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CHAPTER 7
AIRCRAFT WHEELS, TIRES, AND TUBES

INTRODUCTION

Modern aircraft wheels are among the most highly stressed parts of an aircraft. High tire pressures, cyclic loading, corrosion, and physical damage contribute to failure of aircraft wheels. Complete failure of an aircraft wheel can be catastrophic. When wheel failure occurs, the fragments are often propelled several hundred feet. You must have the ability to identify potential safety hazards when you work on aircraft tires and wheel assemblies. You must practice all the safety precautions related to wheel and tire maintenance procedures. At the organizational maintenance level, aircraft wheels are removed frequently for tire changes, inspections, and lubrication. Familiarity with various types of wheels and tires, and related safety precautions, will increase your ability to perform your duties.

LEARNING OBJECTIVES

When you have completed this chapter, you will be able to do the following:

1. Recognize the components of the different types of wheels. Identify the maintenance responsibilities of both the O-level and I-level maintenance activities.
2. Recognize the procedures for dismounting, mounting, and inflating aircraft tires. Identify various tire markings. Determine preventive maintenance requirements indicated by tire tread wear.
3. Recognize the procedures for identifying aircraft tire tubes. Identify the procedures for storing aircraft tubes. Identify the procedures for the inspection of aircraft tire tubes.

AIRCRAFT WHEELS

Aircraft wheels are made from either aluminum or magnesium alloys. These materials provide a strong, lightweight wheel that requires very little maintenance.

The wheels used on naval aircraft are of two general types—divided and demountable flange. Both of these designs make wheel buildup a fairly simple operation. The wheels used with tires and tubes have knurled flanges to prevent the tire from slipping on the wheel. Wheels used with tubeless tires have the wheel sections sealed by an O-ring, and they use special valves that are a part of the wheel.

DIVIDED (SPLIT) WHEEL

*Figure 7-1* shows a typical divided (split) wheel. This type of wheel is divided into two halves. The two halves are sealed by an O-ring and held together with nuts and bolts. Each wheel half is statically balanced. This procedure allows any two opposite halves of the same size and type to be joined together to form one wheel assembly. If the outboard half of a wheel is beyond repair, a new outboard half may be drawn from...
supply. The new outboard half is then matched to the old inboard half. This type of wheel is used on nose, main, and tail landing gears.

**Figure 7-1 — Typical divided (split) wheel assembly.**

**DEMOUNTABLE FLANGE WHEEL**

The demountable flange wheel is made so one flange of the wheel can be removed to change the tire. The flange is held in place by a lockring.

The wheel is balanced with the flange mounted on the wheel. Then, both the wheel and flange are marked. To ensure proper balance of the wheel during assembly, the two marks should be lined up. *Figure 7-2* shows a typical demountable flange wheel. This type of wheel is commonly used on the main landing gear.

The similarity of one wheel to another in size and shape is not proof that the wheels can be interchanged. One wheel may be designed for heavy duty while the other may be designed to carry a lighter load. Also, the wheels may be designed for use with different types of brake assemblies.

**TYPICAL WHEEL ASSEMBLY**

A complete wheel assembly is shown in *Figure 7-3*. The wheel casting is the basic unit of the wheel assembly. It is to this part that all other components are assembled and upon which the tire is mounted.
The demountable flange is attached to the wheel to simplify tire removal and installation. The demountable flange lockring secures the flange to the wheel. The flange is fitted into a groove in the wheel casting.

The bearing cups are shrink-fitted into the hub of the wheel casting; the bearing cups are the parts on which the bearings ride. The bearings are tapered roller bearings. Each bearing is made of a cone and rollers. This type of bearing absorbs side thrust as well as radial loads and landing shocks. These bearings must be cleaned and lubricated in accordance with the NAVAIR 04-10-1 manual.

A three-piece grease retainer keeps the grease in the inboard bearing and keeps out dirt and moisture. The retainer is composed of a felt seal and inner and outer closure rings. A lockring secures the assembly inside the wheel hub.

The hubcap seals the outboard side of the hub. It is secured with a lockring. On some aircraft, the hubcap is secured with screws.

All wheels designed to be used on the main landing gear are equipped with braking components. These components are attached to the wheel casting. They may consist of either a brake drum or brake drive keys. The wheel shown in Figure 7-3 is equipped with drive keys. This wheel is designed for disc brakes.

The trend in the military is toward smaller, faster, more powerful aircraft with increased load carrying capabilities. This means heavier loads and higher landing speeds. The friction of long landing rollouts and taxiing causes heat to be absorbed by the wheel. Because of the heat, possible wheel failure may occur. This may damage equipment and injure personnel. To prevent this situation, aircraft manufacturers have developed a safety device called a “fusible plug.” The fusible plug contains an alloy that will melt and permit the tire to deflate. This action occurs in the event the wheel is exposed to excessive heat. Wheels that contain fusible plugs should have a metal tag affixed that reads "Fusible Plugs Installed."

Figure 7-2 — Demountable flange wheel.
ORGANIZATIONAL-LEVEL TIRE AND WHEEL MAINTENANCE

Corrosion and loss of bearing lubrication are two of the major causes of failure or rejection of aircraft wheels. It is extremely important that all organizational maintenance activities take precautions to protect aircraft wheels/bearings from water—particularly salt water. More often than it is lost, wheel bearing lubrication gets contaminated and/or breaks down from excessive heat and water. When wheels are exposed to a stream of water (such as a hose), the water usually penetrates the hub area, contaminating the bearing lubricant. This contributes to corrosion in the bearing area. All wheel bearings should be lubricated at every tire change, and as required by the applicable maintenance requirements cards (MRCs). All wheel and bearing assemblies should be removed according to the applicable maintenance instruction manual (MIM) for that specific aircraft.

Cleaning

Bearings, bearing cups, wheel bores, and grease retainers should be cleaned with MIL-PRF-680 (type II solvent) in accordance with NAVAIR 04-10-1, to remove all traces of the grease, preservative compounds, and contamination.
WARNING

When a wheel is to be removed from an aircraft, the nitrogen or dry air must be removed from the tire prior to removing the wheel. This should be done with the Palmer Safe-Core valve tool (P/N 968RB), which traps the valve core in the body of the Palmer Safe-Core valve tool. See Figure 7-4. This precaution must be taken because of the possibility that the bolts in split wheels might have been sheared and cause the wheel halves to separate when the axle nut is removed. A tire deflated (valve core removed) metal tag should be installed on the valve stem prior to removing the wheel from the axle. See Figure 7-5. Several people have been killed because they failed to remove the air from the tire before removing the axle nut.

Figure 7-4 — Safe-core valve tool.

Figure 7-5 — (A) Deflated tire flag, (B) Storage of valve core and cap using alternate deflated tire flag.

Bearings should be treated with fingerprint neutralism (MIL-C-15074E) by immersing and agitating for 2 to 3 minutes, then drying bearings and the hub area with compressed air. Care must be taken not to spin the unlubricated bearings. A visual inspection should be performed of the bearings, bearing retainers, and bearing cups with a 10X magnifier. All excessively worn, dented, scored, or pitted bearing cups should be replaced. Most bearing cups will display some wear. This is not cause for replacement as long as no step can be felt and there are no dents, scores, or definite corrosion pits. Some cups will have a light gum or surface corrosion deposit that can be removed by lightly polishing with abrasive webbing (A-A-58054). A coarse abrasive should not be used and the base material should not be removed. After the bearing cup is polished, it should be thoroughly cleaned, along with the wheel bore, to remove all deposits. The polished bearing cups should be reinspected for defects, and replaced when necessary.
Any obvious defects on bearing cone and roller assemblies, including cracks in the bearing retainer, are cause for replacement.

**Lubrication**

The bearings should be repacked with MIL-PRF-81322F grease by spreading a thin layer of grease on bearing cups. The rubber grease retainers should be inspected for evidence of deterioration. The felt grease retainers should be inspected for deterioration, contamination, or water saturation and replaced if necessary. Freshwater-saturated felt retainers may be dried and reused if they are otherwise serviceable. Saltwater contaminated felt seals must be replaced. Felt retainers should be presoaked with MIL-PRF-32033 oil prior to their installation. The wheel on the aircraft should be reinstalled according to the applicable MIM.

**Installation**

When reinstalling the wheel on the aircraft, the proper adjustment of the bearings is extremely important. The following general rules apply to wheel installation:

1. Tighten the axle nut while you spin the wheel with your hand.
2. When the wheel no longer spins freely, back off the axle nut one castellation (one-sixth turn). When properly installed and adjusted, the wheel will turn freely, but will not move sidewise.

   **NOTE**

   This procedure may vary from one aircraft to another. Some aircraft require a specific torque to be applied to the axle nut. In these cases, you should refer to the applicable MIM.

3. Install the appropriate axle nut safety device.
4. Install and lock the hubcap in place.

There are some inboard bearings that do not need to be removed except to be replaced. These bearings are listed in *Table 3-2 of Aircraft Wheels, NAVAIR 04-10-1*.

**Safety Training**

When performing tire and wheel maintenance, inflated and partially inflated wheel assemblies should be handled with the same respect and care as live ordnance because of the destructive potential of a gas under pressure.

If tire and wheel maintenance is performed within a command, the command should conduct appropriate training. The minimum requirements for the training program should include the following:

- Quality assurance representative (QAR)-supervised tire and wheel assembly removal and replacement
- QAR-supervised wheel bearing cleaning and lubrication
- QAR-administered examinations
- NAVAIR publications familiarization training
• Display of tire and wheel safety posters in the work centers (See Figure 7-6)
• Documentation of completed training

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**Aircraft Tires, Tubes and Wheels**

**Ask yourself these questions before working on a tire and wheel assembly.**

1. Have I read NAVAIR 04-10-506 Technical Manual for Aircraft Tires and Tubes, or NAVAIR 17-1-129, Support Equipment Tire and Wheel Assemblies, as applicable?
2. Have I read the Maintenance Instruction Manual for this particular assembly?
3. Have I read NAVAIR 17-1-123 Technical Manual for Operating and Maintaining the Tire Inflator Assembly?
4. Have I performed the pre-use inspection of the inflator-assembly kit in accordance with NAVAIR 17-600-174-6-1?
5. Do I understand the hazards of high-pressure gases?
6. Do I understand the procedures for inflating and deflating tires?
7. Am I fully qualified for the task in accordance with current directives?

**Precautions for Inflation**

- Inflate unmounted tires only in a tire cage.
- Do not inflate mounted tires until the axle nut is secured against the wheel bearings.
- High-pressure sources must be equipped with valves that limit pressure to 150 percent above maximum tire-inflation pressure or 600 psi, whichever is less.
- Do not modify hose couplings or valve-stem adapters, and do not substitute adapter-valve cores.
- Handle remote-control inflator gauges gently.
- Use only the correct remote-inflator gauge after ensuring it has been calibrated within the last 12 months in accordance with the latest calibration directives. *Note: Do not adjust relief-valve setting.*
- Clear the tire-inflation area of loose objects within a 20-ft. radius.
- Clear the area of unneeded personnel (refer to NAVAIR 17-1-123, work package 03, page 10 for danger areas).
- Never set the regulator higher than 600 psi.
- Ensure all inflation-hose couplings are connected tightly.
- Stand as far away as the inflator hose will permit (10 ft.) in a line fore or aft of the wheel.
- Open the source valve slowly. Inflated tire in 10-psi increments to desired pressure—do not over-inflate. If over-inflation occurs, open bleeder valve on inflation gauge to release pressure. Allow tire pressure to stabilize a few minutes before disconnecting hose at valve stem.
- Replace valve cap on valve stem.

*Note: Use water-pumped nitrogen to inflate tires. Dry, oil-free air should be used only when nitrogen is not available.*

**Deflation, Removal and Disassembly**

Before removing a wheel and tire assembly from an aircraft, completely deflate the tire with an approved tire-deflator tool. When deflated, remove the valve core and install a “deflated-tire flag” in accordance with NAVAIR 04-10-506. Break the tire beads before removing any wheel bolts.

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*Figure 7-6 — Aircraft tires-tubes-wheels safety poster.*
INTERMEDIATE-LEVEL WHEEL MAINTENANCE

One of the responsibilities of an intermediate maintenance activity (IMA) is to determine wheel overhaul requirements. Other IMA responsibilities include painting, cleaning, inspection (lubrication), corrosion and physical damage blendout, and wheel half mismatching.

Painting

When the wheel paint has deteriorated to the extent that touch-up is not feasible, wheels may be stripped and repainted. Stripping and repainting are allowed only if the IMA is authorized to paint with aliphatic polyurethane.

Cleaning

Thorough cleaning of aircraft wheels is essential to allow proper inspection for cracks, physical damage, corrosion, and paint touch-up as required. All built up dirt, rubber, and grease deposits must be completely removed. Cleaning for appearance’ sake is not a requirement and removal of stains is not considered necessary. For example, many wheels will display visible discoloration after all rubber deposits are removed from tire bead areas. This discoloration is acceptable and further cleaning is unnecessary. Similarly, there are often discolored areas around brake keys which are virtually impossible to remove without damaging the paint.

The following steps describe the primary wheel cleaning procedures. Further information regarding the cleaning of aircraft wheels can be found in Aircraft Wheels, NAVAIR 04-10-1.

The procedure is nonhazardous and involves the use of a high pressure, high temperature parts washer cabinet with a water-based detergent.

Clean the wheels as follows:

1. The detergent used in the parts washer shall be procured in accordance with the Qualified Product List (QPL) for MIL-PRF-29602.

   CAUTION

   When charging the washer, follow the detergent manufacturer’s recommendations with regard to safe handling procedures and safety equipment.

2. Initially charge the parts washer solution in accordance with the detergent manufacturer’s recommended concentration and pH level. The hardness of the shop water supply may require that the manufacturer’s recommended amounts be altered to reach these optimum levels. Once the washer is operational, the solution should be tested daily to make sure that the concentration and pH are at their optimum levels. This is accomplished with a titration kit or handheld pH meter. As the detergent’s performance profile is established, solution monitoring can be reduced to weekly testing.

3. The solution must be pumped out and replaced whenever it becomes excessively dirty, with special attention given to ensure that any residual
detergent attached to the inside of the tank be removed so that it does not change the concentration. Under most operating conditions, solution replacement will be required every couple of months. It is also important to follow the detergent manufacturer’s recommended maximum operating temperature to avoid immediate deterioration of the solution.

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4. Turn the main power supply on.

5. Set the temperature. At first, use trial and error to determine the proper temperature. Most wheels will be sufficiently clean at a temperature of 160-190 degrees Fahrenheit. Make sure that the washer has reached at least minimum operating temperature before starting a wash cycle.

6. Set the timer according to workload requirements. Use trial and error to find proper time duration. Start with a 10-minute wash and 2-minute rinse cycle. Most wheels will be sufficiently clean within 10 to 20 minutes.

7. Load the wheels onto the turntable of the parts washer. Secure them using stainless steel wire, bungee cord, or similar setup. Racks, fixtures, or “wheel trees” may be required to keep wheels in place during washer operation. They should be made from 300 series stainless steel, heavy gauge polypropylene, or other suitable plastic. Fixtures should not be manufactured from zinc or cadmium-plated steels; chromic acid anodized aluminum, or painted material. It is important to position wheels so they are thoroughly exposed to the spray steam. However, a minimum distance of four inches must be maintained from the spray nozzles at all times. The wheels should be positioned for maximum drainage and should be rotated as they are removed from the washer.

8. Secure the door and start the wash/rinse cycle.

9. At the completion of the cycles, visually inspect the parts. They should be free from obvious soils. If there is no change in the cleanliness of the parts, increase the parameters.

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Wheels will be very hot after processing. Handle with thermally protective and water repellent gloves. Drain any entrapped solution back into washer.

10. Visually inspect all crevices or holes for possible retained solution. Rinse these wheels with hot flowing water and drain. Air-dry wheels.

11. A freshwater spray rinse is required immediately after the wash cycle for parts proceeding to paint or fluorescent penetrant nondestructive inspection (NDI) processes. If parts are to be recleaned using approved wipe cleaning techniques...
prior to fluorescent penetrant or painting, the rinsing requirement may be waived. Rinsing can be accomplished by using the automatic rinse cycle feature available on some part washers or by using a hand-held sprayer at 20-40 psi. A high efficiency air sprayer is recommended.

12. Visually examine for corrosion immediately after cleaning and before next process.

13. After each cleaning cycle, manually inspect the inside of the washer for solid foreign objects and remove them immediately to prevent possible Foreign Object Damage (FOD).

14. If there is a distinct decrease in cleaning efficiency: (a) check for proper parameters such as time, temperature, and detergent, (b) visually inspect the spray nozzles for blockage or misdirection, (c) inspect the filters for blockage, and (d) check the solution concentration and if it is suspected that it is not correct, test and replenish the detergent in accordance with manufacturer’s recommendations for that detergent product.

15. Foaming of the solution is a function of pH, temperature, and detergent concentration. Too low temperature or too low detergent concentration promotes foaming.

16. Run the oil skimmer until grease and oil are totally removed prior to processing. This should be done while the solution is cool, during non-operational periods.

**Inspection**

A visual inspection should be performed of the wheel for cracks, loose bearing cups, corrosion, physical damage, and melted fusible plugs. See Figure 7-7. Forward all wheels with cracks or loose bearing cups to supply for overhaul. Partially melted fuse plugs should not cause a wheel to be rejected. The plug may not need to be replaced. If the eutectic core material does not extend more than one-sixteenth of an inch above the top surface of the hex head, the plug may be kept in service "as is" with no restrictions. If the eutectic core material at the threaded end is not depressed more than one-sixteenth of an inch and there is no evidence of pinholes, the plug may be kept in service with no restrictions. The eutectic material should never be filed, sanded, or removed. If the eutectic material appears to be filed, sanded, or broken, it should be assumed the serviceable limits have been exceeded and the plug rejected.

The eddy current inspection should be performed for wheels listed in *Table 3-3* of the NAVAIR 04-10-1. All tie bolts should be inspected for corrosion, elongation, bending, stripped threads, or deformed shanks. A magnetic particle inspection for cracks should also be performed according to NAVAIR 01-1A-16. Any of the listed defects is cause for
rejection of the tie bolt. Self-locking tie bolt nuts may be reused provided the nut cannot be turned onto the tie bolt by hand with the fingertight method prescribed in Structural Hardware, NAVAIR 01-1A-8. On disc wheels, brake keys or gears should be inspected for wear and looseness in accordance with NAVAIR 04-10-1. Worn brake keys and gears should be replaced or loose brake keys and gears reattached in accordance with NAVAIR 04-10-1. Corrosion or rust on brake keys and gears is common, and is not cause for rejection.

**Bearing Maintenance**

The bearing cone and roller assemblies should be removed and inspected according to the applicable MIM. The bearings, bearing cups, wheel bores, and grease retainers should be thoroughly cleaned with MIL-PRF-680 (type II solvent) to remove the grease, preservative compounds, and contamination.

**NOTE**

The organizational-level and intermediate-level procedures for cleaning and inspecting wheel bearings, retainers, cups, and cone and roller assemblies are the same.

Bearings should be repacked with MIL-PRF-81322F grease. Bearings may be repacked either with pressure equipment or by hand. See Figures 7-8 and 7-9. The pressure method is recommended because it is easier, faster, and reduces the possibility of contamination. The pressure method assures a more even distribution of grease within the bearing.
A thin layer of grease should be spread on the bearing cups and the grease retainers inspected for evidence of deterioration, contamination, or water saturation. They should be replaced if necessary. The retainers should be presoaked with MIL-PRF-32033 oil prior to installation.

The NAVAIR 01-1A-503 manual should be consulted for more detailed information on wheel bearing maintenance.

**Corrosion and Physical Damage Blendout**

Limited and isolated corrosion and physical damage should be blended. Damage such as nicks, gouges, and pock marks on wheel rims and outside ends of bearing hubs are not considered significant unless the defect is deeper than 0.020 of an inch. The defect should not be blended out unless there is active corrosion in the defect. However, all burrs must be removed. Corrosion or other defects should be blended out not to exceed a maximum of one-sixteenth of an inch. All damage must be removed within this allowance. The maximum depth of blendout for all other wheel areas is 0.010 of an inch.

The rims, bearing hub ends, and tire bead area can be blended out with a medium or fine cut half-round or round file. The damaged area should be lightly filed to remove the defects. After the defects have been removed, the areas should be polished with 320 or finer grit aluminum oxide (P-C-451). All file marks should be removed. The areas should be painted according to NAVAIR 04-10-1 and NAVAIR 01-1A-509.

**Matching Wheel Halves**

Split rim wheels are manufactured and assembled as a matched assembly. Each half will have the same serial number. If a wheel half is rejected at the IMA, the remaining half may be matched to a serviceable replacement to make a complete assembly. When combining unmatched wheel halves, each half must have the same part number. Every effort should be made to keep the manufacture dates of each half as close as possible. Each half of this wheel assembly will now have different serial numbers, which is acceptable.

**AIRCRAFT TIRES**

Proper care and maintenance of tires have always been important items in aircraft maintenance. Because of the modern fast-landing aircraft, careful tire maintenance has become increasingly important. Aircraft tires are built to withstand a great deal of punishment, but only by proper care and maintenance can they give safe and dependable service.

The dimensions used to identify wheels are not necessarily the dimensions of the wheels themselves. Instead, they refer to dimensions of the tire.
TIRE CONSTRUCTION

Figure 7-10 shows the construction details of a tube-type aircraft tire. Tubeless tires are similar to tube tires except they have a rubber inner liner that is mated to the inside surface of the tire. The rubber liner helps retain air in the tire. The beaded area of a tubeless tire is designed to form a seal with the wheel flange. Wear indicators have been built into some tires as an aid in measuring tread wear. These indicators are holes in the tread area or lands in the bottom of the tread grooves.

The cord body consists of multiple layers of nylon with individual cords arranged parallel to each other and completely encased in rubber. The cord fabric has its strength in only one direction. Each layer of coated fabric constitutes one ply of the cord body. Adjacent cord plies in the body are assembled with the cords crossing at nearly right angles to each other. This arrangement provides a strong and flexible tire that distributes impact shocks over a wide area. The functions of the cord body are to give the tire tensile strength, to resist internal pressures, and to maintain tire shape.

The tread is a layer of rubber on the outer surface of the tire. It protects the cord body from abrasion, cuts, bruises, and moisture. It is the surface that contacts the ground.

The sidewall is an outer layer of rubber adjoining the tread and extending to the beads. Like the tread, it protects the cord body from abrasion, cuts, bruises, and moisture.

The beads are multiple strands of high-tensile strength steel wire imbedded in rubber and wrapped in strips of open weave fabric. The beads hold the tire firmly on the rims and serve as an anchor for the fabric plies that are turned up around the bead wires.

The chafer strips are one or more plies of rubber-impregnated woven fabric wrapped around the outside of the beads. They provide additional rigidity to the bead and prevent the metal wheel rim from chafing the tire. Tubeless tires have an additional ply of rubber over the chafing strips to function as an air seal.
The *breakers* are one or more plies of cord or woven fabric impregnated with rubber. They are used between the tread rubber and the cord body to provide extra reinforcement to prevent bruise damage to the tire. Breakers are not part of the cord body.

**Tread Patterns**

The tread is made of rubber, compounded for toughness, durability, and wear. The tread pattern is designed in accordance with aircraft operational requirements. The circumferential ribbed tread with tread grooves is widely used today to provide good traction under varying runway conditions. Tread grooves help to improve adhesion with the ground surface and provide a mechanism to channel water away from the area between the tire and runway surface.

**Tread Construction**

The tread construction is one of the following types:

- Rubber tread. A rubber tread is constructed without nylon ply material between the tread wearing surface and casing plies.

- Fabric Reinforced Tread. A reinforced tread consists of a single fabric ply or multiple plies constructed in the material between the outer casing plies and the bottom of the tread groove (*Figure 7-11*). These plies help to strengthen and stabilize the crown area, by reducing tread distortion and increase stability for high-speed operations. This feature is identified with one of the following terms on the sidewall: Reinforced Fabric Tread; Reinforced Tread; Fabric Reinforced; or Fabric Reinforced Cut Resistant.

- Fabric Tread. A fabric tread consists of a fabric ply or plies constructed in the tread ribs above the bottom of the tread grooves. As the tire wears, the fabric ply (or plies) becomes exposed as part of the wear surface. Also referred to as a floating ply, it is identified by the term "Fabric Tread" on the sidewall.

- Other. Other tread types may be provided under specific circumstances or as required by applicable MS standards or drawings.

![Figure 7-11 — Sectional view of two aircraft tires showing different construction details.](image-url)
Ply Rating (PR)

Ply rating is a comparative term used to identify a tire’s maximum recommended load for specific types of service. It does not represent the actual number of casing plies in a tire. There is no direct relationship between the PR and actual number of nylon fabric casing plies. Most nylon cord tires have PRs greater than the actual number of fabric plies in the casing.

Tire Rebuilding/Retreading

The rebuilding of aircraft tires has been practiced for many years. A rebuilt tire is one that has a new tread section attached to a carcass or worn tire. Each rebuilt tire saves aircraft operators approximately 75 percent of the cost of a new tire. Data shows that a rebuilt tire gives service comparable to a new tire. The General Accounting Office (GAO) and the Department of Defense (DOD) policies mandate "aircraft tires will be rebuilt in all cases where economics can be realized without affecting safety of personnel and/or equipment." The Navy has established rebuilding criteria consistent with tire technology and service experience. By using this approach, functionally sound tire carcasses are returned to qualified contractors for rebuilding. In conjunction with these procedures, Navy laboratories monitor rebuilt tires to ensure the fleet receives a satisfactory product. The military rebuilt tire is as safe as, or safer than, a new tire because it is built on a service-tested tire carcass, whereas a new tire has had no service use to establish its construction reliability and performance suitability. Rebuilt tires are subjected to quality control procedures that are far more stringent than those imposed on a new tire. Unlike a new tire, each rebuilt tire receives a final nondestructive inspection with laser beam optical holographic methods. This procedure detects separations, voids, and multiple cord fractures within the carcass, which is cause for tire rejection.

TIRE TYPES, SIZES, AND DESIGNATIONS

Pneumatic aircraft tires are supplied as tubeless and tube-type tires. There are four types described below which are procured under MIL-PRF-5041. In addition, most Type VII and VIII tires supplied to the Navy must meet more stringent test requirements of various military standards and aircraft manufacturer procurement specifications. Tire sizes are illustrated and explained in Figure 7-12.
• Type III, Low Pressure. Type III—comparable to Type I—has beads of smaller diameter, larger volume, and lower pressure.

• Type VII, Extra High Pressure. Type VII is in universal service on today’s military and civilian jets and prop-jets. It has a high load capacity and narrow width.

• Type VIII, Low Profile High Pressure. Type VIII is a design created for very high takeoff speeds. It has a high load capacity and is wider than a comparable Type VII tire.

• Radial. Designed with the casing plies running radially from bead to bead, and fabric plies running circumferentially under the tread.

1. Manufacturer’s Name or Trademark
2. Type of Tread (On Some Tires)
3. Type (On Some Tires)
4. Cut Limit (Inches)
5. Manufacturer’s QTR
6. Size
7. Ply Rating
8. NSN
9. Type (Tubeless or Tube)
10. Serial Number
11. Military Standard Number

Figure 7-13 — New tire identification markings.
Standard Identification Markings

The Aviation Structural Mechanic (AM) should be familiar with the markings on the sidewall of a tire. This information is needed to complete a VIDS/MAF for a tire change. The markings engraved or embossed on a sidewall are shown in Figure 7-13.

Most of the markings are self-explanatory. Item 10 in Figure 7-13 has a maximum of ten characters. The first four positions show the date of manufacture in the form of a Julian date (last digit of the year followed by the day of the year, or 07 Jul 2005 = 5188). The

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Figure 7-14 — Retread tire identification markings.
next positions are completed by the manufacturer and are either numbers or letters. They are used to create a unique serial number for a particular tire. The cut limit is expressed in thirty-seconds of an inch and is used to evaluate the depth of cuts in the tread area. Tires are marked with a red dot on the sidewall to indicate the lightweight (balance) point of the tire.

Retread Tires Identification Markings

In the tire retreading process, additional markings are engraved or embossed on the sidewall. See Figure 7-14. First, R or TR followed by a number identifies the number of times the tire has been rebuilt. Next, the Julian date of the tire's rebuilding is added. Finally, the name of the rebuilder and plant location is added.

Vent Markings

Tube tires with inflation pressures greater than 100 psi and all tubeless tires must be suitably vented to relieve trapped air. Tube tires are vented in one of two ways. The first method uses air bleed ridges on the inside tire surface and grooves on the bead faces. The ridges and grooves channel the air trapped between the inner tube and the tire to the outside. The second method uses four or more vent holes that extend completely through each tire sidewall. They relieve both pocketed air and air that accumulates in the cord body by normal diffusion through the inner tube and tire. Tube tire vent holes are marked with an aluminum or white-colored dot.

Tubeless tires have vent holes that penetrate from the outside of the tire sidewall to the outer plies of the cord body. They relieve air that accumulates in the cord body by normal diffusion through the tubeless tire liner and the tire carcass. Vent holes in tubeless tires are marked with a bright green dot.

TIRE STORAGE

The life of a tire, whether mounted or unmounted, is directly affected by storage conditions. Tires should always be stored indoors in a dark, cool, dry room. It is necessary to protect them from light—especially sunlight. Light causes ultraviolet (UV) damage by breaking down the rubber compounds. The elements, such as wind, rain, and temperature changes, also break down the rubber compounds. Damage from the elements is visible in the form of surface cracking or weather checking. UV damage may not be visible. Tires can be protected from light by painting the storeroom windows. Tires must not be allowed to come in contact with oils, greases, solvents, or other petroleum products that cause rubber to soften or deteriorate. The storeroom should not contain fluorescent lights or sparking electrical equipment that could produce ozone.

Tires should be stored vertically in racks and according to size. See Figure 7-15. The edges of the racks must be smooth so the tire tread does not rest on a sharp edge. Tires must never be stacked in horizontal piles. The issue of tires from the storeroom should be based on age from the date of manufacture so the older tires will be used
first. This procedure helps to prevent the chance of deterioration of the older tires in stock.

TIRE INSPECTION

There are two types of inspections conducted on tires. One is conducted with the tire mounted on the wheel. The other inspection is conducted with the tire dismounted.

Mounted Inspection

During each daily or special inspection, tires must be inspected for correct pressure, tire slippage on the wheel (tube tires), cuts, wear, and general condition. Tires must also be inspected before each flight for obvious damage that may have been caused during or after the previous flight.

Maintaining the correct inflation pressure in an aircraft tire is essential to safety and to obtain its maximum service life. Military aircraft inner tubes and tubeless tire liners are made of natural rubber to satisfy extreme low-temperature performance requirements. Natural rubber is a relatively poor air retainer. This accounts for the daily inflation pressure loss and the need for frequent pressure checks. If this check discloses more than a normal loss of pressure, the valve core should be checked for leakage by putting a small amount of suitable leak detection solution (such as Leaktec) or soapy water on the end of the valve and watched for bubbles. The valve core should be replaced if it is leaking. If bubbles appear, it is an indication that the inner tube (or tire) has a leak. When the tire and wheel assembly shows repeated pressure loss exceeding 5 percent of the correct operating inflation pressure, it should be removed from the aircraft and sent to the FRC or IMA.

⚠️ WARNING ⚠️

Overinflation or underinflation can cause catastrophic failure of aircraft tire and wheel assemblies. This could result in injury or death to personnel, and damage to aircraft or other equipment. After making a pressure check, you should always replace the valve cap. Be sure that it is screwed on finger tight. The cap prevents moisture, salt, oil, and dirt from entering the valve stem and damaging the valve core. It also acts as a secondary seal if a leak develops in the valve core.
Tires that are equipped with inner tubes, and operate with less than 150 psi, and all helicopter tube tires must use tire slippage marks. The slippage mark is a red paint stripe 1 inch wide and 2 inches long. It extends equally across the tire sidewall and the wheel rim, as shown in Figure 7-16. Tires should be inspected for slippage on the rim after each flight. If the markings do not align within one-fourth of an inch, the wheel assembly should be replaced and the defective assembly forwarded to the FRC or IMA for repair. Failure to correct tire slippage may cause the valve stem to be ripped from the tube.

Tire treads should be inspected to determine the extent of wear. The maximum allowable tread wear for tires without wear depth indicators is when the tread pattern is worn to the bottom of the tread groove at any spot on the tire. The maximum allowable tread wear for tires with tread wear indicators is when the tread pattern is worn either to the bottom of the wear depth indicator or the bottom of the tread groove. These limits apply regardless of whether the wear is the result of skidding or normal use.

The tread and sidewall should be examined for cuts and embedded foreign objects. Figure 7-17 shows the method for measuring the depth of cuts, cracks, and holes. Glass, stones, metal, and other materials embedded in the tread should be removed to prevent cut growth and eventual carcass damage. A blunt awl or screwdriver may be used for this purpose. Care should be taken to avoid enlarging the hole or damaging the cord body fabric.

![Tire Slippage Mark](image)

**Figure 7-16 — Tire slippage mark.**

Aircraft should not be parked in areas where the tires may stand in spilled hydraulic fluids, lubricating oils, fuel, or organic solvents. If any of these materials is accidentally spilled on a tire, it should be immediately wiped with a clean, absorbent cloth. The tires should then be washed with soap and thoroughly rinsed with water.
Extra care should be taken when inspecting mounted helicopter tires. Because of the long intervals between tire changes, helicopter tires are subject to weather and UV damage.

1. Measure remaining tread depth

2. Measure depth of cut

3. Subtract the depth of the remaining tread from the depth of the cut. The result is the measurement to be compared with the cut limit.

4. The cut limit is located on the tire sidewall. Remove tire if cut exceeds cut limit.

![Diagram of tire measurement](image)

**Figure 7-17 — Method of measuring depth of cuts, cracks, and holes.**

**Dismounted Inspection**

Whenever a tire has been subjected to a hard landing or has hit an obstacle, it should be removed in accordance with the applicable MIM and dismounted for a complete inspection to determine if any internal damage has occurred. The tire beads should be spread, and the inside of the tire inspected with the aid of a light. If the lining has been damaged or there are other internal injuries, the tire should be removed from service. The entire bead area and the area just above the bead should be checked for evidence of rim chafing and damage. The wheel should also be checked for damage as it may damage the tire after it is mounted.

**AIRCRAFT TIRE MAINTENANCE**

Aircraft tire inspection and maintenance have become more critical through the years because of increased aircraft weight and higher landing and takeoff speeds. Carrier operations place extra demands on the tire maintenance. In many cases tire failures are attributed to material failures and/or manufacturing defects when actually improper maintenance was the underlying cause. Poor inspections, improper buildup, operation of tires in an underinflated or overinflated condition are common causes for tire failure.
Strict adherence to proper inspection procedures and maintenance instructions is mandatory. This will ensure that sound tires with minor discrepancies will not be removed prematurely, unsafe tires will be replaced before flight, and worn tires will be removed at the proper time to permit rebuilding.

During the mounting, dismounting, and inflating of tires, safety is paramount. Compressed air and nitrogen present a safety hazard if the operator is not aware of the proper operation of the inflation equipment and the characteristics of the inflation medium. It is also very important to know the wheel type and be familiar with the manufacturer's recommended procedure before attempting to dismount a tire. For specific precautions concerning a particular installation, the applicable MIM should be consulted.

**Dismounting**

In the tire shop, tires should be rechecked for complete deflation before disassembling the wheel and breaking the bead of the tire. Breaking the bead means separating the bead of the tire from the wheel flange. When a tire has been completely deflated and set aside to await the bead-breaking operation, the valve core should be removed and a deflated tire tag installed on the valve stem. The tire tags should be so constructed as not to be installable unless the valve core has been removed. Refer to Figure 7-5.

**BREAKING THE BEAD** — The use of proper equipment for breaking the bead of the tire away from the wheel flange will save materials and man-hours. Aircraft tires, inner tubes, and wheels can be damaged beyond repair by improper mounting and dismounting equipment and procedures. The applicable manufacturer's operating manual should always be consulted prior to using this equipment. The equipment shown in Figure 7-18 is recommended in NAVAIR 04-10-506. Other commercially available or locally fabricated equipment that uses either a hydraulically actuated cylinder or a mechanically actuated device may also be used, like the Regent model 8137 (Figure 7-20) provided the equipment will not damage the tires or wheels. The bead-breaking equipment shown in Figure 7-18 is available in two models. The Lee-I model is designed for use at shore-based facilities. The Lee-IX model is an explosion-proof version of the Lee-I, and is intended for shipboard use.

An example of the steps used for bead breaking using the Lee-I equipment follows:

1. Ensure the tire is completely deflated.
2. Determine the type and size of the wheel to be dismounted, and assemble the proper parts on the drive shaft.

3. Push the outer centering rollers toward the front of the machine, and roll the wheel (positioned with the lockring side facing outward for demountable flange wheels) on the outer centering rollers. You should use the up and down push buttons to raise or lower the drive shaft to the proper height for the wheel being dismounted. Push the wheel onto the drive shaft. If an open-rimmed tire assembly is being dismounted, omit step 4 and proceed to step 5.

4. Insert the locking bar and turn it about 90 degrees counterclockwise. Mount the wheel cone on the locking bar and insert the locking pin.

5. Push the air valve switch to the right. This will clamp the wheel on the drive shaft.

6. Use the UP push button to raise the center of the wheel to line up with the center of the bead-breaking disc.

7. Rotate the tire by pushing the tire rotating toggle to the right. Position the front bead-breaking disc against the outside bead of the wheel flange. You should adjust the position of the hydraulic pump assembly by loosening the position lockpin and sliding the pump to the proper position. After turning the pump release valve clockwise as far as it will go, apply hydraulic pressure against the bead by pumping the handle, as shown in Figure 7-19. Use the guide handle to properly position the disc. Push the bead back far enough to allow the removal of the lockring or loose flange.

8. Remove the lockring and loose flange. You should use the bead shoes to hold the bead back while you are removing the lockring. Release and retract the front bead-breaking disc by turning the release valve counterclockwise.

9. Repeat the bead-breaking operation against the rear surface of the tire with the rear bead-breaking assembly.
10. After the beads are broken on divided (split) wheels, remove the nuts and bolts while the wheel assembly is mounted on the machine.

Dismounting Divided (Split) Wheels — The tire bead should be broken away from the wheel and the nuts and bolts removed according to the bead-breaking procedure. If the tire has a tube, the hex nut should be removed and the valve pushed away from the seated position. This will prevent damage to the inner tube valve attachment when the tire bead is broken loose. Then, the wheel assembly should be removed from the tire. If the tire is tubeless, the wheel seal should be removed carefully from the wheel half and placed on a clean surface. Wheel seals in good condition may be reused if replacement seals are not available. If the tire has a tube, it should be removed. Inner tubes can be reused if they are in good condition and less than 5 years old.

Dismounting Demountable Flange Wheels — The tire bead should be broken away from the wheel according to the bead-breaking procedure. If the tire has a tube, the hex nut should be removed and the valve pushed away from the seated position. This will prevent damage to the inner tube valve attachment when the bead is broken. If trouble is encountered as the flange is removed while the wheel is mounted on the bead-breaking machine, the tire should be removed from the machine. The tire and wheel assembly should be laid flat with the demountable flange side up, driving the demountable flange down by tapping it with a rubber, plastic, or rawhide-faced mallet. This should enable you to remove the locking ring.

If the tire is tubeless, the wheel seal should be carefully removed and placed on a clean surface. Wheel seals in satisfactory condition may be reused if replacement seals are not available. Next, the tire and wheel assembly should be turned over and the wheel lifted out of the tire. It is important to remember to keep the wheel flange and locking ring together as a unit to avoid mismatch during remounting.

Mounting

Prior to mounting a tire on a wheel, the tire should be inspected to ensure the inside of the tire is free of foreign materials. The inner tube must be inspected for bead chafing, thinning, folding, surface checking, heat damage, fabric liner separation, valve pad separation, damaged valves, leaks, and other signs of deterioration.

Mounting Divided (Split) Wheels — All wheel halves should be matched by year and month of manufacture as closely as possible. Wheel assemblies received from overhaul that have matching overhaul dates on both rims should be maintained as matched assemblies. In the event a wheel assembly is received or made up of wheel halves having different overhaul dates, the wheel overhaul should be based upon the earlier date. All wheels should fit together easily.
When a tube tire is mounted, the tube should be dusted with talcum powder and inserted in the tire. The tire should be positioned so the balance marker on the tube is located next to the balance marker on the tire.

NOTE
The balance marker on an inner tube is a stripe of contrasting colors approximately 1/2 inch wide and 2 inches long. It is located on the valve side of the tube. The balance mark on a tire is a red dot approximately one-half inch in diameter. It is located on the sidewall near the bead.

The tube should be inflated until it is round, and then the valve-hole half of the wheel should be placed into position in the tire. The valve stem should be pushed through the hole. Finally, the other half of the wheel should be inserted and the bolt holes aligned.

NOTE
All bolts must be magnetic particle inspected to ensure they are not defective.

Install four bolts, nuts, and washers 90 degrees apart. The bolts should be started by hand, and tightened evenly until the wheel halves seat. The remaining bolts, nuts, and washers should then be installed. Next, the bolts should be tightened in a crisscross order to prevent distorting the wheel or damaging the inserts. A pneumatic-powered impact wrench may be used, provided the torque obtained does not exceed 25 percent of the specified final torque required for the wheel. A calibrated torque wrench can be used to tighten each bolt in increments of 25 percent of the specified torque value in a crisscross order until the total torque value required for each bolt in the wheel has been reached.

NOTE
When lubtork is specified on the wheel half, coat all the treads and bearing surfaces of the bolt heads with MIL-T-5544C antiseize compound. Lubtork must not be used on magnesium wheels. For magnesium wheels, you should use MIL-G-21164D lubricant. All excessive lubricant should be removed.

Before mounting tubeless tires, check the tire sidewall for the word tubeless. Tires without this marking should be treated as tube tires. When mounting tubeless tires, the valve stem (valve core removed) is installed in the wheel assembly. Removing the valve core prevents unseating of the wheel seal by the pressure built up when the tire is installed. One wheel half should be inserted in the tire and the tire positioned so the balance marker on the tire is located at the valve stem. Next, the wheel seal is installed. It is important to be sure the outer wheel half has been lubricated with a light coat of
MIL-G-4343C lubricant. The other wheel half should be inserted and the bolt holes aligned. The bolts, washers, and nuts should be installed in the same manner used for the wheel assembly containing inner tubes.

**MOUNTING DEMOUNTABLE FLANGE WHEELS** — When mounting a tube tire on a demountable flange wheel, the inner tube should be prepared and inserted in the tire in the same manner used on a split or divided wheel. The wheel is then positioned on a flat surface with the fixed flange down. The tire should be pushed on the wheel assembly as far as it will go, and the valve stem guided into the valve slot with the fingers. The demountable flange should be installed on the wheel and the locking ring secured according to the assembly instructions required by the applicable wheel manual.

When a tubeless tire is mounted on a demountable flange wheel, the valve stem (valve core removed) should be installed in the wheel assembly. Removing the valve core prevents unseating the wheel seal by the pressure built up when the tire is installed. The wheel seal should be lubricated with the same lubricant and in the same manner as previously mentioned for split or divided wheel assemblies using tubeless tires. Next, the wheel seal should be installed on the flange and the locking ring secured according to the assembly instructions required by the applicable wheel manual.

**Tire Inflating**

According to Federal Specification BB-N-411, water-pumped nitrogen should be used to inflate tires. When nitrogen is not available, dry, oil-free air may be used. Nitrogen is provided in a number of mobile carts. The NAN-4 cart is shown in Figure 7-21. Tire shops are generally equipped with a bulkhead nitrogen outlet.

All high-pressure inflation sources should be equipped with a regulator that limits the line pressure to the remote inflator assembly. The regulator should be set to provide a controlled inlet pressure to the inflator. It should not exceed the required tire inflation pressure by more than 50 percent or 600 psi, whichever is less.

![Figure 7-21 — Nitrogen servicing unit.](image-url)
The tire inflator assembly kit is an excellent maintenance device if it is used and cared for according to the NAVAIR 17-1-123 manual. See Figure 7-22. This manual includes the operation instructions, maintenance instructions, and illustrated parts breakdown for the remote inflator assembly and dual chucks stem gauge. The tire inflator assembly kit consists of a remote controller, a low- and high-pressure gauging element, and a 10-foot service hose. The remote inflator assembly should be calibrated upon initial receipt, before being placed in service, and every six months thereafter. The unit is equipped with a built-in relief valve to prevent over pressurization of a tire during inflation. The relief valve should

Figure 7-22 — Tire inflator assembly kit.

Figure 7-23 — Operator position while servicing tire.
to be set at 20 psi above the maximum pressure required. It should also be sealed with a "calibration void if seal broken" decal. The needs of each activity will be different, depending on the type of aircraft supported. For example, an organizational activity with a single type of aircraft will only need a single inflator assembly. An activity with multiple types of aircraft will need an inflator assembly preset for each type of aircraft, based on the required pressure. Intermediate activities (tire shops) should use two gauge elements; one element for use on tires in the range of 10 to 150 psi and another for a second inflator with relief pressure set at 500 psi for tires ranging from 136 to 480 psi. The inflator assembly controller relief pressure should be clearly labeled or marked. The carrying case should be labeled with the type of aircraft for which the relief valve is set. *Figure 7-23* shows the operator’s position while servicing tires installed on an aircraft.

After the buildup of a new tire at an FRC or IMA, it should be placed in a safety cage for inflation. A typical safety cage is shown in *Figure 7-24*. The method of inflation used depends on whether a tube or tubeless tire is being inflated.

To inflate tube tires, the valve core should be removed and the wheel assembly placed in the safety cage. A remote tire inflation gauge assembly should be attached to the valve stem. It is important to check that the inner tube is not being pinched between the tire bead and the wheel flange. On demountable flange wheels, the demountable flange and locking ring should seat properly. The safety cage door should be secured and the tire inflated to its maximum operating pressure. This will seat the tire beads against the rim flanges. The tire should then be deflated and the valve core installed. Then, the tire should be inflated to its maximum operation pressure and allowed to remain at this pressure for a minimum of ten minutes. At the end of this ten-minute period, there should be no detectable pressure loss.

If no pressure loss is detected, the tire pressure is reduced to 50 percent of the maximum operating pressure or 100 psi, whichever is less. The tire and wheel assembly is then removed from the safety cage, a valve cap installed, and the assembly stored in a rack, ready for issue.

If there is a significant pressure loss, the tire pressure is reduced to 50 percent of the maximum operating pressure or 100 psi, whichever is less. Then, the assembly is removed from the safety cage and the cause of the leak determined. If a slow leak is detected, the air retention test should be extended to 24 hours.

*NOTE*

Install only aircraft tire valve cores, P/N TRC24 or C4, identified by a slot in the head of the pin. See *Figure 7-25*.

*Figure 7-24* — Inflation safety cage with aircraft tire inflator/monitor attached.
If the leakage exceeds 5 percent, the tire should not be issued until remedial action is taken.

A loss of pressure less than 5 percent may be experienced during the first 24 hours after initial inflation of a new tire. This is attributed to normal tire stretch. The tire pressure should be adjusted accordingly. Tubeless tires are inflated in the same manner as tube tires except the valve core is not removed.

**Figure 7-25 — Valve core identification.**

TIRE RETREADING AND REPAIR

The Navy considers all aircraft tires to be potentially retreadable. Used aircraft tires and tubes shall not be discarded or scrapped until it has been definitely determined that they are unfit for further use. Successful operation of the tire retreading program makes it mandatory for all personnel concerned with aircraft tires to strictly adhere to the requirements of this manual.

**Serviceable Tires**

Serviceable tires are those judged suitable for continued service use by the tire shop personnel. They should be retained in service until the remaining tread at any spot is one thirty-second of an inch thick or to the limits of the tread wear indicators. Defects permitted are cut limits contained on the tire sidewall or as listed in *Aircraft Tires and Tubes*, NAVAIR 04-10-506. Cuts are permitted in the sidewall provided they do not penetrate to the cord body fabric.

**Nonserviceable Tires**

Nonserviceable tires may be nonretreadable or retreadable. Nonretreadable tires should be coded "H" (BCM-9) for condemnation and forwarded to the local supply department. The following inspection criteria must be used by the tire shop personnel to determine those tires that are nonretreadable:

- Blowouts and the mating tire, if a dual wheel assembly
- Punctures extending through the entire casing
- Tread cuts or skid damage which exposed the casing plies
- Loose, frayed, or broken cords evident on the inner tire surface
- Casing ply damage visible to the naked eye without the use of mechanical devices
- Kinked, broken, or exposed wire beads
- Tread separation and bulges exceeding 1 inch
• Tires saturated with rubber deteriorating liquids
• Tires exposed to excessive heat as evidenced by tackiness of the rubber near the wheel rim

NOTE
Exposure of tread reinforcing cords on high-speed/high-performance aircraft tires is permissible. These tires can be identified by one of the following terms embossed on the sidewall: FABRIC TREAD, REINFORCED TREAD, REINFORCED FABRIC TREAD, REINFORCED, FABRIC REINFORCED, or FABRIC REINFORCED CUT RESISTANT. Condition code these tires “F.”

All tires removed from service, which are not condemned, are potentially rebuildable and should be condition coded "F" (BCM-1) and returned to the supply department for retreading. The number of retreads a carcass may receive will be based solely on carcass integrity as determined by the inspection criteria.

TIRE PREVENTIVE MAINTENANCE

Debris on runways and in parking areas causes tire failures, and results in many tires being removed long before they reach full service life. It is important that those areas be kept clean at all times.

When an aircraft is ground handled, it should not be pivoted with one wheel locked or turned sharply at slow speeds. This not only scuffs off the tread, but also causes internal separation of the cords. The aircraft should always be moving before a turn is attempted. This allows the tire to roll instead of scrape.

Every effort should be made to prevent oil, grease, hydraulic fluid, or other harmful materials from coming in contact with the tires. When there is a chance that harmful materials may come in contact with the tires during maintenance, they should be protected by covers. To clean tires that have come in contact with oil, grease, or other harmful material, a brush or cloth saturated in a soap and water solution should be used and the tire rinsed with tap water.

Uneven Tread Wear

If a tire shows signs of uneven or excessive tread wear, the cause should be investigated and the condition remedied before the tire is ruined. Some of the common causes of uneven tread wear are underinflation, overinflation, misalignment, and incorrect balance.
UNDERINFLATION — Underinflation causes the tire to wear rapidly and unevenly at the outer edges of the tread, as shown in Figure 7-26. An underinflated tire develops higher temperatures during use than a properly inflated tire. This can result in tread separation or blowout failure.

OVERINFLATION — Overinflation reduces the tread contact area, causing the tire to wear faster in the center, as shown in Figure 7-27. Overinflation increases the possibility of damage to the cord on impact with foreign objects and arresting cables on the runway or flight deck.

MISALIGNMENT — Figure 7-28 shows rapid and uneven tire wear caused by incorrect camber or toe-in. The wheel alignment should be corrected to avoid further wear and mechanical problems.

BALANCE — Correct balance of the tire, tube, and wheel assembly is important. A heavy spot on an aircraft tire causes that spot to always hit the ground first upon landing. This results in excessive wear at the one spot and an early failure at that part of the tire. A severe case of imbalance may cause excessive vibration during takeoff and landing. This makes handling of the aircraft difficult.

Nylon Flat Spotting

If the aircraft stands in one place under a heavy static load for several days, local stretching may cause an out-of-round condition with a resultant thumping during takeoff and landing.

Dual Installations

On dual-wheel installations, tires should be matched according to the dimensions indicated in Table 7-1. Tires vary somewhat in size between manufacturers and can vary a great deal after being used. When two tires are not matched, the larger one supports most, or all, of the load. Since one tire is not designed to carry this increase in load, a failure may result.

AIRCRAFT TUBES

The purpose of the inner tube is to hold the air in the tire. Tubes are identified by the type and size of the tire in which they are to be used.
IDENTIFICATION

Tubes are designated for the tires in which they are to be used. For example, a Type I tube is designed for use in a Type I tire. The size of the tube is the size of the tire in which it is designed to fit.

Inner tubes required to operate at 100 psi or higher inflation pressures are usually reinforced with a ply of nylon cord fabric around the inside circumference. The reinforcement extends a minimum of one-half inch beyond that portion of the tube that contacts the rim.

Type III and type VII inner tubes have radial vent ridges molded on the surface, as shown in Figure 7-29. These vent ridges relieve air trapped between the casings and the inner tube during inflation.

Inner tube valves are designed to fit specific wheel rims. However, when servicing the tire, a special valve-bending configuration or extension to provide access to the valve stem may be required.

TUBE STORAGE

Tubes should be stored under the same conditions as new tires. New tubes should be stored in their original containers. Used tubes should be partially inflated (to avoid creasing), dusted with talc (to prevent sticking), and stored in the same manner as tires. Each tube should be plainly marked to identify contents, size, type, cure date, and stock number. Under no circumstances should inner tubes be hung over nails or hooks.

**Table 7-1 — Tolerances for Diameters of Paired Tires in Dual Installations**

<table>
<thead>
<tr>
<th>Tire Outside Diameter</th>
<th>Maximum Difference In Outside Diameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 18 inches</td>
<td>1/8 inch</td>
</tr>
<tr>
<td>18 to 24 inches</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>25 to 32 inches</td>
<td>5/16 inch</td>
</tr>
<tr>
<td>33 to 40 inches</td>
<td>3/8 inch</td>
</tr>
<tr>
<td>41 to 48 inches</td>
<td>7/16 inch</td>
</tr>
<tr>
<td>49 to 55 inches</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>56 to 65 inches</td>
<td>9/16 inch</td>
</tr>
<tr>
<td>More than 65 inches</td>
<td>5/8 inch</td>
</tr>
</tbody>
</table>
INSPECTION

Inner tubes should be inspected and classified as serviceable or nonserviceable. Usually, leaks due to punctures, breaks in the tire, and cuts can be detected by the eye. Small leaks may require a soapy water check. Complete submersion in water is the best way to locate small leaks. If the tube is too large to be submerged, soapy water should be spread over the entire surface and examined carefully for air bubbles. The valve stem and valve base should be swished around to break any temporary seals. The tube should be checked for bent or broken valve stems and stems with damaged threads.

Serviceable Tubes

Inner tubes should be classified as serviceable if they are found to be free of leaks and other defects when they are inflated with the minimum amount of nitrogen required to round out the tube and water checked.

Nonserviceable Tubes

Nonserviceable tubes may be repairable or nonrepairable. Nonserviceable tubes with the following defects should be classified as repairable:

- Bent, chafed, or damaged metal valve threads
- Replaceable leaking valve cores

Nonserviceable tubes with the following defects should be classified as nonrepairable:

- Any tear, cut, or puncture that completely penetrates the tube
- Fabric-reinforced tubes with blisters greater than one-half inch in diameter in the reinforced area
- Chafed or pinched areas caused by beads or tire breaks
- Valve stems pulled out of fabric-base tubes
- Deterioration or thinning due to brake heat
- Folds or creases
- Severe surface cracking
End of Chapter 7

AIRCRAFT WHEELS, TIRES, AND TUBES

Review Questions

7-1. Aircraft wheels are made from what two materials?
   A. Aluminum or magnesium alloy
   B. Carbon steel or chrome
   C. Hardened steel or magnesium alloy
   D. Magnesium alloy or carbon steel

7-2. What are the two general types of wheels used on naval aircraft?
   A. Divided and demountable flange
   B. Knurled flange and divided
   C. Solid and cast forged
   D. Split rim and remountable flange

7-3. On a demountable flange wheel, what holds the flange in place?
   A. A lockring
   B. Bolts with locking washers
   C. Axle nut
   D. Tie bolt

7-4. What part of the tire gives it tensil strength, resistance to internal pressure, and
   the ability to maintain its shape?
   A. Fabric reinforcement
   B. The cord body
   C. Undertread
   D. Wire beads

7-5. What is the most common tread pattern design used on naval aircraft tires?
   A. Multi grooved pattern
   B. Nonskid pattern
   C. Plain pattern
   D. Ribbed pattern

7-6. What term refers to a tire's maximum recommended load for a specific type of
   service?
   A. Knot rating
   B. Load limits
   C. Ply rating
   D. Size designation
7.7.  A Type III tire is used with what type of tube?

A. Radial vent type  
B. Type I  
C. Type II  
D. Type III

7-8. Radial vent ridges molded on the surface are found on what type(s) of inner tubes?

A. High pressure type  
B. Type I  
C. Type II  
D. Type III and type VII

7-9. To prevent sticking, used tubes should be dusted with what substance?

A. Air  
B. General-purpose oil  
C. Sawdust  
D. Talc