

Coming in for a Landing

The airplane is in the final stage of its descent from flight altitude. The pilot is slowing down the airplane and getting ready to land.

The pilot pulls a lever. With a whine and a thump, the landing gear is deployed.

A few minutes later, the tires touch the runway, leaving a bit of smoke in their wake.

Animation

Sky and runway

On entry:

Airplane moves into the frame from the right, and lands on the runway. Puff of smoke comes out the back of the airplane when the wheels hit the runway.



Intro

No other single part of an airplane structure takes a beating the way the airplane's landing gear does.

A single hard landing can apply forces that are many times more than the weight of the entire airplane structure.

In this chapter you will be introduced to the different landing gear configurations and to the parts that comprise an airplane's landing gear system.



Types of Landing Gear

The landing gear on an airplane serves two purposes. It allows the plane to take off and land safely and allows the pilot to maneuver the plane on the ground.

The type of landing gear used on an airplane depends upon where the airplane needs to land.

Airplanes can be equipped with:

- Floats for water landings
- Skis for landing on snow and ice
- Conventional or tricycle gear for ground landings

Click on each image to learn more about each landing gear type.

Animation

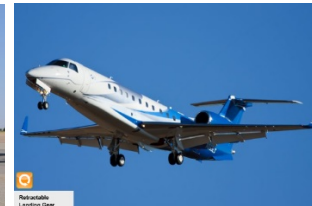
As narration is read, each of the following appear on screen, in order:

A photograph of a seaplane

A photograph of a ski plane

A photograph of a light airplane with conventional gear (two wheels forward, one aft)

A photograph of a commercial aircraft with tricycle gear (one wheel forward and multiple wheels aft)



Landing on the Water

Planes that are designed to land on water are equipped with floats made from fiberglass or aluminum.

Rudders attached to the rear of the float allow the pilot to steer the airplane across the surface of the water.

Animation –

Use vector illustration of a seaplane

When the second paragraph is being read, label for rudder fades in.



Landing on Snow or Ice

Some planes have landing gear that allows them to land on snow or ice.

These planes either have skis in place of wheels, which means they can only land on snow or ice, or they have a retractable ski assembly which allows the plane to land on snow or on a dry runway.

Illustrations –

On enter:

photograph of a ski plane, first with only skis



When third paragraph is read, fade to photograph of plane with retractable skis



Landing Gear Configurations – Conventional Landing Gear

In a conventional landing gear configuration, two wheels are mounted on struts beneath the cabin of the airplane, and a smaller wheel, called a tail dragger, is mounted at the rear of the plane.

Originally, the tail wheel was stationary, however, in modern lightweight airplanes this wheel is steerable using the rudder pedals.

Illustrations –



Landing Gear Configurations – Tricycle Landing Gear

The most common configuration for landing gear on commercial aircraft is the tricycle configuration.

Tricycle gear is configured like the wheels in a child's tricycle, with one set of wheels beneath the nose of the aircraft and two or more sets of wheels aft, beneath the wings, cabin, or both.

Like the rear wheel in a conventional gear configuration, the nose wheel is steerable via the rudder pedals.

The gear is retracted just after takeoff and remains stowed until it is deployed again, just before landing.

Illustrations –



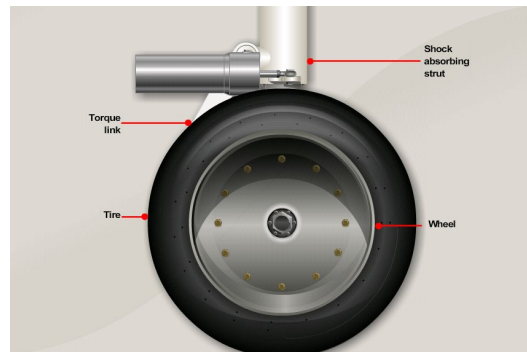
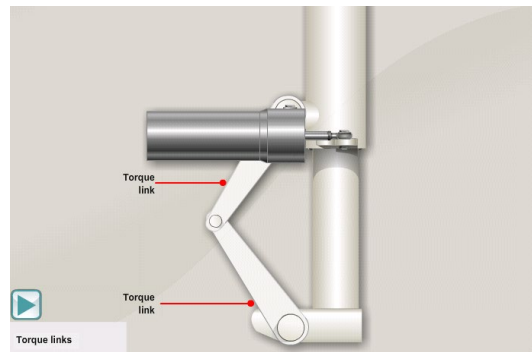
Parts of a Landing Gear System

Regardless of how the landing gear is configured, and whether the gear is retractable or not, all landing gear systems have similar components, including:

- Shock absorbing struts
- Torque links
- Wheel assembly

Animation: Labels fade in as each part is read from the list.

Use image one for strut and torque links, then fade second image in with wheel.



Oleo Struts

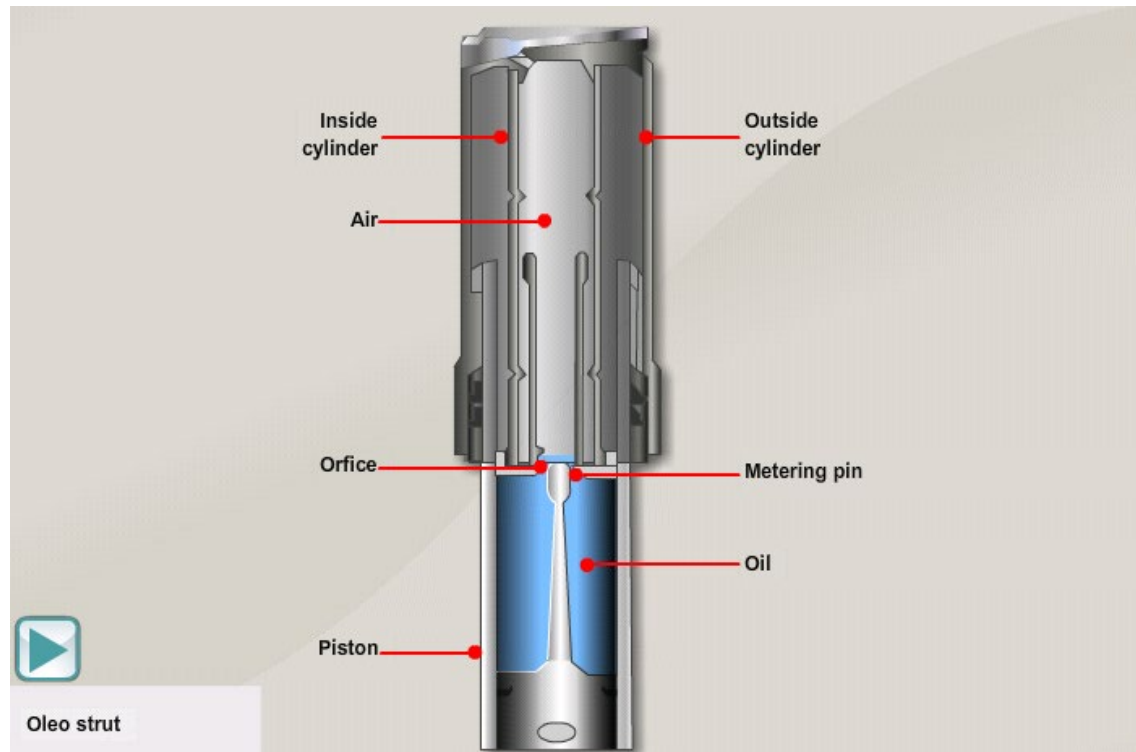
If an airplane's landing gear did not include some kind of system to absorb the force generated by the weight and speed of the plane, it would cause a lot of damage to the airplane. To prevent this, airplane landing gear contains a shock-absorbing piece called a strut.

The landing gear assemblies found on commercial aircraft use Oleo struts, which use a combination of air and oil to absorb the shock of the aircraft landing.

Oleo struts have the following components:

- Inside cylinder
- Piston
- Orifice
- Metering pin
- Air
- Oil

Animation: Labels fade in as each part is read from the list.



Oleo Struts

When an airplane lands, the force of the plane against the strut moves the piston and pushes the oil into the air chamber.

The air is compressed absorbing part of the force of the airplane landing.

To prevent very rapid extension of the strut after initial compression, various types of orifices are used to restrict the reverse fluid flow,

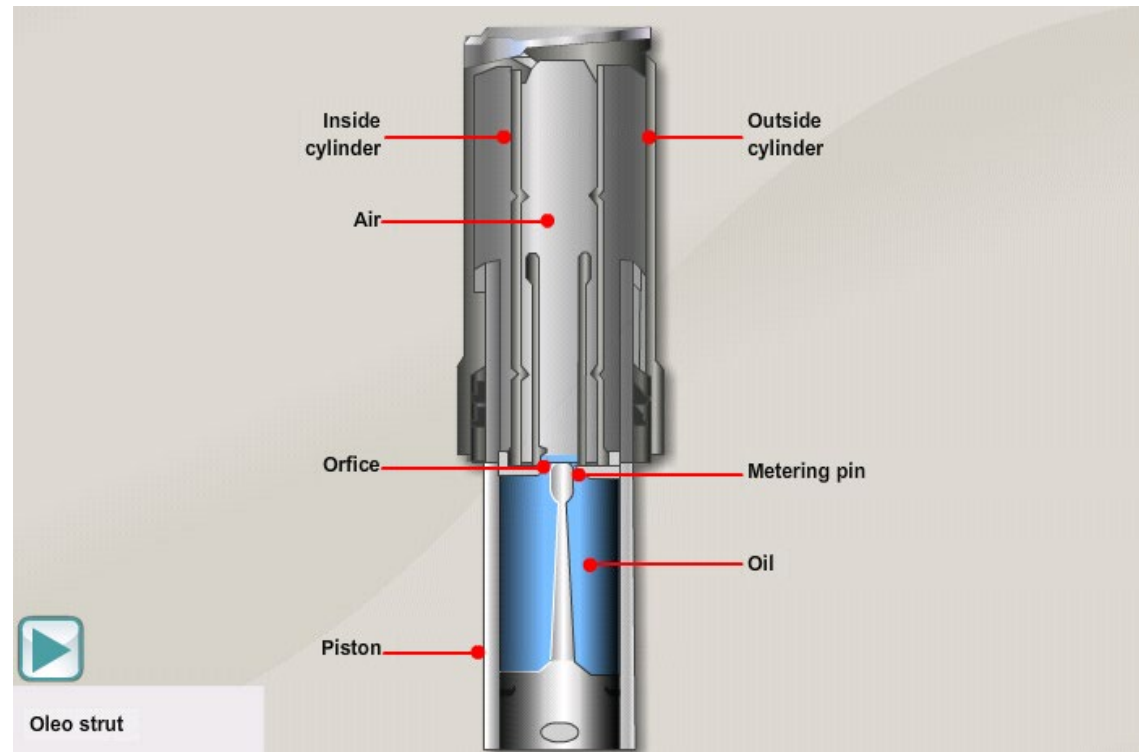
The air is compressed absorbing part of the force of the airplane landing.

The remaining force is absorbed by the metering pin closing off the orifice in the upper cylinder.

Click the Play button to see the Oleo strut in action.

Animation –

Vector drawing of the Oleo strut extended
On click – strut works



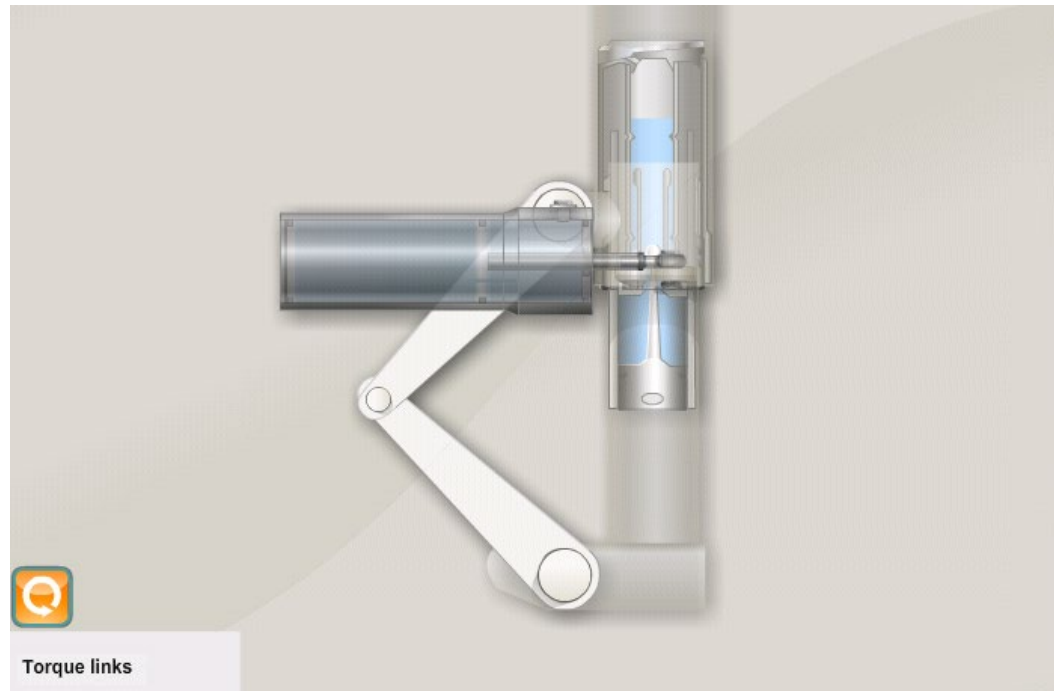
Torque Links

Torque links keep the landing gear pointed straight ahead as the airplane lands.

One link is connected to the strut, and the other is connected to the wheel piston. The links are hinged at the center so that the piston can move up and down in the strut.

Illustration –

Transparent strut illustration with torque link arms and hinge labeled



Wheel Assembly

“Wheel” is often used to describe the part that allows the airplane to move along the ground.

A “wheel” is not actually a single part. It comprises two parts: an inner metal hub and an outer rubber tire.

Together, these parts make up the wheel assembly.

Illustration

Wheel front and side view with metal hub labeled as “wheel” and rubber tire labeled as “tire.”



Wheel Hubs

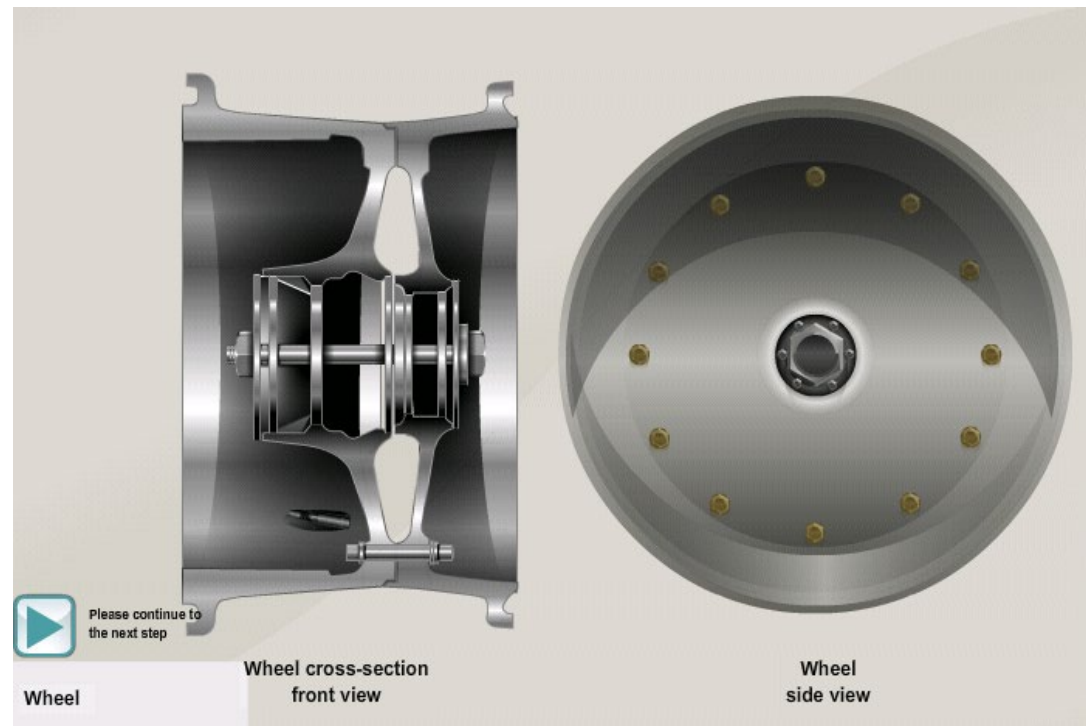
Wheels are made from either aluminum or magnesium alloy, both of which are strong, lightweight and require little maintenance.

A split wheel hub is used in the landing gear in all modern aircraft.

Split wheel hubs are held together using nuts and bolts and sealed with an O-ring.

It is important for the wheels of an airplane to be in proper alignment with the airframe.

Illustration – Vector drawing of split wheel showing parts



Tires

Aircraft tires travel fewer miles, but experience far more stress than a standard automotive tire.

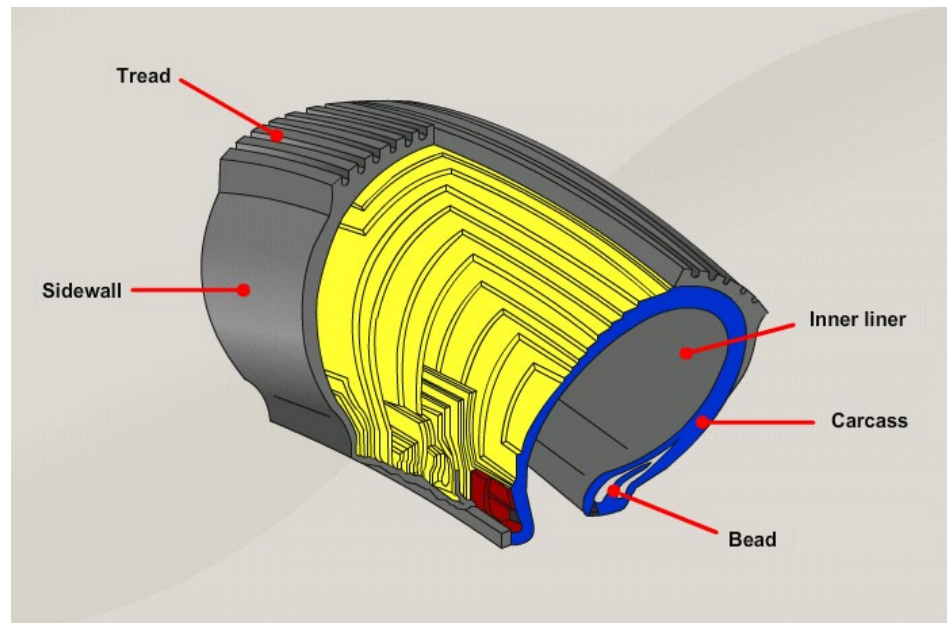
The unique stresses require aircraft tires to be built differently than a standard automotive tire, even though they have the same component structure:

- An exterior tread and sidewall
- An Interior liner, carcass, and bead

Click each component name to learn more about it.

Illustration –

Vector drawing of cutaway of the tire (see below), need labels for the parts in the bullet list in the main text, but nothing else. Labels appear as each bullet point is read. Labels are interactive and branch to the slides that follow.



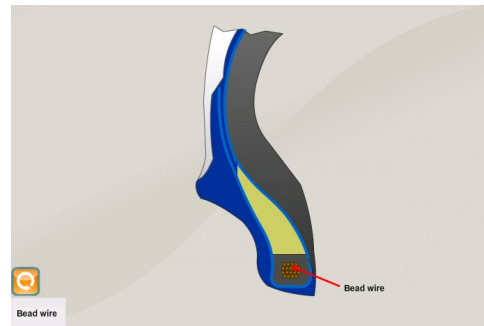
Bead

The bead in an airplane tire is composed of multiple strands of high tensile steel wire embedded in rubber and wrapped in strips of fabric.

The bead functions to hold the tire on the rim and anchor the fabric plies that encase the bead wires.

Illustration –

Zoom to close up on the right with the bead wire labeled
Close button should appear at bottom left of screen.

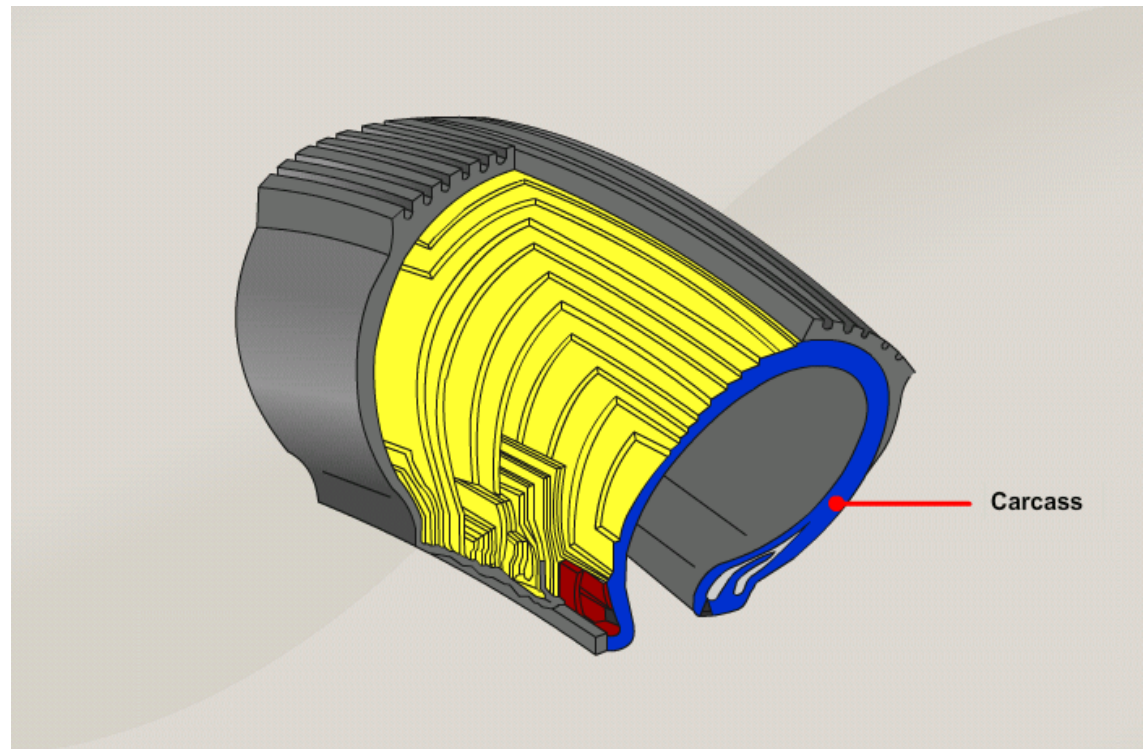


The Carcass

The inner layer of cord fabric in an airplane tire is called the carcass.

It is the most important piece in the framework of a tire. The carcass maintains the tire's air pressure and vertical load, and helps absorb shocks.

Illustration –
Vector image from frame 23 with just the carcass labeled



The Tread

The tread is the layer of rubber on the outer surface of the airplane tire. It is the part of the tire that contacts the ground and protects the body of the tire from abrasions, cuts, bruises, and moisture.

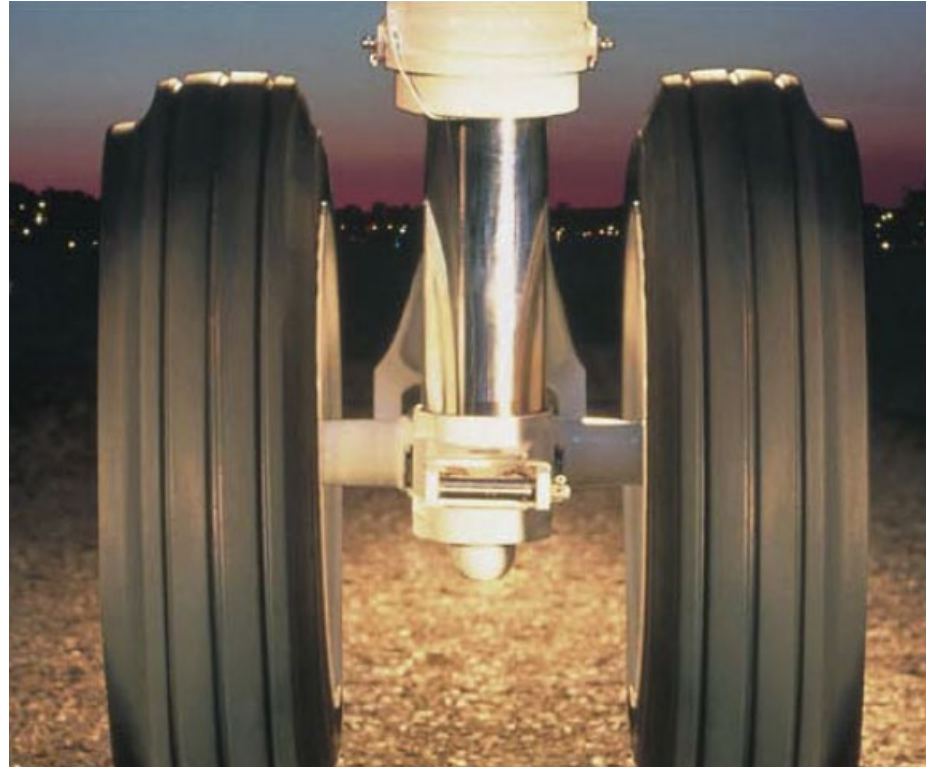
The tread on an airplane tire is far less complex than the tread on the tire for your car.

Some airplane tires, called smooth contour tires, have a smooth, uninterrupted surface.

The most common airplane tire has a ribbed tread. A ribbed tread has three or more continuous ribs separated by grooves.

Illustration –

Photograph of close up of the tread on an airplane tire



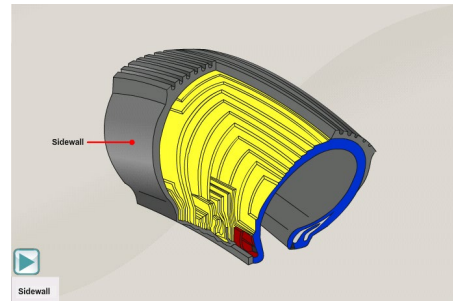
The Sidewall

The sidewall is the outer layer of rubber that adjoins the tread and extends to the bead.

It makes up the sides of the tire.

The sidewall of the tires for many airplanes also includes a chine. A chine is a flared ring that sticks out from the tire, and deflects water to the sides of the airplane, away from the engine inlets.

Illustration – vector drawing from frame 23



Fade to illustration below when third paragraph is read.



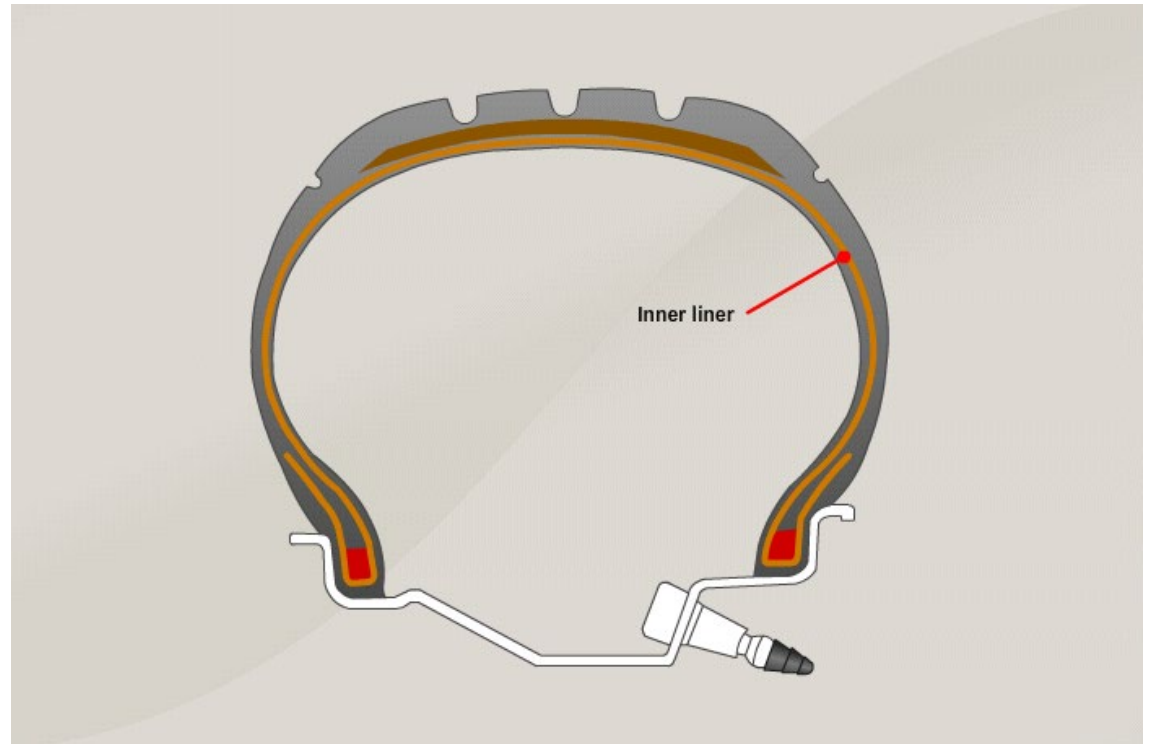
The Inner Liner

The inner liner is a layer of rubber inside the tire. The inner liner replaces the inner tube, and maintains tire pressure.

The inner liner is generally made of a polyisoprene rubber or synthetic rubber called butyl.

Illustration –

Vector drawing of the tire with the inner liner labeled (see below)



Wheel Assembly Alignment

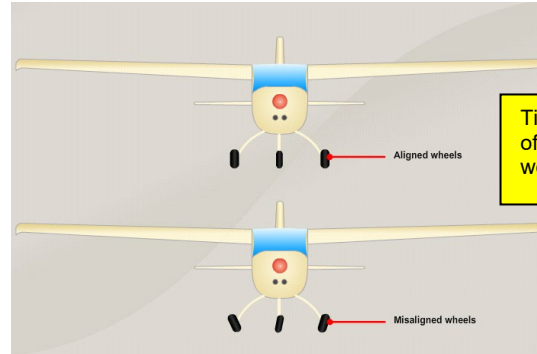
It is important for the wheel assemblies of an airplane to be in proper alignment with the airframe.

Two alignment checks are important:

- Toe
- Camber

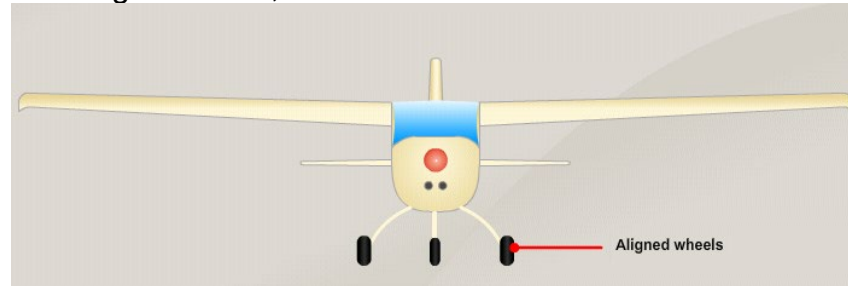
Select each to learn more.

Landing:



Tires mounted on misaligned wheels often show rapid and uneven tread wear and can fail without warning.

Warning fades out, buttons fade in:



Add buttons: Toe and Camber

Toe

Toe is the degree to which the angle of a wheel assembly deviates from pointing directly forward.

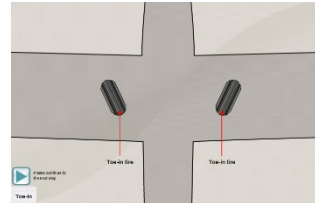
In a wheel system that is aligned toe in, the front of the wheels are closer together than the back.

As the airplane moves forward the wheels try to move closer together.

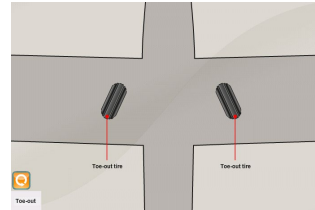
In a wheel system that is aligned toe out, the front of the wheels are farther apart than the back.

As the airplane moves forward, the wheels try to move farther apart.

Toe In:



Toe out:

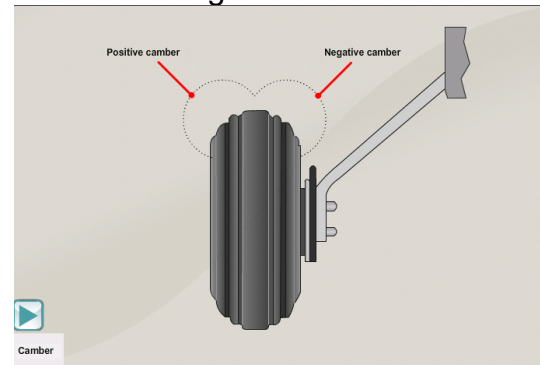


Camber

Camber is the amount the wheels of an airplane are tilted, or inclined, from the vertical position.

If the top of the wheel tilts outward, the camber is positive, and if it tilts inward, the camber is negative.

Animation – Start with image of wheel



On first click –
have the wheel tilt so that the top of the wheel is tilted to the left (outline for positive camber)



On second click-
Have the wheel tilt so that it is tilted to the right (outline of negative camber)

Wheel Assembly Configurations

The wheel assembly is the first part of the plane that touches the ground during landing. As a result, it is one of the most highly stressed parts of the aircraft.

As the weight of the airplane increases, the configuration of the wheel assembly changes.

Click on each image to learn more.

Fade these images in one at a time as the narration is read.



Single Wheel Assembly

Light aircraft often only have one wheel assembly per leg.



Fixed Tricycle
Landing Gear

Bogie Assemblies

As the weight of the aircraft increases, more wheel assemblies are used per gear leg to help spread the airplane's weight over a larger area.

Two wheels attached to a single strut and torque link assembly is called a bogie.

Two or more wheels (bogie):



Truck Assemblies

The largest aircraft often have multiple double-wheel (bogie) assemblies per gear leg.

This type of wheel assembly is called a truck.

Multiple bogies (truck):



Course Title: Aircraft Systems
Chapter Title : Landing Gear Systems
Lesson: Parts of Landing Gear Systems

End Sample