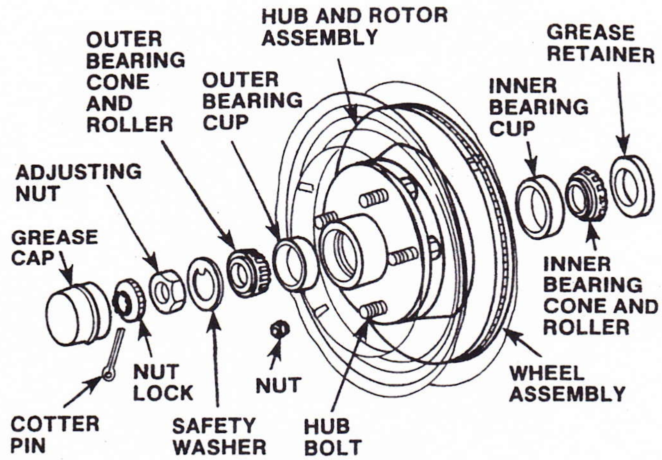


FIGURE 35–25 Exploded view of a typical front wheel assembly for RWD vehicle. Safety washer, used between outer bearing and spindle nut, is found on all cars. It must always be in place. *Courtesy of Ford Motor Company*

for driven wheels, a unit in which both bearing rings were flanged was studied. The outer ring became a stiff structural member and thus permitted a simplification of the hub carrier. The hub was eliminated as the rotating inner ring flange took over its function. Design and assembly were simplified and there was a consequent savings in weight and space. Because the bearing rings are rigid, bearing geometry is precisely controlled.

There are three popular hub units (Figure 35–26).

HUB UNIT 1 This unit is a double-row, angular contact ball bearing with a two-part inner ring. The bearing has the correct axial clearance when mounted. Therefore, no adjustment is required and there is no risk of preloading the bearing. The contact angle of 32 degrees gives a large distance between the pressure centers of the bearing and reduces sensitivity to tilting movements. An added benefit is good axial carrying capacity, which is particularly important during cornering conditions. A tapered roller bearing version is available for use in which radial space restricts the fitting of the ball bearing type. This unit has a higher radial carrying capacity but is more sensitive to misalignment. Both ball and roller types are designed for compact FWD cars.

HUB UNIT 2 This unit is a double-row, angular contact ball bearing with a two-part inner ring and a flanged outer ring. The contact angle is 32 degrees. It is designed for outer ring rotation and incorporates the function of the wheel hub, having a spigot for centering the wheel and the brake drum or disc. Since a hub cap provides protection, there is no need for an outboard seal. This unit was designed for FWD vehicles that are somewhat larger than those using hub unit 1.

A

B

C

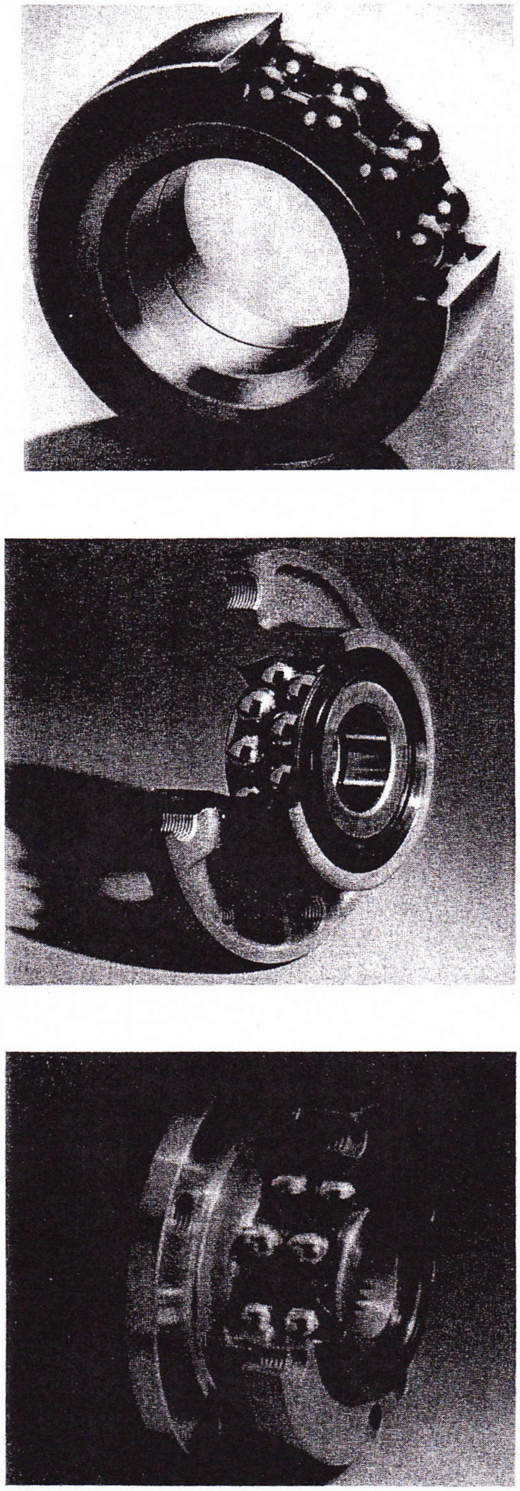


FIGURE 35–26 Examples of ready-to-mount units: (A) hub unit 1, (B) hub unit 2, and (C) hub unit 3. *Courtesy of SKF USA, Inc.*

HUB UNIT 3 This unit, designed primarily for mid-sized FWD cars, is a double-row, angular contact ball bearing with a correct angle of 32 degrees. Both inner and outer rings have been shaped to take over the functions of the other. The inner ring is extended on the outside to provide a flange and spigot. The bore is also splined, which enables hub unit 3 to completely replace the conventional driven wheel hub. The extremely stiff outer ring is also flanged and is provided with bolt holes for attachment to the steering knuckle. Therefore, it becomes a structural part of the suspension. Because the bearing outer ring is self-supporting, the steering knuckle can be designed for fatigue strength rather than for stiffness. The CV-joint shaft no longer needs to be designed to hold the bearing assembly together. Its only requirement is to transmit torque, and it can be locked in the inner ring by a retaining ring.

Some early European sports models featured a so-called quick-change hub assembly. While this is similar to the standard disc type, it has a wire spoke center that slides into a splined hub and is retained by a single quick release or knock-off spinner nut. The wheel and tire assembly can be changed merely by removing this nut. The wheel then pulls off. To replace, merely reverse the procedure. This quick-change design requires special hubs.

Rear Hubs Most RWD axle bearings are of the straight roller bearing design (Figure 35–27), in which the drive axle shaft serves as the bearing race. Some rear wheel axle bearings are of the ball or tapered roller bearing type. Figures 35–28 and 35–29 show typical rear bearing designs.

A popular 4WD design is the so-called detachable rear axle hub (Figure 35–30). In this design, the hub is secured to the tapered axle end by means of a nut and key. The key fits into a groove cut in both the hub and axle. The key is used to prevent the hub from slipping on the axle.

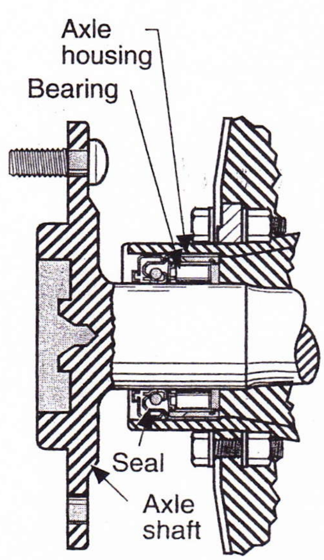


FIGURE 35–27 Straight roller-type rear-axle bearing-and-seal arrangement. Notice the absence of a separate inner bearing race. Rollers run directly on the axle shaft. *Courtesy of Oldsmobile Division, General Motors Corporation*

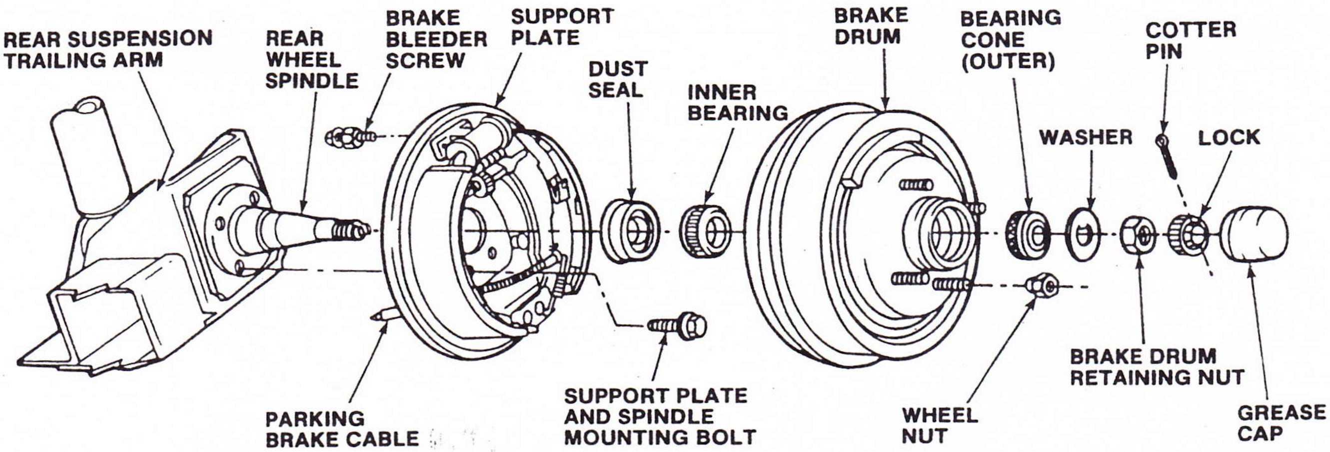


FIGURE 35–28 Typical rear wheel bearing assembly for a FWD vehicle. *Courtesy of Ford Motor Company*

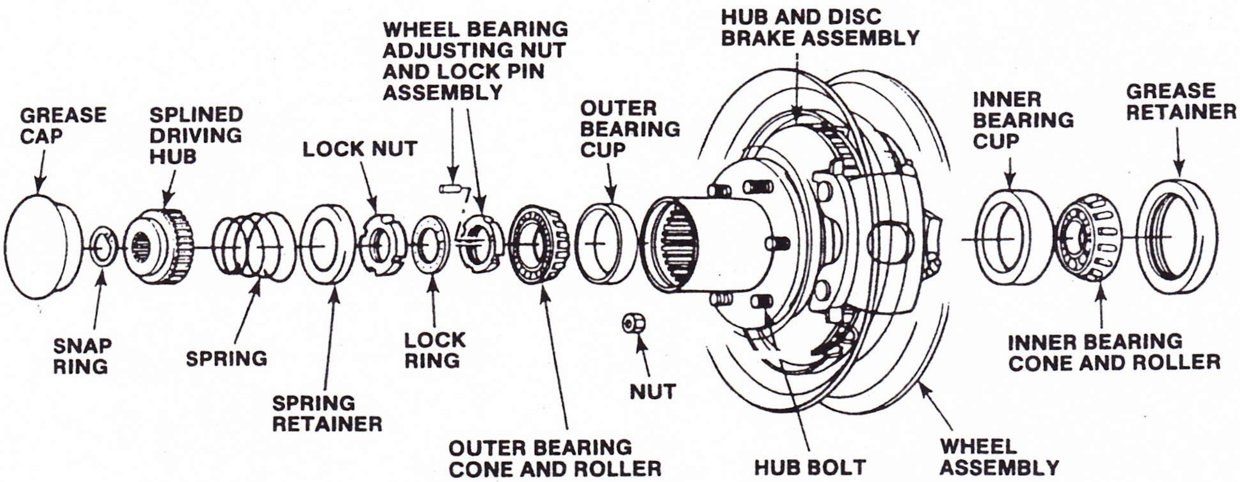


FIGURE 35–29 Exploded view of 4WD wheel hub and bearing assembly. *Courtesy of Ford Motor Company*

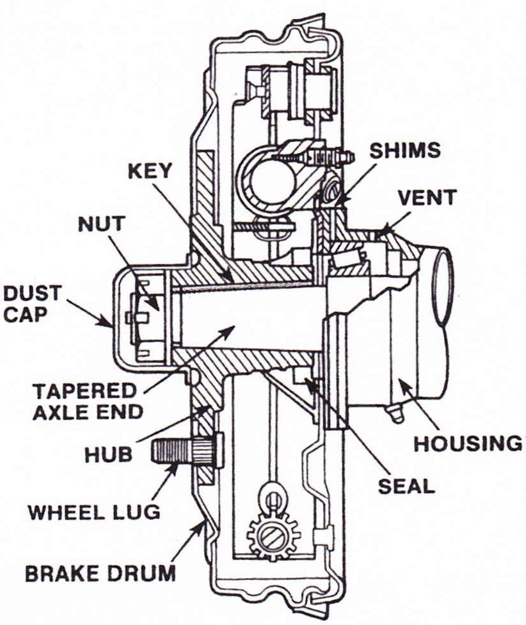


FIGURE 35–30 Detachable rear axle wheel hub. Hub is kept from turning on tapered axle end by a key. *Courtesy of Chrysler Corporation*

WARNING!

Never drive or move a vehicle with the wheel nuts loosened. Such an action could damage the wheel. ■

Wheel Bearing Grease Specification The grease for wheel bearings should be smooth textured, consist of soaps and oils, and be free of filler and abrasives. Recommended are lithium complex (or equivalent) soaps, or solvent-refined petroleum oils. Additives could be added to inhibit corrosion and oxidation. The grease should be noncorrosive to bearing parts, with no chance of separating during storage or use.

Using the correct amount of lube is also essential. Failure to maintain proper lubrication might result in bearing damage, causing a wheel to lock (Figure 35–31). To lubricate a bearing, force grease around the outside of the bearing and between the rollers,

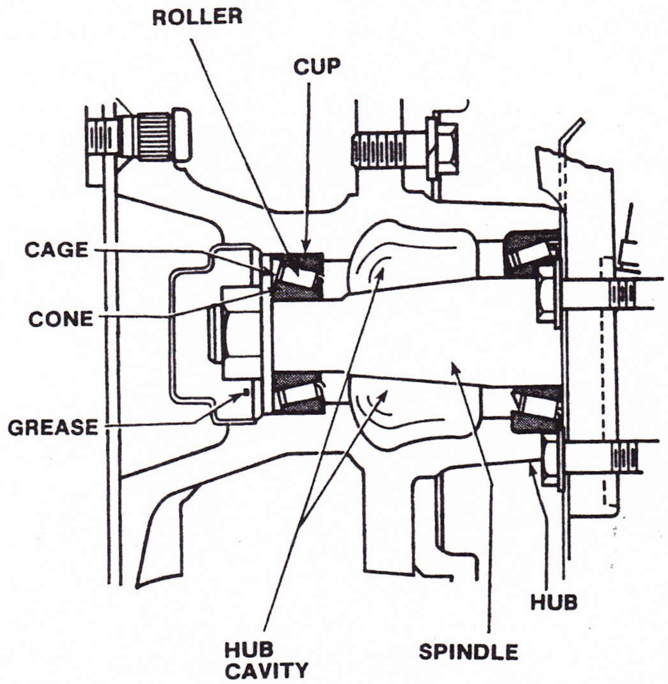


FIGURE 35–31 Wheel bearing lubrication.

cone, and cage. Also, pack grease into the wheel hub. The depth of the grease should be level with the inside diameter of the cup.

Oil Lubrication Since it is thinner than grease, oil needs more frequent service intervals. Generally, oil is used to lubricate bearings in high-temperature and/or high-speed applications. It is primarily used on heavy-duty fleet, automotive, and agricultural vehicles.

Bearing Troubleshooting Wheel bearings are designed for longevity. Their life expectancy, based on metal fatigue, can usually be calculated if general operating conditions are known. Bearing failures not caused by normal material fatigue are called premature failures. The causes can range from improper lubrication or incorrect mounting, to poor condition of the shaft housing or bearing surfaces.

When servicing, replacing, or installing wheel bearings, always follow the procedure given in the service manual.

CASE STUDY

A customer wishes to purchase new tires for a sports car. The original size tire for the car is P235 VR60-15. He receives an estimate for purchasing four new tires of the same size and made by the same manufacturer. He is hesitant to spend that amount of money on replacement tires. He then asks for an estimate on a variety of alternative tires. The cost of the same tire from different tire manufacturers varies. A slightly narrower tire, e.g., P215 VR60-15, costs slightly less than the original size tire. Lower speed rated tires, e.g. H-series, cost considerably less. The customer is inclined to go with the H-series tire. Is he making the correct decision?

Although it is unlikely the customer will travel at 150 mph, the original tires for that car were rated at these speeds. Speed ratings not only indicate the top speed the tire can safely run, they also indicate the amount of heat they can withstand. A tire rated at 150 mph can withstand more heat than a tire rated at 130 mph. The V-series tires would be a safer tire for that car. Therefore, if the vehicle's manufacturer installed a V-series tire, so should the customer.

This same logic is true for not changing the width of the tires. The car was built and the alignment specifications set for a particular width tire. Therefore, the customer should be advised not to switch to narrower tires.

The only possible way the customer can save money on buying replacement tires for his car is to change brands. However, all the features of the OE tires should be compared to the features and specifications of the other brands. As a technician, you should be able to give sound advice based on a knowledge of tires.

KEY TERMS

Bead
Belted bias ply
Bias ply
Drop center
Dynamic balance
GAWR
GVWR
Hub
Lateral runout
Lug nuts
Plies
Radial ply
Radial runout
Series
Sidewalls
Sipes
Static balance
Tire profile
TPC
Tread
Treadware grade
Tubeless tires
Valve stem
Wheel
Wheel offset
Wheel shimmy
Wheel tramp

SUMMARY

- Wheels are made of either stamped or pressed steel discs riveted or welded into a circular shape or are die-cast or forged aluminum or magnesium rims.

- The primary purpose of tires is to provide traction. They also are designed to carry the weight of the vehicle, withstand side thrust over varying speeds and conditions, transfer braking and driving torque to the road, and absorb much of the road shock from surface irregularities.
- Pneumatic tires are of two types: those that use inner tubes and those that do not. The latter are called tubeless tires and are about the only type used on passenger cars.
- There are three types of tire construction in use today: bias ply, belted bias ply, and radial ply.
- Tires are rated by their profile, ratio, size, and load range.
- Tire construction affects both dimensions and ride characteristics, creating differences that can seriously affect vehicle handling.
- To maximize tire performance, inspect for signs of improper inflation and uneven wear, which can indicate a need for balancing, rotation, or alignment. Tires should also be checked frequently for cuts, bruises, abrasions, blisters, and stones or other objects that might have become imbedded in the tread.
- A properly inflated tire gives the best tire life, riding comfort, handling stability, and even gas mileage during normal driving conditions.
- To equalize tire wear, most car and tire manufacturers recommend the tires be rotated. It must be remembered that front and rear tires perform different jobs and can wear differently, depending on driving habits and the type of vehicle.
- Most tires used today have built-in tread wear indicators to show when tires need replacement.
- There are three popular methods of tire repair: head-type plug, cold patch repair, and hot patch repair.
- There are two types of wheel balancing: static and dynamic.
- The front wheel hubs on ball or tapered roller bearings are lubricated by wheel bearing grease.
- Rear wheels are bolted to integral or detachable hubs.

TECH MANUAL

The following procedures are included in Chapter 35 of the *Tech Manual* that accompanies this book:

1. Inspect tires for inflation and wear.

2. Remove and install front wheel bearings on a RWD vehicle.

3. Balance a tire and wheel assembly (off the vehicle).