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AIRCRAFT TIRES: Their Care and Feeding

Tires can make a big difference in your plane's ground handling safety and temperament. An understanding of their nature and functions will lengthen their worth and add to your flying comfort

What is an aircraft tire?

"A landing gear wheel may be equipped with any make or size of tire, provided that tire is a proper fit on the rim of the wheel, provided that the approved tire rating is not exceeded, under the following conditions," etc. That is how it is described in Civil Air Regulation 3.362.

Does this mean that you can mount any size tire on your airplane that suits your fancy?—Definitely not. Factors such as tire growth, weight limitations, retraction problems dictate the size of tires that can be used.

Before we discuss other tire problems, who knows the outside diameter of a 29x13-5 tire? What's the difference between 8.00 and 800x4? Is a 15x600-6 the same size as a 600x6? Confusing? You bet it is!

Tires are divided into seven "Types". Each type is measured and described in a different manner.

Type I Smooth Counter is a tire with a sidewall parallel to the outer surface of the aircraft wheel. "SC's" are a type of tire, not a tread type. They may be made with various types of treads. Type I tires are described by one dimension only, the outside diameter of the tire. For example, an 8.00 SC is a small tailwheel tire used on the Cessna 180, eight inches in diameter, and the two side vertical surfaces of the tire are the same dimension as the wheel itself. Examples of Type I SC tires are 10.00, 12.50, 27 inches, etc.

Type II Tires are high pressure type. Two dimensions are used to describe them. The first given is the outside diameter of the tire. The second dimension is the measurement of the tire at its greatest width. Example: A 32x8 tire would have a 32-inch outside diameter and an eight-inch greatest width. Other examples of Type II tires are 26x6 and 34x9.

Type III tires are described as low pressure. These are used almost exclusively today on light aircraft. They are measured by rim diameter (also the inner dimension of the tire) and width. For instance, a 600x6 tire has a six-inch rim diameter, or six-inch wheel, and is six inches in width. The 600x6, or the "six by six" as known in the trade, is the most popular size tire in use on aircraft today.

Type IV tires are nearly obsolete. They are known as extra low pressure, and are found on older type aircraft (Lockheed 10, 30x13-6; Beech C18S, 29x13-5). These tires are popularly known as "donuts", and are measured in three dimensions—first, outside diameter; second, width of tire; third, inside diameter of tire (and wheel). Thus, the 29x13-5 would have 29-inch outside diameter, 13-inch tire width, and the inside diameter of the tire would be 5 inches.

Type V tires are completely obsolete and are no longer manufactured. They were known as "streamline" and were measured by the outside diameter of the tire only. Stearmans were originally equipped with 24-inch streamline tires, now replaced by the 8.90x12.50.

Type VI tires are known as low profile. While many people might think that this is a new type of tire, possibly developed to decrease the outer diameter and to lessen the size of wheel wells on newer aircraft, this is not the case. The low profiles have been around for 25 years. The P-39 *Aircobra* used this type of tire in 1941. Three dimensions are used for measurement, i.e., a 15x600x6 tire is 15 inches in outside diameter, times 6 inches wide, times a 6-inch inside diameter of tire (and wheel). These tires are presently in use on the Beech *Musketeer* and Cessna 210. They are not interchangeable on retractable gear aircraft with the 600x6, because the 600x6 is 16 inches in outside diameter while the 15x600x6 is only 15 inches in outside diameter.

Type VII tires are extra high pressure, sometimes carrying 250 pounds per square inch inflation pressure, as does the 29x7.7, 16-ply nose tire of the Convair 880 *Jetliner*. They are also still used on the P-51 tail (12½x4½) and *Constellation* nose (34x9.9). They are measured in the same manner as Type II tires.

So there it is. Now you know that the outside diameter of a 29x13-5 is 29 inches; that an 8.00 is 8 inches in outside diameter; that an 800x4 is 8 inches in width and fits a 4-inch wheel, and is not interchangeable with an 8.00; and that a 15x600-6 will fit the same size wheel as a 600x6, but that the 600x6 cannot be used on some aircraft because it has a 16-inch outside diameter, while the 15x600-6 is only 15 inches in diameter.

A tire contains a cushion of air to support the airplane while on the ground, during shocks of landing and takeoff, and to transmit brake forces.

An aircraft tire consists of three parts: The cord body, the bead, and the sidewall and tread. The cord body is made up of an even number of rubberized cords (almost exclusively nylon) directly under the tread and carried down the sidewall to the bead. These cords, having strength only in one direction, are moulded into the tire in a crosshatch position (ply) to give balanced strength. Ply-turnups are also provided to secure the bead of the tire to the cord body. Chafing strips are placed along the outside of the bead to protect the bead from rim chafing, mounting damage, and to make it more rigid. Tubeless tires are manufactured with an inner liner. The inner liner seals air inside the tubeless tire, thereby eliminating the need for an inner

tube.

The tire bead is a round gathering of steel wires, fabric wrapped, imbedded in rubber, to which the cord body is wrapped and bonded. The bead holds the tire firmly on the wheel. Wrapping the bead wires with fabric gives a bond and also insulates the steel when the tire is cured.

Now, prepare yourself for a shock—The most visible part of an aircraft tire and the part usually examined by persons unacquainted with tires is the least important part! This is the sidewall and tread. Sidewalls and treads are made only of a layer of rubber. The tread serves as a wearing surface and the sidewall helps to protect the cord body from moisture, cuts, and bruises. Many safe landings have been made with the tread or parts of the sidewall completely gone from the tire.

Remember, however, that most tire troubles come when 90% of the tread is gone, leaving the carcass more susceptible to failure through cuts, punctures, and abrasions. When deciding whether to re-tire, carefully weigh the cost to your aircraft through a ground loop or gear damage as a result of tire failure.

Many variations of tire construction may be encountered, but are not usually found in light aircraft sizes. Some of the more usual are fabric-reinforced treads for high-speed jet tires; ice grips, which have steel wire imbedded in the outer layer of tread rubber and are just what the name implies, for use on icy runways; helicopter tires, identified by their lighter weight and marked "helicopter" on the sidewall; tires that show when replacement time comes by exposing a colored section and tires with wear-depth holes for the same purpose.

"Should I buy a six-ply instead of a four-ply and get additional wear time and safety?" is a question often asked by aircraft owners.

You do not get any more tire wear with a six-ply than you do with a four-ply, and there is usually the same amount of rubber on the tread of a four-ply. The ply consists of the number of cord plies in the body of the tire. It can be made with less than the called-out number of cords and still have the same or greater strength. These are the cases where the phrases "four-ply rating" or "six-ply rating" are used. To make the matter more complicated, when operating an aircraft in extreme conditions, better service will often be afforded by a lighter tire, due to its more rapid heat dissipation.

Don't worry about whether the manufacturer codes his tires by ply or rating. All major brand tires sold today fully meet FAA TSO C62B, a set of demanding Government standards calling for uniform marking, size, and testing. Part of the C62B physical test calls for the tire to withstand 100 landings at 90 m.p.h., and 100 landings at 120 m.p.h. at a carcass temperature of not less than 160° F.

If you are in doubt about which ply to use, consult your tire dealer. He will figure the weight of your airplane and consult the bible of the industry, the Tire and Rim Handbook, to advise you on the correct ply and size.

A general guide to standard tire sizes and plies is also contained in the older FAA specification sheet for each airplane manufactured. Lately, however, the FAA has eliminated from the spec sheets much useful information such as part numbers for wheels, brakes and accessories, and refers the aircraft owner to the "manufacturing data" (wherever this might be).

Your tire dealer should be able to tell you from memory which tire to use on standard aircraft. He will also have FAA aircraft specifications available to consult, will go to the TRA Handbook to solve your problem if necessary and will be able to tell you the exact weight of each tire he sells, not only for aircraft engineering application, but for shipping costs. If your present tire dealer is unable to do the above, you'd better find a more in-the-know supplier.

Many owners have had problems with tubeless tires, some of which were not due to the tire but to faulty mounting. Tubeless tires require a special mounting technique. Many improvements have been made recently in the tubeless line. One manufacturer now offers a metal sidewall valve stem, eliminating the troublesome rubber sidewall inflating valve.

A tubeless wheel airplane can be converted to a tube type in roughly three hours, by drilling holes for the tube valve stems. Tubeless tires can also be used with tubes, and being of a heavier construction, are sometimes used (with tubes) by flying schools and by owners having special wear problems. Tube-type tires cannot be used as tubeless tires on a tubeless wheel.

Your tire dealer will have on hand approved conversion instructions for converting to tube-type tires if you desire. They are usually given free with the purchase of a set of tires.

Owners looking for bargains may see glowing offers for recap tires which sound like a real money saver. Flies in the ointment here are the shipping costs and the fact that your tire, when sent, and shipping already is paid for, may not be suitable for recapping.

Recapping, or tire renovation by vulcanization, is done in three degrees—top capping, which involves replacing only the portion of the tire which contacts the ground; full cap, a misleading term, involves replacing only the rubber of the tire as in a top cap, plus the rubber about halfway down the sidewall; and bead to bead, which replaces all the rubber on both sidewalls, plus the wear portion of the tire.

Cost use of renovated tires exceeds the cost of purchase of new tires in the smaller light aircraft sizes. Current price of the 600x6 four-ply tire is $10.95, with shipping charges for two tires in the western states running about $2, or anywhere in the contiguous states about $3.50. Recapping the same tire will run close to $9 each. The sticker is the two-way shipping charge

Results of misuse or ignorance of the nature of aircraft tires is reflected in the abused carcasses here: (1) Flat spot on tread caused by twisting on one wheel or too-severe brake action. (2) Wear on one side due to improper camber in landing gear. (3) Shoulder wear due to underinflation. (4) Tread wear from overinflation. (5) Separation of tread due to trapped air from improper installation, excessive heat, improper inflation or excessive speed. (6) Abrasive wear from rough runways or excessive braking at high speed. (7) Bead damage caused by brake drag, brake heat. (8) Weather checks due to smog or ozone do not affect tire strength unless the cords can be seen

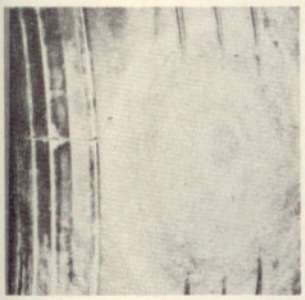

FIGURE 1

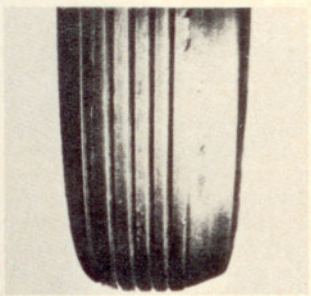

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FIGURE 5

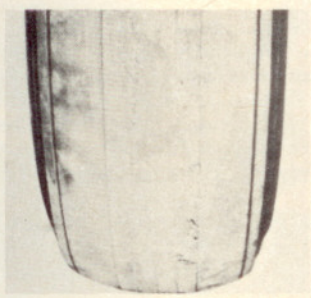

FIGURE 6

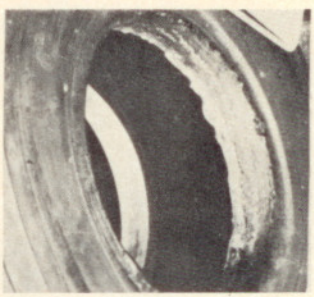

FIGURE 7

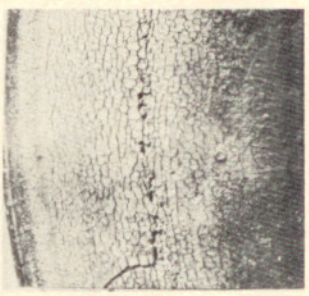

FIGURE 8

to send your tire to the recapper and get it back.

In general, tires are limited to three recappings. Recaps can be identified by the name and date of recapping agency which must be inscribed on the tire at the time of renovation. Recaps, if done by a recognized agency, are fully airworthy and usually give good service. Largest users of recapped tires are the military and airlines because the cost of the new large-size tires they require often run into the hundreds of dollars.

"Should I buy surplus or overstock tires?" This can be answered only with a qualified yes. Buy them if you know what you are buying, or if the dealer guarantees them in writing, either in his advertising or when you purchase the tire or tube. Surplus tires in some cases can be very good buys; in others, a waste of money. To go back to the old theme, buy from a reputable dealer who will stand behind his merchandise, whether it is new production or surplus.

Owners of aircraft such as the T-6 or F-51 often have little choice in tire selection. Some of the "odd ball" sizes are no longer manufactured and, if they are, the newly manufactured price is prohibitive. For instance, a 27-inch T-6 or F-51 10-ply nylon tire can be purchased as surplus for $34.50, while in new production the price runs about $100.

Surplus tires made originally for the military are rigidly controlled in manufacture. Only the finest materials are used and manufacturing process is held strictly to MIL specifications. If the tire or tube has been properly stored and cared for, it will give equal or better service than new production civilian tires.

One surplus tire to be avoided, however, is the helicopter tire. These are totally unsuited to any kind of conventional aircraft use, due to their light construction. Surplus ice grips can sometimes be found at bargain prices and usually will give the same service as a conventional tire. If you operate in ice and slush, they will give excellent braking action.

If you buy tires that have a few checks or small cracks, or your tires develop these marks while in service, don't worry about it. The strength of the tire comes from the cord body, not from the rubber. Cracks are caused by "smog" or "ozone" and develop on almost all tires after a period of time.

By all means, add new tubes when re-tiring if your tires are tube-type. When comparing the cost of a tube to the labor involved in jacking up the airplane, removing the brake disc, removing the wheel, dismounting the tire, etc., at the going labor rate of about $6.50 an hour, it's the most economical thing to do. Small aircraft tubes sell for less than an hour's labor cost. If you feel the tubes are too good to replace, at least put new valve cores in the old tubes.

Thousands of dollars in tire money is wasted annually by improper care or mounting, unnecessary damage and general abuse through "not knowing how." Usually, aircraft tires are marked with size, ply, construction, serials, date of manufacture and compliance with FAA TSO C62B, and balance marks to aid in proper mounting.

In mounting tube-type tires, dust tubes with a small amount of tire talc. The balance mark on the tire is a red dot. This indicates the *light* portion of the tire. The balance mark usually found on tubes is a yellow stripe, placed at the base of the *heavy* spot in the tube. Place the yellow stripe in line with the red dot, or if there is no marking on the tube, put the valve stem next to the red dot.

It is surprising how many FAA-licensed mechanics and plane owners are not acquainted with this simple

procedure to eliminate out-of-balance and shimmy problems.

Next, tie a piece of safety wire or string to the valve stem to facilitate drawing the stem through the hole in the wheel. Be sure the tube stem, if offset, is on the proper side of the wheel. Install the tube in the tire and inflate only enough to get the tube to position itself properly and until the tire beads begin to spread. Then probe between the tube and the sidewall of the tire with the hands to relieve any trapped air. *This is very important.* Aircraft tires are susceptible to blisters, which cause sidewall and tread separation as a result of trapped air.

A sure sign of improper mounting or tube leakage is the appearance during the first days of service of air blisters on the tire. Blisters not over one inch in diameter, when noticed promptly, can be punctured with an ice pick without affecting the service life of the tire. Larger blisters may cause serious damage, and the tire may have to be discarded. The best course if a tire blisters is to deflate it, remove the wheel and start over again with the approved tire mounting procedure.

Next, install the wheel halves onto the tire and tube, wipe the bead with a damp rag to remove any tire talc (this is to eliminate any slippage), install the wheel bolts if it is a divided type wheel, and torque the nuts. Torque values are usually printed on the wheel sides.

If you don't have an accurate torque wrench, beg, borrow or steal one! Some lightplane wheels cost over $100 each, so trying to guess on this step is bad judgment. Overtightened wheel bolts will cause cracks in the wheels. Undertightening will enlarge the bolt holes. Tighten the bolts in small increments, working in a 180° pattern.

After the tire and tube are mounted on the wheel, make a crude balance check by cleaning all grease from the wheel bearings and mount the assembly. Rotate the wheel and let it come to a stop. The heavy part of the assembly will come to rest at the bottom. If the assembly seems to be abnormally out of balance, lead can be added to correct, but this is a condition not often encountered and should be handled only by qualified mechanics.

Paint a red stripe slippage mark from the sidewall of the tire onto the wheel so that you may determine if the tire is slipping on the wheel. Rubber valve stems often stretch, and it is not possible to detect tire slippage by this means.

Nylon tires stretch for 24 hours when first installed and inflated. Stretching and ground sitting cause flat spots in nylon tires. If, after 24 hours, the flat spots in nylon tires still are there, inflate the tire to 1½ times its normal capacity, let stand for two hours, then deflate to normal pressure. Do not fly the airplane with this pressure overload, however. Nylons usually "warm up" and lose any humps due to sitting before the takeoff point is reached.

This defect is not noticeable in rayon tires, but 95% of the tires manufactured today are of nylon cord body due to nylon's superior resistance to rotting.

Take special care in mounting tubeless tires to avoid leaks. First, check to see that beads are clean and undamaged. Lubricate the inner wheel ring rubber "O" ring seal with either MIL-L-7711 specification grease or sealing compound, MIL-I-8660. If necessary, Vaseline can be used. Do not stretch the seal when applying grease with the hands, or leaks will occur. Install the seal on the wheel half, taking care not to twist it. Always use a new seal.

Place the wheel half containing the seal on a clean, flat surface. If the tubeless tire is of the rare type with valve core projecting through the wheel, put the red balance dot at the valve. If it does not have this feature, no attention to this step is necessary. Install the bolts and nuts and torque in the same manner as with a tube-type wheel. Inspection for leaks can be made by immersing small sizes in water, but trapped air will issue from the assembly for some time. Small vent holes in the sidewall are a feature of all aircraft tires.

Dismounting of aircraft tires is virtually the same procedure as mounting except that the following precautions must be observed: Always completely deflate the tire by removing the valve core (gradually; the valve core itself is a lethal weapon if carelessly handled). Do not pry between bead and wheel with sharp tools. A better dismounting procedure is to stand on the tire or use a bead breaker, if one is available.

Do not interchange wheel halves. A good idea is to take the serial numbers from the wheel halves and to make a rejoining mark so that when they are put back together the same bolts will be in the same holes and the wheel halves will be in the same position. This procedure eliminates many causes of tire imbalance. Use no lubricants to remove or mount any type of tire. Lubricants will cause slippage when the tire is remounted.

The usual beat-up tire gauge found at the end of the airport compressed air tank filling hose is useless. If you want maximum tire life, buy a reliable gauge and check for recommended pressure yourself, or hand your gauge to the line boy and have him do it. Oil or other contaminants on tires should be removed with a mild soap-suds solution, never with gasoline or cleaning solvents, as they are injurious to rubber. Wheel covers made from resin-coated fabric will keep oil off your tires and give added life.

Tires and tubes should be stored in a dark, cool place, temperature not below 32° or above 80°, and not in the same room with electrical equipment, battery chargers, or fluorescent lights. Store tubes in sealed boxes, wrapped in paper, dusted with tire talc, with enough air in them to avoid folding creases. Do not inflate too much or stretching will occur. ●