CHAPTER 1

WHEELS, RIMS, AND TIRES

REVISED FEBRUARY 2008

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CHAPTER 1

WHEELS, RIMS, AND TIRES

1. INTRODUCTION. This chapter describes tires, wheels, and rims and their major parts; provides an inspection procedure for these items; and lists the load ratings of foreign and domestic tires.

2. DEFINITIONS.

a. Bandura Tire. A treadless new tire that receives its first application of the tread at the distributor or dealer to complete the manufacturing process. This type of new tire has not been manufactured since 1974, so any applications of Bandag tread rubber since then are retreads.

b. Breaker or Belt. One or more plies under the tread area and approximately as wide as the tread.

c. City-Suburban Tire. A tire designed for use on buses operating only in city and suburban service at speeds limited to 55 mph for continuous operation not to exceed one hour.

d. City Tire. A tire for use on buses operating only in slow speed, startand-stop intracity service, at speeds not, to exceed 35 mph.

e. Cord. Strands forming the plies in a tire.

f. Cord Separation. Parting of the cords from adjacent rubber compounds.

g. Groove. Space between adjacent tread ribs, lugs, or other tread configurations. A space less than 5/64 inch in width is not a groove.

h. Load Rating. Maximum load the tire is designed by the manufacturer to carry safely at a given inflation pressure.

i. Lock Ring. Steel ring designed to hold the side ring to the rim base of multipiece rims or wheels.

j. Major Groove. Any one of the tread's two or more circumferential depressions that had the greatest equal depth when the tire was new.

k. Maximum Load Rating. Load rating at the maximum permissible inflation pressure for that tire.

1. Ply. Layer of rubber-coated parallel cords.

m. Ply Separation. Parting of the rubber compound between adjacent plies.

n. Pneumatic Tire. Tire designed to be inflated or capable of inflation with compressed air.

o. Regroovable Tire. Tire manufactured with sufficient material for renewal of the original tread pattern or generation of a new tread pattern without exposing the cord.

p. Rim. Metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

q. Side Ring. Separate flange that retains the tire on multipiece rims.

r. Spacer. Device used with dual tires on cast spoke wheels to hold. the two rims apart and provide proper spacing between the tires.

s. Tread Separation. Pulling away of the tread rubber from the-tire body plies, belts, or breakers.

3. WHEEL CONSTRUCTION.

a. Disc Wheels. Disc wheels are secured to the axle hub by means of studs and cap nuts (or cone nuts for discs specially designed for them). Three different methods of securing a dual disc wheel assembly are shown in Figures 1-1, 1-2, and 1-3. Each wheel manufacturer recommends a tightening sequence for his wheels, with the most common sequence shown in Figure 1-4.

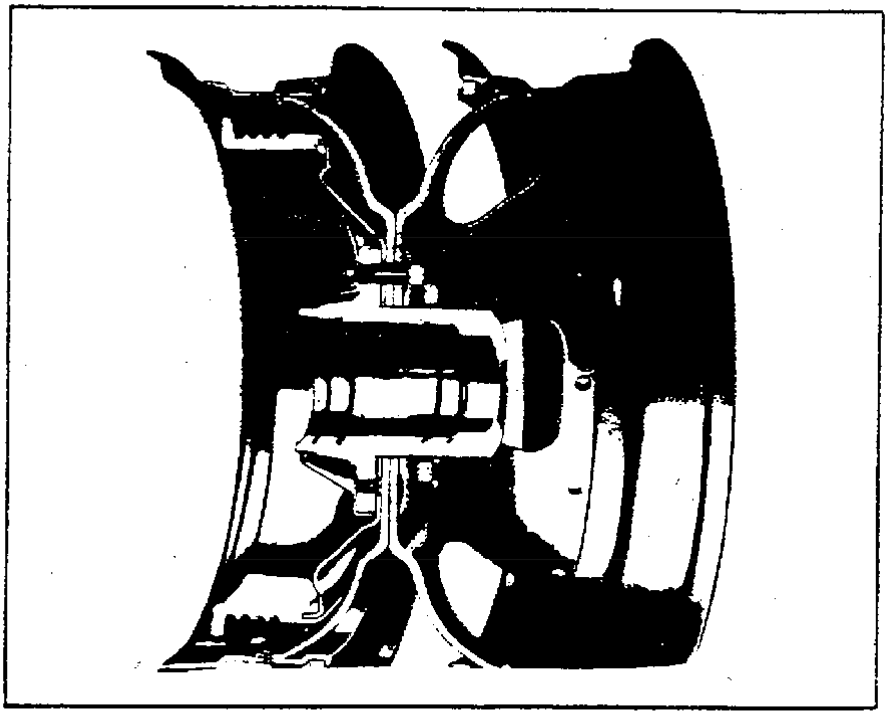


Fig. 1-1. Dual Disc Wheels, Three-Piece Lock Ring, with Nut and Plate Securement

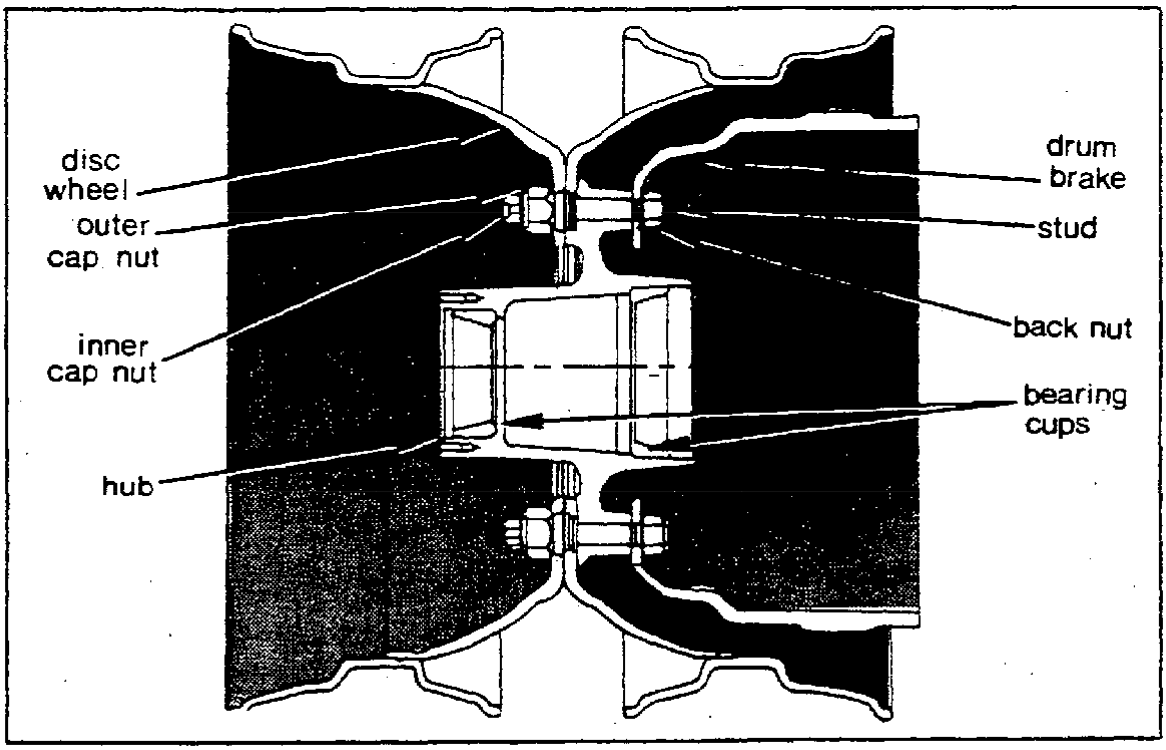


Fig. 1-2. Dual Disc Wheels, Drop Center Rims with Inner and Outer Cap Nut Securement

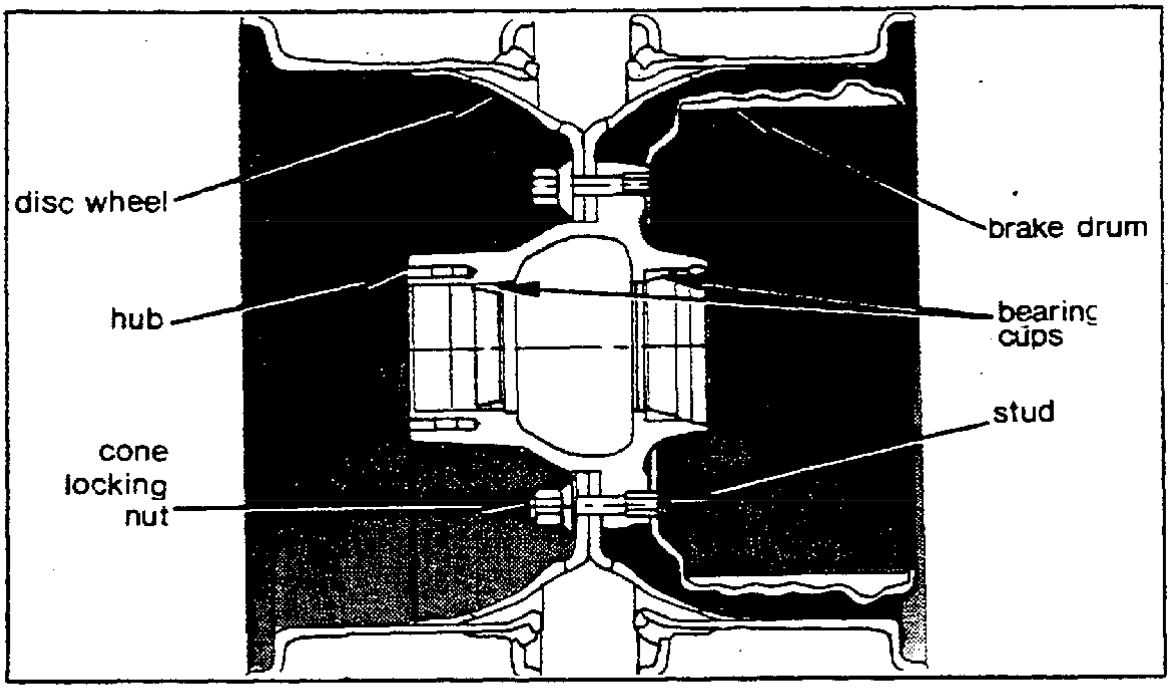


Fig. 1-3. Dual Disc Wheels, Three-Piece Lock Rim with Cone Nut Securement

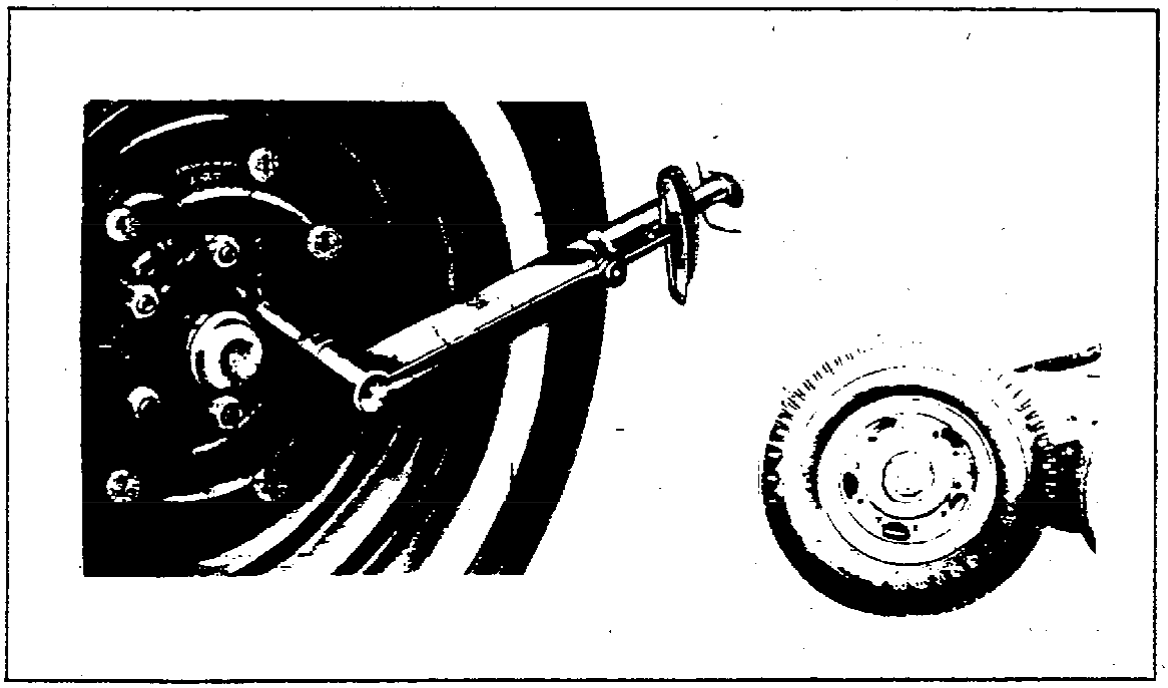


Fig. 1-4. Disc Wheel Nut Tightening Sequence

b. Cast Spoke Wheels. Rims on cast spoke spiders are secured by clamps that are held by studs or bolts and nuts. An exploded view of a cast spoke wheel assembly with dual rims and the nomenclature of each part is shown in Figure 1-5. Clamps and nuts are designed for specific wheels and are not generally interchangeable between wheels of different manufacturers. The most common types and their tightening sequence are shown in Figures 1-6 and 1-7.

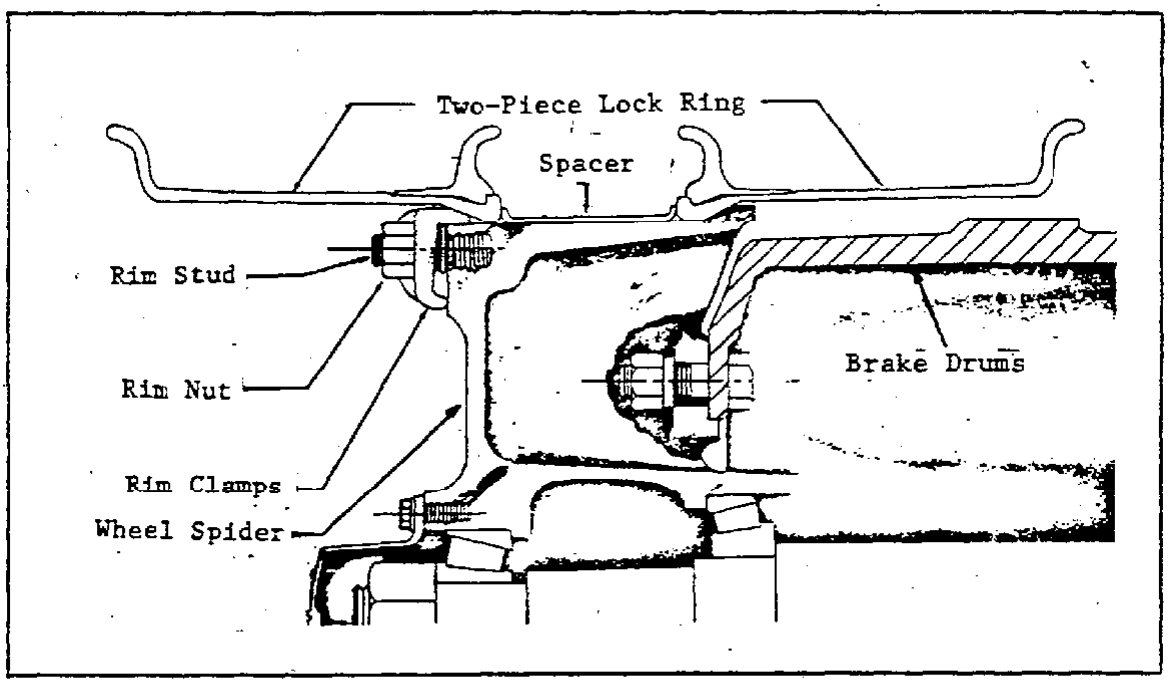
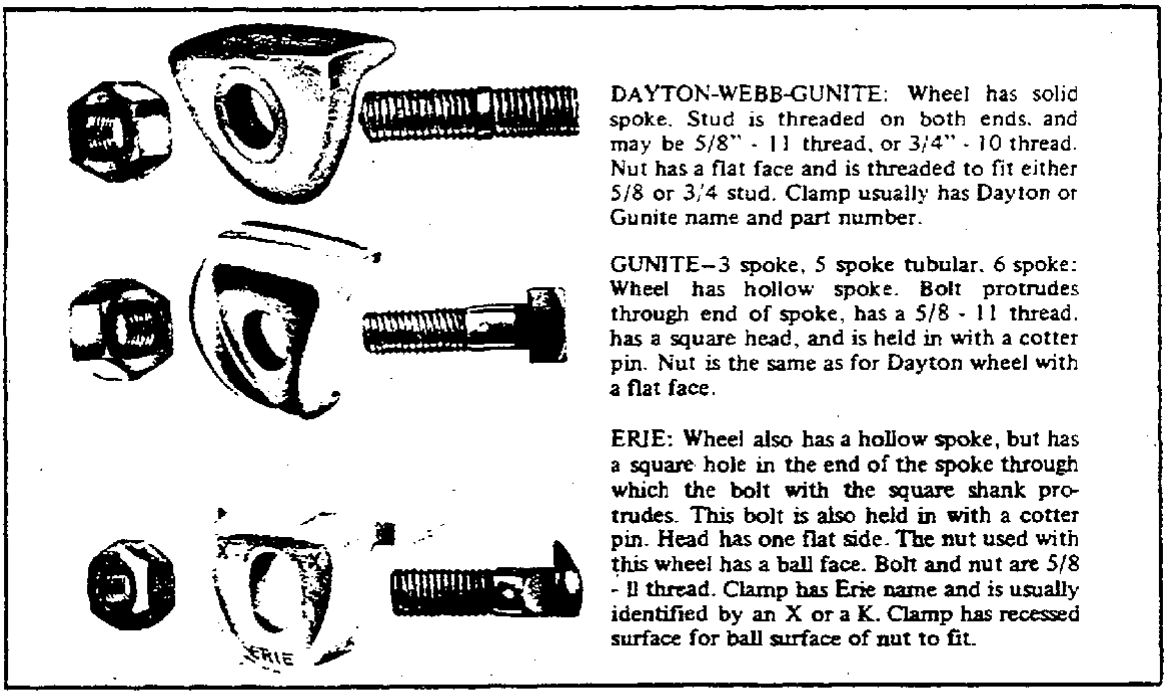


Fig. 1-5. Two-Piece Lock Rim and Securement to Cast Spoke Wheel



DAYTON-WEBB-GUNITE: Wheel has solid spoke. Stud is threaded on both ends, and may be 5/8" - 11 thread, or 3/4" - 10 thread. Nut has a flat face and is threaded to fit either 5/8 or 3/4 stud. Clamp usually has Dayton or Gunite name and part number.

GUNITE–3 spoke, 5 spoke tubular, 6 spoke: Wheel has hollow spoke. Bolt protrudes through end of spoke, has a 5/8 - 11 thread, has a square head, and is held in with a cotter pin. Nut is the same as for Dayton wheel with a flat face.

ERIE: Wheel also has a hollow spoke, but has a square hole in the end of the spoke through which the bolt with the square shank protrudes. This bolt is also held in with a cotter pin. Head has one flat side. The nut used with this wheel has a ball face. Bolt and nut are 5/8 - 11 thread. Clamp has Erie name and is usually identified by an X or a K. Clamp has recessed surface for ball surface of nut to fit.

Fig. 1-6. Cast Spoke Wheel Clamps, Studs, Bolts, and Nuts

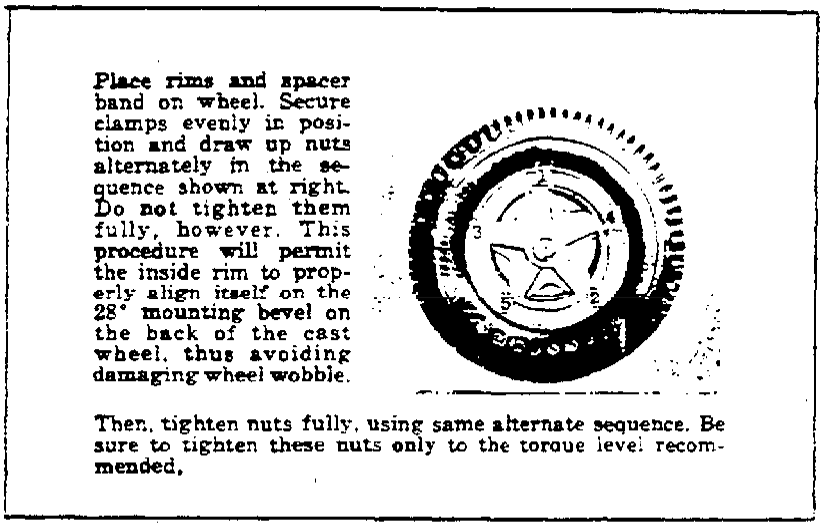


Fig. 1-7. Cast Spoke Wheel
Nut Tightening Sequence

c. Rim Construction. Rims are constructed as either drop center or lock ring types. Lock rings are used on flat rim bases or semi-drop center rims. A rim may be either a permanent part of a disc wheel or a separate component clamped to a cast spoke wheel.

(1) Drop Center Rim. Drop center rims are formed in one piece with the rim base made in a shallow "L"' shape to permit tire installation, as the flanges are not removable. Tubeless tires can be used only on drop center rims. See Fig. 1-8.

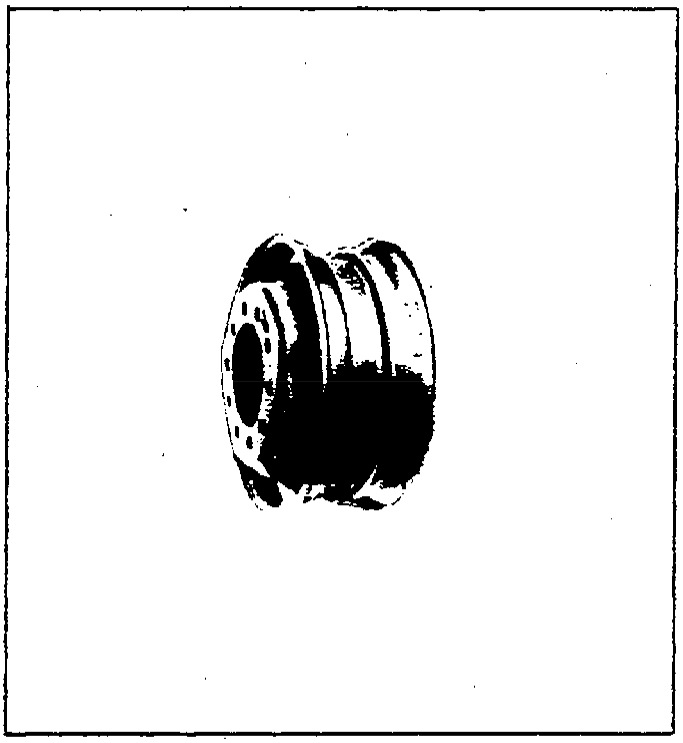


Fig. 1-8. Drop Center Disc Wheel

(2) Lock Ring Rim. The rim base assembly has one removable ring, known as a combination side and lock ring, or two rings, known as the side ring and the lock ring. Tires with tubes can be used only on these rims.

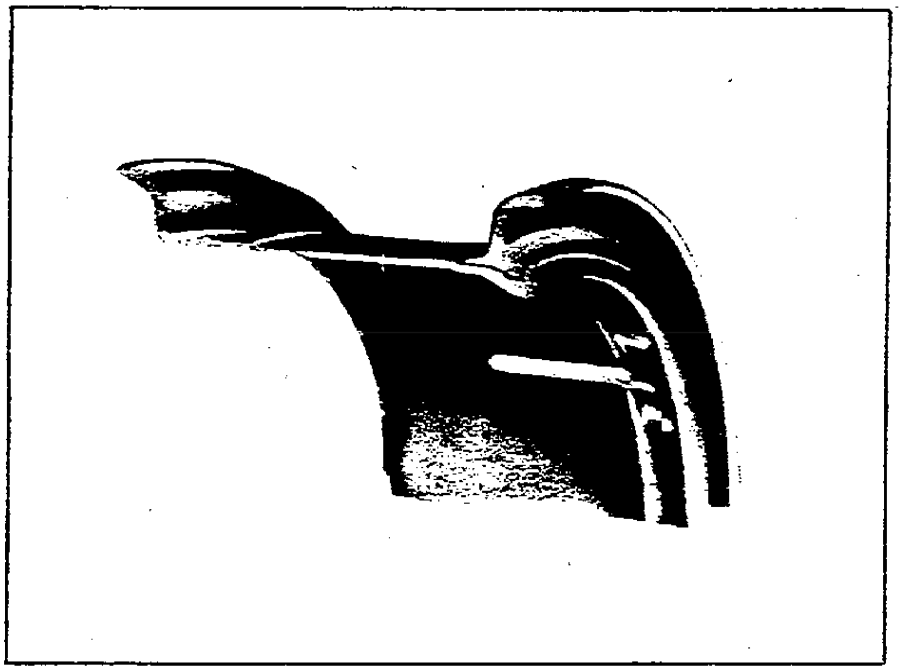


Fig. 1-9. Two-Piece Lock Ring Rim

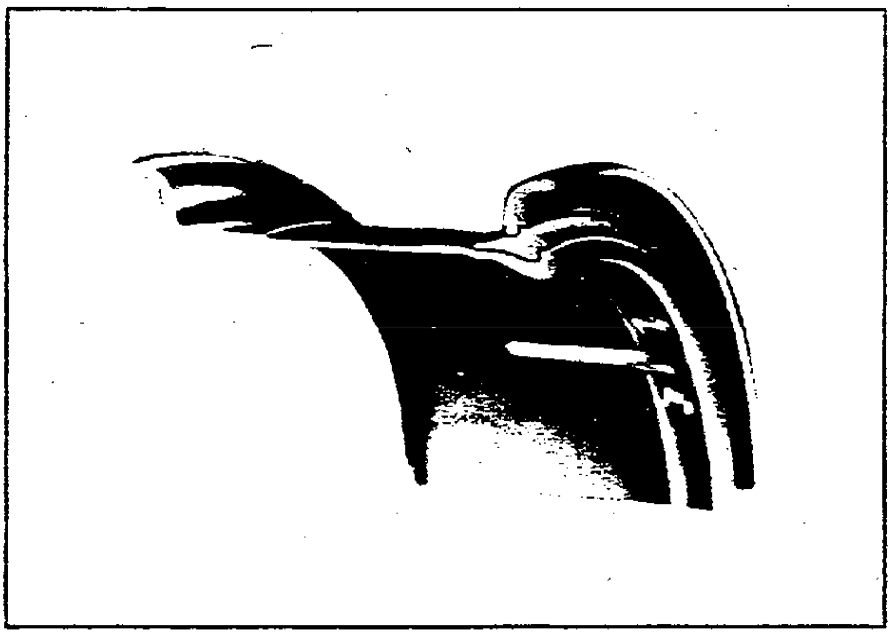


Fig. 1-10. Three-Piece Lock Ring Rim

4. TIRE CONSTRUCTION.

a. Type of Ply. Typical tire construction and nomenclature are shown in Figure 1-11. The three principal types of passenger car and light truck tires (bias ply, belted bias ply, and radial ply) are shown in Figure 1-12. These designs may be in either tube or tubeless type.

(1) Bias Ply. Bias ply tires may have two, four, or more body plies made from rayon, nylon, polyester, or other material. These plies cross the, centerline of the tire at an approximate angle of 35 degrees and provide strength to contain the inflation pressure. Bias tires may have breaker strips in the tread area.

(2) Bias Belted Ply. Bias belted ply tires are similar to bias ply tires but have two or more additional cord layers or "belts" under the tread. This construction reduces tread movement ("scrub" or "squirm") during contact with the road.

(3) Radial Ply. Radial ply tires have body cords that extend from one bead to the other crossing the centerline of the tire at an approximate .angle of 90 degrees. These tires have two or more belts extending around the tire under the tread, thereby reducing tread movement ("scrub" and "squirm") during contact with the road. This construction gives greater strength to the tread area and more flexibility to the sidewall.

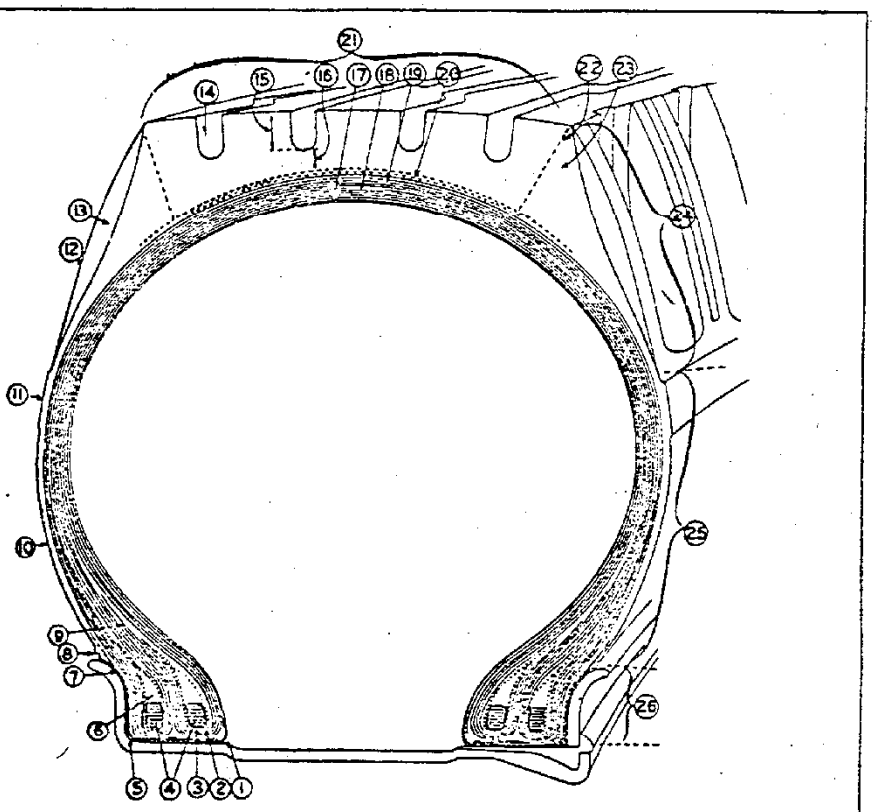
b. Snow Tread Tire. Snow tread tires have the following characteristics:

(1) Passenger car tires that are permanently marked on one sidewall with the words "MUD AND SNOW" or any contraction using the letters "N" and "S" (such as MS, M/S, M-S, M&S, etc.) in accordance with the Rubber Manufacturers Association standards are snow tread tires.

(2) Passenger car tires without the M&S markings are snow-tread tires if they have a deep aggressive tread pattern and are of a type and design manufactured for use on snow as a replacement for tire chains. (Generally tires manufactured before January 1, 1976, when the RMA standard became effective.)

(3) Light truck tires (to which the RMA marking standard does not apply) are snow-tread tires if they have a deep and aggressive tread pattern and are of a type and design manufactured for use on snow as a replacement for tire chains.

(4) Snow tires with the tread worm to a depth of less than 6/32 inch are no longer effective as snow treads and should not be used in lieu of chains.



1. Bead Toe
2. Flipper
3. Wrap
4. Insulated Bead Wire
5. Bead Heel
6. Gum Neck
7. Chafer
8. Vent Rib
9. Ply Turn Up
10. Sidewall
11. Buffing Rib
12. Buttress
13. Shoulder
14. Groove
15. Non-Skid Depth
16. Under Tread or Base
17. First or Drum Ply
18. Carcass Plies
19. Top or Cap Ply
20. Breaker Plies
21. Tread Area
22. Center-Wing Junction
23. Tread Wings
24. Shoulder Area
25. Sidewall Area
26. Bead Area

Fig. 1-11. Tire Nomenclature

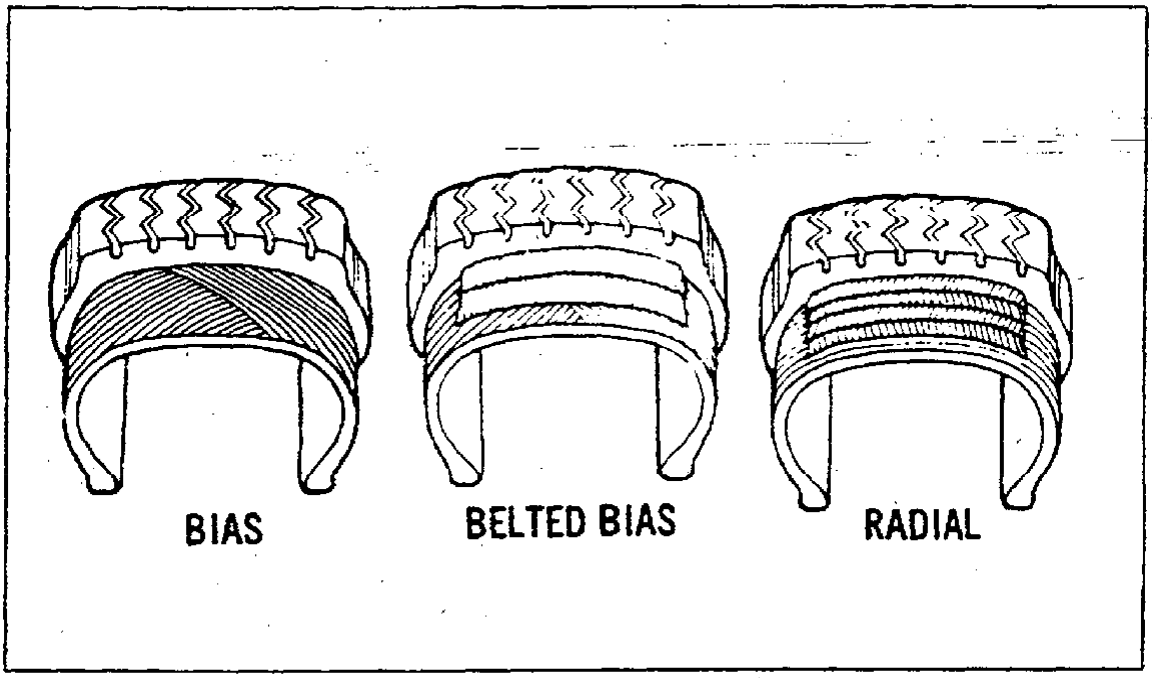


Fig. 1-12. Typical Passenger Car and Light Truck Tires

c. Tire Profile. Tire "profile ratio" represents the tire cross-section height as a percentage of the cross-section width as shown in Figure 1-13. Tire profiles have changed over the years, going from an almost round tube. type profile number of 83 for older conventionall tires down to as low as 35 for modern wide tires. Large truck tires generally have a ratio of 90 except for wide base types, which have a ratio of approximately 65.

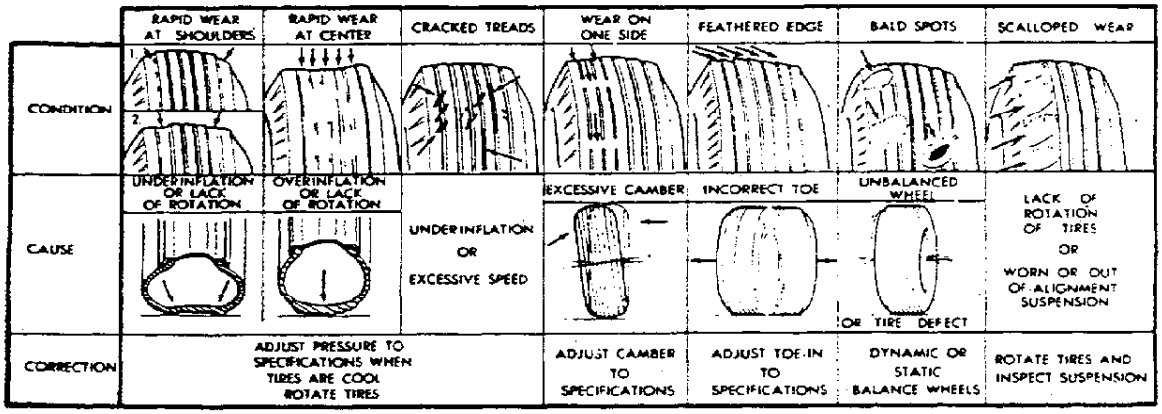


Fig. 1-14. Tire Wear Problems and Cures

d. Tire Wear Causes. The most common tire wear problems and cures are shown in Figure 1-14

e. Tire Markings. Tires are required to be marked as follows:

(1) New Tires. Passenger car tires manufactured after January 1, 1968, are required to have the following markings illustrated in Figure 1-15 (FMVSS 109, FMVSS 119, 49CFR Part 574, and Title 13, California Administrative Code, Section 1084)

(a) The "DOT" symbol followed by identification number shown in Figure 1-16

(b) Identification of manufacturer by name or brand name.

(c) Size designation.

(d) Maximum load rating.

(e) Maximum permissible inflation pressure.

(f) Actual number of plies in the sidewall and the actual number of plies in the tread area, if different.

(g) Composition of cord material in sidewalls and, if different, in tread.

(h) The word "tube type" or "tubeless" as applicable.

(i) The letter denoting the tire load range.

(j) Speed restriction, if 55 mph or lower.

(k) The word "regrooveable" if the tire is designed for regrooving.

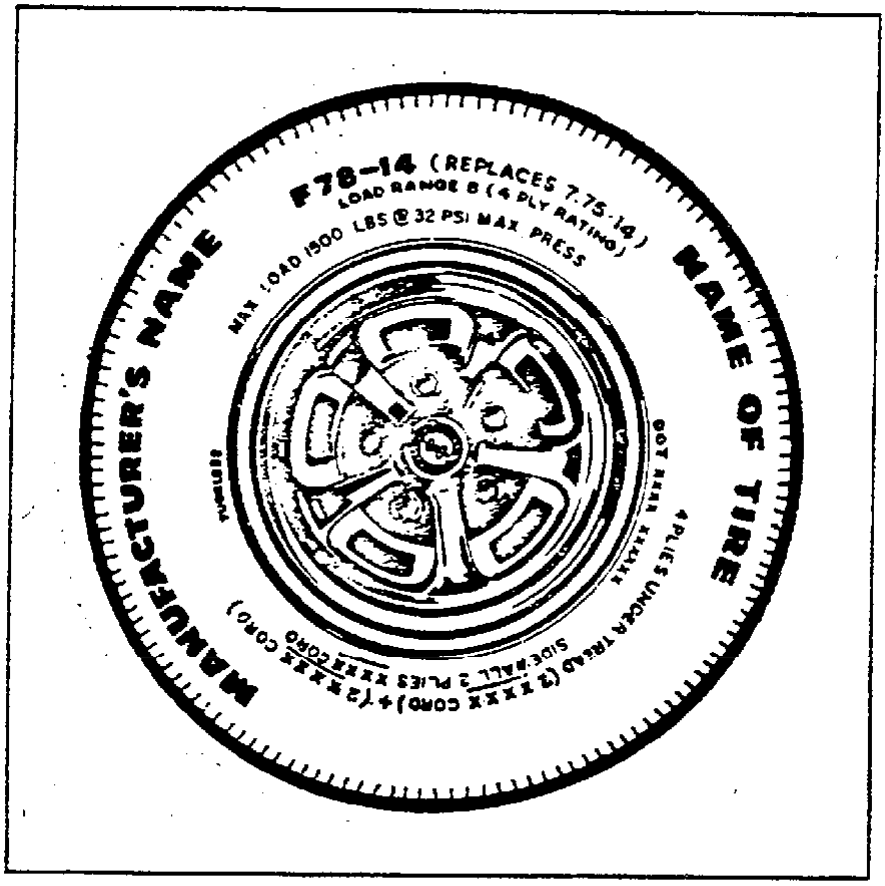


Fig. 1-15. New Passenger Car Tire Marking

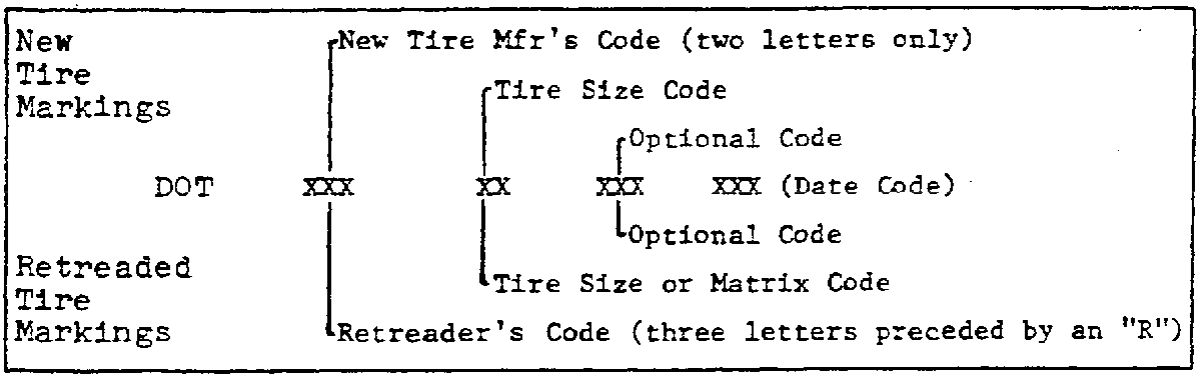


Fig. 1-16. New and Retreaded Tire Identification Marking

(2) Retreaded Tires. Retreaded tires used on the front wheels of vehicles subject to Motor Carrier Regulations (except buses, school buses, and farm labor vehicles) are required to be marked with the California Retreading Standards Committee symbol or the Tire Manufacturers Retreading symbol shown in Figure 1-17 (Title 13, California Administrative Code, Section 1088(d)).

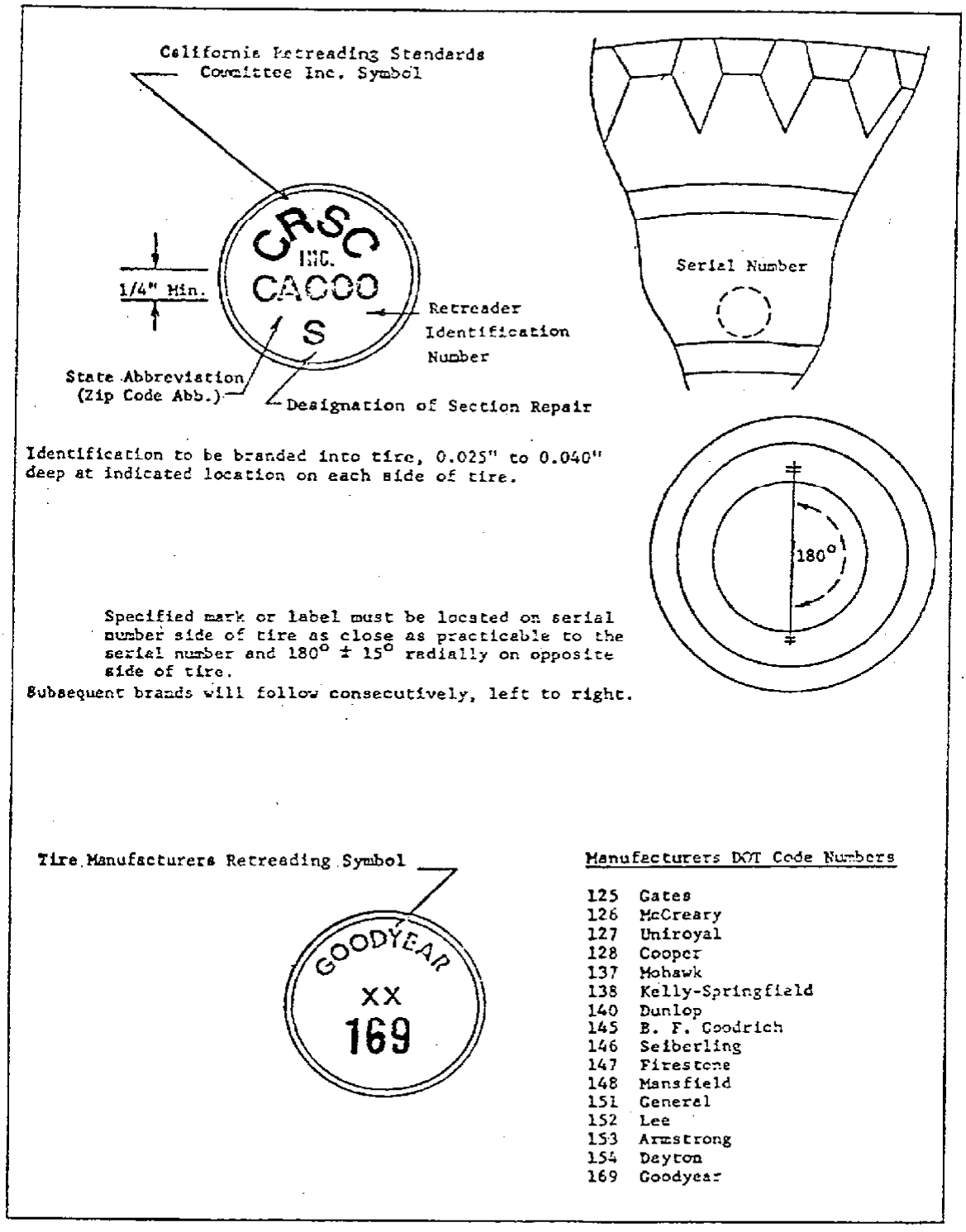


Fig. 1-17. Retread Tire Marking

5. INSPECTION PROCEDURE.

a. Wheel Defects. Wheels and rims shall be inspected for the following defects, which are conditions of improper maintenance. Malfunctions or defects which are immediate safety hazards may constitute a violation of Section 24002(a) VC:

(1) Cracks at any location on the rim or wheel web.

(2) Rim and lock ring or side ring that are not matched as shown in Figure 1-18.

(3) Aluminum wheels with evidence of welding or other heat having been applied.

(4) Aluminum wheels with evidence of corrosion or flaking as shown in Figure 1- 19.

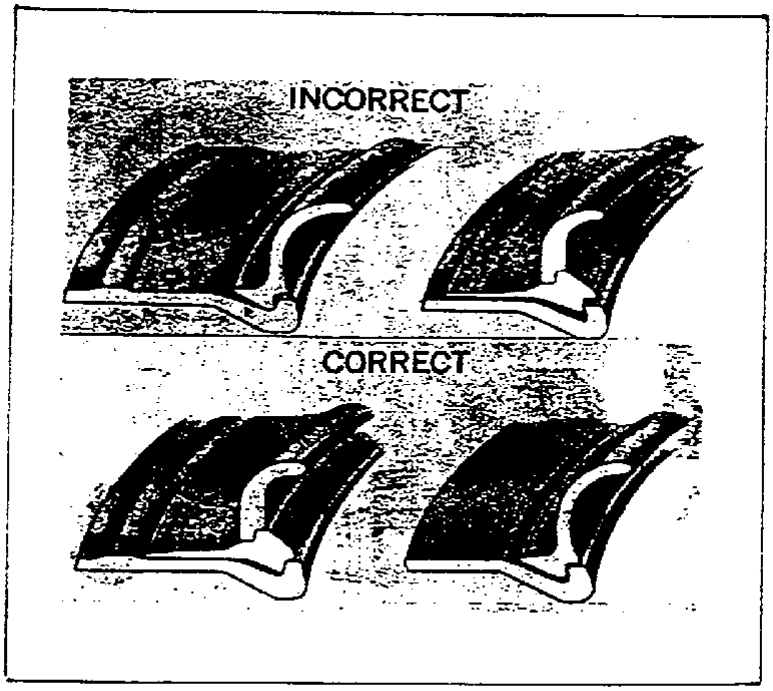


Fig. 1-18. Rim and Lock Ring Matching

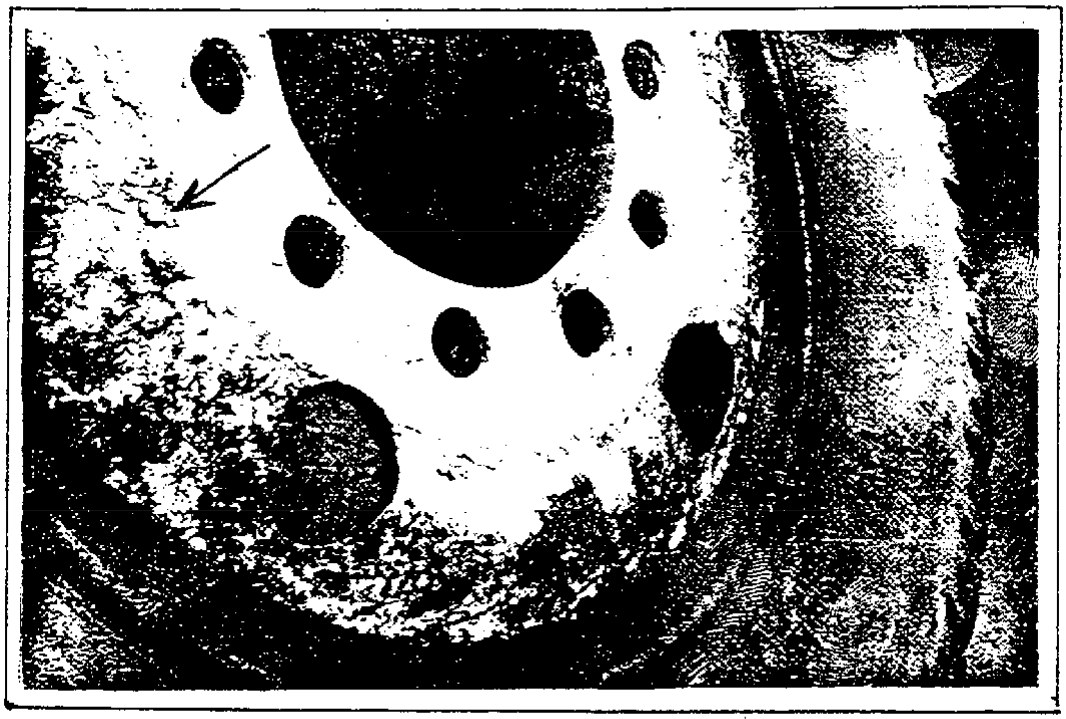


Fig. 1-19. Aluminum Wheel Corrosion or Flaking

b. Wheel Securement Deficiencies. Studs, nuts, or clamps shall be inspected for the following defects, which are conditions of improper maintenance. Malfunctions or defects which are immediate safety hazards may constitute a violation of Section 24002(a) VC:

(1) Studs, nuts or clamps that are missing, broken, or fit improperly (Figure 1-20) on any wheel in excess of the following numbers:

(a) Two or more on wheels with ten stud holes.

(b) One or more on all other types of wheels.

(c) Studs or nuts that are too small or do not fit the wheel seat properly.

NOTE: Nuts used on aluminum wheels may appear to be too small.Thicker aluminum wheels may have around the stud opening a countersunk area 1/16 inch deep by 1/8 inch wide. This area prevents the nut shoulder from contacting the ball seat of the wheel and permits the use of the inner and outer cap nuts originally supplied with the steel wheels. This is a permissible condition.

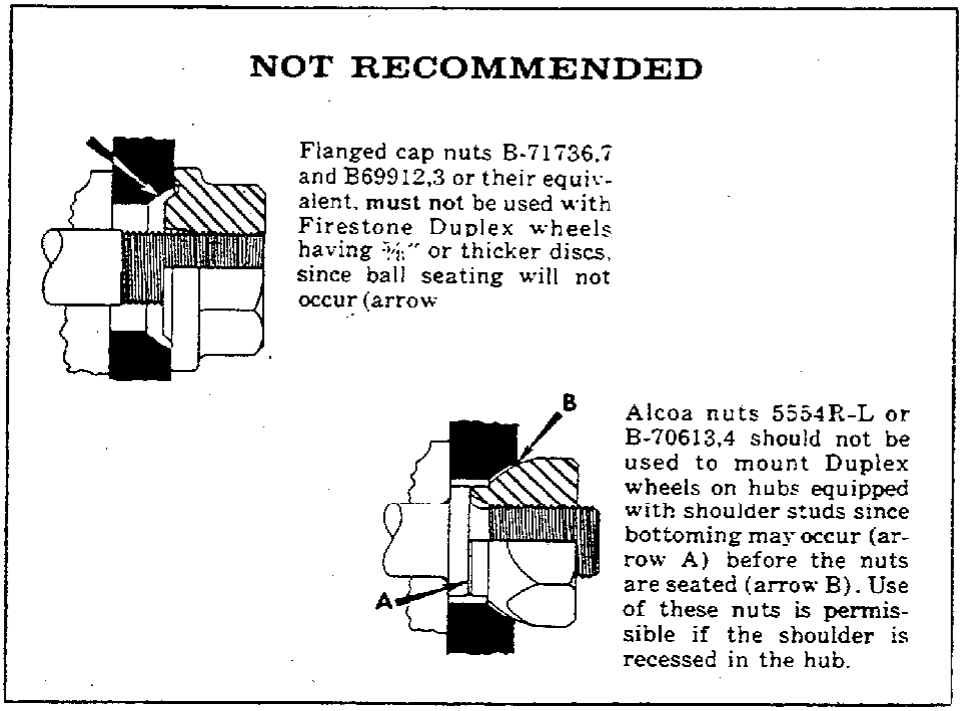


Fig. 1-20. Improperly Fitting Nuts

(2) Nuts on steel wheel studs with a thread engagement of less than 0.6 of the stud diameter.

NOTE: Because the mounting flange thickness of aluminum wheels is greater than that of most steel wheels, the last threads in the nut may not be completely engaged with the stud. The actual length of thread engagement with the assembled wheel cannot be determined by simplevisual inspection, since the distance from the ball seat of the wheel mounting flange to the first thread of the nut may vary. To determine the number of engaged threads, tighten all nuts in the regular manner then loosen one to a hand-tight position. Remove the nut from the stud, counting the number of turns required to disengage the units. For disengagement it should require at least seven full turns for a 3/4-inch nut and five full turns for a 1-1/8-inch nut.

c. Tire Tread Depth. Tread depth shall be measured, avoiding locations with tiebars, fillets or humps. Since 1968, passenger car tires have wear bars molded into the tread. Since March 1975, truck and bus tires also have thesee wear bars. When these smooth bands appear in two or more adjacent grooves, the tires have been worn to 2/32 inch or less. (FMVSS 119 requires motorcycle tires to have wear bars at 1/32 inch.)

(1) Passenger Cars and Light Trucks. All tires (except those on vehicles subject to California motor carrier safety regulations, including school buses) with a tread depth of less than 1/32 inch in two adjacent grooves at any location, as shown in Figure 1-21, are in violation of Title 13, California Administrative Code, Section 1088(a) (2).

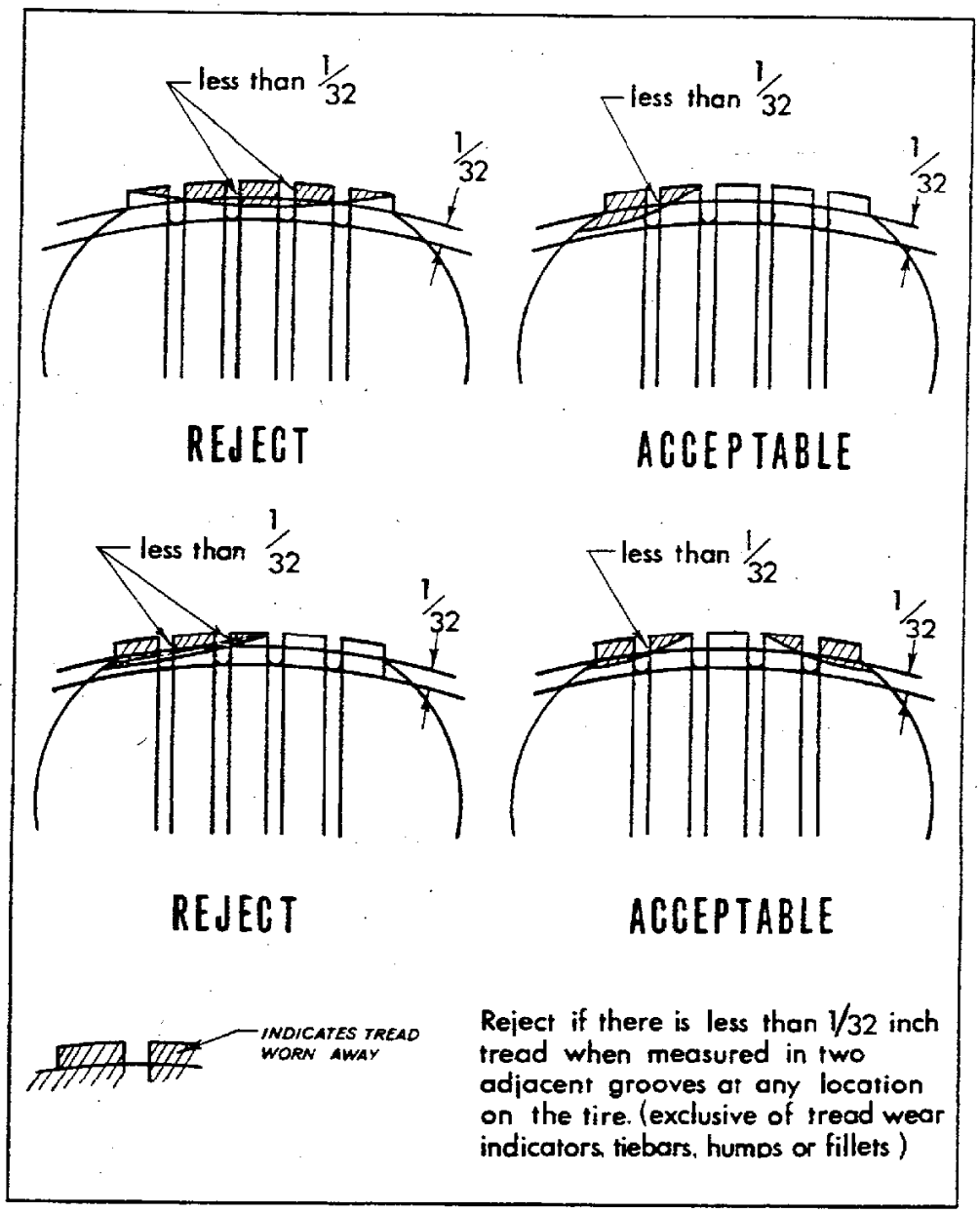


Fig. 1-21. Tread Depth Measurement for Vehicles Not Subject to Motor Carrier Regulations

(2) Motor Carrier Trucks. A tire mounted on the steering axle of a vehicle subject to motor carrier regulations is in violation under the following conditions:

(a) Tire is so worn that the tread depth is less than 2/32 inch in a major tread groove at any location on the tire (13 CAC 1088(a_)(1)).

(b) Tire has been regrooved (13 CAC 1088(c)).

(c) Retreaded tire does not display the CRSC marking or major tire manufacturer retread marking as shown in Figure 1-5 (13 CAC 1088(d)).

(3) Buses, School Buses and Farm Labor Vehicles. Any tire mounted on buses, school buses and farm labor vehicles is in violation under the following conditions:

(a) Tire is so worn. that the tread depth is less than 2/32 inch in a major tread groove at any location on the tire (13 CAC 1088(a)(1)).

(b) Retreaded tire is on the front axle (13 CAC 1088(d)).

d. Tire Condition. Tires should be inspected for the following defects and conditions of improper maintenance that may ue violations of Title 13, California Administrative Code, Section 1088(b):

(1) Use of boot or blowout patch.

(2) Unrepaired fabric break.

(3) Exposed or damaged cords.

(4) Bumps, bulges, or knots.

(5) Cuts that measure more than one inch and expose the body cord.

(6) Cracks in valve stem rubber.

(7) Treads regrooved or recut below the original tread groove depth, except on commercial vehicle tires which have extra undertread rubber for that purpose (13 CAC 1087(a)).

e. Tire Misuse. Tires should be inspected for the following conditions of-misuse in violation of 13 CAC 1086:

(1) Load per tire exceeding the maximum load rating except provided. for increased tire loads at reduced speeds as provided in paragraph 6 d of this chapter. Nonradial tube in radial tire.

(2) Tires with following markings not used as specified:.

(a) LT Tires. Tires identified with the letters "LT" after the size (such as 7.00-15LT) are designed for light trucks and may be used on any vehicle.

(b) MH Tires. Tires identified with the letters "MV' after the size (such as 8-14.5MH) shall be used only on mobile homes and other trailers.

(c) ML Tires. Tires identified with the letters "ML" after the size (such as 10.00-22ML) shall not be used on vehicles traveling more than 50 miles (80 km) in any 1-hr period, and at no time shall they be used on vehicles that exceed a speed of 80 km/h (50 mph) .

(d) NHS Tires. Tires identified with the letters "NHS" after the size (such as 7.00-15 NHS) shall not be used except on implements of husbandry. Tires identified as "NHS" may be used on cotton trailers (defined as implements of husbandry in the Vehicle Code) only when ; such trailers are operated at not more than 64 km/h (40 mph).

(e) SL Tires. Tires identified with the letters "SL" after the size (such as 9.00-16SL) shall be used only on agricultural and industrial equipment operated at not more than 32 km/h .(20 mph).

(f) ST and Other Trailer Tires. Tires identified with the letters "ST" (such as 7.00-13ST) or with the words "TRAILER" or "TRAILER SERVICE'" after the size shall not be used on motor vehicles.

(g) T Tires. Tires identified with the letter "T" after the size (such as 3.75-19T) shall be used only on motorcycles or sidecars with tapered bead rims.

(3) Tires with markings such as follows indicating they are not designed for use on the highway:

(a) "Off-Highway"

(b) "Racing Purposes Only"

(c) "Not f or Highway Use"

(d) "Farm Use Only"

(e) "Aircraft"

6. TIRE LOAD LIMITS.

a. Tire Table Basis. Tables in this chapter give load limits required by Federal Motor Vehicle Safety Standards 109, for passenger car tires and 119 for truck, bus, and trailer tires of various constructions, sizes, uses, and load ranges.The maximum load limit for the tire (not adjusted for reduced speed) is the load in pounds molded on at least one sidewall of the tire.

b. Load Range. A tire's "load range" is identified on truck, bus, and trailer tires by a capital letter (A, B, C, etc.) indicating. the range of loads a tire may carry at various cold inflation pressures. For example, a size 10.00-20 truck tire with load range designation E may carry not more than 4,290 pounds at 60 psi to 6,610 pounds at 115 psi on a single wheel. Tables in this guide show only the maximum allowable load at maximum cold inflation pressure taken from the standards of the Tire and Rim Association, the European Tire and Rim Technical Organization, and the Japanese Standards Association. The letter after the words "load range" on a tire corresponds as follows to the tire strength ply rating, which it replaces (although the actual number of plies may be fewer than shown):

Load Range	Former Ply Rating	Load Range	Former Ply Rating
A	2	G	14
B	4	H	16
C	6	J	18
D	8	L	20
E	10	M	22
F	12	N	24

c. Maximum Load Limit. The tables in Annexes B, C, and D list the maximum weight the tire may carry at its maximum cold inflation pressure, limited in some instances to certain types of service. The weights in these tables are the same as the maximum load rating required to be molded on at least one sidewall of new tires as required in the federal standards. If a tire in question is not listed in these tables, the amount shown on the sidewall is the maximum load that can legally be carried by the tire, except as provided in the following subsection d. (13 CAC 1080-1087) Information on tires not listed may be obtained from Commercial and Technical Services Section.

d. Load Limit at Reduced Speeds. Certain types of tires are allowed to carry increased loads at higher inflation pressures when operated at reduced speeds. The footnotes in the particular tables show the percentage increases in allowable load at the reduced speeds. These loads are not allowed unless the vehicle has a mechanically-restricted top speed appropriate for the load or unless it has a maximum speed sign on the rear as specified in 13 CAC 1080-1087 and is operated at a speed not exceeding that limit.

e. Wheel Load Limit. Where a vehicle manufacturer or operator uses a wheel of a lower rating than shown for the particular tire size, the load on the highway shall not exceed the wheel rating. Some wheels are labeled in accordance with SAE J179 and are marked on the outside of the rim base or the wheel disc with the maximum load at maximum inflation pressure.

Example: SAE J179

MAX LOAD 5430 LB

MAX PSI 85

7. TIRE LOAD LIMIT TABLES. Tire load limits are shown in tables in Annexes B, C, and D. If a tire manufacturer designs tires (such as steel belted radials) for load ratings that are higher than those in these tables, the loads shown in the manufacturer's tire data book are acceptable.