Oil Hydraulics and Pneumatics
Prof. Somashekhar S
Department of Mechanical Engineering
Indian Institute of Technology, Madras

Part 1: Hydraulic accumulators, basic functions of an accumulator, Classifications-weight-loaded or Gravity-loaded accumulator, Spring-loaded accumulator and Hydro pneumatic accumulator
Lecture - 64
Subsystems: Hydraulic accumulations, Classifications, Applications, Accumulator physics, Maintenance, Numericals

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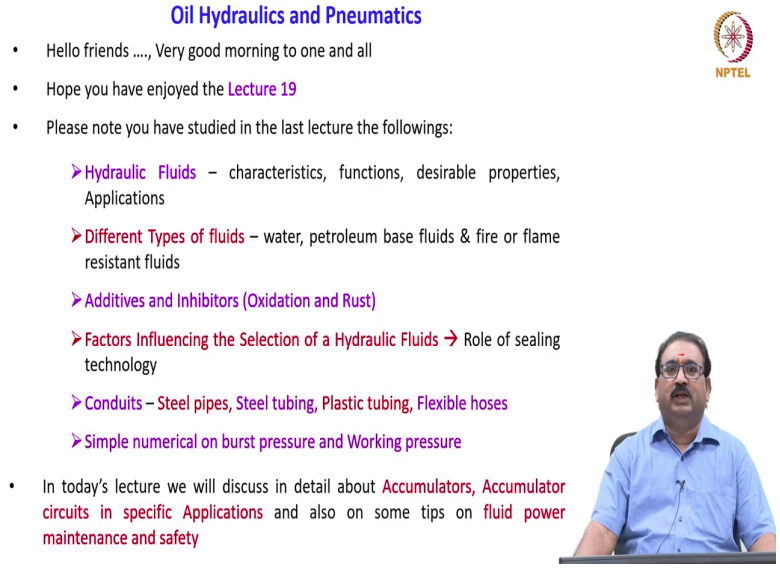

My name is Somashekhar, course faculty for this course. Hello friends, very good morning to one and all; hope you have enjoyed the lecture 19. Please note you have studied in the last lecture the following contents; hydraulic fluids, mainly characteristics, functions, desirable

properties, applications. Different types of fluids mainly water, petroleum base fluids, and fire or a flame resistant fluids.

Additives and inhibitors; inhibitors include oxidation and rust inhibitors. Also we have seen factors influencing the selection of hydraulic fluids, in which we have seen the role of sealing technology to reduce a leakage. Later we moved on conduits, in which we have studied steel pipes, steel tubing, plastic tubing, flexible hoses.

Finally, we have seen one simple numericals on how to calculate the burst pressure and a working pressure. Friends in today's lecture, we will discuss in detail about the one more auxiliary device or sub systems accumulators, which are known as the storage devices. Here we will discuss accumulator circuits in some specific applications and also on some tips on fluid power maintenance and safety.

Friends again I will tell you here, this is a big ocean; I am concentrating mainly on the important points.

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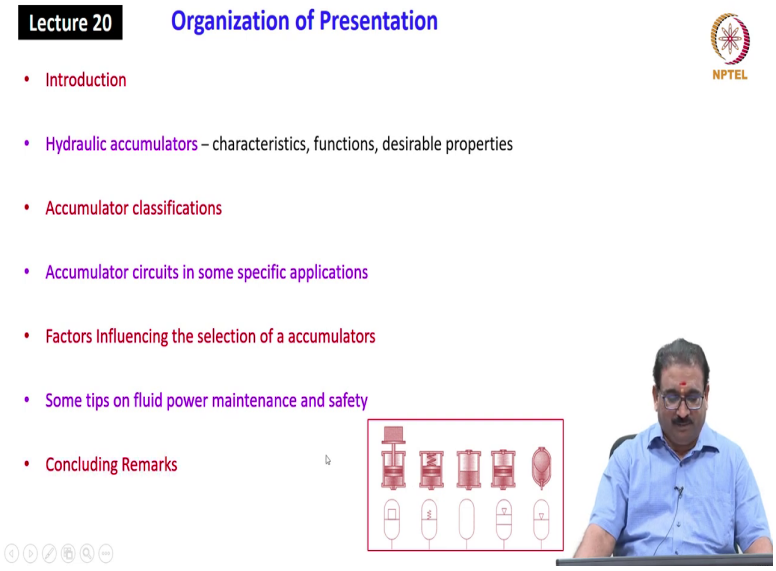

Let us we will see the lecture 20th organization of presentation is as follows. Introduction, hydraulic accumulators; here we will discuss the characteristics, functions and desirable properties. Accumulator classifications; accumulator circuits in some specific applications; factors influencing the selection of accumulators and finally some tips on fluid power maintenance and a safety, concluding remarks.

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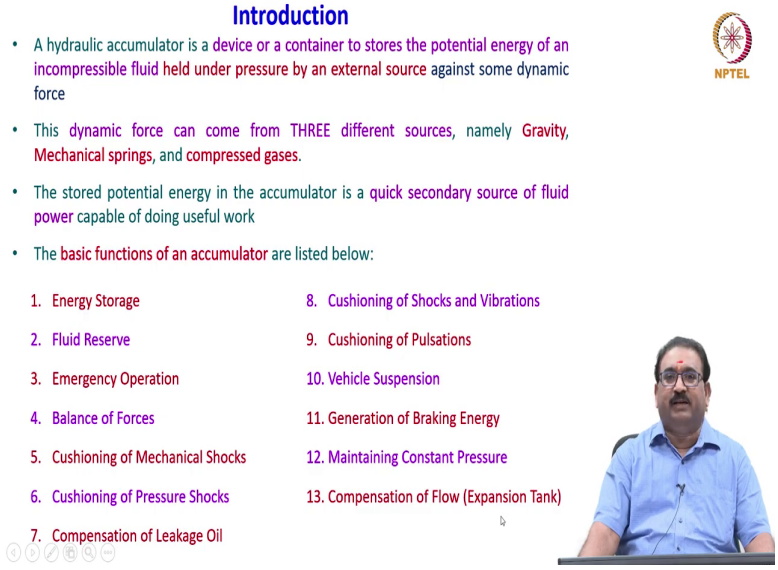

Let us we will move on to the introduction. A hydraulic accumulator is a device or a container to stores the potential energy of an incompressible fluid held under pressure by an external source against some dynamic force. The dynamic force can come from three different sources, namely gravity, mechanical springs, and compressed gases. The stored potential energy in the accumulator is a quick secondary source of fluid power capable of doing the useful work.

The basic functions of the accumulators are listed below; the x as a energy storage, fluid reserve, emergency operations, balance of forces, cushioning of mechanical shocks, cushioning of pressure shocks, compensation of leakage oil, cushioning of shocks and vibrations, cushioning of pulsations, basically the pump pulsations, vehicle suspension,

generation of breaking energy, maintaining the constant pressure, compensation of flow meaning expansion tank.

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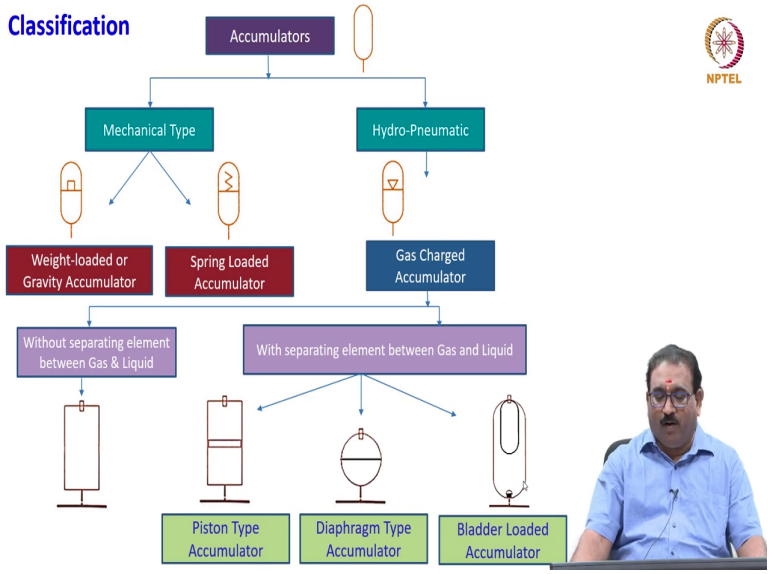

Let us we will see very quickly how these accumulators are classified and used in industries. As we already studied in fluid power symbol, accumulators are represented using the symbol. Accumulators are classified as a mechanical type and hydro pneumatic type. Under mechanical type, accumulators are classified weight loaded or a gravity accumulator.

You see the symbol friends here, the dead weight is placed here; then spring loaded accumulator, you see the spring on other one side and this is a inlet to the pump. Hydro pneumatic, gas charged accumulators which are commonly used in many industries; it is represented using fluid power symbol like this, one triangle. Here triangle naught field, as because here we are using the nitrogen gas.

Here gas charged accumulators are further classified into without separating element between the gas and liquid, and with the separating element between the gas and liquid. Based on the element which you are using as a separating element, they are further classified; in without separating element between the gas and liquid, it is represented like this, you will see here.

It is a inlet, liquid inlet, this is for the gas, in without separating element like this. With separating element, if you are using the piston, it is known as a piston type accumulator; meaning one side gas, another side liquid. Similarly, a diaphragm type element; a diaphragm, flexible diaphragm is a separating element between the gas and the liquid. Similarly and last one is a bladder loaded accumulator, this is a bladder and another side is a liquid; this bladder ensures the positive ceiling. Let us we will see these accumulators in detail in today's class.

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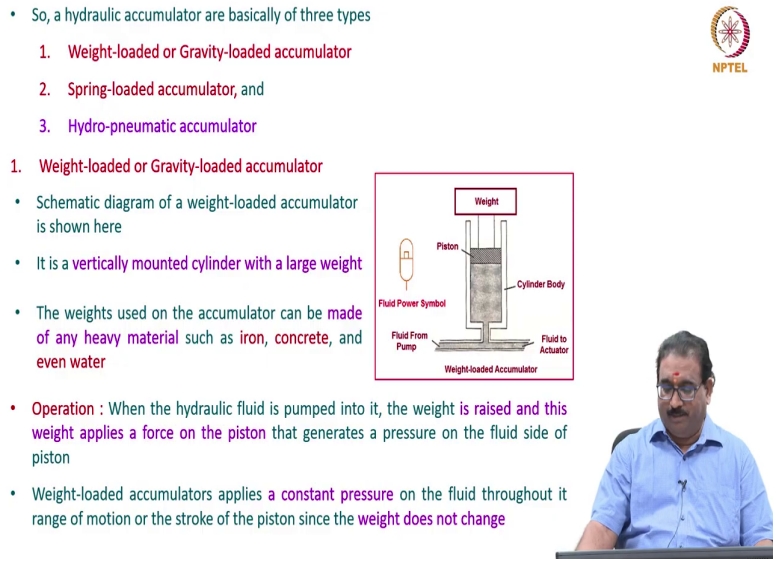

So, a hydraulic accumulators are basically three types, weight loaded or a gravity loaded accumulator, spring loaded accumulator, and hydro pneumatic accumulator; meaning a gas loaded accumulators are also known as hydro pneumatic accumulators. Let us we will begin with weight loaded or a gravity loaded accumulators. The schematic diagram of a weight loaded accumulator is shown here.

See here friends, it is a cylinder body and then the piston and weights on other side, dead weights. And here you will see, it is connected to the fluid from the pump and then it will goes to the actuator. The symbol as I have told you that, dead weights are placed on the piston; it is a vertically mounted cylinder with a large weight.

The weights used on the accumulator can be made of heavy material such as iron, concrete, and even fluid like a water. The operation when the hydraulic fluid is pump into it, the weight is raised and thus weight applies a force on the piston that generates a pressure on the fluid side of the piston. Weight loaded accumulators applies a constant pressure, because of the dead weight; the weight is not changing again and again.

Then which ensures the constant pressure fluid throughout the range of motion or the stroke of piston.

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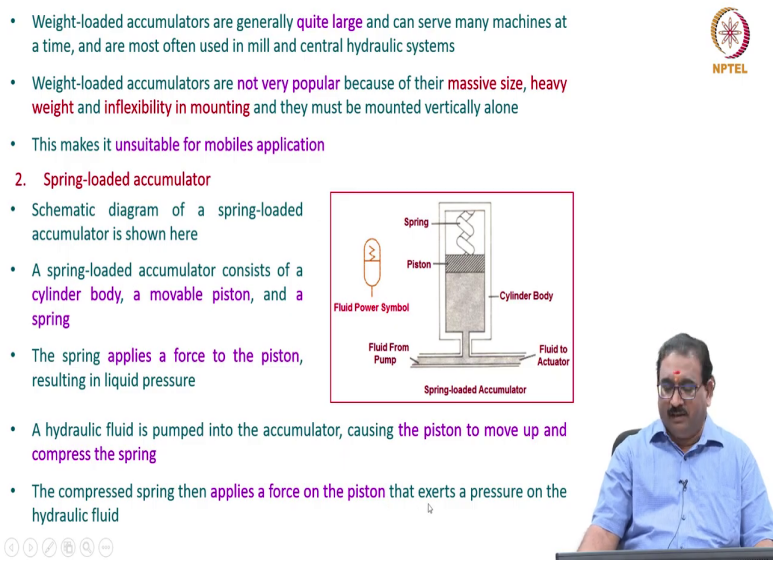

Weight loaded accumulators are generally quite large and can serve many machines at a time, and are most often used in mill and central hydraulic systems. Weight loaded accumulators are not very popular because of their massive size and heavy weight and also inflexibility in mounting and they must be mounted vertically alone. This makes it unsuitable for mobile applications.

Next one is a spring loaded accumulator; schematic diagram of the spring loaded accumulator is shown here. You will see friends again piston, previously weight is there over the piston, now it is a spring. And other one more side is a what it is the inlet, which is connected to the pump passages. A spring loaded accumulator consists of a cylindrical body, and a movable piston, and a spring here.

The spring applies a force to the piston, resulting in a liquid pressure. A hydraulic fluid is pumped into the accumulator, causing the pistons to move up and compress the spring. The compressed spring then applies a force on the piston that exerts a pressure on the hydraulic fluid.

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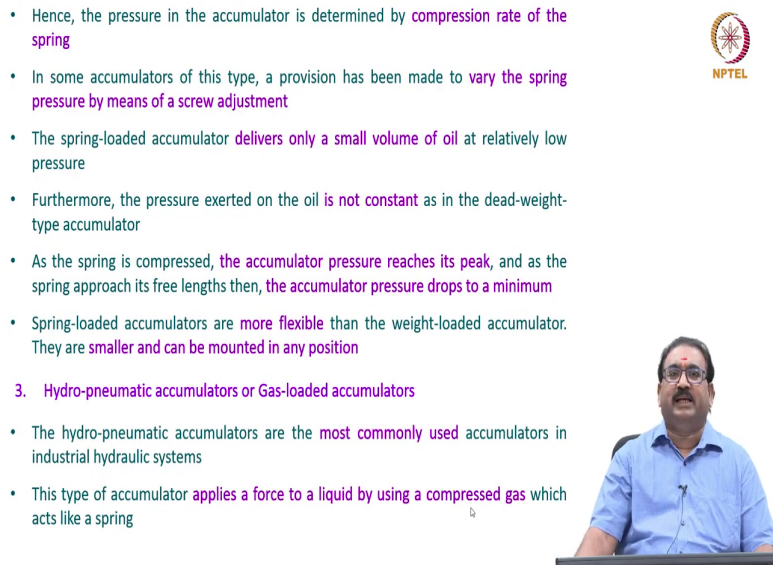

Hence the pressure in the accumulator is determined by compression rate of the spring. In some accumulators of this type, a provision has been made to vary the spring pressure by means of a screw adjustment. The spring loaded accumulators delivers only a small quantity of oil at a relatively low pressure.

Furthermore, the pressure exerted on the oil is not constant as in the dead weight type accumulator. As the spring is compressed, the accumulator pressure reaches its peak and as the spring approaches its free length, then the accumulator pressure drops to a minimum.

Spring loaded accumulators are more flexible than the weight loaded accumulator, they are smaller and can be mounted in a any position.

3rd one is hydro pneumatic accumulators also known as gas loaded accumulator. The hydro pneumatic accumulators are the most commonly used accumulators in industrial hydraulic system. This type of accumulator applies a force to a liquid by using a compressed gas, which acts like a spring.

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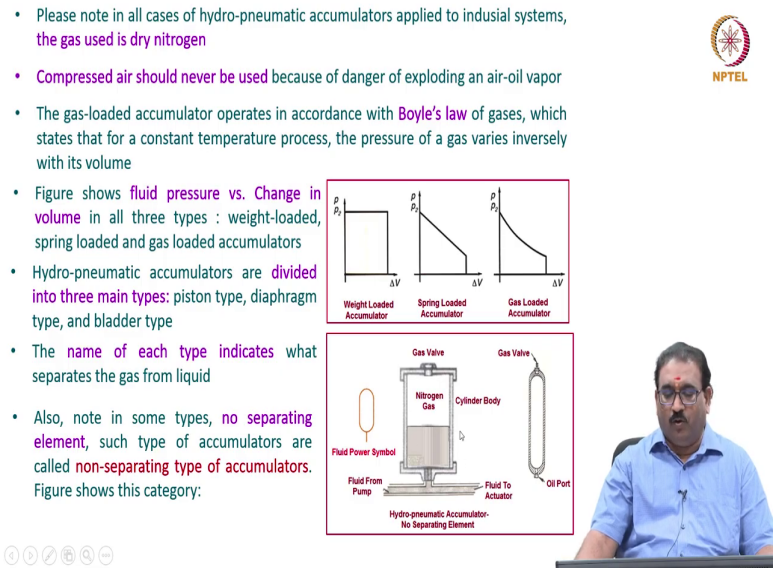

Please note in all cases of hydro pneumatic accumulators applied to industrial system, the gas used is dry nitrogen. Compressed air should never be used, because of danger of exploding an air-oil vapor. The gas loaded accumulator operates in accordance with Boyle's law of gases, which states that for a constant temperature process, the pressure of a gas varies inversely with its volume.

Further I will show you here the fluid pressure versus the change in volume for all three types of accumulator; like a weight loaded accumulator, and a spring loaded accumulator, and a gas loaded accumulator. Here pressure the P 2 is a the maximum pressure stored in accumulator.

Then how it will be volume changes you will see here. Due to the spring rate, it will be like this; due to the gas which is a compressible in nature, the nature is drops like this non-linear type, ok.

Hydro pneumatic accumulators are divided into three main types; piston type, diaphragm type, and bladder type. The name of each type indicates that what separates the gas from the liquid.

The name of each type indicates what separates the gas from liquid. Also, note in some types, no separating element, such type of accumulators are called non separating type of accumulators. Figure shows this category, you will see here no separating element here; the one side nitrogen gas, other side is a liquid.

Here the gas valve inlet and here it is a oil port inlet. Then how it is loaded? Using fluid from the pump and other side it will go to the accumulator. Here no separating element between the gas and the liquid.

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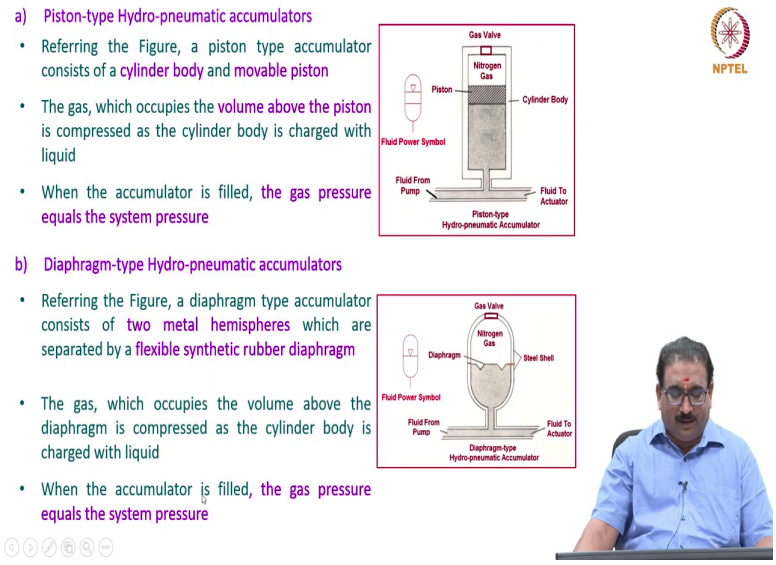

Here piston is a separating element between the gas and the liquid. Referring to figure here, a piston type accumulator consists of a cylindrical body and a movable piston. The two inlet one is a gas valve, where you are loading the nitrogen gas and other is a oil inlet; meaning from the pump, the oil will flows to the accumulator.

The gas which occupies the volume above the piston is compressed as the cylinder body charged with the liquid. When the accumulator is filled, the gas pressure equals the system pressure.

Next category is diaphragm type hydro pneumatic accumulator; here separating element is e flexible diaphragm. Here referring to the figure, the diaphragm type of accumulator consists of a two metal hemispheres, which are separated by the flexible synthetic rubber diaphragm.

The gas, which occupies the volume above the diaphragm is compressed as the cylinder body is charged with the liquid. When the accumulator is filled, the gas pressure equal the system pressure.

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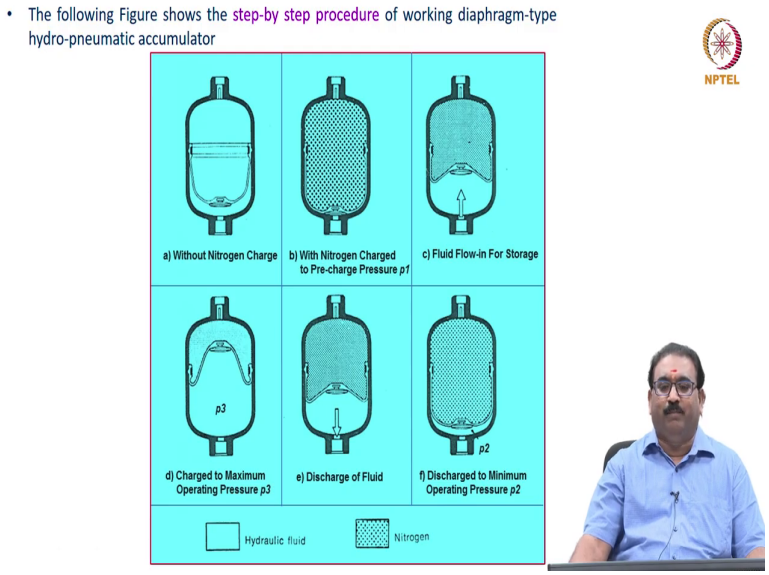

The following figure shows the step by step of procedure of working diaphragm type hydro pneumatic accumulators. Now, I will show you here, the first one is you will see here without nitrogen gas, nothing is there here. Now, what? You have to charge the nitrogen gas; with the nitrogen gas charged to a pre charged pressure p 1, meaning you will see here full is occupied by the nitrogen gas.

Then what? Then it is connected to the pump line. What happens? Fluid flow in for storage. Then what happened? It will compresses the diaphragms. You will see here p 3; what is the p

3? The charged to a maximum operating pressure p 3. Then afterwards once it is completely charged, pressures are system pressure; then you have to drain for particular purpose.

That time the charge of fluid takes place; then what happens? Again discharged to a minimum operating pressure p 2. Please remember friends, these are very very important, how the diaphragm type accumulators will work.

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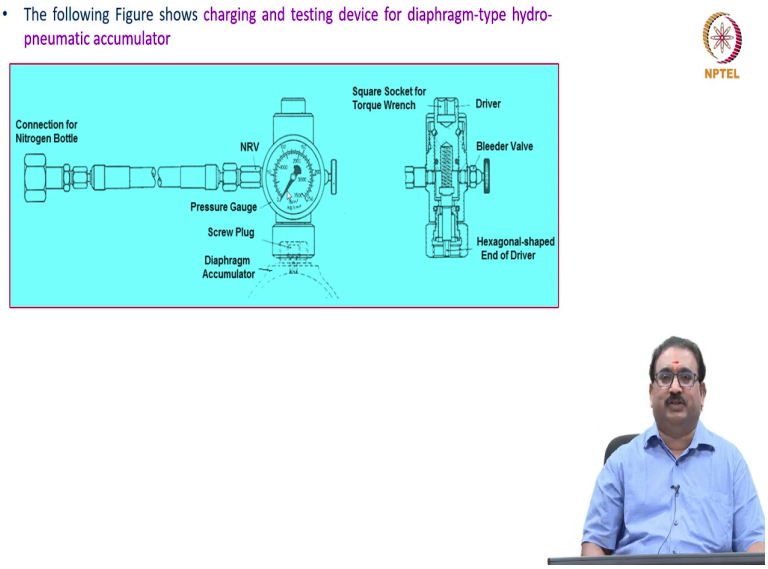

How to charge the accumulator for nitrogen gas? The following figure shows the charging and a testing device for a diaphragm type accumulator. You will see here the connection for nitrogen bottles and these are the hoses, then non return valve is there. And a pressure gauge to the required level you have to charge, the diaphragm accumulators.

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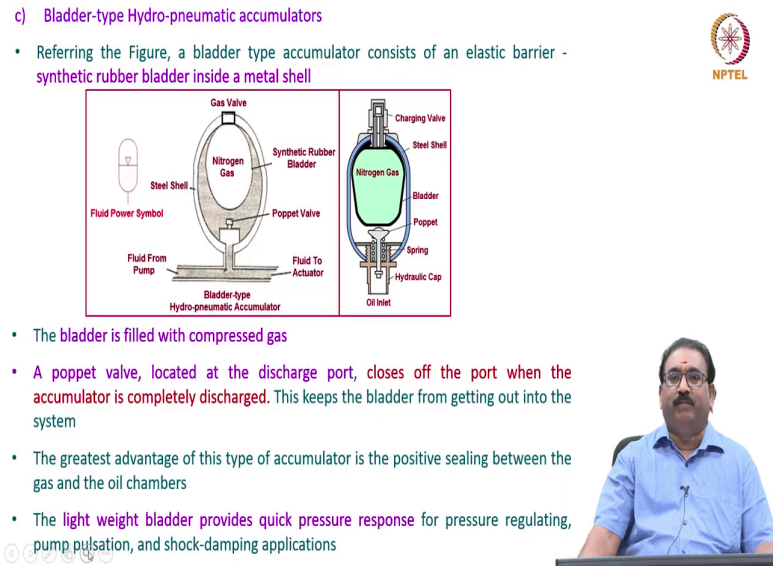

Now, we will see the bladder type hydro pneumatic accumulators. Referring to the figure, a bladder type accumulator consists of an elastic barrier synthetic rubber bladder inside a metal shell; outside one is a material shell, inside one is a synthetic rubber bladder, which stores the nitrogen gas.

The bladder is filled with compressed gas. A poppet valve located at the discharge port, closes off the port when the accumulator is completely discharged. This keeps the bladder from getting out into the system. The greatest advantage of this type of accumulator is the positive sealing between the gas and the oil chamber. The light weight bladder provides a quick pressure response for pressure regulating, pump pulsation, and a shock damping applications.

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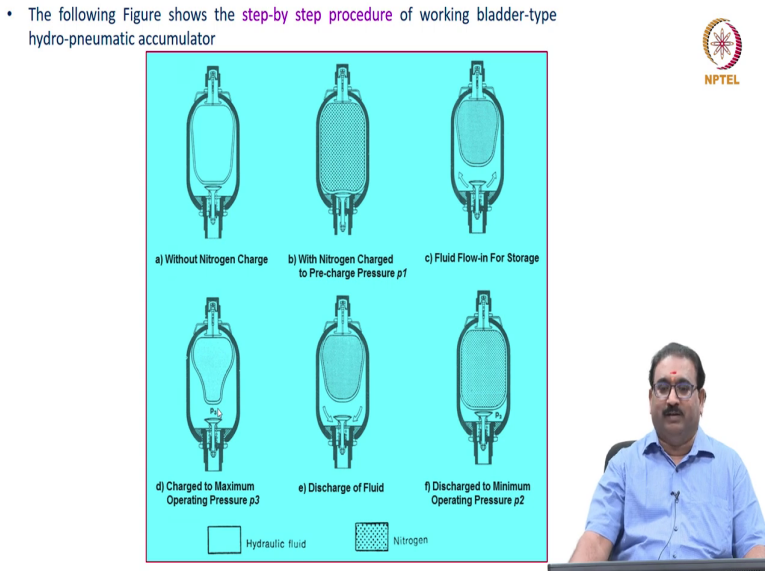

Again the following figure shows the step by step procedure of working the bladder type hydro pneumatic accumulator. It is very much similar to the diaphragm type, but here separating element is a bladder. Just see here now, exactly same here it is. Without nitrogen charge, it is like this. Then what you will do? You will charge the nitrogen with a required pre charge pressure p 1.

Then after this what happens, the fluid flow in for the storage; fluid will enters from the pump line. Then what happen, it will compresses like this. Then charged to a maximum operating pressure p 2, which is equal to the system pressure what you want. Then as and when required the fluid from the accumulator, it will be drenched, it will be taken out; that is discharge of fluid. Then how much it is? Discharged to a minimum operating pressure p 2.

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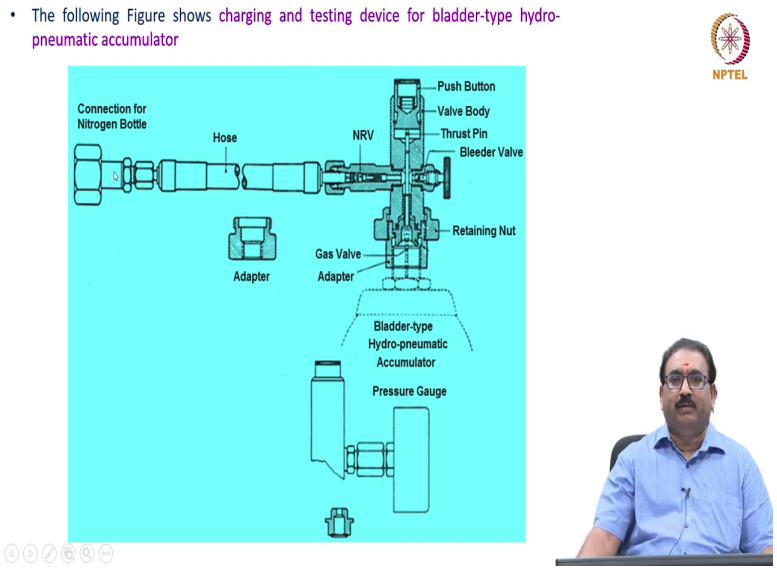

The following figure, the following figure shows the charging and testing device for a bladder type hydro pneumatic accumulator. It is similar to that; here connection for nitrogen bottle, as I have told you hoses are there. Then interchangeable adopters are there here; this is a gas valve, the bladder type hydro pneumatic accumulator, pressure gauge, the push button, the valve body, thrust pin, the bleeder valve, similar to previous one, then it is a retaining nut.