

Aircraft Maintenance
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Lecture – 05
Aircraft Landing Gear System

Now, coming to the next aircraft system, aircraft landing gear system, in this system we will see the different types of landing gears for different types of aircrafts. The break systems, the wheels, the tires, tubes; what are the inspections to be carried out on all these parts, as well as the trouble shooting. So, let us see; what are the different types of landing gears, on different types of aircrafts?

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Aircraft Landing Gear System

- Aircraft landing gear supports the entire weight of an aircraft during landing and ground operations.
- They are attached to primary structural members of the aircraft.

The type of gear depends on the aircraft design and its intended use.

- **Wheels type** - operation to and from hard surfaces, such as airport runways.
- **Skids type** -helicopters, balloon gondolas, and in the tail area of some tail dragger aircraft. Operation to and from hard surfaces, such as airport runways.



Aircraft landing gear supports the entire weight of an aircraft during landing and ground operations. So, the complete weight of the aircraft is supported on the landing gear, during landing as well as all ground operations.

These landing gears are attached to the primary structural members of the aircraft; the type of gear depends on the aircraft designed and its intended use. So, the landing gears are of different types and it all depends on the type of aircraft, the use of the aircraft. So, these landing gears, type and design depends on the utility of the aircraft, wheel type,

operation to and from hard surfaces such as airport runways. So, in the first figure you can see an aircraft with wheels.

So, these landing gears; these wheels type landing gear they operate from hard surfaces such as the runways. Then in the second figure you can see a helicopter with a skid there are no wheels in that figure. So, skid type helicopters balloons, gondolas, and in the tail area of some tail dragger aircraft. This type of machine also operates to and from hard surfaces such as airport runways.

So, in the first figure you can see landing gear with the wheels and in the second figure you can see the machine without wheels; it has a skid, but both of them are operating from the hard surfaces such as the runways.

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- **Skis type** - Aircraft that operate to and from frozen lakes and snowy areas may be equipped with landing gear.
- **Pontoon-type or float type** - Aircraft that operate to and from the surface of water have landing gear.
- Regardless of the type of landing gear utilized, shock absorbing equipment, brakes, retraction mechanisms, controls, warning devices, cowling, fairings, and structural members necessary to attach the gear to the aircraft are considered parts of the landing gear system.



Next type of landing gear you can see; the first figure this aircraft is positioned on snow. So, skis type aircraft that operates to and from frozen lakes and snowy areas may be equipped with landing gears. So, the aircraft which are operating from snowy areas from frozen lakes; these types of aircrafts, they have skis in place of the wheels.

Next is pontoon type or float type, aircraft that operates to and from the surface of water have this type landing gear. So, in the second figure you can see an aircraft operating from a river; from a surface of water. So, these types of aircrafts, we call them amphibian

aircrafts, these aircrafts they operate over water surface they take off and land from the surface of water.

So, these types of aircrafts have float type landing gear they do not have the wheels. So, regardless of the type of landing gear utilized, shock absorbing equipment, brakes, retraction mechanisms, controls, warning devices, cowling, fairings, and structural members necessary to attach the gear to the aircraft are considered parts of the landing gear system

So, depending on the type of operation the aircraft is involved in; your landing gear is designed according to the utility of the aircraft. But in general the landing gear system involves shock absorbing equipment, the initial shock; after taking after landing the machine has to take initial shock, so that shock has to be to absorb the shock absorbing equipment's, the brakes for stopping the machine, the retraction mechanisms there may be types of landing gears, where your landing gear may be retracted after takeoff.

So, the retraction mechanisms; the controls the warning devices, cowlings, fairings, and structural members which are required to attach the gear to the aircraft, they are all considered as parts of the landing gear system.

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Landing Gear Arrangement

Tail wheel type landing gear (also known as conventional gear)-

- Used in early aircraft
- Allows the use of a long propeller that compensates for older, underpowered engine design
- Operated in and out of non-paved runways
- Light weight



Tandem landing gear-

- Main gear and tail gear aligned on the longitudinal axis of the aircraft.
- Placing the gear only under the fuselage facilitates the use of very flexible wings.



Now, landing gear arrangement, in the figure you can see, in the first figure you can see the two wheels in the front they are the two main wheels and then you can a third wheel

a small wheel on the tail. So, this is a tail wheel type landing gear also known as the conventional gear in old, olden aircrafts initial days aircrafts used to have this tail type landing gear.

They were used in early aircrafts; it allows the use of a long propeller that compensates for older underpowered engine design. So, in this type of a machine you have the option of using a longer propeller, this type of an aircraft is operated in and out of non paved runways and is also very light weight. So, the very basic type of landing gear system the two main wheels and a tail wheel this is called the tail wheel type landing gear.

And the second figure you can see there is a glider shown in the second figure the landing gear arrangement is the tandem landing gear it has a main gear and tail gear, aligned on the longitudinal axis of the aircraft.

So, you can see on the longitudinal axis of the aircraft from the nose tail, there is a main gear, there is a main wheel there and the tail wheel, a small tail wheel placing the gear only under the fuselage facilitates the use of very flexible wings. So, in this type of machine the gears, the wheels are just under the fuselage this helps in using very flexible wings.

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Tricycle-type landing gear-

- It is comprised of main gear and nose gear.
- Used in modern large and small aircraft
- Allows more forceful application of the brakes without nosing over when braking, which enables higher landing speeds.
- Provides better visibility from the flight deck, especially during landing and ground manoeuvring.
- Prevents ground-looping of the aircraft. Since the aircraft center of gravity is forward of the main gear, forces acting on the center of gravity tend to keep the aircraft moving forward rather than looping, such as with a tail wheel-type landing gear.



Next comes, the tricycle type landing gear. In the figure you can see an aircraft with two main wheels and one nose wheel. So, this is the tricycle type landing gear, in the modern

aircrafts, large aircrafts, small aircrafts, almost all the aircrafts these days are using this tricycle type landing gear arrangement, this type of arrangement allows more forceful application of the breaks without nosing over when breaking which enables higher landing speeds.

So, this type of landing gear helps in forceful application of the breaks without nosing over when breaking. So, you can land with a higher landing speed because you do not you are not afraid of getting the aircraft getting nosing over. So, you can apply more forceful application of the breaks, it provides better visibility from the cockpit.

Specially during landing and ground maneuvering, it prevents ground looping of the aircraft, since the aircraft centre of gravity is forward of the main gear forces acting on the centre of gravity tend to keep the aircraft moving forward rather than looping, such as with a tail wheel type landing gear.

So, you see the advantages of tricycle type landing gear more forceful application of breaks, higher landing speeds, better visibility from the cockpit during landing and ground maneuvering and prevents ground looping of the aircraft.

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Type of landing gear

There are two types:-

1. Fixed landing gear- The shock energy is altered and transferred throughout the airframe at a different rate and time than the single strong pulse of impact.

a. Leaf-Type Spring Gear-

- Used in small, single engine light aircraft
- Utilize flexible spring steel, aluminium, or composite struts
- Receive the impact of landing and return it to the airframe to dissipate at a rate that is not harmful.

b. Rigid type-

- rigid, welded steel landing gear struts
- Shock load transfer to the airframe is direct.
- Use of pneumatic tires aids in softening the impact loads.



Now, coming to the types of landing gear, earlier we have seen the landing gear arrangements, the main wheels, the nose wheels. Now you can see the different types of landing gear; one is the fixed landing gear. In the fixed landing gear, the shock energy is

altered and transferred throughout the airframe at a different rate and time than the single strong pulse of impact, fixed landing gear the shock energy is altered and transferred throughout the airframe.

So, just after landing the first impact, the shock energy is transferred throughout the airframe, at a rate and time as compared to the single strong pulse of impact. Fixed landing gears are of different types, it may be a leaf type spring gear or it may be a rigid type. So, in the first figure you can see it is a leaf type spring gear, it is used in small single engine light aircraft and it utilizes flexible spring steel; made of aluminium or composite struts, it receives the impact of landing and returns it to the airframe; to dissipate at a rate that is not harmful.

So, the landing impact is received and transferred to the airframe, at such a rate which is not harmful for the structure. Next figure, you can see the bottom figure is the rigid type fixed landing gear. It is rigid, welded steel landing gear struts, the shock load is transferred to the airframe directly and the use of pneumatic tires aids in softening the impact loads.

So, leaf type spring gear you can see it receives the impact landing and returns it to the airframe at a rate which is not harmful. But in the rigid type of landing gear the shock load is transferred to the airframe directly, and the use of pneumatic tires somewhat helps in softening the impact loads.

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c. Bungee Cord type-

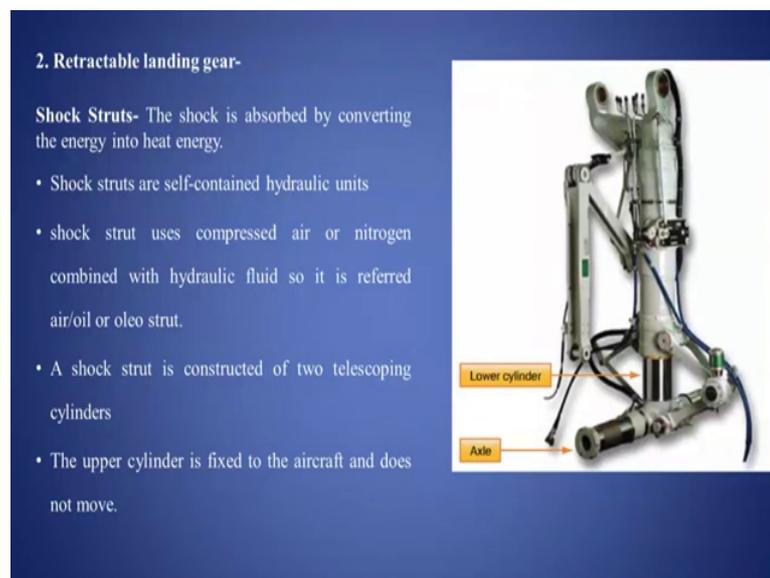
- Bungee cords are positioned between the rigid airframe structure and the flexing gear assembly to take up the loads and return them to the airframe at a non-damaging rate.
- The bungees are made of many individual small strands of elastic rubber.



Next is the bungee cord type, you can see in the figure there is a bungee there, bungee cords are positioned between the rigid airframe structures and the flexible gear assembly to take up the loads and return them to the airframe at a non damaging rate. So, the bungee you can see the cord there which is there between the rigid structure and the flexible gear assembly, it takes up the loads and transfers them to the airframe at a rate, which is not harmful, which does not damage the aircraft structure.

The bungees are made of many individual small strands of elastic rubber. So, you can see the elastic rubber cord there in the figure, in the second figure, in the first figure it is covered that bungee is covered with a cover, in the second figure you can see it is not there with a cover they are made of small strands of elastic rubber and is positioned between the rigid airframe structure and the flexing gear assembly and it takes up the loads and transfers to the airframe structure at a rate which is not harmful for the aircraft structure.

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Second type of landing gear is the retractable landing gear; the first one you have seen is the fixed type. The second one is the retractable landing gear, in retractable landing gear you can see the shock struts in the figure the shock strut is there the shock is absorbed by converting the energy into heat energy.

So, when you convert the shock energy into heat energy the shock is absorbed, the shock struts are self contained hydraulic units, these shock struts are hydraulic units, they use

compressed air or nitrogen; combined with hydraulic fluid. So, it is referred as air oil or oleo strut; so, the shock struts are using compressed air or nitrogen and hydraulic fluid.

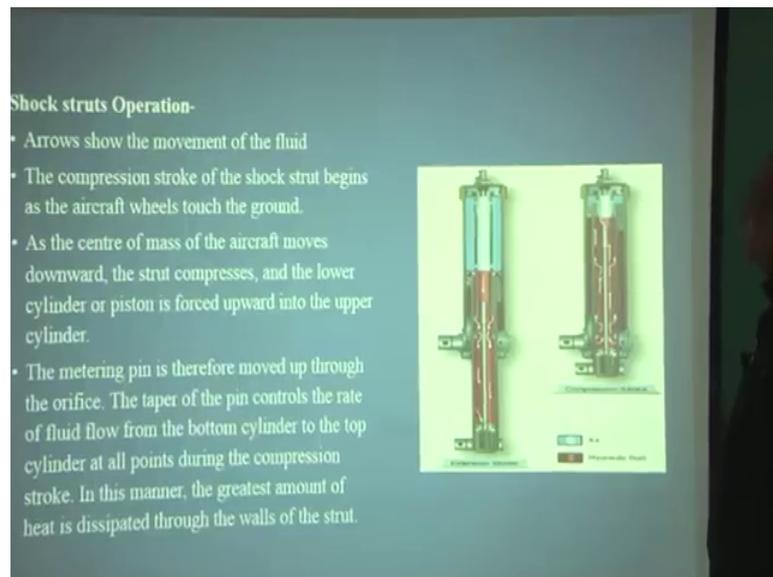
So, compressed air or nitrogen along with hydraulic fluid that is why it is called air oil or oleo strut. A shock strut is constructed of two telescoping cylinders; the upper cylinder is fixed to the aircraft and does not move. So, you can see in the retractable landing gear this the shock strut, this is a hydraulic unit, these shock struts are also called oleo struts they use air and oil they may be using compressed air or nitrogen or and hydraulic fluid.

Since, they are using compressed air or nitrogen along with hydraulic fluid they are also called oleo struts or air oil struts. They are constructed of two telescoping cylinders you can this is one cylinder, and this is another cylinder this upper cylinder is fixed to the aircraft and does not move and this lower cylinder you can see this is the lower cylinder this is also called the piston. So, this is the shock strut and here is your axle, so this the lower cylinder called also called the piston, this lower cylinder it is free to slide in and out of the upper cylinder.

So, once there is a shock the aircrafts lands this cylinder this is free to move inside the upper cylinder, and this lower cylinder this lower chamber this is always filled with hydraulic fluid and the upper chamber is filled with the compressed air or nitrogen. So, you have the hydraulic fluid in the lower chamber the upper chamber has the compressed air or nitrogen there is an orifice between the two cylinders.

So, between the upper cylinder and the lower cylinder there is an orifice, this orifice provides a passage for the fluid from bottom chamber to enter the top chamber when the strut is compressed. So, this is the upper cylinder, the upper chamber this is the lower cylinder or lower chamber you have hydraulic fluid in the lower chamber compressed air in the upper chamber there is an orifice in between the two chambers the lower chamber and upper chamber when the aircraft lands. This hydraulic fluid from the lower chamber moves to the upper chamber through the orifice.

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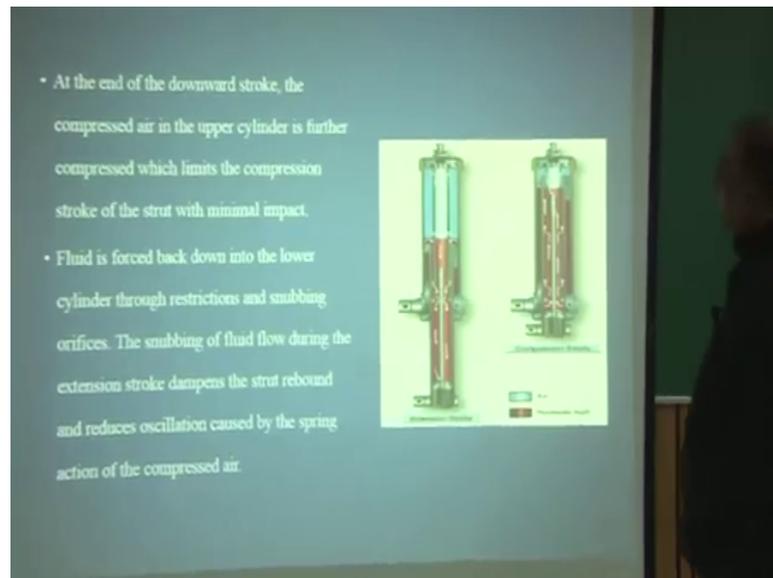
So, here in this diagram you can see, this shock strut this is an upper chamber, this is the lower chamber; this upper chamber is filled with compressed air or nitrogen, this lower chamber this red portion, this is hydraulic fluid this is the lower chamber and in between the two chambers; you an orifice here. The compression stroke of the shock strut begins as the aircraft wheels touch the ground. So, as the aircraft wheels touch the ground; your compression stroke of the shock strut begins.

In the compression stroke, your hydraulic fluid is moving from the lower chamber to the upper chamber. As the centre of mass of the aircraft moves downward, the strut compresses and the lower cylinder of piston is posed upward into the upper cylinder. So, you can see in the compression stroke; the lower chamber, the lower cylinder or the piston has moved up in the upper cylinder; you can see the arrows here, now the hydraulic fluid is moving up from the upper chamber to the upper chamber.

The metering pin is therefore, moved up through the orifice; here is your metering pin this is your metering pin. This metering pin is moved up through the orifice, the taper of the pen controls the rate of fluid flow from the bottom cylinder to the top cylinder. So, this metering pin; this is a tapered and this tip tapering of the pen controls the rate of fluid flow from the lower chamber to the upper chamber, in this panel the greatest amount of heat is dissipated through the walls of the strut.

So, during the compression stroke the fluid is moving from the lower chamber to the upper chamber through the orifice. There is a metering pin here; metering pin it is tapered and the taper of the pin controls the rate of fluid flow from the bottom chamber to the upper chamber at all points of the compression stroke.

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So, at the end of the downward stroke; the compressed air in the upper cylinder is further compressed. So, at the end of the compression stroke your compressed air in the upper cylinder is further compressed, which limits the compression stroke of the strut with minimum impact. At the end of the compression stroke your fluid has already moved in just at the end of the stroke compression stroke your air is further compressed and it minimizes the impact.

Fluid is forced back down into the lower cylinder through restrictions and snubbing orifices. So, after the end of the compression stroke, fluid is again forced back in to the lower chamber through the restrictions and snubbing orifices, you can see the fluid coming back. The snubbing of fluid flow during the extension stroke dampens the strut rebound.

So, now at the end of the compression stroke and at the beginning of the extension stroke this fluid is forcing back down into the lower chamber through the restrictions and the snubbing orifices. The snubbing of fluid flow during the extension stroke dampens the strut rebound and reduces oscillations caused by the spring action of the compressed air.

So, now the hydraulic fluid is coming back through the orifices, through the restrictions and your snubbing orifices; this dampens the strut rebound.

So, if this return of fluid is not happening through the orifices and snubbing restrictions this strut will rebound. And. so during the extension stroke you can see the fluid is returning through the orifices through the restrictions and snubbing orifices the snubbing of fluid flow, during the extension stroke this dampens the strut rebound; this will dampen the strut rebound and it will reduce oscillation caused by the spring action of the compressed air.

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Components of shock strut

Torque links-

- To keep the piston and wheels aligned
- One end of the links is attached to the fixed upper cylinder. The other end is attached to the lower cylinder (piston) so it cannot rotate.

Trunnion-

- A fixed structural support that is part of or attached to the upper strut cylinder of a landing gear strut.
- It contains bearing surfaces so the gear can retract.

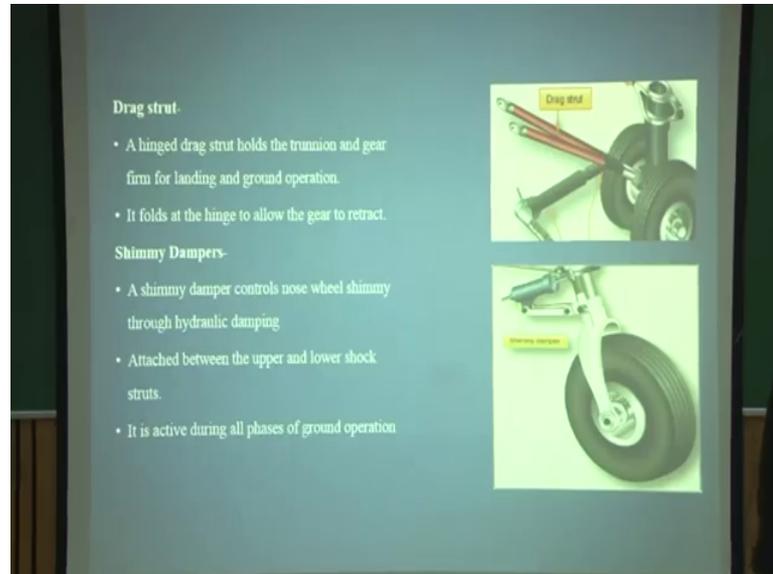


Now, coming to the components of shock strut, the first figure you can see the torque links this is a type thing you can see there torque links, they keep the piston and wheels aligned. Now coming to the components of shock strut the first figure you can see the torque links.

These are your torque links, they keep your piston and the wheels aligned one end of the link is attached to the fixed upper cylinder and the other end is attached to the lower cylinder that is the piston. So, it cannot rotate the second figure in this figure this is trunnion it is the fixed structural support that is part on of or attached to the upper strut cylinder of a landing gear strut. So, this trunnion is either part of your landing gear strut or is attached to the upper portion of the landing gear strut it is the fixed structural

member which supports your landing gear strut this trunnion also has bearing surfaces so that the gear can retract or extend in case if it is a retractable type landing gear.

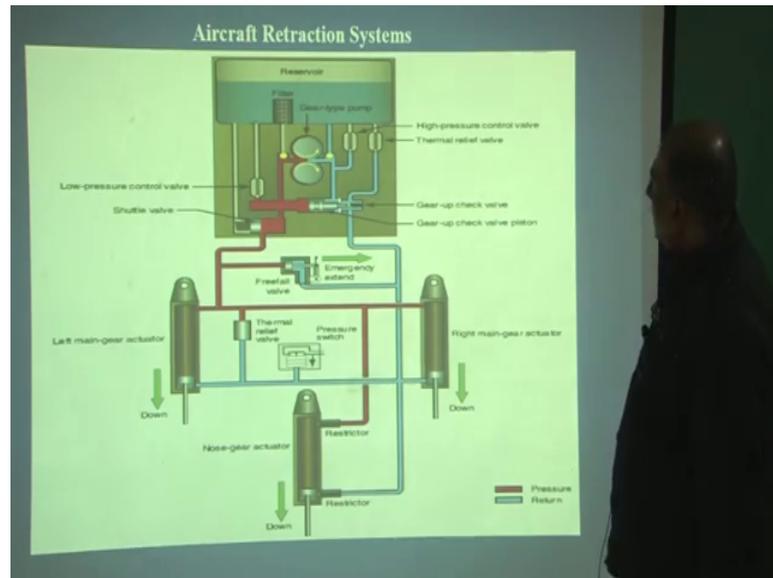
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In this figure, you can see these are the drag struts, they are a hinged drag struts holds the trunnion and the gear firm for landing and ground operation, this drag strut this will hold the landing gear and the trunnion firm for landing and ground operation it folds at the hinge to allow the gear to retract. So, there is a hinge point also on this drag strut which allows the gear to retract.

So, in the second figure you can see this is the shimmy damper which controls the nose wheel shimmy through hydraulic damping, this is attached between the upper and lower shock struts you can see the attachment here this shimmy damper is attached here as well as here. So, it is attached between the upper and lower shock struts this is active during all phases of ground operation.

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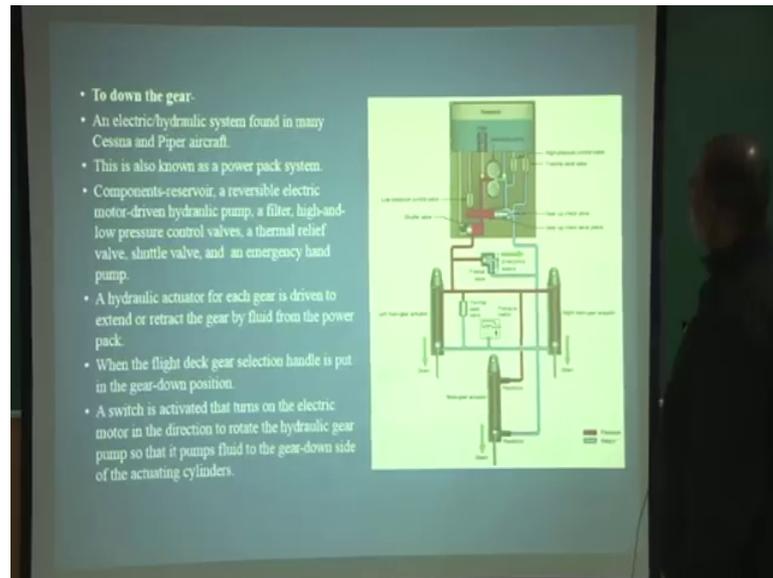


So, now the retraction system the aircraft landing gear retraction, you can see a small diagram here. In this diagram this is your electro hydraulic pump, which is electrically operated this it has a hydraulic system inside this is the reservoir, here is your filter this electro hydraulic pump motor is has high pressure control valve, it has a thermal relief valve and this has a low pressure control valve. So, you can see low pressure control valve high pressure control valve thermal relief valve then gear up check valve.

This is the gear up check valve, this is the shuttle valve. So, it has the gear up check valve, shuttle valve, low pressure control valve, high pressure control valve, thermal relief valve, reservoir, filter, and the pump. So, this complete unit this is the electro hydraulic unit this is also called the power pack. Then for emergency extension you have a system here it can be manual, it can be a either way, it can be hydraulic also.

So, this the emergency extend system then in this system you can see there is thermal relief valve, this is the pressure switch, then these are the three actuators this is the left main gear actuator, this is your right main gear actuator and this is your nose gear actuator. So, these actuators they are connected to the landing gears the shock struts, this nose gear actuator this has restrictors on the two sides.

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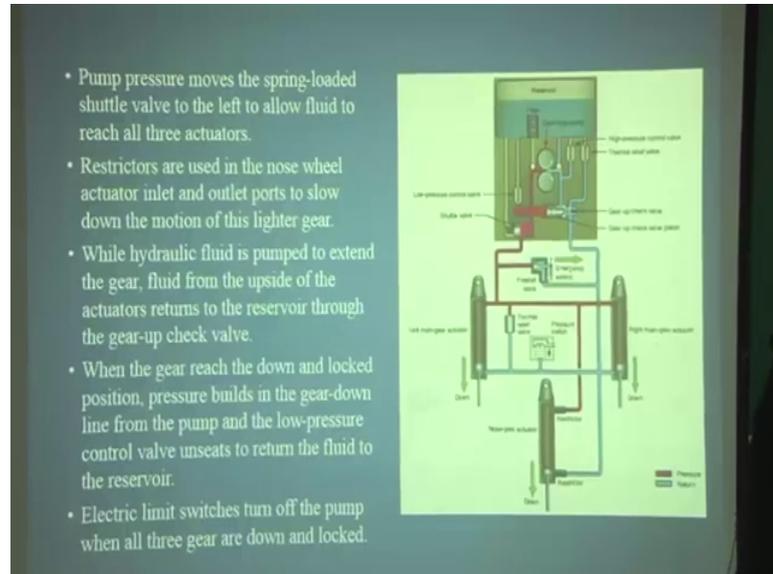
So, this is an electric hydraulic system which is found in many small aircrafts, like Cessna piper aircrafts, this is also known as the power pack system, just now I told you that this is the power pack. The components are the reservoir, a reversible electric motor hydraulic pump a filter, the high pressure control valve, the low pressure control valve, thermal relief valve, shuttle valve and the emergency hand pump, then hydraulic actuator for each gear these are the hydraulic actuators.

These hydraulic actuators are there to extend or retract the gears by fluid from the power pack. So, from the power pack you get the fluid and with the fluid power these actuators they retract or extend the gear. When the flight deck gear selection handle is put in the gear down position. Now when you put the gear selection lever in the down position then we will see what happens, a switch is activated that turns on the electric motor in the direction to rotate the hydraulic gear pump.

So, as soon as you put the gear selection handle in the down position a switch is activated that will turn the motor, that will turn this electric motor in the direction that it will rotate the hydraulic gear pump. So, that it pumps fluid to the gear downside of the actuator. As soon as the gear selection handle is put in the down position, this pump gets activated; a switch activates this pump in the direction. So, that the fluid is supplied in the downside of the actuator you can see; in the figure this red line this is the pressure.

Now the fluid is has been supply to the three actuators so this thing this actuator as well as this actuator.

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Now, the pump pressure moves the spring loaded shuttle valve, this is your shuttle valve, this is your shuttle valve, this pump pressure you can see this pump pressure; this moves the shuttle valve to the left hand side. Once the shuttle valve moves to the left hand side, this pressure this speed pressure moves through this line, it goes to this cylinder, it goes to this cylinder, and to this cylinder.

It allows the fluid, this shuttle valve to move, to the left and fluid is transferred to the three actuators, the restrictors are use in the nose wheel actuators inlet and outlet boards you can see the restrictors in the nose actuator both inlet and outlet boards to slow down the movement of this lighter gear.

Since, this nose gear is light as compared to the main gears to slow down the movement of this gear there are restrictors in both the inlet and the outlet board. While hydraulic fluid is pumped to extend the gear, now this hydraulic fluid is been pumped to extend the gear fluid from the upside of the actuator this is the upside of the actuator you can see the this is the upside of the actuator.

Fluid from the upside of the actuator returns to the reservoir through the gear up check valve. Now when this pressure fluid this is coming from this side the fluid which is there

on the upside of the actuator is returned to the reservoir this fluid this blue line this is returned to the reservoir you can see this is returned to the reservoir through the gear up check valve.

So, this fluid this is come here, this is come here, this is come here, and it is going back to through this gear up check valve to the reservoir. When the gear reaches the down and lock position, now when the gear has reached you have selected the initially you had selected the gear selection lever to the down position, the pump was operated, the pump pressure came to the downside of the actuator. The actuators moved in the down position the fluid from the upside of the actuator went back to the reservoir and now your landing gear is down and locked, it reaches the down and lock position.

The pressure builds in the gear down line from the pump and the low pressure control valve unseats to return the fluid to the reservoir, now when the gear has reached the down lock position pressure builds in the gear down line from the pump. This is the low pressure control valve, now when your landing gears have down and locked the pressure builds in the line and the low pressure control valve this unseats and returns the fluid back to the reservoir.

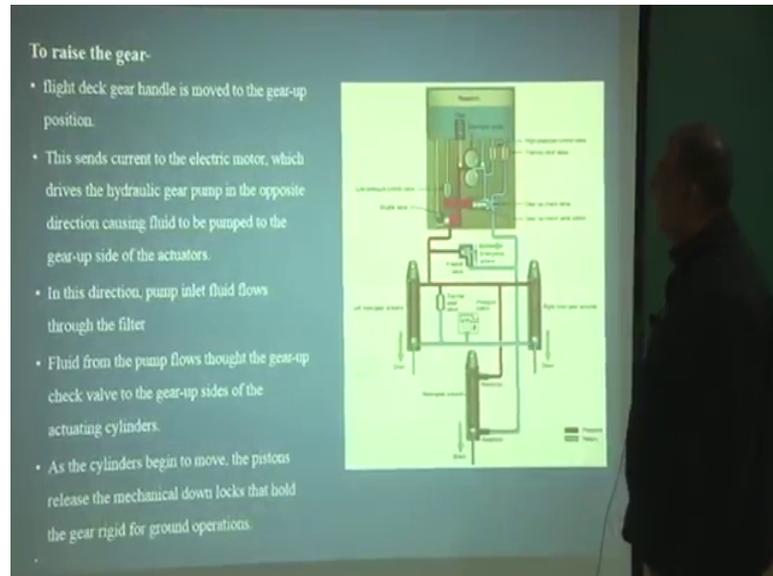
So, this hydraulic fluid pressure was used to lower the landing gears, once the landing gears were lowered they were locked, once it was locked the pump pressure was there the pump pressure was build up after at a certain level of pressure this low pressure control valve will unseat and it will allow the fluid flow back to the reservoir.

The electric limit which is will turn off the pump when all the three gears are down and locked. After this there will be an electric switch, limit switch which will shut off this pump when all the three gears are down and locked position. So, you have seen to lower the gear you have selected the landing gear selection lever down with the landing gear selection down a switch activates the pump, the pump moves in the direction. So, that the hydraulic fluid flow moves to the down side of the actuator this is the hydraulic.

Fluid flow red line this is moving to the down side of the actuator. It starts lowering your actuator your landing gears starts getting lowered from the other side of the actuator that is from the up side of the actuator the fluid is forced back to the reservoir. Once your landing gears are downed and they get locked, the pressure in the line builds up the pump, builds up the pressure, at a certain level of the pressure this low pressure control

valves opens this unseats and allows the hydraulic fluid to go back to the reservoir. The after that the electric limit switches will turn off this pump and the landing gears are now down and locked.

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Now, coming to the same diagram, in case now you have to raise the gear you select the landing gear, selection lever to the up position the landing gear selection lever in the cockpit is now selected up. Once the landing gear selection lever is selected up this will send the current to electric motor which will drive the hydraulic pump in the opposite direction causing fluid to be pumped to the gear upside of the actuators, once the selection lever is selected up this pump gets moving in the opposite direction and the hydraulic fluid is being supplied by this pump to the upside of the actuators.

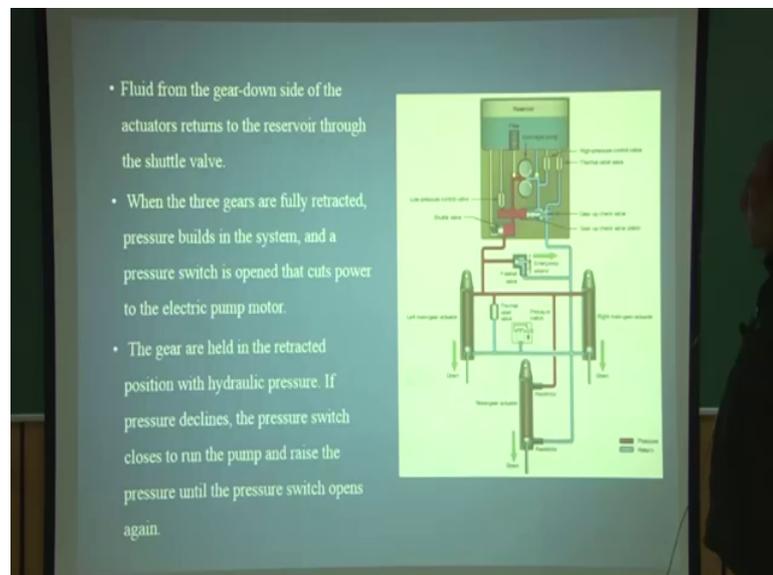
Now the reverse is happening what you had seen earlier now the reverse is happening the motor operates in the opposite direction, the fluid flow comes to the upside of the actuators the blue line you can see. In this direction, pump inlet fluid flows through the filter, now in this direction pump this fluid is flowing through the filter fluid from the pumps flows through the gear up check valve.

Now the fluid it flows from the up check valve it is coming from the gear up check valve to the gear up sides of the actuating cylinders, you we know that in the check valve it is a one line flow fluid can flow in one direction only. So, this is the gear up check valve this

allows the fluid to flow in one direction and now the fluid is coming through the gear up check valve to the three actuators on their upside.

As the cylinders begin to move now the cylinders since the fluid pressure has come this side, this side, and this side. Now your actuators have started moving in the opposite direction; that means, your gears are now starting moving up the pistons release the mechanical down locks. So, now as the cylinders begin to move these pistons they release the mechanical down locks that hold the gear rigid for ground operations. So, once the mechanical down locks are unlocked the gears start to move up.

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Now, fluid from the gear down side of the actuators, this is the down side of the actuator you have seen this is the down side of the actuator. Now the gears have started moving up once the gears have started moving up the fluid from the down side of the actuator returns to the reservoir through the shuttle valve now this is the shuttle valve fluid from the down side of the actuator is moving back to the reservoir through the shuttle valve, you have selected the landing gear in the up position, the landing gear selection lever was selected in the up position in the cockpit the pump was operated in the opposite direction.

The fluid through the gear up check valve was given to the upside of the actuators; the fluid came to the gear up check valve through the up side of the actuators with the fluid pressure here. Now the mechanical down locks opened the mechanical down locks

opened and the gear started moving up, once the gear has started moving up fluid from the down side of the actuator is moving back to the reservoir through the shuttle valve, when the three gears are fully retracted.

Now when the gears when all the three gears are fully retracted pressure builds in the system and a pressure switch, this is the pressure switch here. Once the three gears have fully retracted, pressure has build in the system then this pressure switch gets opened and it cuts power to the electric bump motor.

So, you have seen you selected, the selection lever in the up position the pump operated in the opposite direction, supplied hydraulic pressure through the gear up check valve to the three actuators on their upside with the hydraulic fluid pressure, when the gear start moving your mechanical down locks they unlocked your gear started moving up started retracting up the hydraulic fluid from the downside of the actuator starts moving back to the reservoir through the shuttle valve.

Once your three gears have completely retracted pressure builds in the system and this pressure switch senses that pressure which is pre set it senses the pressure and cuts the power to the pump, now your gears have fully retracted. In the up position, there are no mechanical locks the gears are held in the retracted position with the hydraulic pressure. So, in the up position your gears are held with hydraulic pressure, if pressure declines the pressure switch closes to run the pump and raises the pressure until the pressure switch opens again.

Now in this type of system we have mechanical down locks, but we do not have mechanical up locks in the up position in the retract position the gears are held in the retracted position with the help of hydraulic pressure only. So, once that hydraulic pressure is there this pressure switch has cut the motor and now it is not operating.

So, the hydraulic pressure is holding the ret actuating cylinders in the landing gears in the up position, if the hydraulic pressure declines then this pressure switch will again come into action and it will supply current to the pump and again the hydraulic pressure will be generated.

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Emergency Extension Systems-

The emergency extension system lowers the landing gear if the main power system fails.

Mechanical extension Systems- An emergency release handle in the flight deck that is connected through a mechanical linkage to the gear unlocks. When the handle is operated, it releases the unlocks and allows the gear to free-fall to the extended position under the force created by gravity acting upon the gear.

Pneumatic extension Systems- This is non-mechanical back-up, pneumatic power to unlatch the gear. Compressed air is used to down the landing gear.

Free-fall extension Systems- when the free-fall valve is opened, hydraulic fluid is allowed to flow from the gear-up side of the actuators to the gear-down side of the actuators, independent of the power pack.

- Pressure holding the gear up is relieved, and the gear extends due to its weight.
- Air moving past the gear aids in the extension and helps push the gear into the down-and-locked position.

Now, the emergency extension systems; the emergency extension system lowers the landing gear, if the main power system fails. So, in case if your main power system fails your main retraction system, your extension system; it fails, you are flying up in the air you want to land the landing gear system your extension system is not working, you have selected the lever down, but your landing gear has not come down or it is not down and locked or it is left somewhere in transit, then emergency extension system is required to lower the landing gear.

Emergency extension system may also be of different types one is the mechanical extension system. This is an emergency release handle in the cockpit that is connected through a mechanical linkage to the gear; which this mechanical linkage will unlock the gear, when the handle is operated it releases the unlocks and allows the gear to free fall to the extended position under the force created by gravity upon the gear.

So, this mechanical linkage when you select the emergency lever in the cockpit, it since it is connected to a mechanical linkage the gears get unlocked and the gear starts making a free fall to the extended position under the force of gravity.

Another system is the pneumatic extension system; this is a non mechanical back up pneumatic power is use to unlatch the gear and the compressed air is used to down the landing gears. So, in this there is no mechanical linkage, mechanical backup is not there;

the pneumatic power is used to unlock the gear and compressed air is used to this type of system.

Next is the free fall extension system, when the free valve is opened; hydraulic fluid is allowed to flow from the gear up side of the actuators to the gear down side of the actuators independent of the power pack. So, this is the system we had just seen in the diagram, there were no mechanical up locks; there was only hydraulic pressure lock which was holding the gears in the up position.

So, in this type of system when the free valve is opened hydraulic fluid is allowed to flow from the gear upside of the actuators to the down side of the actuator independent of the power pack. So, the pressure holding the gear up is relieved and the gear extends due to its weight, since the hydraulic pressure was holding the gear in the up position. So, that pressure the pressure which was holding; the actuators the landing gear in the up position is relieved and a gear extends due to its weight, air moving past the gear aids in extension and helps push the gear into the down and locked position.

So, this is a very simple system, very fool proof system where you just relieve the hydraulic pressure; the up lock hydraulic pressure and the gear extends due to its weight the air moving past the gear this aids this helps in extension and helps to push the gear into the down and locked position. In the next slide, we will see the different parts of the landing gear on the aircraft as well as how our landing gear extension and retraction is done on an aircraft.