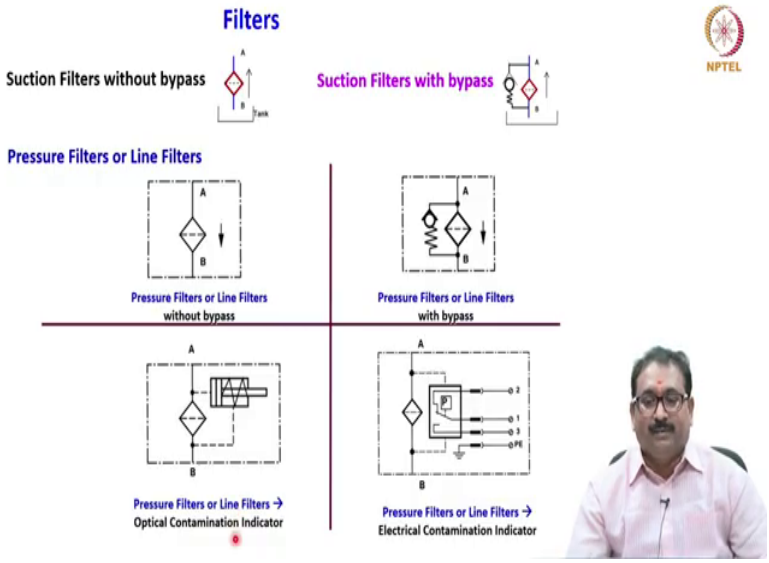
**Oil Hydraulics and Pneumatics**
**Prof. Somashekhar S**
**Department of Mechanical Engineering**
**Indian Institute of Technology, Madras**

**Fluid Power Symbols**
**Lecture – 12**
**Part 3: Symbols for Filters, Check Valves, DCVs, Spool Actuation methods, PCV, Miscellaneous, Port Configurations**

(Refer Slide Time: 00:23)




My name is Somashekhar course faculty for this course. Now we will move on to the Filters; the filters are represented using the rhombus. How to represent the suction filters without bypass? Please see here it is a rhombus, the dotted lines are there, inlet is there, outlet is there.

Now, we will see the direction flow is moving from B to A; it is a suction filter without bypass. What is the meaning? From A to B also through the this filter only, but some

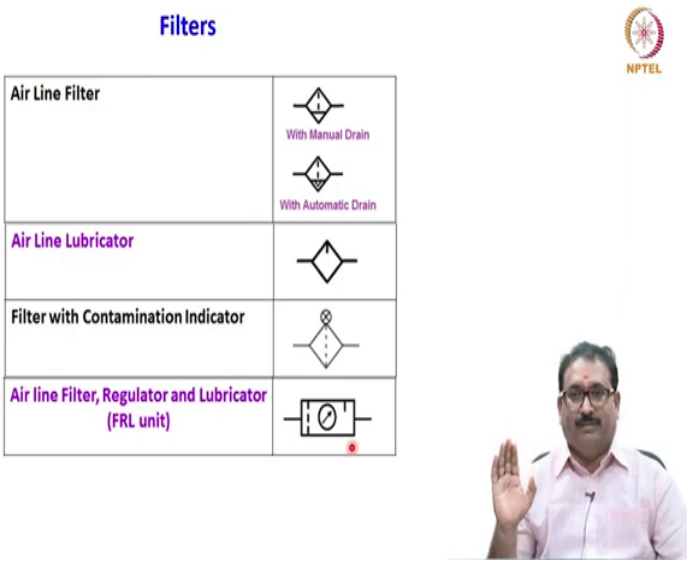
capabilities are there in some of the filter. Suction filter with bypass; meaning you will see friend B to A is through the filter and A to B is through the NRV fitted with the spring.

Because after doing the work, oil will get contaminated, you do not send the flow through the filter here you will send the fluid; but here it is bypass to the tank. Then I will show you the pressure filters or a line filters; these are the suction what I have shown. Now I will show you the pressure filters or a line filters; you see here friends.

Now, pressure or a line filter from A to B how they are representing we will see, this is known as pressure filters or a line filter without bypass with bypass; pressure filters or a line filter with bypass through the NRV. You will see friends the one more symbol I have drawn here see understand it the symbol, this is pressure filter or a line filter optical contamination indicator it is; optical contamination indicator is there.

If you want to represent using the electrical contamination indicator, they are represented like this please understand this; whenever you will see this it is also a filter pressure line filter electrical contamination, if you will see here like this it is a optical contamination indicators.

(Refer Slide Time: 02:31)



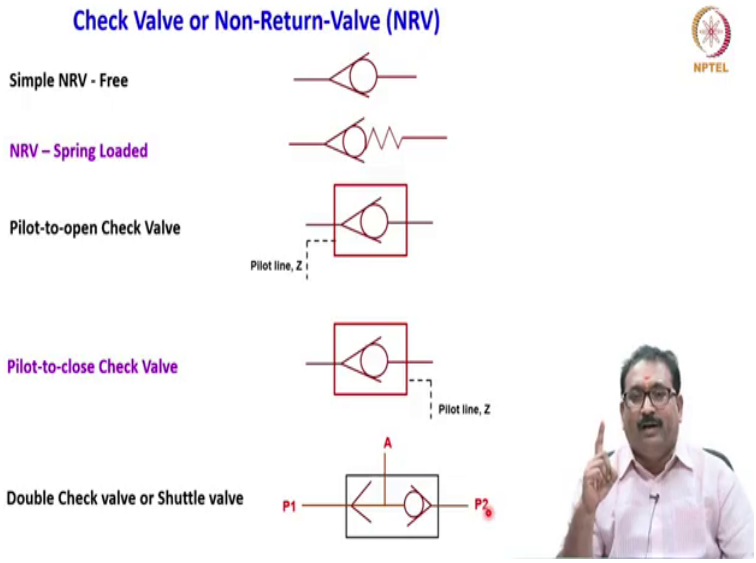

Then I will show you some more filters air line filters, they are represented you will see here how dotted with one line; meaning it is with manual drain it is, here with automatic drain you will see some here one more triangle I am putting. Airline lubricator you will see friends very careful here only one line I am putting here on the rhombus.

Meaning airline lubricator, they will give the small quantity of fluid in the air for the lubrication purpose, when you will see this type of symbol it is a air line lubricator. Similarly we will see filter with contamination indicator are represented like this see here because it is a filter contamination indicators how they are representing.

Then you will see very carefully this is known as FRL unit in the pneumatics. What is FRL? Filter Regulator Lubricator it will do the three important function. How to represent? As

usual dotted line for the filter, regulators, then it is lubricators; this is more frequently used in the pneumatics this is FRL units.

(Refer Slide Time: 03:53)




Now, we will move on to the check valve or Non Return Valve briefly known as NRV what is this? It allow the flow in one direction, other direction flow is restricted how to represent? You will see here. Simple NRV free flow it is meaning here see here from left to right it will lift the ball and moves.

But when the fluid is coming from the right to left that time ball is fitted over the valve seat no flow only flow is in this direction this direction restricted. Then similar to this here NRV fitted with the spring loaded it is; ball is pressed over the valve seat; meaning here more force is required to lift, but here only ball here it is with spring.

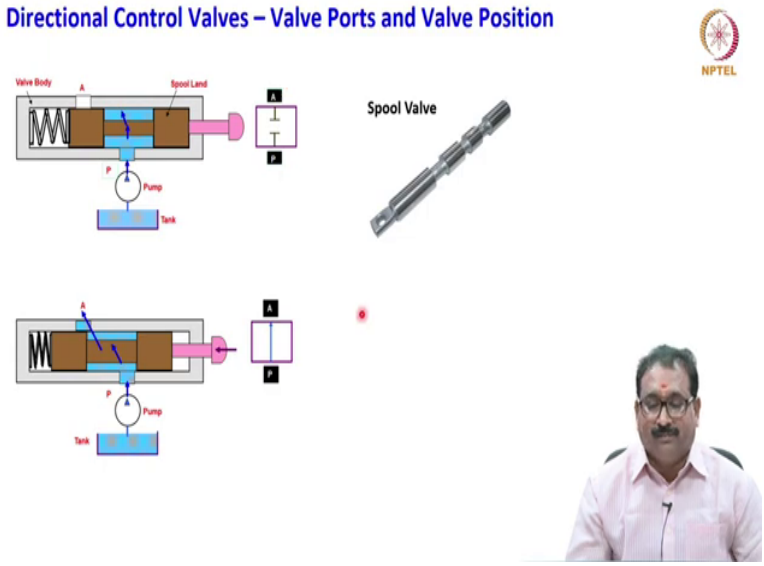
Flow is moving from left to right, right to left is not allowed this is known as NRV with spring load. Pilot to open check valve; you will see friends here how do I resenting, how to represent, enclosed in the box here pilot line. What is the purpose here? You will see friends here, the flow is allowed from left to right because, the fluid will lift and it will move from here to here, but here to it is here it is not allowed.

But I am marking here pilot line when you pilot lines. What are these pilot line? Pilot lines are the control signals as and when required you will call, otherwise they act as a normal valve. If no pilot lines then pilot to open check. How it will work? It acts as a ordinary check valve like this; meaning flow is moving from left to right to left is not allowed.

But when you will call the pilot line what happen? The ball will be lifted with the pilot signal, then flow will move from right to left also that is why it is known as pilot to open check valve. Similarly, the pilot to close check valve we will see pilot line I applied in other side. Meaning when pilot signal is there flow will not from left to right also; that is why these are pilot signals are used as and when required.

You will see here double check valve or it is also known as shuttle valves; you see friends here P1 and P2; always wherever you will see P term it is a power source. Meaning A actuator end is receiving flow either from P1 or P2 whichever is greater. Now, you will see A is receiving from P1, P1 is on that time ball will slide over and it will close here; it is represented like this, this is double check valve, check valve 1, check valve 2. I will show you the constructional details later.

(Refer Slide Time: 07:04)




Now, we will move on to the directional control valves, here we will discuss the valve ports and valve positions; these are very important. Let us we will see this what is this meaning of this you will see here. I have shown diagram here, here what is this? You will see this is known as the valve body, in the valve body two ports are there A and P, already told P is a pressure port connected to the pump and A is a actuator port it is.

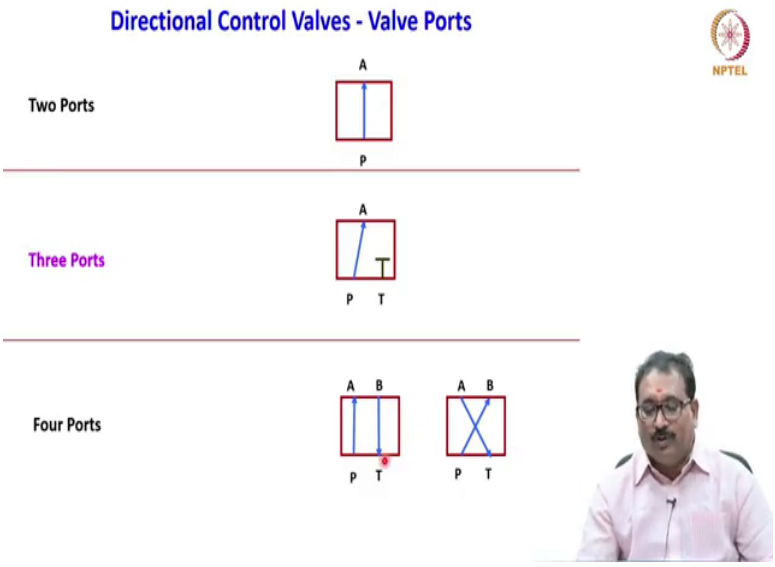
Now, what I need here friends, I used here you will see here this is known as a spool valve. What is this spool valve? It is a cylindrical body moving inside the valve body; these are called a lands and these are the grooves, this land is used to open and close the valve. Now we will see how I did here using the strip spring in the valve body, I made in such a way that the spool lands close the port A; meaning the pump flow will not received here.

And when it will receives? When I will push the spool. How I am pushing the spool? You will see the some arrangements I made here. It is the rod with push button, when I will push this what happen? The spool will move, the spring will compress the flow will takes place see here flow will takes place.

Again one more pushing, what happen? This stiff spring push back here such a way that the ports are closed. Meaning you will see here these are known as the valve position this is called a null position what I have drawn. In the null position A port is blocked with the P you see here. How to represent?

A is not receiving any flow that is why they are blocked. When you will push this button what happened? Flow is taking place from P to A this is first position null position and this is actuated positions how many ports here friends? Two ports P and A.

(Refer Slide Time: 09:14)



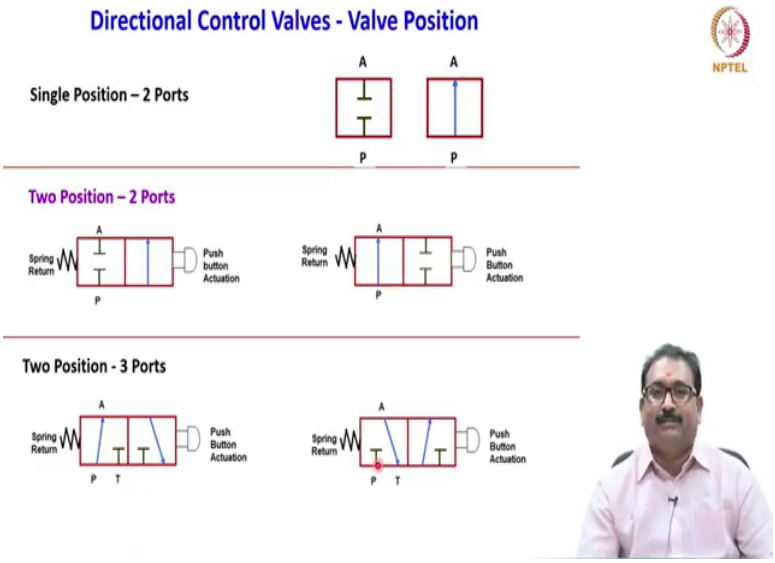

Now, let us we will see the what we will call directional control valves and valve ports we will see now how many ports are there, how to represent. Two ports as usual P and A you will show like this; this is the first position whatever it is; open position now it is called P is open to A; three ports one more port is a tank port here you will see tank port.

How to how it is what is? Open position, now it is look here P is connecting to A, but T is blocked; three ports are there. Then similarly four ports you will see here pressure port, tank port and A and B are the actuator fight; this is for the double acting cylinders. And one more thing like this also you will show; now we will see what is the difference between this and this.

Here P is connecting to A; B is connecting to tank; this is known as parallel configuration, this is known as crossed configuration P is connecting to B, A is connecting to T each valve

position is showing like this. The maximum ports as I have told you in the functional symbol there are four ports you will represent like this.

(Refer Slide Time: 10:27)

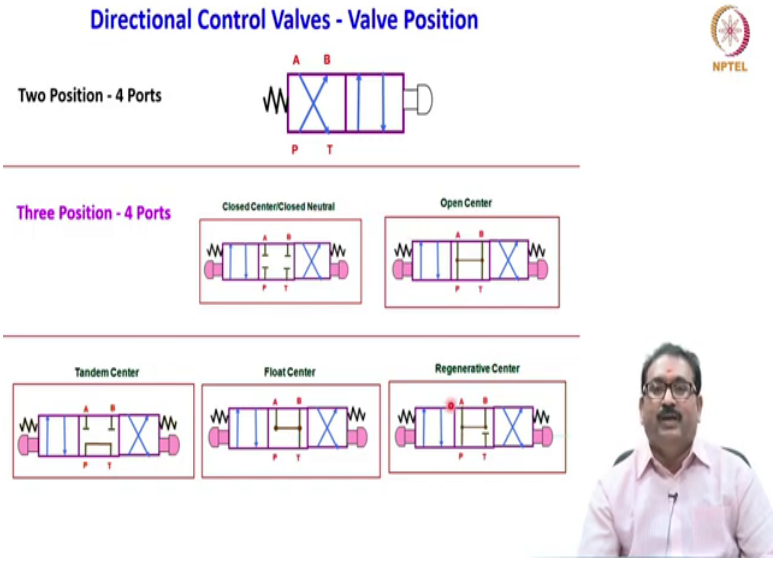



Now, we will move on to the single position; 2 ports single position means, null position generally. What is that? In null position, maybe the 2 ports are blocked or maybe the 2 ports are opened like this P to A, but only 2 ports are there; it is closed and open each position is represented using the square box with these arraignments.

See the two position, now we will see two position first position second position or a 0 position 1 position; the two position 2 ports, you will see here friends using the spring the spool lands closed the port here P and A are blocked. But when you will push this button P is connecting to A or like this also in null position P is connecting to A and in actuated position both are blocked.

Similarly, see here friends two position 3 ports you will see here null position P is connecting to A T is blocked; in the actuated position, A is connecting to tank P is blocked similarly other. How to represent you have to learn 3 ports two position only.

(Refer Slide Time: 11:50)




Two position 4 ports; position 1, position 2; this is a null position spring side P is connecting to B, A is connecting to T or you will connect like this also P is connecting to A, B is connecting to T null position. In the actuated position parallel configuration here you will see, P is connecting to A, B is connecting to T in actuated position.

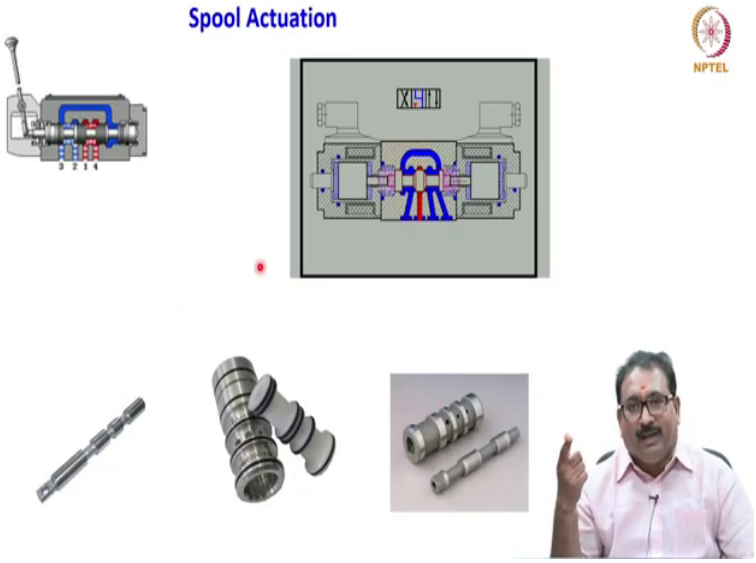
Three position 4 ports see here now three position; null position, first position, second position. In null position, there are various combinations are there because it is a 4 ports are there; now it is all ports are blocked it is known as closed center or a closed neutral. Many

combinations are possible in the center, based on that different types of control valves are available in three position.

You will see here all ports are opened in the middle position, each is having its own advantage and application; we will discuss when we are studying the directional control valves. Tandem center what is that? In the middle position P is connecting to T A and B are blocked or you will see A and B are connecting to T and P is blocked.

Regenerative neutral what is that friends? Here A and B are connecting to pump T is blocked; regenerative neutral it is, based on the center how they are connected they will represented with the different names; each having its own advantage and disadvantages.

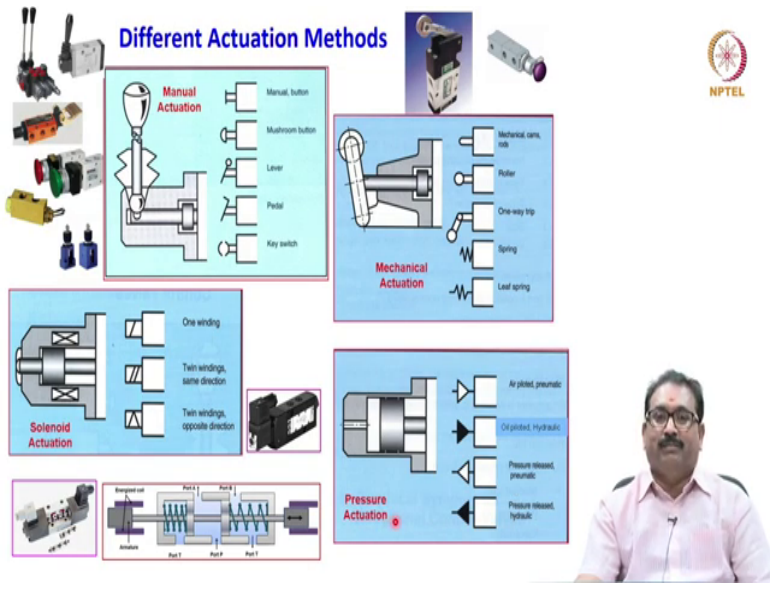
(Refer Slide Time: 13:31)



Now, we will see as I have told you in the previous slide to make the port connection, I want to push the spool. How we will push? This is known as a spool actuation; you will see I am using now here I am using the lever. Now we will see here I am giving I am using some electrical solenoids; because you will see when you will see this here, it is known as electrical solenoid.

What is this electrical solenoid? This solenoid nothing but the ferrous material connected to the rod to push the spool in either direction. How? By applying the current to the coil, if you will activate this push will be spooled here; if we activate this push will be move spool will be moved here, here it is electrical solenoids.

(Refer Slide Time: 14:25)




Like this friends different types of actuation methods are there. Now, let us we will discuss the different actuation methods. See here now I am showing you here the manual actuation;

there are various valves are available. What is manual actuation? Manual button how to represent you will see.

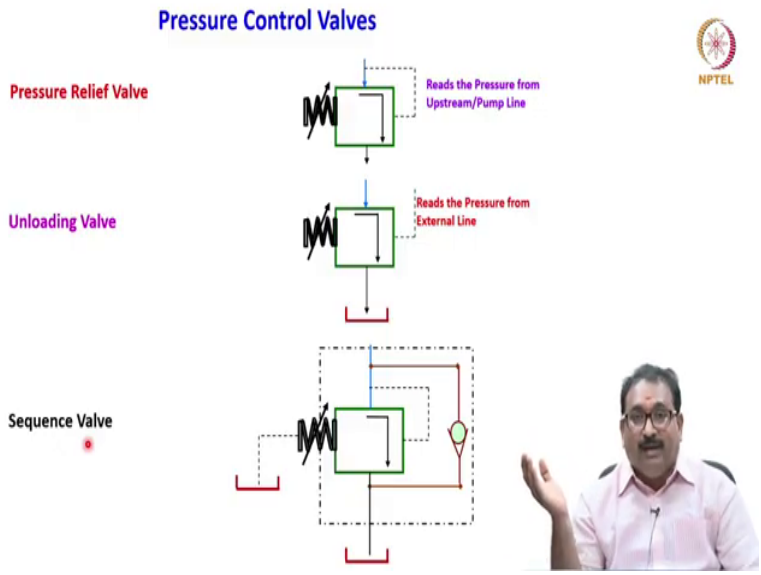
It is a mushroom button or it is a lever or it is a pedal using foot you will foot operated pedals. You will press one, open another press close like this or it is a key switch tuck tuck one time tuck open, one time tuck it will close you will see here how would I representing. This is manual actuation for the spool.

Similarly you will see here mechanical actuation, using the mechanical camps rods rollers one way trip or spring or a leaf spring using the mechanical elements, I am pushing the spool. Or as I have told you solenoid actuation, electronic valve it is what you call this is a ferrous material these are the two coils.

It is one winding, here you will see two if I will put one two wind twin windings same direction; if I will put like this twin windings opposite directions all are available friends. You will see here pressure actuation pressure maybe the air or a fluids if triangle is not filled, immediately you will tell air if triangle is filled hydraulic. You will see here if you will represent like this actuation is air piloted pneumatics.

If you will put triangle here, oil piloted hydraulic. If you will away here pressure released pneumatic here you will put like this pressure released hydraulic; these are the pressure actuations.

(Refer Slide Time: 16:39)



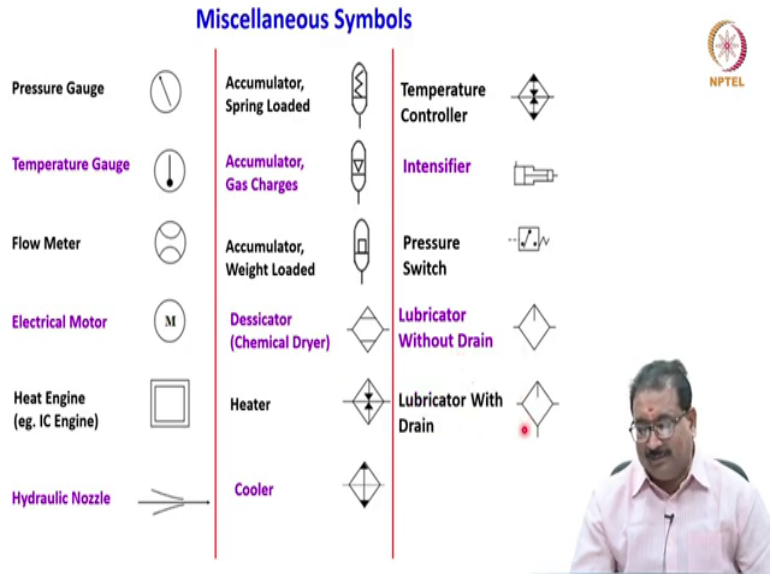

Now, we will move on to the pressure control valves; very quickly you will see here friends again pressure relief valves are represented with look here. Please understand one square functional symbol then you will see arrows how they are putting then they will read how the pressure they will read; known as reads the pressure from the upstream, upstream means pump line.

Here I am putting one spring with arrow. What is the meaning here friends? The pressure you can adjust, if you will buy maximum 100 bar you will adjust you know 50 bar, 60 bar; whatever you want using adjustable spring it is a pressure relief valve. Unloading valve you will see friends however, I am reading the pressure now, reads the pressure from the external line to control you will see the closed position both are closed position again it is adjustable in unloading valve.

Sequence valve you will see friends see the figure here you will see here this is nothing but your pressure relief valve then what I did here? I connected one NRV Non Return Valve; both ends are subjected for the pressure that is why always it will drain as shown here the drain line.

The whole valve is known as sequence valve; when I am sequencing the 2 or 3 cylinders multi cylinder operations that time you will use the sequence valve. I will tell you detailed construction when we are discussing the pressure control valves correct.

(Refer Slide Time: 18:17)




Now, you will see the quickly the miscellaneous symbols very quickly the pressure gauges are represented like this; circle with one arrow; temperature gauge you will see here circle dot with line; flow meters you will see here how they are representing. Electrical motor they will

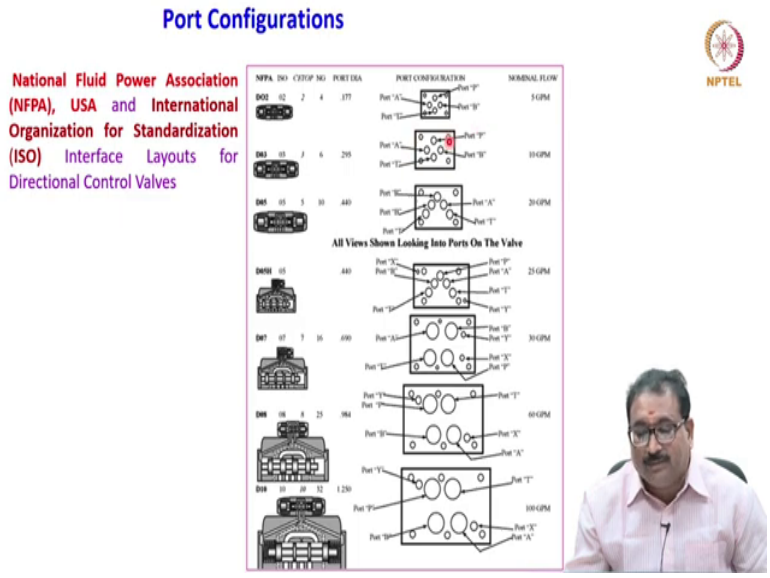
put circle inside m they will write if we will put it like this; it is known as heat engine IC engine two squares correct squares of different sizes one inside the other.

Hydraulic nozzles; you will see here triangle folds accumulator spring loaded you will see accumulator, when you will see such shapes it is a reservoir one more substituting to the main tank accumulator here it is a spring loaded.

Similarly, you will see here if you will put it here like this gas charged here you will put it like this it is weight loaded accumulator. Here chemical dryers or a dessicator how they will represent you will see similar rhombus and two lines. Heater how they are representing you will see the arrows heater it is; cooler you will see how the coolers are represented.

Similarly, temperature controller how they are presenting you will see friends arrows you will see this is when you will see such symbols in the circuit you will see immediately temperature controller it is; by practice it will come no need to remember one or two when the class will move we are designing so, many circuits that time you will come to know that the use of all symbols. Intensifier you will see how they are representing, pressure switch, lubricator without drain, lubricator with drain see.

(Refer Slide Time: 20:20)




Now, we will see the port configuration, when you will buy the valve; either it is a 2 by 2 A valve or 4 by 2 A valve whatever the valve we will buy friends there physically you see all remains same; meaning where thing is same, but very very important thing is you have to connect know P port you have to connect to pump, tank port you will connect to T correct know, then A port is connected to actuator, B port is connected to actuator these are all marked on the valve body.

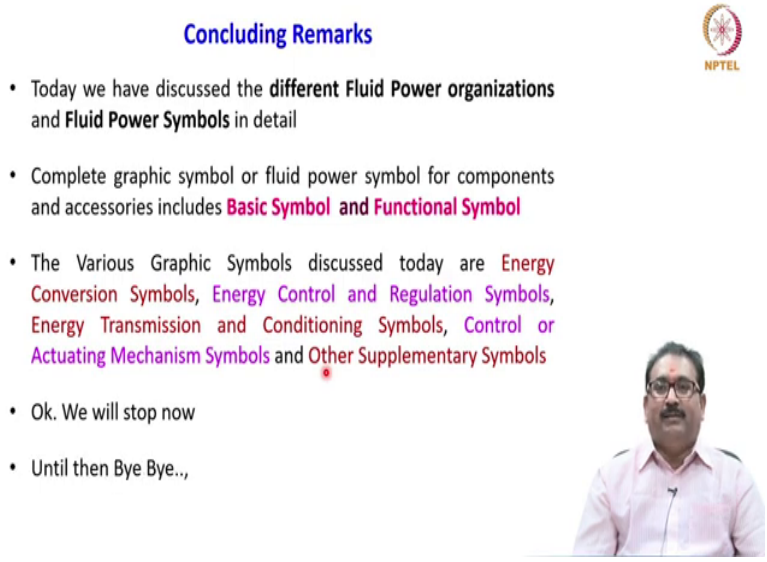
That is you have to understand the port configuration how it is engraved on the valve body of the valve. I will show you here you will see friends here national fluid power association NEPA USA and International Organization for Standardization, Interface Layouts for the Directional Control Valves.

You will see here friends you will see pressure port, tank port how it is? Port A port B; you will see the circle dimensions the you always you do not think always in the same position as soon as you will buy the valve you will see where is my P port is connected connect to the pump.

Where T port is connected you will go connect to the tank, where A is connected connect to the actuator end; meaning you have to see here there are different ways ports are connections are there port connections are there. Also you will see this friends the nominal flow as increases you will see the circles representation also increases.

These are the some of the things you have to understand when you will buy the valve to connect to the power source and the actuator you have to see the down of the valve body they will represent P port where it is, tank port where it is A port where it is ok. All they will mention; this is one of the things what you have to understand in the port configuration ok.

(Refer Slide Time: 22:22)




We will conclude from the today's lecture. Today we have discussed the different fluid power organizations and fluid power symbols in detail. Complete graphic representation or a fluid power symbols for components and accessories which includes the basic symbols and a functional symbols.

The various graphic symbols discussed today are energy conversion symbols, energy control and regulation symbols, energy transmission and conditioning symbols, control or actuating mechanism symbols and other supplementary symbols. Ok friends, we will stop now; until then bye bye.

(Refer Slide Time: 23:21)


Thank you one and all for your kind attention. [FL] Bye bye to all.