U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: AIRCRAFT TIRE MAINTENANCE AND OPERATIONAL PRACTICES

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Change:

1. PURPOSE. This advisory circular (AC) provides recommended tire care and maintenance practices needed to assure the safety of support personnel and the continued airworthiness of aircraft. Specifically, this AC provides guidance on the installation, inflation, maintenance, and removal of aircraft tires. In addition, this AC provides guidance on those operational practices necessary to maintain safe aircraft operations. This AC is not mandatory and does not constitute a regulation. It is issued for guidance purposes and to outline acceptable tire maintenance and operational practices. In lieu of following this method without deviation, operators may elect to follow an alternative method that has also been found acceptable by the Federal Aviation Administration (FAA).

2. CANCELLATION. AC 20-97A, High-Speed Tire Maintenance and Operational Practices, dated May 13, 1987, is cancelled.

3. RELATED REGULATIONS AND DOCUMENTS.

a. Title 14 of the Code of Federal Regulations (14 CFR):

(1) Part 21, subpart O, Technical Standard Order Authorizations.

(2) Part 23, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes.

(3) Part 25, Airworthiness Standards: Transport Category Airplanes.

(4) Part 27, Airworthiness Standards: Normal Category Rotorcraft.

(5) Part 29, Airworthiness Standards: Transport Category Rotorcraft.

(6) Part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration.

(7) Part 145, Repair Stations.

b. FAA ACs. Copies of the following ACs may be obtained from the U.S. Department of Transportation, Subsequent Distribution Center, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785, and may be downloaded at the following Web site: http://www.faa.gov/avr/afs/acs/ac-idx.htm.

(1) AC 65-15, Airframe and Powerplant Mechanics Airframe Handbook, "Aircraft Tires" section.

(2) AC 121.195-1, Operational Landing Distances for Wet Runways; Transport Category Airplanes.

(3) AC 145-4, Inspection, Retread, Repair, and Alterations of Aircraft Tires.

(4) AC 25-7A, Flight Test Guide for Certification of Transport Category Airplane.

c. FAA Orders and Technical Standard Orders (TSO). Copies of the following Order and TSO may be purchased from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. The TSO may be downloaded at the following Web site: http://www.faa.gov/avr/afs.

(1) FAA Order 8110.8, Engineering Flight Test Guide for Transport Category Airplanes.

(2) TSO-C62e, Tires.

d. Airworthiness Directives (AD). Copies of the following AD may be purchased from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. The AD may be downloaded at the following Web site: http://www.airweb.faa.gov.

- AD 87-08-09, Airbus Industrie, Boeing, British Aerospace, Lockheed, McDonnell Douglas; Specified Models. This AD addresses potential explosive chemical reactions in tires caused by the mixture of atmospheric oxygen and volatile gases.

e. Industry Documents. Copies of the following Society of Automotive Engineers (SAE) documents may be obtained from SAE, 400 Commonwealth Drive, Warrendale, PA, 15096-0001. The TSO may be downloaded at the following Web site: http://www.sae.org/stasdardsdev.

(1) SAE-ARP 4834, Aircraft Tire Retreading Practice - Bias and Radial.

(2) SAE-ARP 5265, Minimum Operational and Maintenance Responsibilities for Aircraft Tire Usage.

(3) SAE-AS 4833, Aircraft New Tire Standard – Bias and Radial.

f. Other. Tire manufacturer's maintenance and repair instructions.

(1) TRA, Tire and Rim Association Aircraft Year Book.

(2) ETRTO, European Tire and Rim Technical Organization Standards Manual.

(3) MIL-T-5041, Military Specification of Aircraft Tires.

(4) AIR-8505-A, French Civil and Ministry of Defense Certification Standards for Aircraft Tires.

4. BACKGROUND.

a. As a result of the introduction and installation of new radial tire designs on the U.S. civil aircraft fleet, the FAA initiated a project to update standards and advisory support material. This includes revisions to TSO-C62d, Aircraft Tires; AC 145-4, Inspection, Retread, Repair, and Alterations of Aircraft Tires; and AC 20-97A, High-Speed Tire Maintenance and Operational Practices.

b. Aircraft tires are rated at high deflections (32-35 percent) and inflated to high pressures to carry required loads with a minimum tire physical size and weight. The service interval for an aircraft tire is relatively short (taxi and takeoff, and landing and taxi) and intermittent, with substantial rest periods between service usage. Safe and reliable performance is achieved when the aircraft tire is operated in its designed environment. However, a tire's safe performance is jeopardized when it experiences either overheating or damage by foreign objects. Both conditions can be directly influenced by the operational practices of the operator and the local airport authority.

5. TIRE ENVIRONMENT—OPERATORS.

a. Tire Handling and Preparation For Service.

(1) Mounting Tubeless Tires. The operator should determine that the tire, wheel, and valve assembly are correct for the particular application, and that the wheel is clean and devoid of burrs or roughness. The operator may install a new wheel manufacturer-approved O-ring, following the wheel manufacturer's instructions for lubricants and O-ring installation. The valve (the body and the valve core seat) should be inspected and a new valve core installed. The tire and wheel manufacturer's instructions should be consulted prior to any use of mounting lubrication. Complete the tire and wheel assembly in accordance with the aircraft manufacturer's requirements and the Component Maintenance Manual (CMM) recommended by the aircraft manufacturer.

(2) Mounting Tube-Type Tires. Select a new tube of the correct size for the tire. Dust the tire interior and tube exterior with talc. Confirm that a new valve core is installed in the valve stem and partially inflate the tube to achieve a slightly rounded condition. Insert the tube into the tire with the yellow stripe on the tube aligned with the red spot on the tire. Mount the assembly on the wheel so that the valve stem is properly aligned with the wheel valve hole. Complete the tire and wheel assembly in accordance with the wheel manufacturer's CMM recommendations.

(3) Initial Inflation for Tubeless Tires. Inflate the tire assembly in a safety cage using dry nitrogen to ensure, that the tire does not contain more than 5 percent oxygen by volume (Those aircraft required to comply with AD 87-08-09 shall inflate the tire wheel assembly in accordance with the procedure specified in that AD). The nitrogen source regulator should be pre-set to a value that is no more than the maximum load capacity of the tire. The tire growth will produce a drop in inflation pressure after initial inflation. Pressure stabilization normally occurs within 12 hours. After an initial 12-hour minimum stabilization period at the rated inflation pressure, the tire should maintain the inflation pressure within 5 percent of the initial pressure for a period of 24 hours. The leak source should be discovered and corrected if pressure losses exceed 5 percent. Operators should use this procedure when applicable or comply with the aircraft manufacture's maintenance manuals, or CMM, as applicable to the aircraft and the assembly. Although AD 87-08-09 applies to a specific aircraft, the procedures set forth in the AD are acceptable procedures that should be used for similar tire assemblies.

NOTE: Section 25.733 requires aircraft with a certificated takeoff weight of more than 75,000 pounds to meet an inflation pressure check. The tire is only one of many components in the pressure retention system. All components should be checked if a leak is suspected.

(a) Leaking Tire Assembly. Repeat the inflation pressure check if no leak site is found. If the assembly still exceeds the 5 percent pressure loss limit, de-mount the tire using the instructions in the CMM and in paragraph 5b(7)(c)(2), De-mounting Tires from Wheels. Tag the tire and return the tire to the supplier in accordance with the instruction provided in the CMM and in paragraph 5b(7)(c)(3), Early Removal Documentation.

(b) Sidewall Vent Hole Bubbling. It is normal for the sidewall vent holes of tubeless tires to exhibit some bubbling of leak-check fluid following the initial inflation. Conclusions regarding a leaking assembly should not be based on sidewall vent hole bubbling.

(c) Temperature Effects. Leak test results can be influenced by changes in ambient temperature. An ambient temperature change that creates a ± 5º F change in the inflated assembly undergoing leak testing will alter gauge pressure by 1 percent. Therefore, the ambient temperature should be measured at the start and finish of the leak test to ensure that any pressure change was not caused by an ambient temperature change.

(4) Initial Inflation for Tube-Type Tires. Inflate the assembly to rated pressure in a safety cage and then deflate the tire in accordance with the CMM and paragraph 5b(7)(c)(2) instructions to optimize tube stretch. Re-inflate the tire to rated pressure in a safety cage. After an initial 12-hour minimum stabilization period at rated inflation pressure, the tire should maintain the inflation pressure within 5 percent of the initial pressure for a period of 24 hours. The leak source should be discovered and corrected if pressure losses exceed 5 percent.

(a) Air trapped between the tire and tube that is not released in the inflation process can affect the gauge pressure. The subsequent natural venting of this trapped air can create misleading results in the pressure loss test.

(b) The ambient temperature should be measured at the pressure test start and finish to assure that any pressure change was not caused by an ambient temperature change.

(5) Tire Manufacturer's Handling Criteria. The operator should comply with tire inspection recommendations specified in the tire manufacturer's CMM, and consult the tire inspection advice set forth in this document.

b. In-Service Maintenance of Tire-Wheel Assembly.

(1) Inflation Pressure Control. Tire pressure should be checked **DAILY** using a calibrated gauge whose scale is suited to the pressure range that is being monitored. The pressure gauge measurement accuracy should be within ± 2 percent for the entire tire operating pressure range.

NOTE: Accurately maintaining the correct inflation pressure is the single-most effective task in the preventive maintenance regimen for safe tire operations!

(2) In-Service Inflation Control. Pressure checks are most meaningful on "cold" assemblies. "Cold" assemblies are those that are at ambient temperature, or that have been at rest for at least 2 hours since their last service. When possible, daily pressure checks should be done on "cold" assemblies.

(3) Service Pressure. Service pressure is the inflation pressure needed to support the maximum operating load for a wheel position. Service pressure is measured with the assembly under load. When pressure testing a loaded assembly, inflate and maintain mounted tires with nitrogen. The gauge pressure should indicate a range between 100 percent and 105 percent of the specified service pressure, provided that the rated pressure of the tire and the wheel's TSO qualification pressure is not exceeded.

(4) Reinflation.

(a) Any assembly found to be between 90 percent and 100 percent of the loaded service pressure should be reinflated to the specified service pressure.

(b) Any assembly discovered to have been operating at less than 90 percent of the minimum loaded service pressure should be removed from service.

(c) Any assembly that was operated at less than 80 percent of the minimum loaded service pressure and its axle-mate should be removed from service.

(d) If the user does not scrap tires on site, tires removed from service should be returned to a full service repair facility with a description of the reason for removal as described in paragraph 5b(7)(c)(3).

(5) Tire Operating Environment. Since aircraft tires operate at high loads and inflation pressures, they can be easily damaged when rolled over hard objects that protrude above a paved surface. Tire damage created by these objects can vary from a superficial mark to a serious injury. Penetration into the casing can result in tread loss during operations. Total penetration will result in loss of inflation integrity and over-deflection of the tire. Tires should be inspected after each duty cycle. When this is impractical, tires should be inspected as soon as possible, such as at the next crew change. At a minimum, tires should be inspected daily.

NOTE: Foreign object damage (FOD) is the most common cause of premature tire removals. The operator should clean all loading areas using the following schedule:

Recommended Housekeeping at Loading Areas (areas beneath and adjacent to aircraft)
1) Perform daily walk-around inspection and pickup.
2) Mechanically sweep the entire area every 3 days.

(6) Operational Practices (Operator Flight and Ground Crews). While on the ground, flightcrews and ground handling crews can have a substantial influence on the safe performance of aircraft tires.

(a) Turns.

(1) Aircraft are capable of being maneuvered through tight turns that place high lateral loads on tires. When subjected to such conditions, the tire can experience external damage to the tread or sidewall, internal damage to the casing structure, or bead unseating with consequent pressure loss.

(2) Ground maneuvers should be made at the largest feasible turn radius when possible. For nose landing gear tires, the aircraft should begin rolling with the tires aligned in a straight-ahead position before the turn maneuver is initiated. The minimum turn radius should still allow the tire closest to the center of the turn to continue rolling.

(b) Temperature. Aircraft tires generate internal heat during normal operations. Under high aircraft loads (particularly under sideloading conditions), heat build-up is accelerated by excessive taxi speed and/or excessive taxi distances. Tire integrity and reliability may be compromised when a combination of these conditions occurs.

(7) In-Service Inspections (Operator).

(a) Tread Damage Removal Recommendations. Tires that exhibit any of the following characteristics symptomatic of damage should be removed from service:

(1) Cracking and/or cutting in a tread groove that is undercutting material adjacent to the crack or cutting that has lifted or can be lifted.

NOTE: Do not probe cuts or embedded FOD when the tire is inflated.

(2) Undercutting in a tread rib.

(3) Transverse cracking in the tread that is visible at the surface and shows progression along an angular path down into the rubber.

(b) General Tire Removal Recommendations. Tires with any of the following conditions should be removed from service:

(1) Sidewall cuts that penetrate the outermost structural ply.

(2) Internal separations characterized by bulges or distortions in the tread casing or sidewalls.

(3) Heat or slippage evidenced by reverted or charred rubber above the wheel flange.

(4) Tires worn or flat-spotted to the outermost casing ply (bias) or outermost belt (radial).

(c) Removal Recommendations for Atypical Service Events. Tires that have been subjected to unusual service events, such as high energy rejected takeoffs or high energy overspeed landings (where thermal fuse plugs have released), should be removed and scrapped. Those tires that remain inflated should be removed and returned to a full service tire supplier with a description of the reason for removal, as described in paragraphs 5b(7)(c)(1) and 5b(7)(c)(3).

(1) Post-Removal Tire Inspection. Tires removed from service before tread wearout should have the damaged areas marked prior to deflation. Assemblies removed early for pressure loss should be tested before the tire is de-mounted. Each low pressure assembly should be reinflated in a safety cage to a pressure not to exceed 50 percent of the service pressure and the cause of the pressure loss determined.

(2) De-mounting Tires from Wheels. Tires should be completely deflated before removal from the rim. Deflate the tire by removing the valve cap and valve core, pointing the venting pressure in a direction that will cause no harm if ice forms in the gas stream.

(3) Early Removal Documentation. Tires removed for other than normal wear should have the reason for removal specified and included in the documentation accompanying each tire when it is returned to its supplier. Further, these tires should bear some previously agreed upon markings to assist in its final disposition.

(4) Tire Manufacturer's Inspection Criteria. The operator should comply with tire inspection requirements specified in the tire manufacturer's maintenance manual, and consult the tire inspection advice set forth in this document.

6. TIRE ENVIRONMENT/AIRPORT SURFACES. Aircraft tires can be easily damaged when rolled over hard objects that protrude above a paved surface since they operate at high loads and inflation pressures. Tire damage created by these objects can vary from a superficial mark to a serious defect. Penetration into the casing could result in tread loss during operations. Total penetration will result in loss of inflation integrity and over-deflection of the tire.

NOTE: FOD is the most common cause of premature tire removals. The airport authority should clean all areas of responsibility using the following schedule:

Recommended Housekeeping of Taxiways, Runways, and Ramp Areas (when no construction is taking place)*
1) Perform daily inspection and pickup.
2) Perform mechanical sweeps every 7 days.

* During periods of construction, affected areas should receive continuous monitoring and should be mechanically swept daily.

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Director, Flight Standards Service

APPENDIX 1. GLOSSARY OF TIRE TERMS

The following is a list of common tire terms. Glossaries of other tire terms appear in AC 145-4 and in TSO-C62.

Bead	Zones that are in contact with the rim areas of the wheel, or the coils of steel wire that provide anchors for the plies.
Bias Tire	A pneumatic tire in which the ply cords extend to the beads and are laid at alternate angles substantially less than 90 degrees to the centerline of the tread.
Casing	The structural part of a tire.
Deflection	The ratio (in percent) of the deflected distance between the rim and tread to the undeflected distance.
Flatspotting	A localized accelerated wear condition associated with landings; or A temporary or permanent “out-of-round” condition resulting from a loaded hot tire having not rotated while cooling to the ambient temperature. This condition is most prevalent on bias nylon tires due to the “plastic memory” of the nylon cords.
Foreign Object Damage (FOD)	Material that, if left on the runway, taxiway or ramp, that could cause damage to tires, engines, or other aircraft structures; or Damage resulting from contact with foreign objects.
Innerliner	The integral rubber lining of a tubeless tire that is engineered to prevent the diffusion of the inflation gas into the casing.
Innertube	A gas-tight rubber device placed inside a tube-type tire casing for the purpose of containing the inflation gas. It is provided with an integral valve assembly.
Radial Tire	A pneumatic tire in which the ply cords extend to the beads and are laid substantially at 90 degrees to the centerline of the tire. Additional stabilization is provided by essentially inextensible belting in the tread area.

APPENDIX 1. GLOSSARY OF TIRE TERMS (continued)

Safety Cage	A reinforced structure that has been specifically designed to protect service personnel from the effects of any explosive event that may occur during the pressurization of a tire/wheel assembly.
Separation	Failure of adhesion between components or tearing within a single tire component.
Service Pressure	The inflation pressure needed to support the maximum operating load for a wheel position. Service pressure is measured with the assembly under load.
Sidewall Vents	Specific perforations in the lower sidewalls of tubeless tires, usually located above the rim centering rib, and defined by paint marks. These perforations release detrimental internal casing pressure.
Sidewall	The rubber side area of the tire located between the shoulder and the beads that covers the underlying structure and protects the carcass from damage.
Tire (Pneumatic)	A complex engineered structure made of rubber and cord (of textiles or steel) that provide a resilient protective enclosure for the inflating gas.
Tire Pressure Indicating System (Installed on an Aircraft)	A system installed on an aircraft used for tire pressure checks.
Transverse Crack	A crack at an angle that is not parallel to the principle direction of the outer ply, breaker, or belt.
Tread	The expendable rubber-wearing surface of any pneumatic tire. It contains the groove pattern designed to facilitate water removal from the contact patch, and may, or may not, possess integral fabric materials.
Tube	A gas-tight rubber device placed inside tube-type tire casings for the purpose of containing the inflation gas. It is provided with an integral valve assembly.
Tube-Type Tires	Tires requiring tubes for inflation retention.
Tubeless Tires	Tires not requiring tubes. These tires are constructed with an innerliner.
Undercutting	A rubber fracture that progresses from the tread surface, or in a groove, in a direction parallel to the ply structure.