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AEROSPACE INFORMATION REPORT

SAE AIR5487

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Aircraft Tire History

1. SCOPE:

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

2. 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.

2.1 Background:

This panel was formed within A5-C to utilize the archives of extant tire producers and users so as to provide as large an archival base as possible, while such documentation still exists.

2.2 Approach:

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

2.3 Applicable Documents:

The Tire and Rim Association Yearbooks; military specifications; ETRTO yearbooks; various user manuals produced by tire manufacturers; the book “TIRE BEADS AND TIRES “ [published by National Standard Co.]. 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 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 signal importance. The need to provide for reliable cooperation during service is obvious. These unions have produced some unique configurations.

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 termini 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.

5. TIRE CONSTRUCTIONS:

Beginning with the invention of the pneumatic bicycle tire, it has been a continuing practice to limit the growth of the elastic properties of rubber by imbedding textiles in the matrix. There have been several significant and distinct departures from past practices as the product has matured.

5.1 Tires Reinforced by Woven Fabric:

The earliest of tires were made of rubber-coated woven cloth, and whether of the clincher, or straight sided variety, suffered from an inherent weakness that was basic. Because the weft and warp cords were in intimate contact with one another, the distortions associated with rolling under load, produced a destructive shearing action. This resulted in carcass failures. Almost all early airplane tires shared this problem with the ground vehicle user.

5.2 Bias Tires:

This construction largely overcomes the problems associated with the woven tire. Here, discrete layers of rubber-coated cords are laid up as plies, which are positioned at alternate angles to the tire's circumferential center-line. This practice began in the aircraft tire arena prior to 1914, and eventually spread into all other areas of tire usage. When adapted to the straight side tire it provided an avenue for reducing costs and improving uniformity. By incorporating ever stronger cord materials, - cotton - rayon - nylon - (as well as others), bias tires have become the longest-lived "species" to date.

5.3 Radial Tires:

The radial tire competes with the bias tire by providing a more efficient, cooler-operating carcass with a longer wearing tread surface. With its fewer body cords (displaced at approximately 90 degrees to the circumferential centerline), and its relatively inextensible belting (disposed more nearly parallel to the circumferential centerline), a radial tire, with its reduced hysteresis, is more tolerant of overloading conditions. In order to compensate for the reduction in vertical spring rate, radial tires are designed to match the static loaded radius of a bias tire of the same load rating. The result is that the inflated, un-loaded dimensions of a radial tire are larger than are those of a bias tire. The “thrown and grown” dimensions of radials (due to their increased resistance to centrifugal growth) fall well within the envelope provided for the matching bias tire.

6. TIRE PROFILES:

Tires have been produced in a variety of contours. Each was expected to improve the performance of the aircraft to which it was attached. Efforts to reduce parasitic drag were clearly evident in the period when the landing gear was not retracted.

6.1 Tire Shapes:

When aircraft tires began to address areas where system performance could be affected, they soon lost their original circular cross-sections. Although these will be treated in detail in Section 12, it might be noted that exterior contours have been offered that ran the gamut from narrow, elevated centers, to concavity.

7. TIRE USAGE IDENTIFIED BY APPLICATION:

As the tail wheel replaced the tail-skid, tires began to be catalogued as “main wheel” and “tail wheel” types. These represented one of the earliest attempts at design specialization. Coincidentally, main wheel designs became capable of transferring brake torque to the supporting surface, as that requirement emerged.

8. STRENGTH RATINGS AND LOAD CAPACITY RATINGS:

From the days of the base-line cotton reinforcement, tires have carried a message either listing the actual number of structural layers (plies), or a number related to what would have been necessary had the earlier material continued in use. This system relates to the load carrying capacity of the tire.

From early in their conception, it has been thought that a safety factor of about “four” (bursting strength/inflation pressure), should be required for aircraft tires, seemingly, this requirement has worked well.

9. SIZE MARKINGS:

Aircraft tire producers have left a unique history regarding the way tires have been size marked. The earliest system reflected the then current, surface-vehicle practice and involved specifying the outside diameter, and the width of the cross-section. These dimensions were expressed in inch or metric units. From that time, many alternative systems have been used.

10. THE TIRE AND RIM ASSOCIATION:

This voluntary organization was formed in 1903 to provide a forum, and the procedures for assurance that tire, rim, and valve manufacturers would produce designs that provided utility and interchangeability of product. This arrangement continues to benefit the participants, as well as the users of these symbiotic systems.

11. TIRES DEFINED BY PRESSURE:

By 1939, The Tire and Rim Association was classifying some aircraft tires as “high pressure tires” such as the 32X8 which used 85 psi. By 1943, there was now a category known as “low pressure tires”. The 17.00-16 represented not only an example of this “naming”, but also exemplified the different method of “sizing”, which referred to the section width and the rim diameter (see Figures 5 and 6).

12. TIRES DEFINED BY “TYPE”:

One unique program was once used to describe tires. The word “Type” followed by a marking in Roman numerals was molded on the sidewalls of most tires. It attempted to categorize tires by either usage or design philosophy. This military system began with “Type I” and eventually ended with “Type VIII”. After its adoption, it dominated the commercial arena as well.

12.1 Tires Marked With “Type” Designations:

In 1945 a change was made in the way that tires would be classified. They would be sorted by “Type Markings”.

TYPE I collected the S.C. (smooth contour) tires. These tires displayed only their outside diameter as a size. (e.g., 56 inch). Their widest dimension would be at the rim flange. The aspect ratios were in the low 70% range, and the pressures were as high as 95 psi, the deflection was 37% (used on B-17 and B-24).

TYPE II tires replaced the former “high pressure tires” such as the 30X7. The numbers referred nominally to the outside diameter and the section width. The aspect ratio was about 85%, inflation pressures were less than 90 psi, and the deflections about 27.5% (used on SBD Dauntless).

TYPE III replaced the “low pressure” category. The 17.00-16 was a representative size. The section widths and rim diameters were called out in the sizing. The aspect ratio was about 84%; pressures ranged up to 75 psi; and the deflection was about 25% (used on the Douglas DC-3 [C-47/R4D]).

12.1 (Continued):

TYPE IV collected the extra low pressure tail wheel tires which, in some cases had been called "airwheels". An example would be the 12X5-3. The diameter was 12 inches, the section was 5 inches and the rim diameter was 3 inches; the aspect ratio was 90%; the deflection was 35%; and the inflation as 30 psi or less.

TYPE V catalogued what had been formerly called "Streamline" tires. These tires were identified by single dimension numbers such as 15.50 and 18.00. The aspect ratios were about 70%, and the deflection was 40% for mains, and 35% for tail wheels. The inflation pressure was less than 45 psi.

TYPE VI, formerly called "low profile tires", pioneered the nose wheel usage on such airplanes as the P-80, which used the 22X7.25-11.50. Here, the diameter; section width; and rim diameter were listed. Some tires were devoid of tread patterns. Aspect ratio was 72%; the deflection was 25% and the inflation pressure was around 55 psi.

TYPE VII became the extra high pressure tires such as the 32X8.8, distinguishing themselves from the TYPE II by the decimal point and extra number in the section marking. The aspect ratio was 84%; the deflection was 32%; and the inflation pressure was 100 psi.

TYPE VIII was the last category to be identified as a type. They used the three part sizing of diameter, section width, and rim diameter as their identifier. The 41X15-18 would be representative; the aspect ratio at 77%. (As the TYPE system lost relevance, the term "NEW DESIGN" came into usage.)

12.1.1 Channel Tread: In addition to the "TYPES", CHANNEL TREAD tires were listed as distinct variations (see Figure 13). They were intended to reduce the shimmy tendencies of the landing gear by concentrating load paths on the shoulder ribs. They were made in the same sizes as the TYPE I, TYPE II, the TYPE VII. The inflation pressure was lower than in the standard application. As a footnote to the "Type" situation, it is interesting to find that many years after the relevancy of such markings, several are still perpetuated. This is in part, due to the tremendous inertia that exists within the certification system. In order to re-license an aircraft, it may be necessary that all of the equipment retain the markings that were in place when the original type certificate was issued (although the meaning of the marking may have ceased to be known). As a result, several Type VII, Type III, and even a few Type I's soldier on.

12.1.2 Additional Sub-Types: As specialization has necessarily increased, so have specialized tire categories. There was once a "Beaching Gear" genre that, when temporarily fitted, allowed "flying boat" aircraft to be winched ashore (see Figure 12). "Chine" tires provided water dispersion for nose tires on aircraft with aft-mounted jet engines. Some military tires were designated "Ice Grip" and contained coil springs below the surface of their treads or shredded wire within the tread. (More successful as a concept, than as a practical item.) Tires, not designed in the U.S. were grouped by country of origin. "C" and "B" and "H" type tires represented different rim to section ratios and the first named two, utilized 15 degree bead tapers.

12.1.2 (Continued):

Due to the load transfers that occasion brake applications, it has been accepted that nose wheel tires may be briefly loaded up to 50% more than the static rating that would have been assigned for main wheel application.

13. MULTIPLE WHEEL LAYOUTS:

Even though some early airplanes were equipped with more than one tire per side, the philosophy to meet the demands of larger aircraft and higher loads was with ever larger single tires. Some of the applications reached levels where it was obvious that the loss of a tire would be catastrophic for the aircraft. The XB-36 and the XC-99 flew with single 110” Type 1 tires per side. Curiously, the major thrust behind the bogie systems that replaced them, came from runway bearing strength considerations, rather than other concerns (additional comments in Section 20).

14. TUBELESS TIRES:

Although the tubeless concept was well established in all other areas of tire usage, the concept was slow to move into the aircraft tire arena. This was due to multiple piece wheels, and the need for reliable sealing. (It would also be necessary to re-certify each wheel design). With the advent of the jet propelled aircraft, and the loss of aerodynamic braking from propellers, the amount of energy transferred through the brakes could produce dangerous heat levels that could cause tire explosions. The tubeless tire, with its internally exposed rim base, provided egress for unacceptable heat or pressure through the use of relief plugs.

15. HELICOPTER TIRES:

When tires were initially approved for helicopter operations, it was recognized that their use was more for parking, and landing. With these constraints, the tires were sized to restrict drag and weight. Elevated inflation pressures were provided that would assist in restricting tire deflections and ground resonance interactions.

Should these considerations no longer reflect actual duty cycles, especially where taxiing is concerned, many tires will have been inadequately sized for this change in mission.

16. TESTING:

In addition to the proofs of strength from static burst tests, it became beneficial to perform some dynamic testing. The variable mass dynamometer became a standard for the industry. Here, a system of plates of known mass could be bolted to the flywheel. With the flywheel revolving at a pre-determined speed, the tire would, at rated load, be landed against the wheel, and allowed to coast until it had absorbed a specific amount of energy. Two different speed ranges were usually involved. These tests were capable of determining carcass weaknesses for tires required for propeller airplanes, but with the advent of jet powered airplanes, and their need for higher speed take-offs, a better simulation was necessary. This led to the programmable variable speed dynamometer. Here, a duplication of the aircraft's reaction to its tires, involving load and speed as functions of time, could be performed. It became a practice to require 50 such exercises. Additionally, 3 taxi rolls of 35,000 feet at 35 mph were added, and 100 landings continued to be part of the qualification test.

Eventually, the landing cycles were eliminated, and were replaced by 8 normal, and 2, overload taxi cycles. One overload take-off cycle was also added. Some dynamometers were equipped with the added capability of cambered and yawed roll; some, were configured to provide cable bruise capability. These were to comply with the unique qualification requirements needed by certain military customers.

17. PERPETUATION OF OBSOLETE SIZES:

Due to the need to continue publishing data on what still exists, there has been reluctance to edit, and place tires in the category of: "Not For New Design". As a result, some unsuccessful sizes have been perpetuated. There is no real forum for assessing this category, but maybe it should be a goal of all involved to create one.

Some aircraft have been burdened by tires that were not only difficult to qualify, but when placed in service, gave less than stellar performance. The tires were seemingly selected solely by virtue of dimensions, and having had a pre-existing status. (No one seems to have reflected on the "merits" of that prior incarnation).

18. TIRE MANUFACTURING:

The tire industry is a "mature industry". The basic technology is not of recent discovery. Mechanization has come slowly to this workplace, and when it has appeared it has been expensive to acquire. Aircraft tires require the most expensive materials and quality controls of any product offered by a tire manufacturer. He must have qualified it to a more rigorous testing regime than any other product that he offers. The liability insurance to protect against a possible failure in service becomes a significant item in the decision of whether to continue offering the line. Normally the economics of volume provides a cushion for most product line-ups. This is not the case for aircraft tires. They represent a tiny fraction of the production schedule. At one time almost every manufacturer of tires also offered aircraft tires. This is no longer the case. The small list, that represents current manufacturers, reflects the economic realities that exist.

19. RETREADING:

This procedure, whereby the wearing surface of the tire is removed and replaced, began as a rubber saving experiment, and has grown to be a significant economic factor for the airline industry. As the industry has progressed, it has implemented inspection techniques and standards that have benefited the new tire manufacturer as well as the users. The fact that a very high percentage of the airline fleet is, at any given moment, equipped with retreaded tires is mute testimony to the success of the process. It is also probable that the ability to accept multiple retreadings will determine the long-term success of new products as they emerge.

20. ADDENDUM:

Deflection Marker: At one time, tires were provided with a raised, concentric ring of rubber molded at a precise distance below the shoulder diameter. The proximity of this ring to the ground provided a rough estimate of the load/pressure relationship (at least for a new tire).

Wear indicators: Some tires were manufactured with holes in tread ribs. The remaining depth of the hole could be used to estimate when a tire should be removed.

Another strategy that has seen use is the provision of a layer of rubber or fabric of a color different from the tread. Since it is positioned below the tread, (when exposed by wear), provides a signal for tire removal.

Fabric tread reinforcements: There have been constructions where cords (nylon or wire) have been incorporated within the tread itself to improve certain service requirements.

The fabric materials used in aircraft tires have progressed in much the same way as have those used in surface tires. Cotton, rayon and nylon have been used. Nylon entered the overall tire market following its successful use on aircraft.

Nylon's strength and heat resistance has made it the body fabric of choice. It is a thermo plastic however, and possesses a “memory”. When warm nylon tires are allowed to cool while supporting a load, the footprint area shrinks and preserves a temporary out-of-round condition. This distortion is gradually lost as the tire is caused to re-warm by rolling during its next duty cycle.

Tire cords, of whatever make-up consist of filaments of specific deniers twisted into discrete string-like structures, and these in turn are twisted into more definite rope-like units which are dependent on the thickness and strength that is desired. Aramid and some steel cord have been employed in radial belt applications. Glass-fiber, and polyester have had little success in the aircraft arena.

There have been attempts made to reduce the cloud of smoke that erupts from tires when they spin-up on landing. These have usually taken the form of vanes molded on the sidewalls. Although they were able to produce in-flight rotation prior to landing, the weight, dimensional differences, inability to match ground-speeds, and questionable effectiveness in reducing treadwear, have kept these efforts on the sidelines.

20. (Continued):

Mathematical characterizations: Due to the complex constructions employed in tires (especially bias tires), it has been difficult to accurately simulate tires on computers. Programmers have to make approximations of intricate, non-linear relationships involving many degrees of freedom. The radial tire, having fewer components, has been more thoroughly studied. These characterizations have provided some helpful insights into the optimization of components and constructions.

“Lesson Learned”?

With all that has gone before, there should come a time when the design of a new aircraft will involve a conference called by the aircraft designers. It would involve the potential suppliers of the landing gear; wheel/brake; and tire. This conference called well before the time when only the available space, design weight, and the potential performance have been finalized, will have selected landing gear/ tire/ wheel/brake systems that will truly fit the new mission and will enhance the operations of the airframe.

21. APPENDIX:

Figures 1 and 2 illustrate the differences in concept between the “Clincher” and the “Straight-side” tires (this artwork is through the courtesy of the National Standard Company).

Figures 3 and 4 are views of a large single tire application as used by a Handley-Page airliner of Imperial Airways (courtesy of Dunlop).

Figures 5 through 13 are pages from Tire and Rim data books of the 1930’s and 1940’s and are provided so that dimensional data as well as load and pressure schedules pertinent to tires of those eras may be shown in greater detail.

Additional comments concerning the use of single tire applications may be in order: The Douglas B-19 is additional example of a large airplane with single main wheel tires. The B-19 was once disabled due to a flat tire. (The XB-36 and XB-99 were relegated to being operational from only two airfields within the continental U.S. prior to incorporating bogie landing gear.)

PREPARED UNDER THE JURISDICTION OF
SAE SUBCOMMITTEE A-5C, AIRCRAFT TIRES OF
COMMITTEE A-5, AEROSPACE LANDING GEAR SYSTEMS

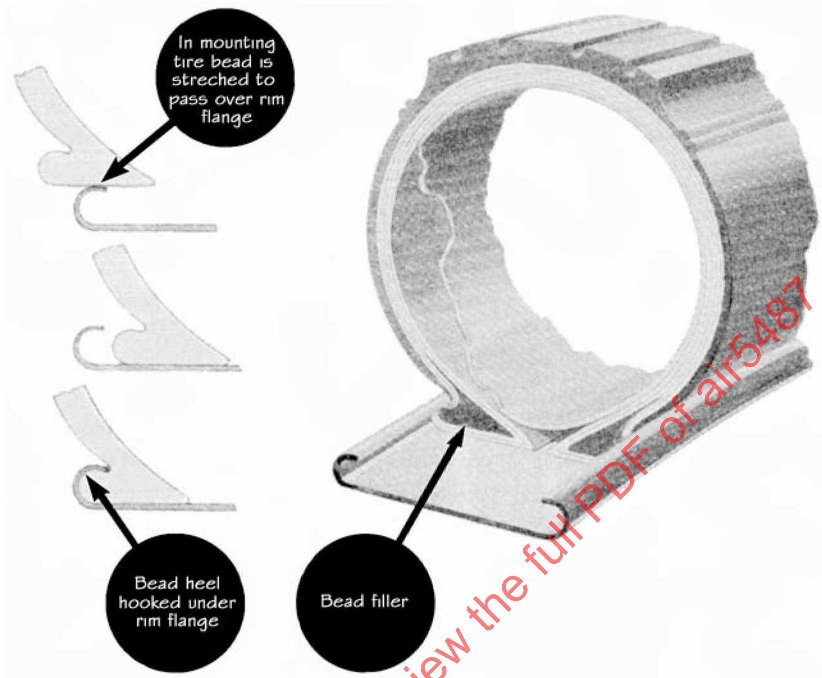


FIGURE 1 - The clincher tire had soft, stretchable beads containing no wire or other form of metal. Beads were shaped to fit inward-curving flanges.

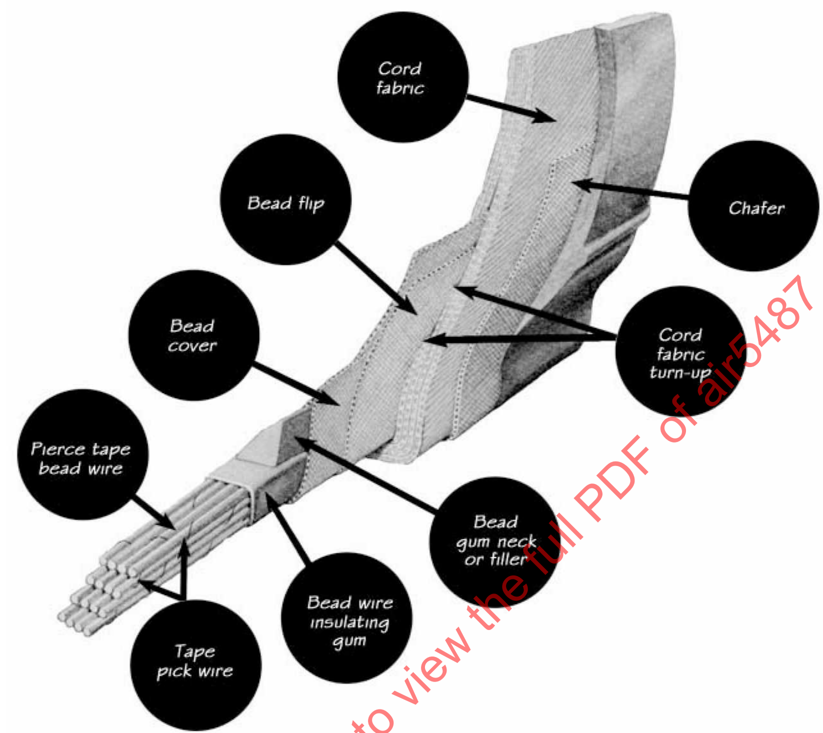


FIGURE 2 - The straight-side tire has nonstretchable beads containing wire which holds beads tightly against rim. Fabric flap protects tube from damage.

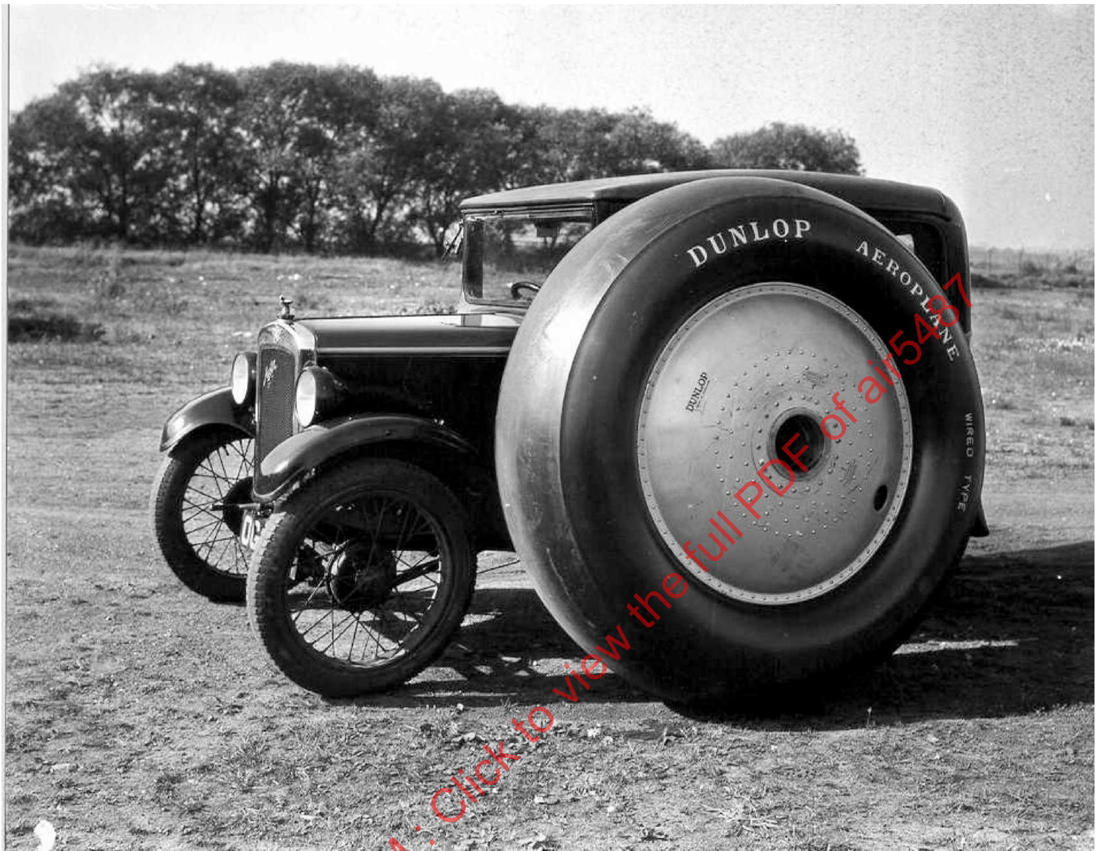


FIGURE 3

FIGURE 4

THE TIRE AND RIM ASSOCIATION, INC.

RECOMMENDED PRACTICE
LOW PRESSURE AIRPLANE TIRES AND WHEELS

LANDING WHEEL TIRES

Size Wheel and Tire	Axle Dimensions: Stub. Dia.	Min. Length Stub	Bolt Circle	Bolt Holes	No. Bolts	Dia. Bolts	Rim Dimensions: Rim Width	Flange Height	Tire Dimensions (Smooth Tread) Tire Cross Section Min.	Tire Cross Section Max.	Tire Outside Diameter Min.	Tire Outside Diameter Max.*	Maximum Static Load	Air Pressure	Valve
7.00-5		See Wheel Mfrs. Data					5¼	11/16	6.74	6.95	16.91	17.25	[illegible]	15	TR 68
8.00-5		See Wheel Mfrs. Data					5¼	11/16	7.50	7.70	18.63	[illegible]	900	15	TR 68
6.50-10	1.5	3.0	4.00	12	6	.25	4¾	11/16	6.50	6.63	21.70	21.94	1200	25	TR 90
7.50-10	1.5	3.0	4.00	12	6	.25	5½	11/16	7.50	7.65	[illegible]	23.77	1550	25	TR 90
8.50-10	2.0	4.0	4.00	12	6	.375	6¼	11/16	8.50	[illegible]	[illegible]	25.62	1950	25	TR 90
9.50-12	2.0	4.0	4.75	12	6	.375	7	⅞	9.50	[illegible]	29.10	29.44	2600	25	TR 90
11.00-12	2.5	5.0	4.75	12	12	.375	8¼	⅞	11.00	11.22	31.80	32.20	3400	25	TR 90
12.50-14	2.5	5.0	5.75	12	12	.375	9½	1*	12.50	12.75	36.00	36.44	4700	25	TR 94 ‡TR 92 opt
15.00-16**	3.0	6.0	8.00	12	6	.5625	11¼	[illegible]	15.00	15.30	41.80	42.31	7000	28	See Page 62

TAIL WHEEL TIRES

Size Wheel and Tire	Axle Diam.	Hub Overall Length	Rim Width	Flange Height	Tire Cross Section Min.	Tire Cross Section Max.	Tire Outside Diameter Min.	Tire Outside Diameter Max.*	Maximum Static Load	Air Pressure	Valve
5.00-4	.625	5 11/16	3½	¾	4.78	4.93	12.92	13.18	550	25	TR 67
7.00-4	.750	7¼	5¼	11/16	6.76	6.97	16.01	16.38	950	25	TR 68
7.00-5	.750	7¼	5¼	11/16	6.76	6.97	17.01	17.35	1050	25	TR 68
†8.00-5	.750	7¼	5¼	11/16	7.52	7.72	18.73	19.07	1200	20	TR 68
9.00-6	1.250	9	6¾	⅞	8.76	9.03	21.64	22.08	1600	20	TR 69

Revised April 5, 1935

NOTE—*The outside diameter of non-skid tires may slightly exceed these dimensions.

NOTE—**The standard tire is 6-ply. An 8-ply tire is also made in this size, rated at 8750 pounds maximum static load at 35 pounds air pressure, and a 10-ply heavy duty tire rated at 10,000 pounds maximum static load at 40 pounds air pressure.

NOTE—†This tire is mounted on the 7.00-5 wheel.
Tire deflection is 35% for landing and tail wheel tires, based on tire height above rim flanges.
For loads less than maximum, the inflation pressure may be proportionately less.

NOTE—‡Obsolete valve.

FIGURE 5

HIGH PRESSURE AIRPLANE TIRES AND WHEELS
TIRE AND RIM ASSOCIATION STANDARD

	Standard Wheel Size	Standard Tire Size	Rim Dimensions		Tire Dimensions—Smooth Tread				Max. Static Load	Air Pressure	Valve
			Width Between Flanges	Ledge Diameter	Tire Cross Section		Tire Outside Dia.				
					Min.	Max.	Min.	Max.*			
LANDING WHEEL TIRES	24 x 4	24 x 4	2½	16	3.96	4.04	23.90	24.06	850	50	Ⅱ62
	28 x 4	28 x 4	2½	20	3.96	4.04	27.90	28.06	1000	50	Ⅱ62
	24 x 4	26 x 5	2½	16	4.83	4.93	25.56	25.76	1250	50	Ⅱ62
	30 x 5	30 x 5	3	20	5.00	5.10	29.56	29.76	1600	50	Ⅱ63
	32 x 6	32 x 6	4	20	6.17	6.29	31.33	31.55	2200	55	Ⅱ63
	36 x 8	36 x 8	5	20	8.12	8.28	34.91	35.21	4000	60	Ⅱ63
	36 x 8	40 x 10	5	20	9.74	9.95	37.99	38.35	5500	65	Ⅱ63
	44 x 10	44 x 10	6	24	10.07	10.28	42.04	42.40	6500	65	Ⅱ47**
	54 x 12	54 x 12	7	30	12.00	12.26	51.63	52.07	10000	70	Ⅱ47**
	58 x 14	58 x 14	8	30	14.30	14.58	55.30	55.82	13000	70	Ⅱ48
TAIL WHEEL TIRES	10 x 3	10 x 3	2½	4	3.12	3.18	10.24	10.36	400	55	Ⅱ43
	14 x 3	14 x 3	2½	8	3.12	3.18	14.24	14.36	500	55	Ⅱ61
	18 x 3	18 x 3	2½	12	3.12	3.18	18.24	18.36	550	55	Ⅱ61
	10 x 3	12 x 4	2½	4	3.96	4.04	11.90	12.06	600	55	Ⅱ43
	14 x 3	16 x 4	2½	8	3.96	4.04	15.90	16.06	750	55	Ⅱ61
	18 x 3	20 x 4	2½	12	3.96	4.04	19.90	20.06	825	55	Ⅱ61

*The overall height of non-skid tires may slightly exceed these dimensions.

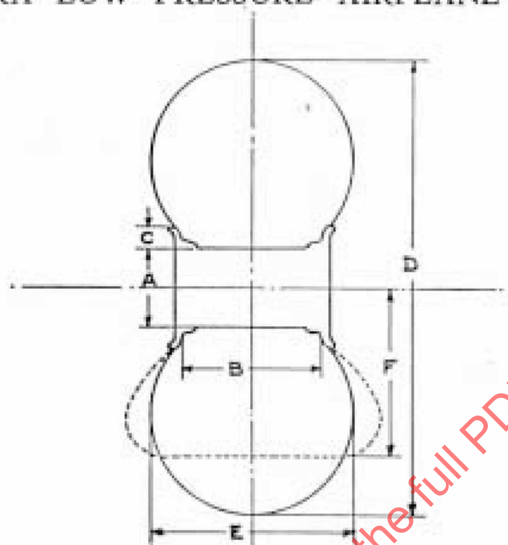
**Ⅱ49 optional.

NOTE—Tire deflections are based on tire height above rim flange, and are 27½% for landing wheel tires and 25% for tail wheel tires.

FIGURE 6

EXTRA LOW PRESSURE AIRPLANE TIRES

TABLE AP-3



NAME SIZE	Rim Dimensions: Dia. A	Rim Dimensions: Width B	Rim Dimensions: Flange Height C	Tire Dimensions: Diam. D	Tire Dimensions: Section E	Tire Dimensions: Loaded Rad. F	Plies	Standard Tire*: Max. Static Load	Standard Tire*: Air Pressure	Plies	Extra Ply and Heavy Duty Tires*: Max. Static Load	Extra Ply and Heavy Duty Tires*: Air Pressure	Valve Number
LANDING WHEEL TIRES													
16 x 7- 3	3.0	5.50	.84	15.3	7.20	5.7	4	600	13	4	900	20	R261
18 x 8- 3	3.0	5.50	.84	17.6	8.20	6.8	4	850	13	4	1175	20	R261
							2	690	(LD)9				R261
19 x 9- 3	3.0	5.50	.84	20.0	9.45	7.6	4	1025	13	4	1375	18	R261
22 x 10- 4	4.0	7.00	1.25	21.9	10.30	8.0	4	1690	15	4	2100	23	R261
25 x 11- 4	4.0	7.00	[illegible]	24.4	11.30	8.9	4	1950	15	4	2450	20	R261
27 x 12- 5	5.0	9.00	1.25	26.2	12.20	9.8	6	2600	18	6	3500	25	R262
										8	3900	(ExHD)23	R262
29 x 13- 5	5.0	9.00	1.25	28.2	13.40	10.4	6	3400	20	6	3825	23	R262
30 x 13- 6	6.0	9.00	1.44	29.0	13.20	11.0	6	3400	20	6	4625	28	R262
										8	[illegible]	(ExHD)33	R262
35 x 15- 6	6.0	[illegible]	1.44	33.8	15.40	12.2	6	4700	20	6	5600	25	R262
36 x 15- 7	7.0	11.00	1.50	35.0	15.60	13.0	6	4800	20	6	6150	28	R262
										8	6500	(ExHD)38	R262
40 x 18 -7	7.0	11.00	1.50	39.0	17.80	13.6	8	7000	20	8	8450	25	R262
41 x 18- 8	[illegible]	13.00	1.50	39.7	18.70	14.1	8	7000	20	8	9125	23	R262
44 x 20 -8	8.0	13.00	1.50	43.4	20.40	15.9	8	8750	23	8	10500	28	R262
45 x 20-10	10.0	14.00	2.75	44.5	20.25	17.3	10	12500	35	12	14000	40	R263
TAIL WHEEL TIRES													
12 x 5- 3	3.0	3.50	.84	12.0	4.90	4.70	4	600	30	4	1200	60	R260
										4	1500	(ExHD)75	R260
16 x 7 -3	3.0	5.50	.84	15.3	7.20	5.75	4	1100	25	4	1950	50	R261
										4	2250	(ExHD)60	R261
18 x 8- 3	3.0	5.50	.84	17.6	8.20	6.84	4	1400	25	4	2250	50	R261
										4	2700	(ExHD)[illegible]	R261
19 x 9- 3	3.0	5.50	.84	20.0	9.45	7.63	4	1550	20	4	2850	40	R261
22 x 10 -4	4.0	7.00	1.25	21.9	10.30	8.00	4	1900	20	4	3100	40	R261

NOTE:—* Loads and inflations shown are approved as EXPERIMENTAL PRACTICE. All other data are published for information only.

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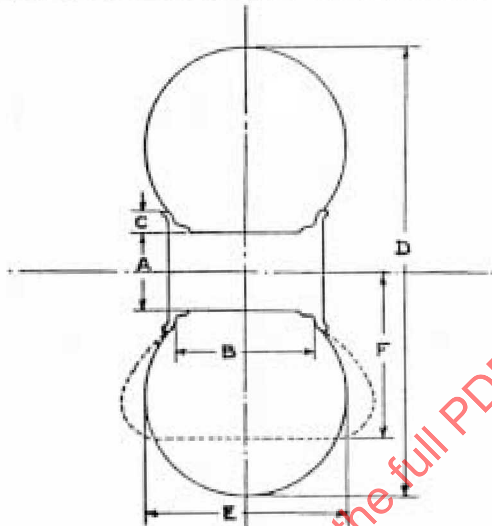
FIGURE 7

EXTRA LOW PRESSURE AIRPLANE TIRES

TABLE AP-3



NAME SIZE	Rim Dimensions Dia. A	Rim Dimensions Width B	Rim Dimensions Flange Height C	Tire Dimensions Diam. D	Tire Dimensions Section E	Tire Dimensions Loaded Rad. F	Regular Tire* Plies	Regular Tire* Max. Static Load	Regular Tire* Air Pressure	Extra Ply and Heavy Duty Tires* Plies	Extra Ply and Heavy Duty Tires* Max. Static Load	Extra Ply and Heavy Duty Tires* Air Pressure	Valve Number
LANDING WHEEL TIRES													
16 x 7- 3	3.0	5.50	.84	15.3	7.20	5.7	4	600	13	4	900	20	TR261
18 x 8- 3	3.0	5.50	.84	17.6	8.20	6.5	4	850	13	4	1175	20	TR261
							2	650	(LD)9				TR261
19 x 9- 3	3.0	5.50	.84	20.0	9.45	7.6	4	1025	13	4	1375	18	TR261
20 x 9- 4	4.0	7.00	1.25	21.0	9.50	7.70	4	1300	15	4	1700	20	TR261
22 x 10- 4	4.0	7.00	1.25	21.9	10.30	8.0	4	1600	15	4	2100	23	TR261
25 x 11- 4	4.0	7.00	1.25	24.4	11.30	8.9	4	1950	15	4	2450	20	TR261
27 x 12- 5	5.0	9.00	1.25	26.2	12.20	9.8	6	2600	18	6	3500	25	TR262
										8	3900	(ExHD)28	TR262
29 x 13- 5	5.0	9.00	1.25	28.2	13.40	10.4	6	3400	20	6	4000	25	TR262
30 x 13- 6	6.0	9.00	1.44	29.0	13.20	11.0	6	3400	20	6	4625	28	TR262
										8	5200	(ExHD)33	TR262
35 x 15- 6	6.0	9.00	1.44	33.8	15.40	12.2	6	4700	20	6	5600	25	TR262
36 x 15- 7	7.0	11.00	1.50	35.0	15.60	13.0	6	4800	20	6	6150	28	TR262
										8	6500	(ExHD)33	TR262
40 x 18 -7	7.0	11.00	1.50	39.0	17.80	13.6	8	7000	20	8	8450	25	TR262
41 x 18- 8	8.0	13.00	1.50	39.7	18.70	14.1	8	7000	20	8	9125	28	TR262
44 x 20 -8	8.0	13.00	1.50	43.4	20.40	15.9	8	8750	23	8	10500	28	TR262
45 x 20-10	10.0	14.00	2.75	44.5	20.25	17.3	10	12500	35	12	14000	40	TR263
TAIL WHEEL TIRES													
12 x 6- 3	3.0	3.50	.84	12.0	4.90	4.70	4	600	30	4	1200	60	TR260
										4	1500	(ExHD)75	TR260
16 x 7 -3	3.0	5.50	.84	15.3	7.20	5.75	4	1100	25	4	1950	50	TR261
										4	2250	(ExHD)60	TR261
18 x 8- 3	3.0	5.50	.84	17.6	8.20	6.84	4	1400	25	4	2250	50	TR261
										4	2700	(ExHD)60	TR261
19 x 9- 3	3.0	5.50	.84	20.0	9.45	7.63	4	1650	20	4	2850	40	TR261
22 x 10 -4	4.0	7.00	1.25	21.9	10.30	8.00	4	1900	20	4	3100	40	TR261

NOTE:—* Loads and inflations shown are approved as EXPERIMENTAL PRACTICE. All other data are published for information only.

Revised July 21, 1939

FIGURE 8