AEROSPACE INFORMATION REPORT

AIR5487™ REV. B

Issued 2002-06
Revised 2011-04
Reaffirmed 2022-02

Superseding AIR5487A

(R) Aircraft Tire History

RATIONALE

AIR5487B has been reaffirmed to comply with the SAE five-year review policy.

INTRODUCTION

The need for pneumatic tires has existed almost since the dawn of powered flight. Although the ability to operate from skids, skis and floats had been seen as methods of coping with unique situations, universal mobility demanded wheels with some sort of pneumatic tire for optimization. Information concerning aircraft tires, as an historical subject, has always existed in disconnected sources. It is hoped that, by collating from these sources and presenting them in the format of an AIR, we will have provided a more ready reference for those interested in this subject.

Background: This panel was formed within A-5C to utilize the archives of existing tire producers and users so as to provide as large an archival base as possible, while such documentation still exists.

Approach: The panel activity has concentrated on searches for relevant tables, drawings and photos that will augment the historical narrative.

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1. SCOPE

This SAE Aerospace Information Report (AIR), is intended to provide a continuum on historical development of aircraft tires.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

TSO-C62 Technical Standard Order – Tires

AC 145-4A Inspection, Retread, Repair, and Alterations of Aircraft Tires

2.2 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3324-1 Aircraft Tyres and Rims – Part 1: Specifications

2.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-9495, https://assist.daps.dla.mil/quicksearch/.

MIL-PRF-5041 Performance Specification, Tires, Ribbed Tread, Pneumatic, Aircraft

MIL-PRF-7726 Performance Specification, Retread Tires, Ribbed Tread, Pneumatic Aircraft

2.4 Other Publications

The Tire and Rim Association (TRA) Aircraft Tire Year Book & Other Publications

The European Tyre and Rim Technical Organisation (ETRTO) Standards Manual

"The Aircraft Tire", William R Woodall, 1/5/99

"Restoring Museum Aircraft", Robert C. Mikesh

"The Story of Tire Beads and Tires (National-Standard Company", Walter E. Burton (1955)

http://ap.bridgestone.co.jp

http://www.dunlopaircrafttyres.com

http://www.goodyearaviation.com

http://www.airmichelin.com

Also, certain artifacts residing in museums have been used for authentication.

3. HISTORICAL PERSPECTIVE

The aircraft tire was, and is, utilized as an efficient interface between the wheel rim and the supporting surface, an interface that provided flotation, traction, shock absorption, and torque transmission with a minimum of maintenance. Since the application of tires to aeronautical machines was preceded by their usage on various surface vehicles, the early airplane tire usually reflected what was “state of the art” for earthbound tires. As the product has matured, aircraft tires have occasionally led in this process. Due to the intermittent nature of their duty cycles, aircraft tires have acquired much higher load ratings and are operated at higher deflections than would be permitted for comparably sized surface vehicle tires, which require uninterrupted service.

4. TIRE TO RIM INTERFACES

The design of the surfaces where the tire and rim contact each other has always been of significant importance. The need to provide for reliable cooperation during service is obvious. These unions have produced some unique configurations. The aircraft tire and rim interface has been standardized by the Tire & Rim Association (TRA) and the European Tire & Rim Technical Organization (ETRTO). Further information on the TRA is supplied in Section 10.

4.1 Clincher Beaded Tires

This term describes the manner whereby the tire is attached to the rim. These tires have internal grooves molded into their lower sidewalls. The grooves match the “hook” shaped terminus of the inwardly curling rim flanges. The tire “bead” has no reinforcing steel wire. It relies on a core of hard rubber and fabric for anchoring purposes. The rim itself provides the primary resistance to the outward forces of inflation. These tires are subject to accidental dismounts from side loads, with the resultant blow out of the innertube. “Clinchers” began service with the earliest of airplanes and continued in use well into the 1920’s. See Figure 1.

4.2 Straight Sided Tires

Tires so designated have one or more coils of rubber coated wire in each bead region. The beads also have interior conical faces designed to match similar conical regions of their specially designed rims. These rims are provided with vertical flanges, thereby entrapping the tire. Since the clincher and straight side equipment are not interchangeable, they were initially marked with the appropriate designation. See Figure 2.

4.3 Single Tube Tires

An early concept that avoided the use of a separate innertube was the “single tube”. A complete innertube was built into the interior of these tires. Inflation caused the fabric carcass to expand in all directions. The downward force, reacting against the rim base, made beads unnecessary. Where concerns about torque (with the possibility of shearing the valve) existed, raised patterns were molded on the base of the tire where it would be in contact with the rim. Rims were manufactured with matching recesses. Single tube tires saw some application as low-pressure, tail wheel tires into the 1930’s.

4.4 Bead Seat Angles

Rim bead seat angles for straight sided tires have usually been about 5 degrees, although some have utilized an angle of 15 degrees. The tire bead has been engineered to appropriately seat on its rim. Changes in tire constructions such as from tube type to tubeless, or bias to radial, may have changed the amount of bead seat interference that was required.

4.5 Rim Flange Heights

Flange diameters have usually been symmetrical and varied in height with the ply rating of the tire. Recently, however, many have been produced that are asymmetrical. The resulting height differences assist in meeting certain unusual wheel qualification and service requirements such as “roll-on-rim” requirements.