



Tire construction

ENGINEERING AND TECHNICAL INFORMATION

AIRCRAFT TIRE CONSTRUCTION

As a function of its purpose, an aircraft tire must withstand a wide range of operational conditions. When on the ground, it must support the weight of the aircraft. During taxi, it must provide a stable cushioned ride while resisting heat generation, abrasion and wear. At take-off, the tire structure must be able to endure not only the aircraft load but also the forces generated at high angular velocities. Landing requires the tire to absorb impact shocks while also transmitting high dynamic braking loads to the ground. All of this must be accomplished while providing a long, dependable, reliable, service life.

These extreme demands require a tire which is highly engineered and manufactured to precise conditions. For this reason, tires are designed as a composite of various rubbers, fabric and steel products. Each of the components serves a very specific function in the performance of the tire.

To meet the aircraft demands of today and tomorrow, Michelin designs and produces different and distinct tire constructions. The conventional cross-ply or BIAS tire, the ORION™ BIAS (unique to Michelin), and the RADIAL tire. Both nomenclatures (BIAS and RADIAL) describe the angular direction of the carcass plies.

While many of the components of a bias or radial tire have the same terminology, the carcass ply angles are not the only difference between a bias constructed tire and a radial constructed tire. The technologies utilized are quite different, involving different design parameters, compounds, and materials.

THE TREAD

refers to the crown area of the tire in contact with the ground. Most Michelin tires are designed with circumferential grooves molded into the tread area. These grooves help to improve adhesion with the ground surface and provide a mechanism to channel water away from the area between the tire and runway surface. This reduces the occurrence of hydroplaning on wet runways.

The tread compound is formulated to resist wear, abrasion, cutting, cracking and heat buildup. It prolongs the life of the casing by protecting the underlying carcass plies.

THE UNDERTREAD

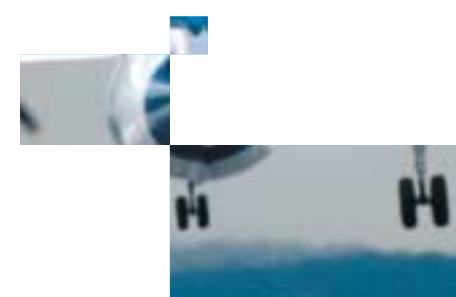
is a layer of specially formulated rubber designed to enhance the bonding between the tread reinforcement / protector plies and the carcass body. For those tires designed to be retreaded, this rubber layer will be of sufficient thickness to act as the interface for buffing the old tread assembly, as well as the liaison with the new retread products.

A CARCASS PLY

consists of fabric cords sandwiched between two layers of rubber. Today, the most common fabric cord is nylon. The carcass body itself is made from multiple layers of carcass plies, each one adding to the strength and load bearing capability of the tire. The carcass plies are anchored by wrapping them around bead wires, thus forming the PLY TURN-UPS.

FOR BIAS constructed tires, the carcass plies are laid at angles between 30° and 60° to the centerline or direction of rotation of the tire. Succeeding plies are laid opposite to each other, with cords running diagonally to provide balanced strength.

FOR RADIAL constructed tires, the carcass plies are laid at an angle approximately 90° to the centerline or direction of rotation of the tire. Each successive layer is laid at this same angle. Radial constructed tires of the same size have a fewer number of plies than do tires of a bias construction because the radial design enables each component of the tire to be optimized independently.



Products Unique to the BIAS TIRE

THE TREAD REINFORCEMENT PLY

consists of single or multiple layers of a special nylon fabric and rubber laid midway beneath the tread grooves and top carcass ply. These piles help to strengthen and stabilize the crown area by reducing tread distortion under load and to increase high speed stability. They also offer a resistance to tread puncture and cutting and help to protect the carcass body.

BREAKER PLIES

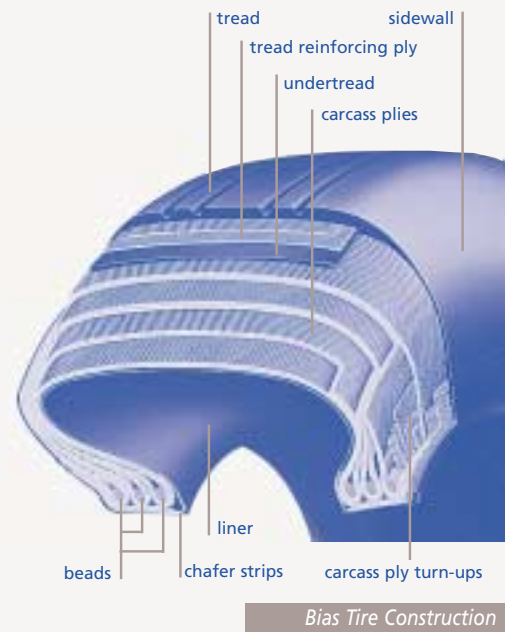
(not shown) are sometimes used to reinforce the carcass in the tread area of the tire.

FABRIC TREAD

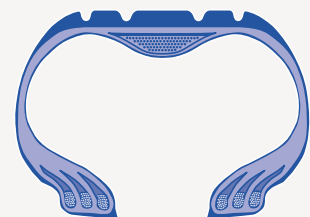
(not shown) is a unique development for application in high speed military aircraft. Multiple plies of nylon cord are layered throughout the tread stock, reducing rubber distortion under load and high speeds, thus reducing heat normally generated by flexing. The laminates also control the formation of high speed “standing waves”. Cut and puncture resistance is also a benefit of this type of construction.

ORION™ TECHNOLOGY

is a development unique to Michelin Bias construction. It consists of a circumferential CROWN REINFORCEMENT placed on the inside of the tire. This CROWN REINFORCEMENT strengthens and provides a more uniform pressure distribution (flatter shape) in the footprint SLOWING THE RATE OF WEAR, improving landings performance in a lighter tire design. Shoulder wear is also reduced due to the small difference in circumference between the center of the tread and the shoulder.



Bias Tire Construction



ORION™ technology

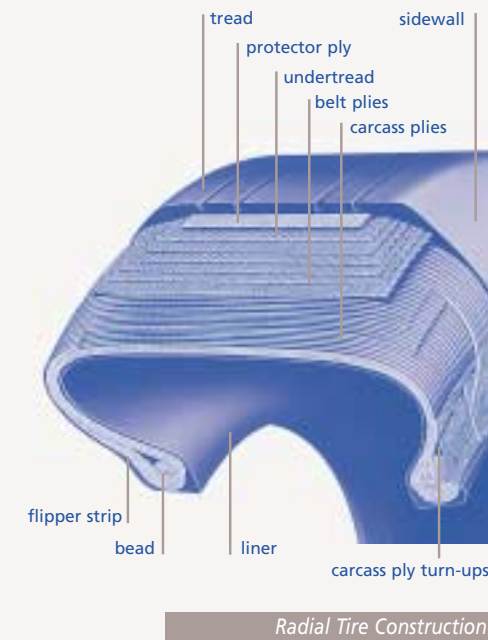
Products Unique to the RADIAL TIRE

THE PROTECTOR PLY

when present, is placed in the crown area just below the tread rubber. It provides cut resistance protection to the underlying belts and carcass plies.

BELT PLIES

(Binding layers) are laid between the tread area and top carcass ply. They restrain the outer diameter of the tire, providing a flatter tread surface with greater resistance to squirm and wear.



Radial Tire Construction

Tire construction

THE BEADS

or bead wires anchor the tire to the wheel. They are fabricated from steel wires layered together and embedded with rubber to form a bundle. The bundle is then wrapped with rubber coated fabric for reinforcement.

Depending on the size and design application, BIAS tires are constructed with 2 to 6 total bead bundles (1 to 3 per side). In contrast, RADIAL constructed tires have 2 bead bundles (1 on each side) regardless of tire size.

CHAFFER STRIPS

are strips of protective fabric laid over the outer carcass plies in the bead area of the tire. Their purpose is to protect the carcass plies from damage when mounting or dismounting and to reduce the effects of wear and chafing between the wheel and the tire bead.

THE LINER

in tubeless tires is a layer of rubber specially compounded to resist the permeation of nitrogen and moisture through to the carcass. It is vulcanized to the inside of the tire and extends from bead to bead.

In tube-type tires, a different, thinner liner material is used to protect the carcass plies from moisture and tube chafing, but is generally insufficient to maintain air retention.

THE SIDEWALL

is a rubber cover over the side of the carcass plies. Its purpose is to protect the cord plies. In addition, the sidewall rubber contains anti-oxidants. They are slowly released over time to protect the tire from ultraviolet and ozone attack, which causes rubber cracking.

CHINE TIRES

The “chine” tire is a nose wheel tire designed to deflect water and slush to the side and away from engine intakes. It was primarily developed for aircraft with rear-mounted jet engines.

It consists of a flared upper sidewall protrusion which deflects the spray pattern of water or slush emitted from the tire contact with the runway. A tire can consist of a single chine (one sidewall flared) for dual nose wheel tire configurations or double chines (both sidewalls flared) for single nose wheel tire configurations.

The chined tire is now in use as standard equipment on many commercial jets. It is fully retreadable and may be used on any aircraft, provided adequate clearance is available.



Single Chine Tire



Dual Chine Tire