Aircraft Maintenance
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Lecture – 06
Aircraft Wheels

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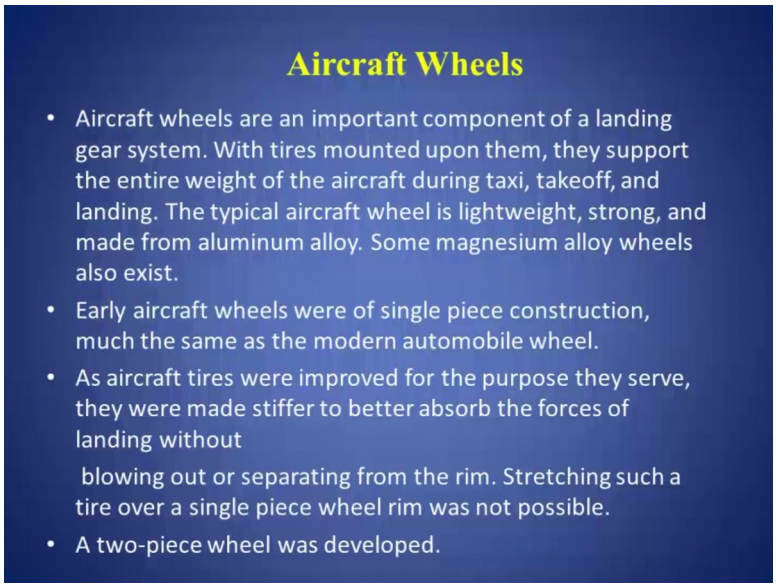

So, now coming to aircraft wheels, as we all know that wheels are a very important part of any vehicle, similarly in aircrafts; they are an important components of the landing gear system. Tires are mounted on these wheels, they are use to support the entire weight of the aircraft during all phases of operation on ground that is during taxing, takeoff and landing. A typical aircraft wheel should be of light weight; strong and is generally made of aluminum alloy, some of the aircraft wheels are also made of magnesium alloy.

Now during the old days, the aircraft wheels were of single piece construction, like we have in the modern automobile wheels, but as time progressed the aircraft tires were improved they were made stiffer, so that they can absorb forces of landing without blowing out or separating from the rim. So, with improved tires single piece rim was not possible because, stretching of tire would have been a difficult thing; with this improved tires with these improved tires a two piece wheel was developed.

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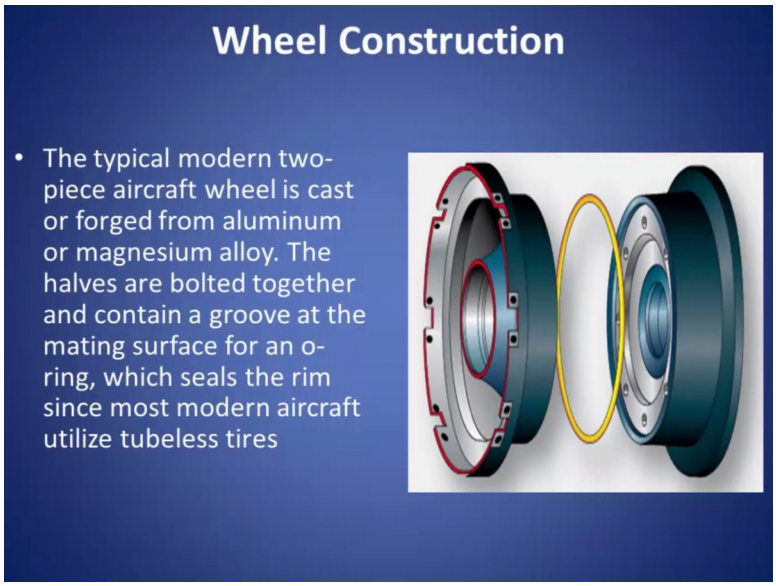

So, you can see in the diagram the wheel construction the wheel is in 2 halves.

This modern two piece aircraft wheel is generally made of casting or forging from aluminum alloy or magnesium alloy, these wheel halves are bolted together and they contain a groove at the mating surface. So, at the groove there is a groove at the mating surface, for an oring which seals the rim since most modern aircraft utilize tubeless tires. So, in the diagram we can see there is an oring a yellow coloured oring in between, this oring gets into the groove at the meeting surface and is used for sealing the rim, SO that tubeless tires can be used.

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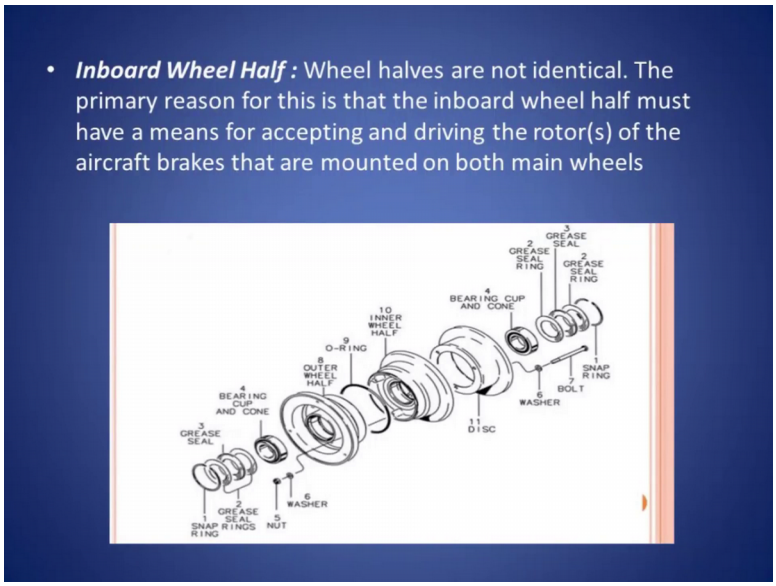

In this slide you can see the diagram, in the diagram you can see there is an outer wheel half, see this the outer wheel half the inner wheel half there are 2 wheel halves the outer wheel half the inner wheel half.

We just now mentioned in the last slide an oring in between, you can see this the oring then there is a disc which is attached to 1 of the wheel half, the inner wheel halves then there are bearing con cones bearing cups and cones on both sides on the outer side as well as the inner side; then beyond the bearings you can see the grease seal rings and the snap rings to loc lock the grease seals.

The inner in the inboard wheel half you can see in the diagram the inboard wheel half, these wheels halves the outboard and inboard they are not identical, the main reason for this is that the inboard wheel half must have a means of accepting and driving the rotors of the aircraft, brakes that are mounted on both main wheels.

So, in the brakes you can see this disc this is mounted to the inboard wheel half, due to this the 2 wheel halves are not identical they are different from each other; this inner inboard wheel halve will have disc attached to it, where as the outboard wheel half has no provision for this disc.

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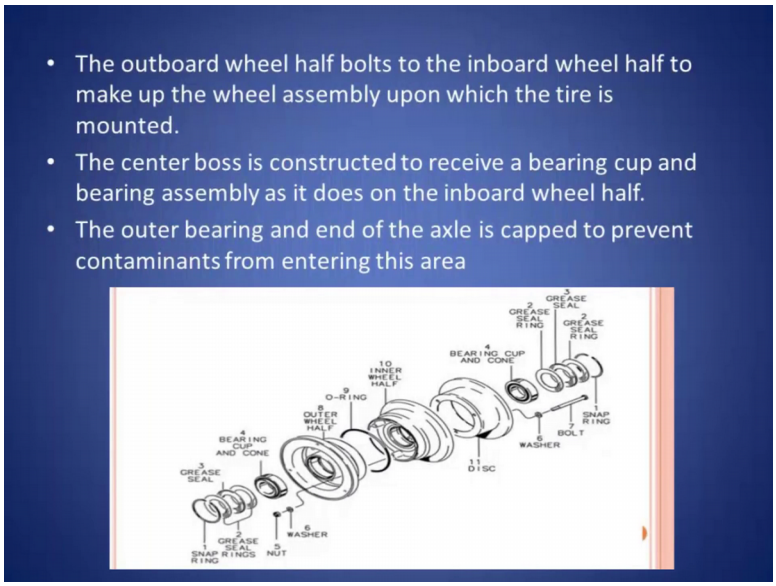

The outboard wheel half bolts to the inboard wheel half to make up the wheel assembly upon which the tire is mounted.

So, this outboard wheel half is bolted to the inboard wheel half and this together makes up the wheel assembly on which the tire is mounted; the centre boss you can see here in the diagram in the centre on both the wheels halves this is the outboard wheel half as well as this inboard wheel half, both places you can see there is a centre boss it is constructed to receive a bearing cup, this bearing goes in this wheel half and bearing assembly as it does on the inboard wheel half.

So, the centre boss is constructed to receive a bearing cup and bearing assembly, on both the wheel halves on both inboard as well as the outboard wheel half. The outer bearing and end of the axle is capped to prevent contaminants from entering this area. So, the bearing and the end of the capsule axle is capped, so that the contaminants do not enter this area.

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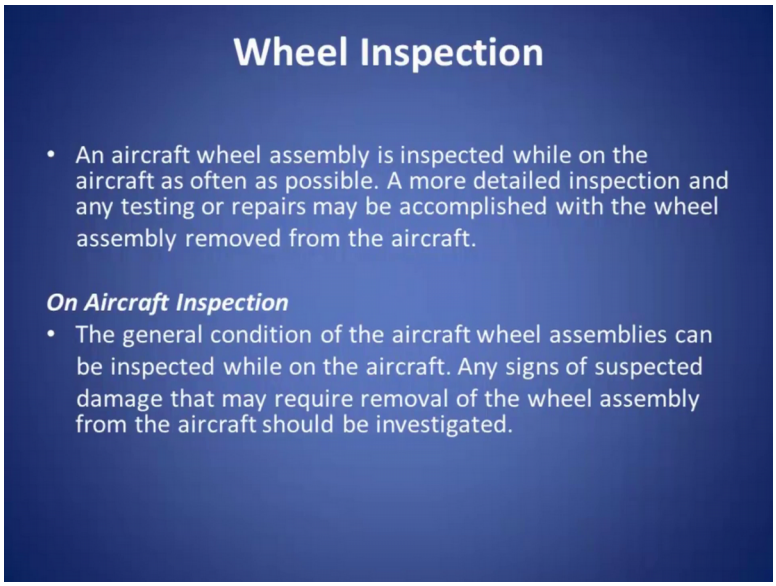

So, what are the inspections we carry out on the wheel? An aircraft wheel assembly is inspected while on the aircraft as often as possible. So, generally in all the p flight inspections before every flight, we carry out an inspection on the aircraft on the wheels also; a more detailed inspection and any testing or repairs may be accomplished with the wheel assembly removed from the aircraft. So, inspections may be with the wheel on the aircraft or removed from the aircraft.

So, more detailed inspection is done with the wheel assembly removed from the aircraft. Now when the wheel assembly is on installed on the aircraft what inspection do we do? The general condition of the aircraft wheel assemblies can be inspected, while on the aircraft any signs of suspected damage that may require removal of the wheel assembly from the aircraft should be investigated. So, when the wheel assembly is there on the aircraft, we carry out a general inspection, a visual inspection to see that the wheel is securely attached there is no damage there is no happen damaged on the wheel assembly.

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Now, coming to tires and tubes the aircraft tires and tubes, the tires may be tube type or tubeless type, they support the weight of the aircraft, while it is on the ground and provide the necessary traction for braking and stopping. The tires also help absorb the shock of the landing and cushion the roughness of takeoff rollout and taxi operations. So, the tires they support the weight of the aircraft while on the ground, provide necessary traction for breaking and stopping, they absorb the shock of landing and cushion the roughness of takeoff rollout and taxi operations.

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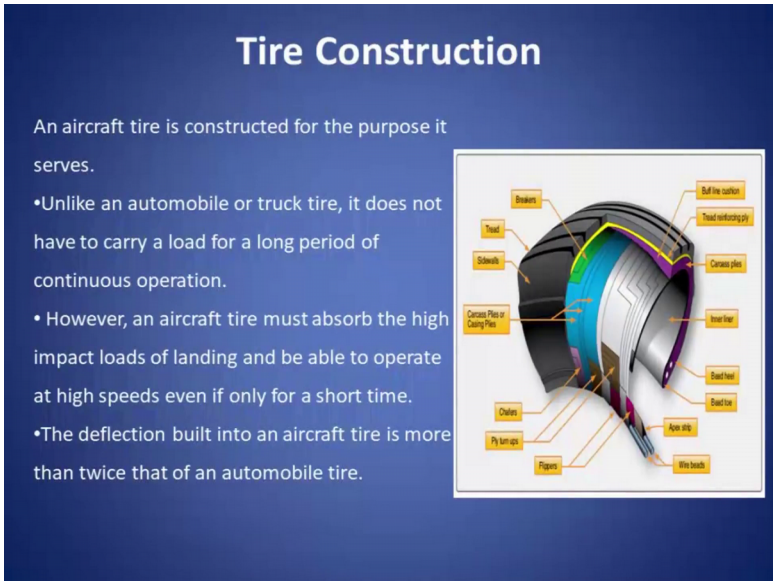

Coming to tire construction in the diagram you can see, a cross sectional view of a tire is given, an aircraft tire is constructed for the purpose it serves; unlike an automobile or truck tire it does not have to carry a load for a long period or of continuous operation.

So, in aircrafts tires they do not have to carry load for long period of continuous operation because, as soon as the aircraft gets airborne there is no load on the tire; however, an aircraft tire must absorb the high impact loads of landing and be able to operate at high speeds even if only for a short time.

So, during landing the tire has to absorb high impact loads and has to operate at high speeds; during takeoff and landing both the speeds are high, so your tire should be able to with stand this high impact loads and should be able to operate at high speeds; the deflection built into an aircraft tire is more than twice that of an automobile tire.

In the diagram, you can see the various parts have been mentioned; here you can see the breakers, this is the tread, these are the tire side balls, these are the casing plies; you can see these are the casing plies, these are the wire beads, bead heel, this is the bead toe, this is the inner liner you can see here the inner liner, then these are the piles. So, this is the cross sectional diagram of the tire showing different layers of piles.

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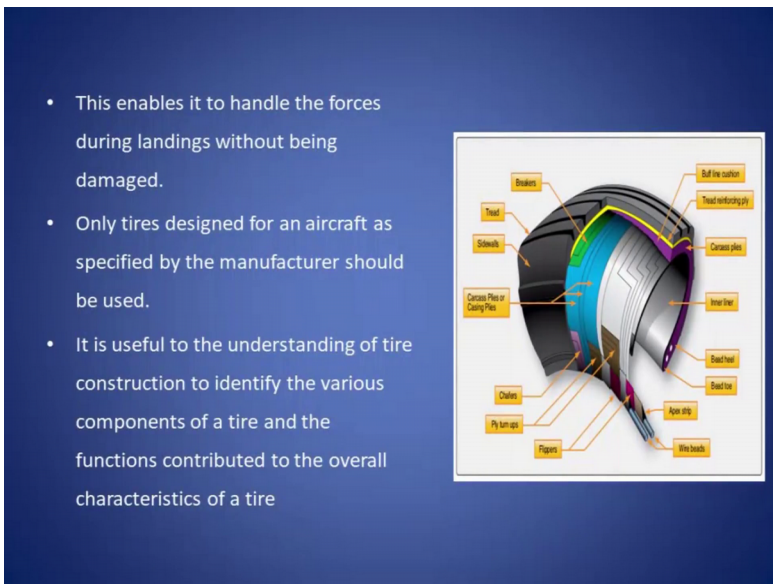

This enables it to handle the forces during landings without being damaged. So, this tire will help in handling the forces during landings, so that there is no damage on the aircraft

Only tires designed for an aircraft as specified by the manufacturer should be used, it is useful to the understanding of tire construction to identify the various components of a tire and the functions contributed to the overall characteristics of a tire.

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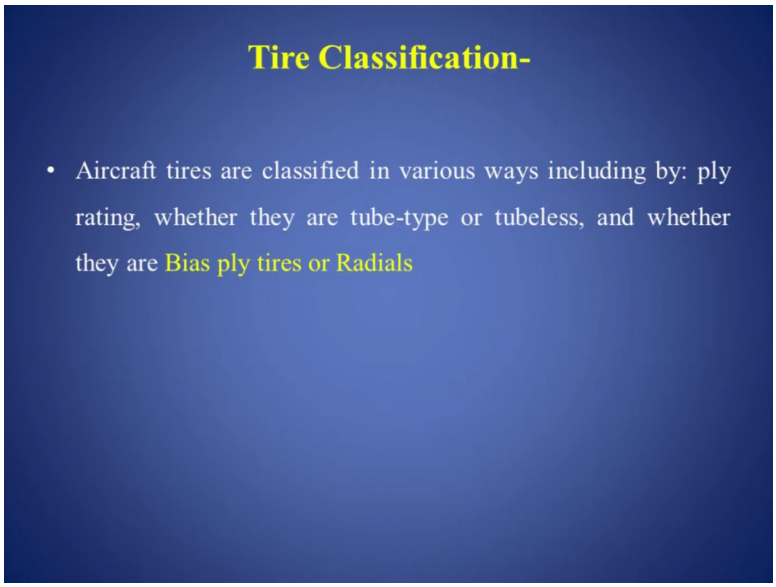

Now, aircraft tires are classified in various ways including ply rating, whether they are tube type or tubeless and whether they are bias ply tires or radials. So, tire classification is by ply rating they may be tube type or tubeless type, they may be bias ply tires or they may be radials tires, this is bias ply aircraft tire you can see in the diagram.

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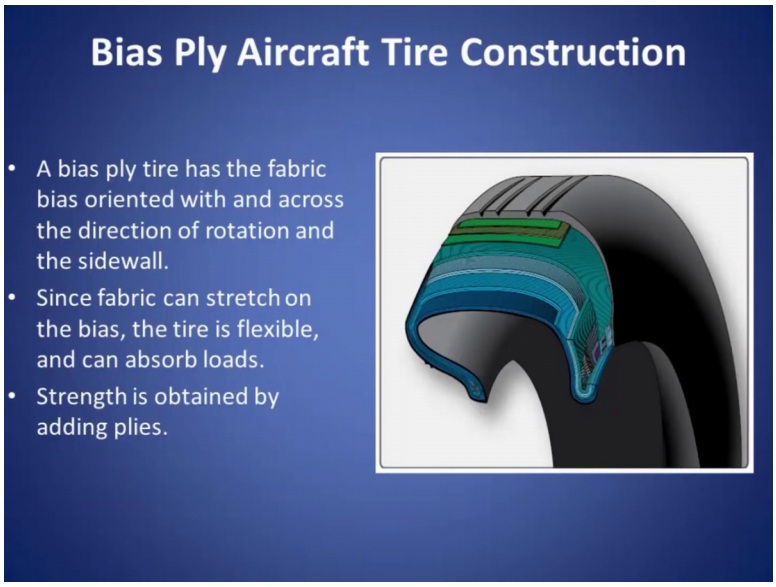

A bias ply tire has the fabric bias oriented with and across the direction of rotation and the sidewall.

Since fabric can stretch on the bias, the tire is flexible and can absorb loads; strength is obtained by adding plies, so the tire is also classified by ply rating the more the number of plies; the more strength the tire has.

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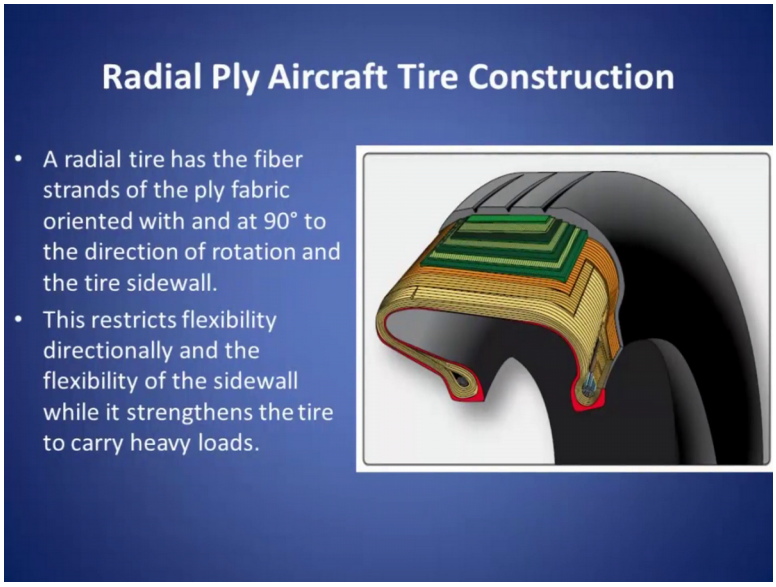

Now, radial ply aircraft tire or radial tire has the fiber strands of the ply fabric oriented with and at 90 degrees to the direction of rotation and the tire sidewall. So, this is the fabric orientation is 90 degrees to the direction of rotation and the tire side wall, this restricts flexibility directionally and the flexibility of the sidewall while it strengthens the tire to carry heavy loads.

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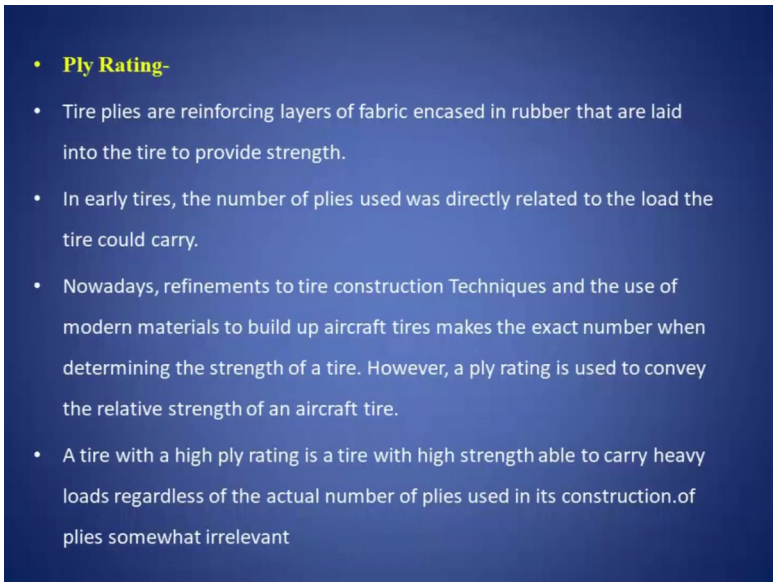

Now, ply ratings, Tires plies are reinforcing layers of fabric encased in rubber that are laid into the tires to provide strength. In early tires the number of plies used was directly related to the load the tire could carry, but now a day's refinements to tire construction technique and the use of modern materials to build up aircraft tires makes the exact number when determining the strength of a tire.

However, a ply rating is used to convey the relative strength of an aircraft tire, a tire with a high ply rating is a tire with high strength which is able to carry heavy loads regardless of the actual number of plies used in it, is construction of plies tube type or tubeless. Aircraft tires can be tube type or tubeless tires that are made to be used without a tube inserted inside, have an inner liner specifically designed to hold air.

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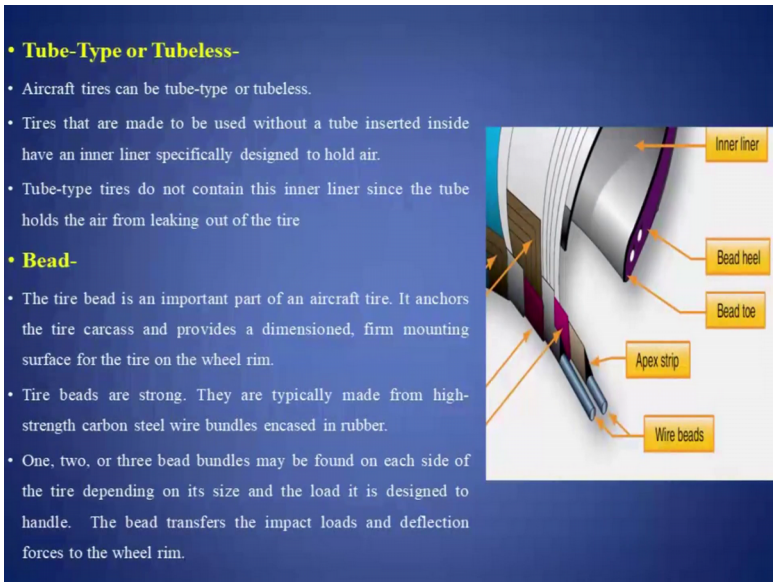

Tube type tires do not contain this inner liner since the tube holds the air from leaking out of the tire.

Bead we will see what is bead? The tire bead is an important part of an aircraft tire; it anchors the tire carcass and provides a dimensioned, firm mounting surface for the tire on the wheel rim. Tire beads are strong; they are typically made from high strength carbon steel wire bundles encased in rubber. So, in the diagram you can see here this is the bead, this is the bead heel, this is the bead toe and the beads they are made of wire they are carbon steel bundles which are encased in rubber.

So, this bead is an important part of an aircraft tire 1, 2 or 3 bead bundles may be found on each side of the tire depending on it is size and the load it is designed to handle; the bead transfers the impact loads and deflection forces to the wheel rim, so this bead transfers the impact loads and deflection forces to the wheel rim.

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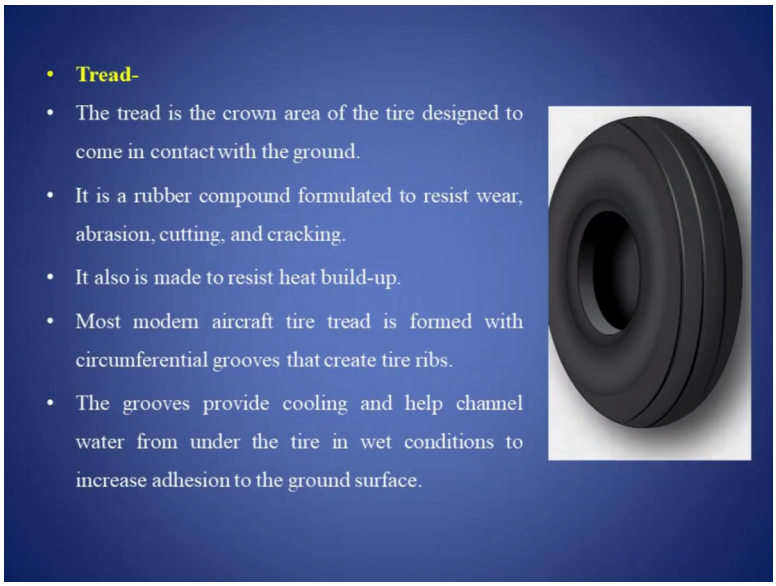

Tread, what is Tread? Tread is the crown area of the tire designed to come in contact with the ground, it is a rubber compound formulated to resist wear abrasion, cutting and cracking. It also is made to resist heat buildup most modern aircraft tires tread is formed with circumferential grooves that create tire ribs. So, in the diagram you can see these are circumferential ribs, you can see circumferential ribs in the diagram, you can see the grooves and these create the tire ribs.

The grooves provide cooling and help channel water from under the tire in wet conditions to increase adhesion to the ground surface. So, the purpose of the grooves, they provide cooling and help channel water from under the tire in wet conditions to increase adhesion to the ground surface.

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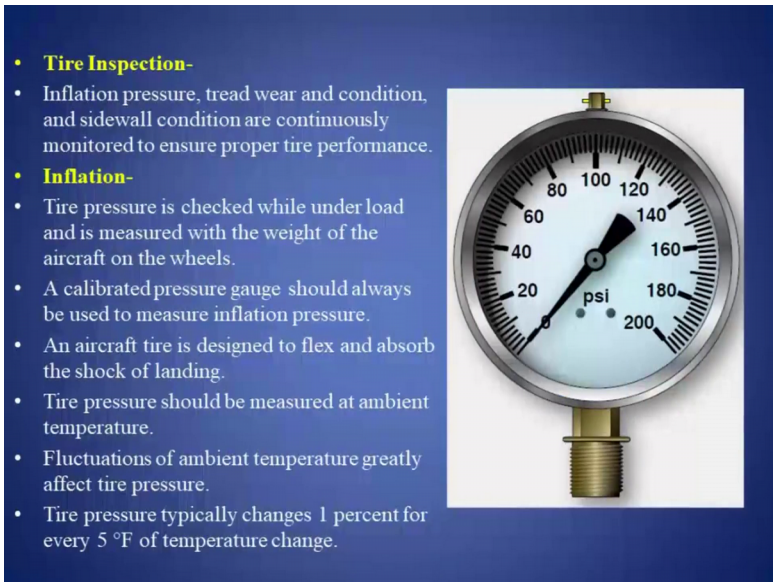

Now, what are the inspections on tire? Inflation pressure, tread wear and condition and sidewall condition are continuously monitored to ensure proper tire performance. So, during the time when the tire is used, almost in daily inspections inflation pressure is tested, tread wear and condition is checked, side wall condition is checked; these things are continuously monitored, so that proper tire performance can be achieved.

Inflation; tire pressure is checked while under load and is measured with the weight of the aircraft on the wheels; a calibrated pressure gauge should always be used to measure inflation pressure. So, in the diagram you can see a pressure gauge has been shown, an aircraft tire is designed to flex and absorb the shock of landing; tire pressure should be measured at ambient temperature.

Fluctuations of ambient temperature greatly affect tire pressure; generally tire pressure changes 1 percent for every 5 degrees Fahrenheit of temperature change. So, we have to be careful at what temperature we are observing; we are checking the inflation pressure, generally it is fluctuation of ambient temperature greatly affect tire pressure.

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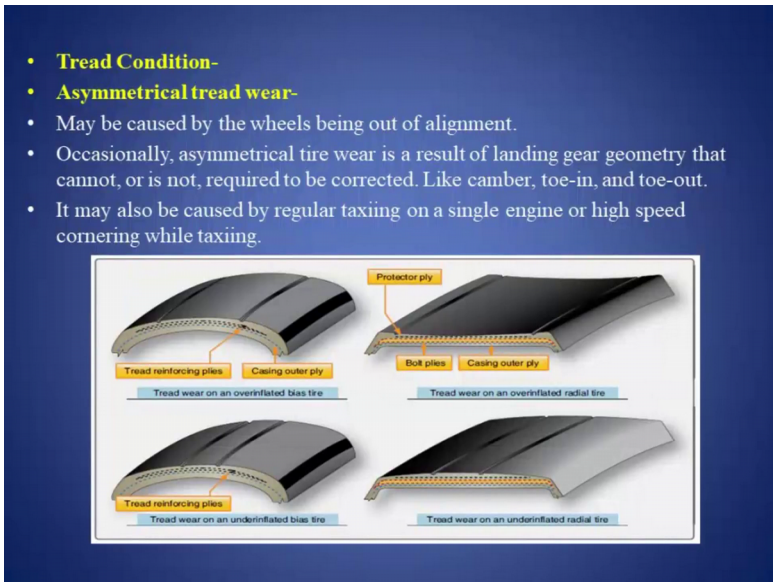

Now, tread condition asymmetrical tread wear may be caused by the wheels being out of alignment. Occasionally, asymmetrical tire wear is a result of landing gear geometry that cannot or is not required to be corrected, like camber toe in and toe out. It may also be caused by regular taxiing on a single engine or high speed cornering while taxiing, see in the diagram you can see there are various tread wear shown.

In this diagram you can see this is tread wear on an overinflated biased tire; this is the biased tire cross section shown, this is tread wear on an overinflated bias tire and this is tread wear on an overinflated radial tire, this is the wear pattern has been shown this is the bias tire tread wear and this is the tread wear on a real radial tire both overinflated.

This is underinflated condition and both tread wear has been shown on bias tire as well as the radial tire, you can see the difference.

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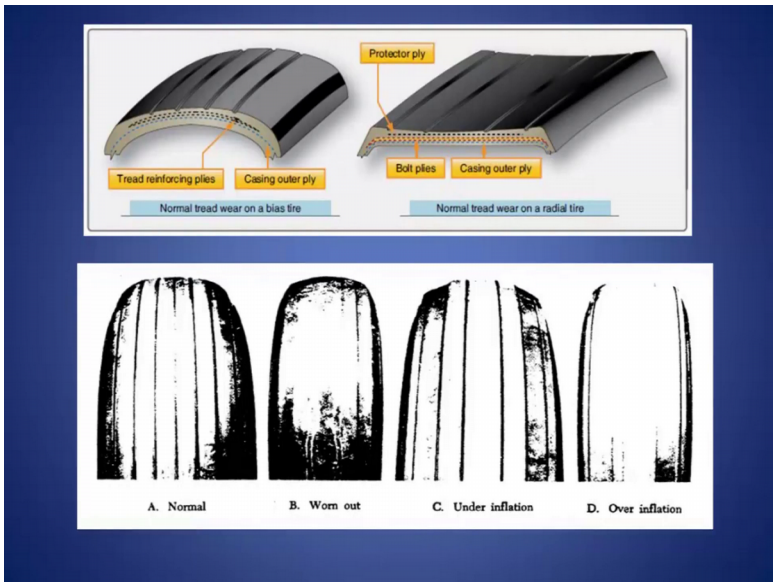

Now, in this diagram this is the normal condition, this tire is worn out; this is under inflation in case if you have been operating your tires under inflation condition. So, that wear will be of this pattern you can see the wear and incase your tire is has been operating in the over inflation condition, your wear will be of somewhat like this kind of thing.

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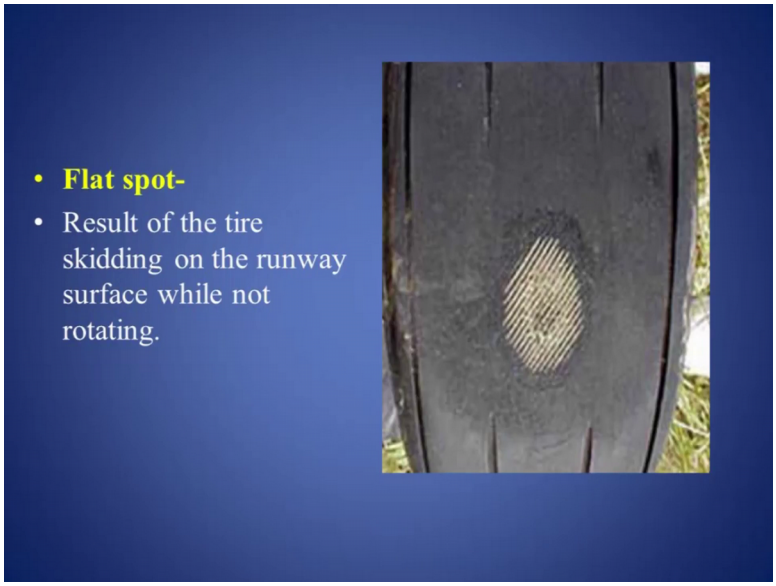

Now, flat spot this is the result of the tire skidding on the runway surface while not rotating. So, you can see the wear here see this wear pattern, this is the result of a flat spot.

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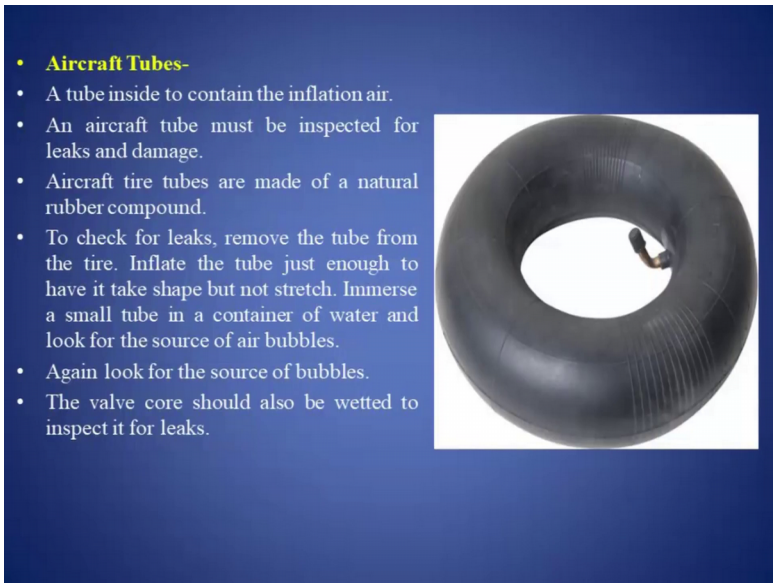

Aircraft tubes a tube is there inside to contain the inflation air, an aircraft tube must be inspected for leaks and damage, aircraft tire tubes are made of a natural rubber compound; in order to check the leaks; remove the tube from the tire inflate the tube just enough to have it take shape but not stretch, immerse a small tube in a container of water and look for the source of air bubbles. Again look for the sources of bubbles the valve core should also be wetted to inspect it for leaks. This is the normal procedure which we do in our automobiles also, so this is just the normal procedure of checking the tubes.

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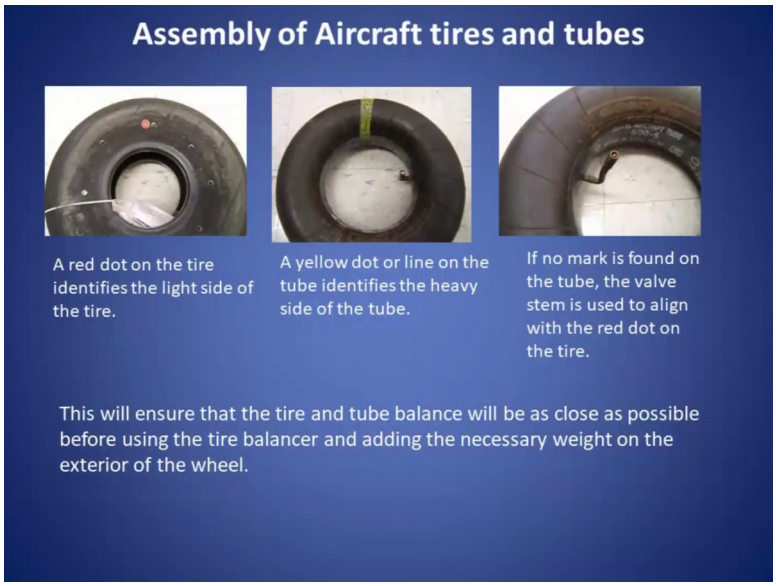

Now, when we assemble the tires and tubes; in the diagram here you can see there is a red dot.

You can see the red dot here, a red dot on the tire identifies the light side of the tire. So, this red dot is indicating the light side of this tire. Now this is the tube in this second diagram you can see this is the tube, there a yellow dot or a line on the tube this identifies the heavy side of the tube. So, this is the lighter portion of the tire, this is the heavier portion of the tube; if no mark is found on the tube the valve stem; the valve stem is used to align with the red dot on the tire.

So, in case if there is no mark on the tube, the valve stem is considered to be the heavy part of the tube. So, while assembling the lighter side of the tire and the heavier portion of the tube they are aligned. So, that the assembly is balanced, this will ensure that the tire and tube balance as close as possible, before using the tire balancer and adding the necessary weight on the exterior of the wheel.

So, this is basically required for balancing the tire and tube assembly, by aligning the lighter portion of the tire and the heavier portion of the tube.

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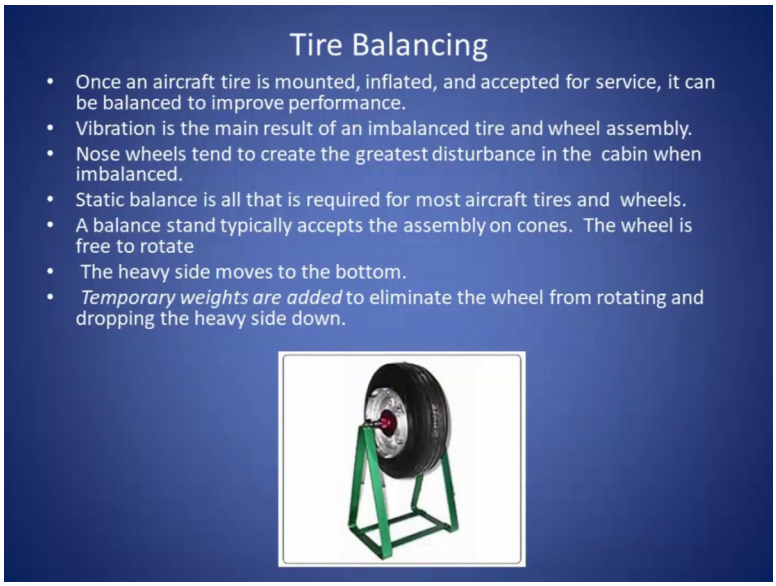

Tire balancing this is also a normal thing as we do in other automobiles also, once an aircraft tire is mounted, inflated and accepted for service it can be balanced to improve performance, vibration is the main result of an imbalanced tire and wheel assembly.

Nose wheels tend to create the greatest disturbance in the cabin when imbalanced, static balance is all that is required for most aircraft tires and wheels. A balance stand typically accepts the assembly on cones, the wheel is free to rotate; the heavy side moves to the bottom. Temporary weights are added to eliminate the wheel from rotating and dropping the heavy side down, so this just as in any other tire this is normal balancing.

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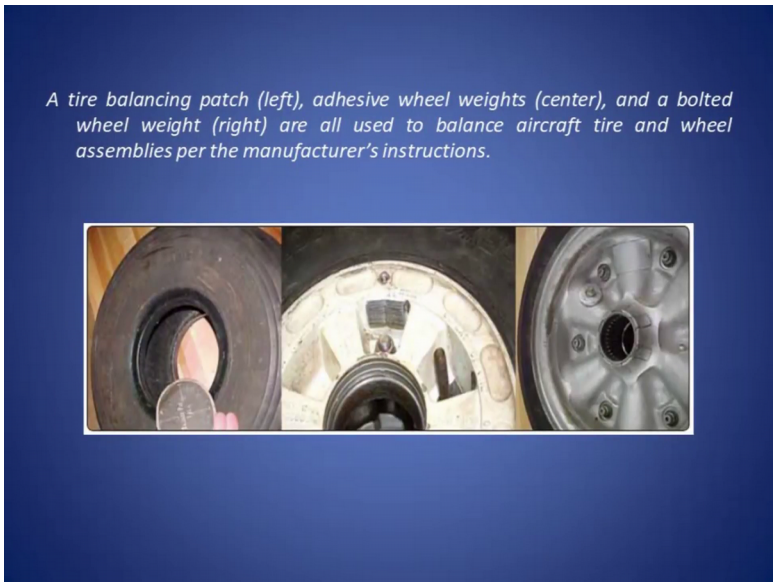

So, here in the diagram you can see a tire balancing patch, this is the tire balancing patch on the left side, these are adhesive wheel weights in the centre and a bolted wheel weight you can see this is the bolted wheel weight on this in this right diagram, they are all used to balance aircraft tire and wheel assemblies, as per the manufacturer's instructions.

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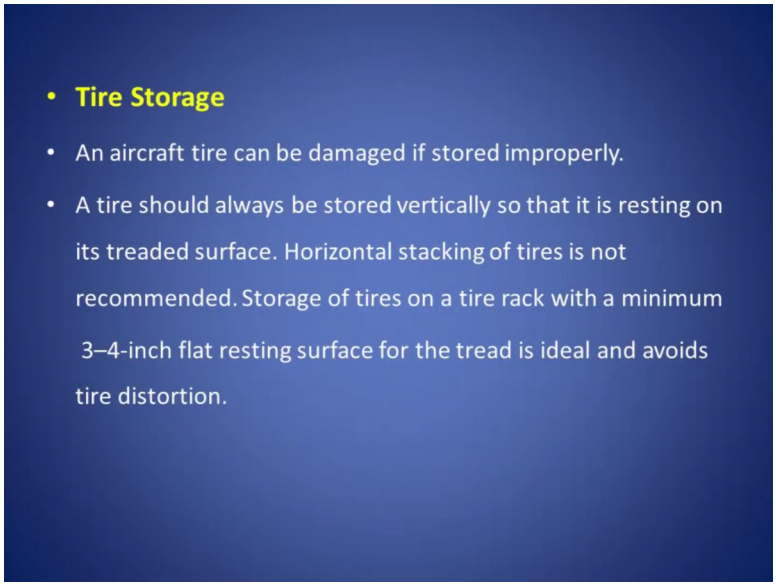

Now, tire storage; an aircraft tire can be damaged if they stored improperly, a tire should always be stored vertically. So, that it is resting on it is treaded surface; horizontal

stacking of tire is not recommended, storage of tires on a tire rack with a minimum 3 to 4 inch flat surface for the tread is ideal and avoids tire distortion.

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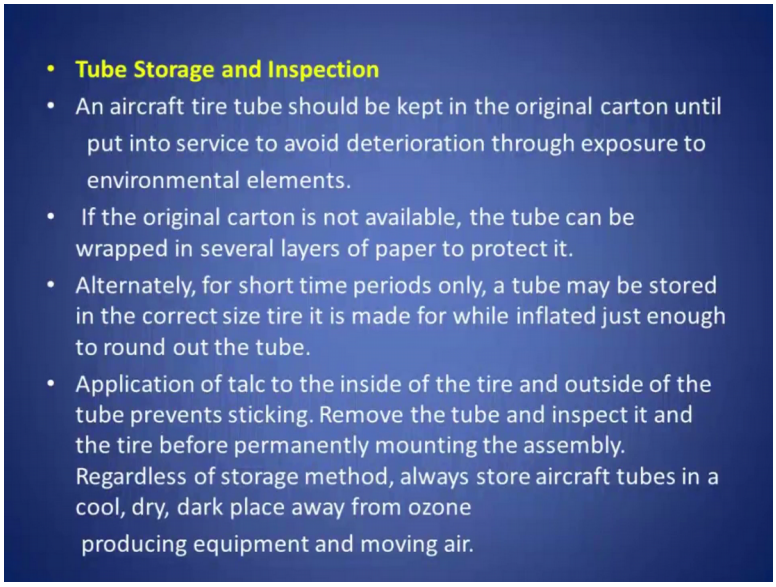

Now, tube storage and inspection; an aircraft tire tube should be kept in the original carton until put into service to avoid deterioration, through exposure to environmental elements. If the original carton is not available the tube can be wrapped in several layers of paper to protect it.

Alternately for a short time period only a tube may be stored in the correct size tire, it is made for while inflated just enough to round out the tube. Application of talc to the inside of the tire and outside of the tube prevents sticking, remove the tube and inspect it and the tire before permanently mounting the assembly.

Regardless of storage method always store aircraft tubes in a cool dry dark place away from ozone producing equipment and moving air. So, these are the general storage steps for the tube, with this we end this module of aircraft landing gear system. So, in this module, we have seen the different types of landing gears, the inspections, the tires and the tubes.

Thank you.