LEVEL 1 COURSE GUIDE AND TEST

MICHELIN CERTIFIED TIRE EXPERT PROGRAM
Radial tire construction

1. Tread
2. Protector ply
3. Undertread
4. Belt plies
5. Sidewall
6. Casing plies
7. Casing ply turn-ups
8. Liner
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Introduction

In order for aircraft tires to deliver exceptional performance under demanding conditions, the tires must be properly cared for and maintained following some universally accepted practices. This manual is designed to help you learn the basics of tires and tire care. This is the introductory level of the program and the prerequisite for the more detailed and demanding Level Two course. The goal of both of these courses is to provide you with a greater understanding of tire construction and care and service while helping you to develop a greater recognition of tire design, serviceability and quality characteristics.

At this point, the value of practicing good study habits cannot be stressed enough. You should make an effort to work through the lessons in this course in an environment that allows you to complete each section without distractions and interruptions.

Gather all of the materials you need for studying this course. We recommend a pencil for taking the final test, a highlighter for emphasizing key points and material that is new to you and perhaps a few pieces of paper for notes, questions and ideas that may arise during your study.

Work in a well-lit area that is comfortably heated or cooled and allows you enough space to be comfortable.

Good luck with this course!
Michelin History

For more than a century, the Michelin name has been synonymous with excellence and innovation in the field of tire manufacturing.

Founded in 1889 by Edouard and André Michelin, the company began as a small rubber factory in Clermont-Ferrand, France. Today, Michelin is one of the largest tire manufacturers in the world.

The Michelin and BFGoodrich brands have earned wide recognition for aircraft tire excellence through their innovative product developments and outstanding manufacturing quality. When the Michelin Group purchased the BFGoodrich aircraft tire division in January of 1989, two of the most highly respected names in the aircraft tire industry were joined to establish a full-service supplier tending to the needs of the military, airline, regional and general aviation segments of the aviation industry.

The combined experiences of two aircraft tire industry pioneers place Michelin in a unique position to help satisfy the requirements of today’s aircraft tire customers and to help define and meet the needs of the future.

Michelin was the first company to research and develop radial tires. For the aviation industry, that research and development culminated in 1981 when the French Air Force introduced the Mirage III – which was equipped with the Michelin® AIR X®, the world’s first operational radial aircraft tire.

Since that time, Michelin has developed numerous other military and civil radial aircraft tire designs, which have been certified and introduced into service. Research and testing confirm radial aircraft tires can deliver advantages such as weight savings, improved overload margins, better tread wear, greater cut resistance and cooler operating temperatures.

Airframe manufacturers have acknowledged Michelin’s expertise by selecting its bias and radial tires for many new aircraft programs. Michelin radial tires are original equipment (OE) on the F-15E, F22 and F35A, EFA (Eurofighter Aircraft), Rafale, Mirage 2000, Tornado, Dassault Falcon 900 and Falcon 8X, Airbus A319/A320, A321, A330/A340 and A350 models, and Boeing B777, 737 Max 7 and 737 Max 8.
Since 1910, the BFGoodrich Company has played a major role in the design and development of bias aircraft tires and has long been associated with historic flights. Legendary aircraft from Charles Lindbergh’s “Spirit of St. Louis” to NASA’s Space Shuttle have been equipped with BFGoodrich (and later MICHELIN Air) aircraft tires.

When Michelin purchased the BFGoodrich aircraft tire division, it acquired a history of research and innovation that paralleled its own. The BFGoodrich Company was responsible for numerous improvements to bias aircraft tire technology – including the design and use of aircraft tire dynamometers, evaluation of synthetic compounds, development of tubeless aircraft tires, the high-speed fabric tread concept and extra-high temperature materials.

Michelin brand bias tires are utilized as original equipment on numerous Boeing commercial aircraft such as the 727, 737, 747, and 757 and on military aircraft including the F-14, F-15, F-16, F-18, P-3, B-1 and T-45.

Throughout Michelin’s more than 100 years in the tire industry, it has maintained a commitment to innovative development. This heritage of leadership, combined with the recent expansion of the company’s technical and manufacturing capabilities, assures that Michelin will be poised to meet the requirements of a new generation of aviation customers. Michelin continues to pioneer research in modern challenges facing aviation, including longer-wearing tread compounds, lighter weight casing designs, and improved high-speed take-off and landing capabilities.
Michelin’s family of exceptional aircraft tires consists of the MICHELIN® AIR X® Radial and the MICHELIN® AIR™ bias tire. Radial tires, such as the AIR X®, are generally recognized as the future of the aircraft tire industry.

While the aviation industry is ever changing, Michelin continues its intensive efforts to develop new technologies to meet the performance demands of modern aircraft. At research facilities in Greenville, South Carolina and Clermont-Ferrand, France, and at manufacturing plants in all major markets, Michelin Aircraft Tire engineers are working under stringent quality standards.

Because Michelin has aircraft tire manufacturing and retreading operations in North America, Europe and the Far East, it is able to meet the global needs of the aviation industry. Michelin products are sold in more than 140 countries around the world. Since its founding more than a century ago, Michelin has grown to encompass nearly 80 manufacturing plants in 19 countries on five continents.

The mission of Michelin Aircraft Tire Company has always been to stay one step ahead of the constantly evolving aviation industry through continuous product improvement. The commitment to technological superiority and product quality established by the Michelin brothers in 1889 remains the driving force behind Michelin tires.
The Bibendum Story

Bibendum, one of the world’s oldest and most recognizable trademarks, symbolizes Michelin’s service to the driving (and flying) public throughout the world.

“Bib,” as he is affectionately called, originated in 1898 at the Lyon Exhibition in France. It was there that Edouard Michelin saw a display of tires stacked one on top of the other. His inventive imagination aroused, Edouard visualized what seemed at that time to be a human form outlined by the stacking arrangement of tires. He remarked to his brother André that if the tires had arms, they would resemble a man.

André agreed.

André commissioned an artist to prepare a number of sketches based upon Edouard’s idea. One of the drawings pictured Bib as a rotund beer drinker who, lifting his glass, shouted, “Nunc est bibendum!” (Now is the time to drink!)

The sketch reminded André of the tire display at Lyon, and “Nunc est bibendum” recalled the slogan Michelin was currently using, “Michelin tires swallow up all obstacles.” Additional sketches were submitted. The beer bottle was replaced with a champagne glass. Bib raised his goblet of nails and glass while proposing a toast to all road hazards.

Bibendum was not officially christened until Théry, the famous race driver, who was preparing for the Paris-Amsterdam race, shouted as André passed, “I say, there goes Bibendum!” Bib’s popularity spread throughout the world along with the famous Michelin tire. Bib walked, danced, jumped, laughed, and made jokes.

Today, Bibendum is widely recognized by young and old alike as Michelin’s congenial international spokesman. He stands as a symbol of Michelin’s pioneering leadership and high standard of technological achievement.
The Product Line

The Michelin Aircraft Tire line consists of the following products:

**MICHELIN® AIR X®** – MICHELIN® AIR X® radial tires are currently available for a wide range of commercial, military and corporate aircraft. MICHELIN® AIR X® radial tires offer numerous advantages over traditional bias-ply aircraft tires, including substantial weight savings, longer treadwear and improved overload capacity.

**MICHELIN® AIR™** – The MICHELIN® AIR™ is our top-of-the-line bias-ply tire. It offers a number of exclusive features designed to improve performance and extend tire life including a sidewall compound that is optimized to provide substantial ozone and ultraviolet light protection and Michelin’s toughest tread compound.

**MICHELIN® AIRSTOP®** – MICHELIN® AIRSTOP® aircraft inner tubes are designed to provide the same high level of performance aviators have come to expect from MICHELIN® tires. They provide long-lasting, dependable performance and are compatible with most tire brands. If you want to avoid tire trouble, you can improve your chances by inspecting your tires regularly, watching for leaks, and remembering a simple rule: When you change tires, change tubes.
Aircraft Tire Construction

**Tread** – the term “tread” refers to the area of the tire that is actually in contact with the ground. Also referred to as the “crown” area, the tread of most MICHELIN® aircraft tires contain circumferential grooves molded into the tire in the tread area. These grooves are designed to channel water from between the tire and the runway surface thereby improving ground traction on wet runways.

**Undertread** – the term “undertread” refers to a layer of specially formulated rubber designed to enhance the bonding between the casing body and the tread reinforcing plies in bias tires or the protector plies in radial tires.

**Casing ply** – a casing ply consists of fabric cords (most often nylon), sandwiched between two layers of rubber. The casing body itself is made from multiple layers of casing plies, each adding to the strength and load bearing capacity of the tire. The casing plies are anchored by wrapping them around bead wires, thus forming the ply turn-ups.

**Bead** – the bead, composed of a number of bead wires, anchor the tire to the wheel. They are made from steel wires that are layered together and embedded in rubber to form a bundle. This bundle is then wrapped with rubber coated fabric for reinforcement. Generally, bias tires are made with 2–6 bead bundles (1–3 per side) whereas radial tires have 2 bead bundles (1 per side) regardless of the tire size.

**Chafer strips** – strips of protective fabric or rubber laid over the outer casing plies in the bead area of the tire. The purpose of these strips is to protect the casing plies from damage when mounting or demounting the tire and to reduce the effects of wear and chafing between the wheel and the tire bead.
Liner – in a tubeless tire, this is a layer of rubber specially compounded to resist the permeation of nitrogen and moisture through to the casing. It is vulcanized to the inside of the tire and extends from bead to bead. On a tubeless tire, the liner replaces the inner tube. With a tube-type tire, a different, thinner liner material is used to protect the casing plies from moisture and the tube from chafing. The liner of a tube-type tire is generally insufficient for air retention.

Sidewall – this is a layer of rubber covering the outside of the casing plies. It protects the cord plies and contains anti-oxidants. These chemicals are slowly released over time to help protect the tire from UV and ozone damage.

Chine – the chine tire is a nose well specially designed to deflect water and slush to the side and away from aft-fuselage mounted engines.

The following terms are specific to radial tires:

Define “radial” – radial tires are constructed with each casing ply laid at an angle that is approximately 90º to the centerline of rotational direction of the tire. Each successive layer is laid at a similar angle. Radial tires have fewer plies than bias tires of the same size because the cord direction is aligned with the burst pressure radial force, allowing for optimized construction.

Protector ply – this is typically found in retreadable tires in the crown area just under the tread rubber. It provides cut resistance to the underlying belts and casing plies.

Belt plies – these are laid between the tread area and the top casing ply. The purpose is to restrain the outer diameter of the tire thereby providing a tread surface with greater resistance to squirm and wear. It also provides a more uniform pressure distribution in the footprint for improved landing performance.
The following terms are specific to bias-ply tires:

Define “bias” – bias ply tires are constructed with the casing plies laid at angles between 30° and 60° to the centerline or rotation direction of the tire. The succeeding plies are laid with the cord at angles that are opposite to each other. This provides balanced casing strength. Most aircraft tires in service today are bias ply tires.

Tread reinforcing ply – this consists of single or multiple layers of a special nylon fabric and rubber laid midway beneath the tread grooves and top casing ply. These plies help to strengthen and stabilize the crown area by reducing tread distortion under load. Additionally, the tread reinforcing ply increases high speed stability and offers added resistance to tread puncture and cutting.

Breaker plies – these are sometimes used to reinforce the casing in the tread area of the tire.

New Bias Technology (NBT™) – this is a technology developed by Michelin that is unique to the construction of some of the Michelin® bias tires. It consists of a crown reinforcement placed on the inside of the tire. This reinforcement strengthens and provides a more uniform pressure distribution in the footprint of the tire. This slows the rate of wear and improves the landing performance of a tire with a lighter weight design.
Safety

Aircraft tire and wheel assemblies must operate under high pressures in order to support the loads placed on them. Consequently they should be treated with respect and regard for the high-pressure nature of the assembly. Follow the recommendations outlined in this training course, the Michelin Aircraft Tire Care & Service Manual, as well as those guidelines, recommendations and regulations provided by industry authorities such as wheel manufacturers, airframe manufacturers and governmental agencies.

Important – In the event of a conflict between recommended procedures, be sure to contact your Michelin representative before undertaking the procedure in question.

Later in this course guide, you will learn about considerations when mounting aircraft tires. When you are doing this type of work there are two basic safety concerns to remember in addition to the mounting information found later in this guide:

• In order to avoid back pain and other lifting-related injuries, always roll tires on the floor rather than carrying the tire. And always use mechanical lifting tools rather than picking the tire up. Aircraft tires and wheel assemblies are often heavy and represent a potential for injury if not handled properly.

• Before mounting any tire, visually check the tire and the wheel for damage that may have occurred in shipping or even during the time that the tire was stored in your facility.

After a tire has been mounted it will need to be inflated. It is important to respect the recommended inflation pressures and all other safety recommendations during the process of inflation. Most aircraft tires over 190 MPH are inflated with nitrogen.

• When inflating tires, be sure to use a suitable inflation cage.

• Keep pressure hose and fittings used for inflation in good condition.

• Allow the tire to remain in the inflation cage for several minutes after reaching its full inflation pressure.

In service, tires should also be treated with care so as to avoid conditions that would damage the tire and wheel assembly or create a dangerous situation for those around the assembly or aircraft.

• Careful attention should be shown to tire and wheel assemblies that are being handled or that are in storage. The Storage section of this course guide will give you more details on proper storage.

• You should never approach, or allow anyone else to approach, a tire and wheel assembly mounted on an aircraft that has obvious damage until that assembly has been allowed to cool to ambient temperature. This cooling generally requires at least three hours.

• Always approach a tire and wheel assembly from an oblique angle, in the direction of the tire’s shoulder.
• Deflate tires before removing the assembly from the aircraft unless it will be immediately remounted (for example, in the case of a brake inspection).
• Always deflate the tires before attempting to dismount the tire from the wheel or disassembling any wheel component.
• Use extreme caution when removing valve cores as they can be propelled from the valve stem at a high rate of speed.
• When tire and wheel assemblies are found with one or more tie bolt nuts damaged or missing, remove the assembly from service.
• Transporting serviceable tire and wheel assemblies must be done in accordance with the applicable regulatory body for the airline. The transportation of a serviceable inflated aircraft tire is covered by the U.S. Department of Transportation Code of Federal Regulations, the International Air Transport Association (IATA) and other regulatory bodies.
• While serviceable tires may be shipped fully pressurized in the cargo area of an aircraft, it is Michelin’s preference to reduce pressure to 25% of the operating pressure or 3 bars/40 psi, whichever is less.

Tire Care Basics

Storage – aircraft tires and tubes should always be stored in a dry dark environment, free from sunlight and ozone producing appliances such as air compressors, electric welding equipment, and electric motors. Aircraft tires do not have a specific shelf life and can successfully be stored for long periods of time, if proper techniques are used. Try to avoid florescent lighting and mercury vapor lights as they generate ozone. Tires should always be stored vertically, on their tread. Stacking tires on their sidewall can cause the beads to collapse, making the mounting process difficult.

Inflation pressure – the most important service you can perform on your aircraft’s tires is to make sure they are properly inflated at all times. If you make one or more flights a day, tire pressure should be checked daily. Tire pressure should be checked on the tires before the first flight of the day. If you fly less than one time per day, you should check tire pressure before each flight. Whether using tube-type or tubeless tires, the operating pressures should be set following the instructions given by the airframe manufacturer.

Properly inflating tube-type tires – air is usually trapped between the tire and the tube during mounting. Although initial readings show proper pressure, the trapped air will seep out around the valve stem hole in the wheel, and under the tire beads. Within a few days, as the tube expands to fill the void left by the trapped air, the tire may become severely underinflated. To compensate for this effect, check tire pressure before each flight for several days after installation, adjusting as necessary, until the tire maintains proper pressure.
**Tire growth** – during the first 12 hours after mounting and initial inflation, bias aircraft tires will generally grow between 6–10%. This is due to the stretching of the nylon plies that make up the internal structure of the tire. This growth will cause the inflation pressure of the tire to drop 6–10% as well. This is entirely normal, and is accounted for during mounting procedures. Radial tires grow somewhat less than 6–10% and with a correspondingly lower loss in pressure.

**Mounting**

**Wheels** – make sure you are familiar with and inspect all key wheel parts before beginning to mount a tire. To assist in this process, wheel manufacturers publish specific instructions in their maintenance manuals. Follow their recommendations and procedures for wheel assembly and disassembly to help obtain trouble-free mounting and dismounting.

Special care should be given to the following:
- Ensure that the bead seating area of the wheel is clean.
- Mating surfaces of the wheel halves should be free of nicks, burrs, small Dents, or other damage. Painted or coated surfaces should be in good condition.
- Be sure fuse plugs, inflation valves, and wheel plugs are in good condition and properly sealed against pressure loss.
- O-ring grooves in the wheel halves should be checked for damage or debris.
- O-rings must be of the proper material.

**Tires** – before mounting any tire, check that the tire markings are correct for the required application (size, ply rating, speed rating, part number, and TSO marking).

Visually inspect the outside of the tire for:
- Damage caused by improper shipping or handling.
- Cuts, tears, or other foreign objects penetrating the rubber.
- Permanent deformations.
- Debris or cuts on the bead seating surfaces.
- Bead distortions.
- Cracking that reaches the cords.
- Contamination from foreign substances (oil, grease, brake fluid, etc.) which can cause surface damage.

Inspect the inside of the tire for:
- Foreign material.
- Wrinkles in the inner liner.
- Inner liner damage.
**Initial pressure retention check** – the initial pressure retention check requires approximately 15 hours to determine if an assembly can be accepted for service. This important process helps assure reliable service and avoid costly returns for repairs. Additional checks are performed on tire/wheel assemblies not meeting the minimum acceptance criteria for pressure loss.

The procedure is as follows:
1. Inflate the newly mounted tire/wheel assembly to operating pressure as specified.
2. Store the inflated assembly for 3 hours.
3. Check the inflation pressure (be sure that the ambient temperature has not changed more than 5ºF – a drop of 5ºF will reduce inflation pressure by 1%).
   a. If the inflation pressure is $\geq 90\%$ of the operating pressure, go to step 4.
   4. If the inflation pressure is $< 90\%$ of the operating pressure, inspect the assembly for leakage. Use a soap solution on tire beads, valves, fuse plugs, etc..
   b. If soap bubbles or leaks are found, make appropriate repairs and return to step 1.
4. Re-inflate the tire to the specified operating pressure.
5. After a 12 hour storage period, check the inflation pressure (once again be sure the ambient temperature has not changed more than 5ºF).
   a. If the inflation pressure is $\geq 97.5\%$ of the operating pressure, re-inflate the tire to the specified operating pressure and accept the tire/wheel assembly. Stop initial pressure retention check.
   b. If the inflation pressure is $< 97.5\%$ of the operating pressure, inspect the assembly for leakage as in step 3b and proceed to step 6.
6. Re-inflate the tire to the specified operating pressure.
7. After a 24 hour storage period, check inflation pressure (be sure the ambient temperature has not changed more than 5ºF).
   a. If inflation pressure is $\geq 95\%$ of the operating pressure, re-inflate the tire to the specified operating pressure and accept the tire/wheel assembly. Stop initial pressure retention check.
   b. If inflation pressure is $< 95\%$ of the operating pressure, reject the tire/wheel assembly.
On-Aircraft Tire Inspection

Inflation pressure – to help avoid false readings, tire pressure should be checked on tires before the first flight of the day. If this is not possible, wait at least 3 hours after landing to allow the tire to cool to ambient temperature. Air in a hot tire will expand, causing a temporary higher pressure reading. Never bleed pressure from a hot tire. Always use a calibrated gauge with a range suitable for the application. It is impossible to know everything about a tire's inflation pressure by only looking at it.

Effects of underinflation – too little pressure can be harmful to your tires and dangerous to your aircraft and those in it. Underinflated tires can creep or slip on the wheel under stress or when brakes are applied. Valve stems can be damaged or sheared off and the tire, tube or complete wheel assembly can be damaged or destroyed. Excessive shoulder wear may also be seen. Underinflation can allow the sidewalls of the tire to be crushed, causing bead damage and making the tire unsafe to use. Severe underinflation may cause ply separation and casing degradation. This same condition can cause inner tube chafing and a resultant blowout.

Effects of overinflation – tires operating under too much inflation pressure are more susceptible to bruising, cuts, and shock damage. Ride quality as well as traction will be reduced. Continuous high pressure operation will result in poor tire wear and reduced landings. Extremely high inflation pressures may cause the aircraft wheel or tire to explode or burst, which may result in serious or fatal injuries. Never operate aircraft tires above rated inflation pressure.

Wear

Removal criteria – In the absence of specific instructions from the airframer, a tire should be removed from service for wear according to the following criteria:

- **NORMAL REMOVAL WEAR LIMIT**: Remove the tire when the wear level reaches the bottom of any groove at one point or up to 1/8 of the circumference.

  **NOTE**: When the NORMAL REMOVAL limit is reached, the tire should be replaced. If it is necessary to continue the tire in service beyond the normal wear limit, the tire should be removed either at the next maintenance base or upon reaching the RETURN TO BASE WEAR LIMIT (Exposed Cord Limit), whichever occurs first. At the RETURN TO BASE LIMIT (Exposed Cord Limit), the tire should be removed and replaced. In such a case however, the subject tire might not be suitable for retreading.

- **RETURN TO BASE WEAR LIMIT (Exposed Cord Limit)**: Remove the tire if either the protector ply (radial) or the reinforcing ply (bias) is exposed at any location over the tread surface. Continued operation of a tire after the top belt plies (radial) or top casing plies (bias) have been exposed, increases the possibility of chunking of the tread and rib stripping.

Note: If an aircraft has made an emergency or a particularly rough landing, the tire, tube and wheel should always be checked.
**Overinflation** – operating a tire at a higher pressure than required will cause increased wear at the center of the tread. This will reduce the life of the tire and make the tire more susceptible to bruises, cutting, and shock damage.

**Underinflation** – when a tire is consistently operated underinflated, shoulder wear will result. Severe underinflation may cause ply separations and casing heat build-up, which can lead to thrown treads, sidewall fatigue, and shortened tire life.

**Worn beyond recommended limits** – if a tire is worn into the casing/body plies, the strength of the tire will be reduced. This may cause the tire to burst or explode, which may result in serious or fatal injuries.

**Flat spotting** – this wear condition is a result of the tire skidding without rotating, and is usually caused by brake lock-up or a large steer angle. The tire should be removed from service if the flat spotting exposes the protector or reinforcing ply, otherwise the tire may remain in service if it does not cause aircraft vibration.

**Asymmetrical wear** – this is a result of the tire operating under prolonged yaw and/or camber. Tires that do not expose any fabric can be dismounted, turned around, and remounted to even up wear.
Limits for Tire Damages

Tread cuts / foreign objects – in the absence of specific cut removal instructions from the airframer, tires should be removed when:

- Cuts, embedded objects, or other injuries expose or penetrate the casing plies (bias) or tread belt layers (radial).
- A cut or injury severs or extends across a tread rib.
- Undercutting occurs at the base of any tread rib cut.
- Round foreign object openings are acceptable up to .375” in diameter.

Bulges or separations – immediately remove the tire from service. Mark these areas with a color crayon before deflating.

Chevron cutting – remove from service if the chevron cutting results in chunking which extends to and exposes the reinforcing or protector ply more than one square inch. Chevron cutting is caused by the sharp-edged ridges of concrete on runways which have been crosscut.

Tread chipping / chunking – remove from service.

Peeled rib – remove from service.

Groove cracking – remove from service if the groove cracking exposes the reinforcing ply of protector ply for more than 1/4” in length. An aircraft may return to a maintenance base to replace tires meeting this condition if there is no continuous cracking exposing fabric greater than one inch in length.
Rib undercutting – remove from service if undercutting extends more than 1/4” under the rib.

Contamination from hydrocarbons – oil, grease, brake fluids, solvents, etc., can soften or deteriorate rubber components. If a tire comes in contact with any of these, immediately wash the contaminated area with denatured alcohol, then with a soap and water solution. If the contaminated area is soft and spongy compared to an unaffected area of the tire, remove the tire from service.

Sidewall cuts – if sidewall cords are exposed or damaged, remove the tire from service. Cuts in the rubber which do not reach the cord plies are not detrimental to tire performance – the tire may remain in service.

Weather / ozone cracking – remove from service only if weather or ozone cracks extend to the cord plies.

Dismounting

Proper dismounting procedures simplify the job of servicing aircraft tires, while increasing safety and reducing the chances of damaging tires or wheels. The task of dismounting tires should not be undertaken without proper equipment, instructions, and trained personnel. The following is the basic sequence that should be followed:

- Before beginning any tire dismount, be sure to follow the instructions and precautions published in the wheel supplier’s maintenance manual.
- Mark damaged or bulge areas, if any, before deflating, using a contrasting color chalk.
- Completely deflate the tire or tube before dismounting.
- Use a bead breaker to loosen tire beads from both wheel-half flanges.
- Apply bead breaker ram pressure or arm pressure slowly, or in a series of sequences or jogs, to allow time for the tire’s beads to slide on the wheel.

What to do if the tire becomes fixed to the wheel:

- Release ram pressure. Apply a soap solution to the tire/wheel interface.
- Allow several minutes for the solution to penetrate between the tire and wheel.
- Reapply a reduced hydraulic pressure to the tire.
- Repeat several times if necessary.

If the tire still remains fast:

- Remove the tire/wheel assembly from the machine.
- Reinflate the tire in a cage until the bead moves back to its correct position.
- Deflate the tire.
Recommence the dismounting procedure:
- Remove tie bolts and slide out both parts of the wheel from the tire.
- For tube-type tires, remove the tube.
- Tire is now dismounted.

**Off-aircraft inspection with tire dismounted** – a systematic approach to tire inspection is recommended to insure that all areas are properly inspected. The following system is recommended:
- Inspect the tread area – follow the procedures for on-aircraft inspections.
- Inspect both sidewall areas – follow the procedures for on-aircraft inspections.
- Inspect the bead areas – check the entire bead area for chafing or damage
- Inspect the innerliner – any tire with loose, frayed or broken cords or wrinkles should be discarded. Liner blisters, especially in tubeless tires, should be left undisturbed.
- Inspect the inner tube, if applicable – tubes with leaks, severe wrinkles or creases, or chafing should be properly discarded.
- Inspect for wheel damage – wheels should be inspected according to the wheel manufacturer's recommendations.

**Vibration and balance** – vibration, shimmy, and other similar conditions are usually blamed on improper tire balance. Imbalance is a well known and easily understood cause for vibration. In many cases, though, this may not be the cause. There are a number of specific aspects of the tire, wheel, and gear assembly which can be the cause or contribute to aircraft vibration. As with any concern, a systematic approach should be taken to isolate its cause. The following inspections will help identify and/or prevent this problem:
- Check that the tire has been inflated to the proper inflation pressure.
- Assure that the tire reaches full growth before it is installed on the aircraft.
- Check that the beads of the tire have been properly seated.
- Check the tire for flat spotting or uneven wear.
- Verify that the tires have been properly mounted.
- Check for air trapped between the tire and tube.
- Check for wrinkles in the tube.
- Check the wheel for an imbalance due to improper assembly.
- Check the condition of the wheel to see if it has been bent.
- Check for a loose wheel bearing caused by an improperly torqued axle nut.
- Check for poor gear alignment as evidenced by uneven wear.
- Check for worn or loose landing gear components.
**Understanding Regulatory Requirements**

**FAA certification / new tires** – this certification requires qualification of the tire to FAA Technical Standard Order (TSO) C62d. Generic static and dynamic tests are determined based upon the speed and load rating of the tire, and may include numerous landing, taxi, and take-off cycle tests.

**FAA certification / retreaded tires** – tires are qualified to the requirements of FAA Advisory Circular 145-4. Tires are tested based upon the speed rating and current retread level.

**OEM certification** – this certification is generally based on aircraft specific requirements, as required by the OEM, in addition to FAA certification per TSO-C62d.

**Course Completion**

Congratulations! You have now completed the course material for Phase I of the Michelin® Certified Aircraft Tire Expert Program. The next step in the certification process is to complete the short test on the following pages, and then submit your answers to Michelin at the address listed on the answer sheet (page 23 of this course booklet). After we receive your answers, we’ll send your certificate out right away, providing you get at least 17 of the 21 answers correct. We’ll also send you information about Phase II of the certification program.

So take your time, and don’t hesitate to use this study guide or other Michelin materials as reference as you work through the test. We don’t consider it to be “cheating,” and you shouldn’t either. The most important thing is for you to truly learn the material. After all, the whole idea is to become an expert.

When you’re done, we’d like to suggest that you keep this booklet around as a handy information resource on aircraft tires. And should you ever have any questions regarding aircraft tires, please don’t hesitate to contact us. Thank you for your participation and best of luck with the test!
Certified Aircraft Tire Expert Phase I Examination

Please indicate your answers to the following questions using the form on page 23. When you are finished, follow the directions provided for submitting your completed examination.

1. Most aircraft tires rated over 190 MPH are inflated with:
   A. Nitrogen.
   B. Oxygen.
   C. Carbon dioxide.

2. Most of the tires in service today on aircraft around the world are:
   A. Bias ply tires.  
   B. Radial tires.

3. Which Michelin brand name is used for radial tires:
   A. MICHELIN® AIR™  
   B. MICHELIN® AIR X®  
   C. MICHELIN® Pilot®  
   D. MICHELIN® AIRSTOP®

4. What is the proper direction from which to approach a damaged inflated tire and wheel assembly?
   A. 90° tread approach. 
   B. 90° sidewall approach. 
   C. Oblique angle, in the direction of the tire's shoulder. 
   D. Any direction.

5. Which of these is cause for immediate tire removal from an aircraft in service:
   A. Rib undercutting which extends more than 1/4" under the rib. 
   B. FOD cut in the sidewall of the tire. 
   C. Ozone cracking on the sidewall. 
   D. Chemical contamination due to exposure to hydraulic fluid.

6. Chevron cutting on a tire is caused by:
   A. Ozone attack on the rubber. 
   B. Miscuring of the tire during manufacturing. 
   C. Cross-grooved runways. 
   D. Chunking.

7. Michelin New Bias Technology (NBT™) is a reinforcement that:
   A. Works only with radial aircraft tires. 
   B. Reinforces the tire’s casing plies and extends the tire’s retreadability. 
   C. Provides a more uniform pressure distribution across the tire’s footprint. 
   D. Provides for better air retention and a smoother ride during taxi, takeoff and landing.
8. Weather/ozone cracking only becomes a reason for removing a tire when:
   A. Ozone cracking is visible on 80% of the sidewall of the tire.
   B. When the ozone cracking is noticeably worse on one side of the tire.
   C. When some of the cracks extend to the cord plies.
   D. When cracking appears on all tires on a single airplane.

9. If the rubber surface is soft and spongy, it is likely caused by:
   A. Contamination from fluids containing hydrocarbons.
   B. Cross-grooved runways.
   C. Improper tire maintenance.
   D. Heavy braking.

10. A tube-type tire shows proper inflation pressure after mounting but in a few days it is severely underinflated. Why?
    A. Inner tubes cause tires to expand more dramatically in a 36–48 hour time period.
    B. Air trapped between the tube and the tire will seep out within a few days.
    C. Air pressure gauges must be calibrated for each new type of tire.
    D. Inner tubes retain less air than tires alone.

11. Which of these is a reason for immediate tire removal:
    A. Pressure loss greater than 5% per day.
    B. Chevron cutting FOD cut which penetrates through the casing plies.
    C. Skid burn which does not go through the protector ply.

12. A quick glance at a tire will tell you everything you need to know about its inflation pressure.
    A. True, visual inspection is usually reliable.
    B. False, outward appearance can be deceiving.

13. What condition(s) can occur on an underinflated tire?
    A. Excessive heat from overdeflection.
    B. Excessive wear in the shoulder area.
    C. Creeping or slippage on the wheels when braking or under a heavy load.
    D. All of the above.

14. During the first twelve (12) hours after initial inflation and mounting, aircraft tires will generally grow by how much?
    A. 1% – 5%.
    B. 6% –10%.
    C. 11% – 15%.
    D. 16% –20%.
15. Which is the best way to conduct an inspection of aircraft tires?
   A. Following a systematic approach inspecting the tread, sidewalls, beads, inner liner, tube (if applicable), and wheel.
   B. Using a tire pressure gauge.
   C. Using a diagnostic computer to check for each potential problem.
   D. Visual inspection of each tire at each city upon landing.

16. Which of the following causes ozone cracking?
   A. Electric welding equipment.
   B. Electric motors.
   C. Fluorescent lighting.
   D. Exposure to the sunlight.
   E. All of the above.

17. FOD cuts that expose or penetrate casing plies (bias) or tread belt layers (radial) are reason for premature tire removal.
   A. True.
   B. False.

18. Overdeflection (underinflation) of an aircraft tire may cause:
   A. Excessive center rib wear.
   B. A partial or complete tread loss.
   C. Greater risk of FOD cuts.
   D. All of the above.
   E. None of the above.

19. A tire with wear to the bottom of the groove one eighth the circumference of the tire:
   A. Should be removed at the next scheduled maintenance.
   B. Should be removed immediately.

20. Which of these statements is false?
   A. Tire pressure should be checked as part of preflight inspection or on the first flight out.
   B. Tire pressure should be checked daily for aircraft seeing routine scheduled service.
   C. Bias tires are usually cooler running and last longer than radial tires.
   D. Underinflation can result in excessive shoulder wear.

21. Underinflation is more acceptable than overinflation:
   A. True, underinflation is the lesser of two evils.
   B. False, both conditions are unacceptable.
Michelin Certified Tire Expert Program
Phase I Examination

Date ____________________________

Name ________________________________________________________________

Company __________________________________________________________________

Mailing Address __________________________________________________________________

City _________________________________________________________________________

State ____________  Zip _________________  Country _____________________________

Telephone __________________________________  Fax _____________________________

E-mail ______________________________________________________________________

Would you like to receive the second phase of this program? Circle:    Yes     or     No

Instructions:
Questions for this examination are contained on pages 20–22. Please select only the best answer. Place your answers below next to the appropriate question number, using upper case letters. When you have completed all questions, detach this perforated sheet and mail to the address listed below.


Please mail your completed examination form to:  
Michelin Tire Test Level 1
Michelin Aircraft Tire Company, LLC
One Parkway South
P.O. Box 19001
Greenville, SC 29615   USA
1. Tread
2. Tread reinforcing ply
3. Undertread
4. Sidewall
5. Casing plies
6. Casing ply turn-ups
7. Liner
8. Bead
9. Chafer strips