Oil Hydraulics and Pneumatics
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Fluid Power Symbols
Lecture – 11
Part 2: Symbols for Functional Units, Hydraulic Pumps, Hydraulic Motors, Cylinders, Air Compressors, Pneumatic Motors and Orifices

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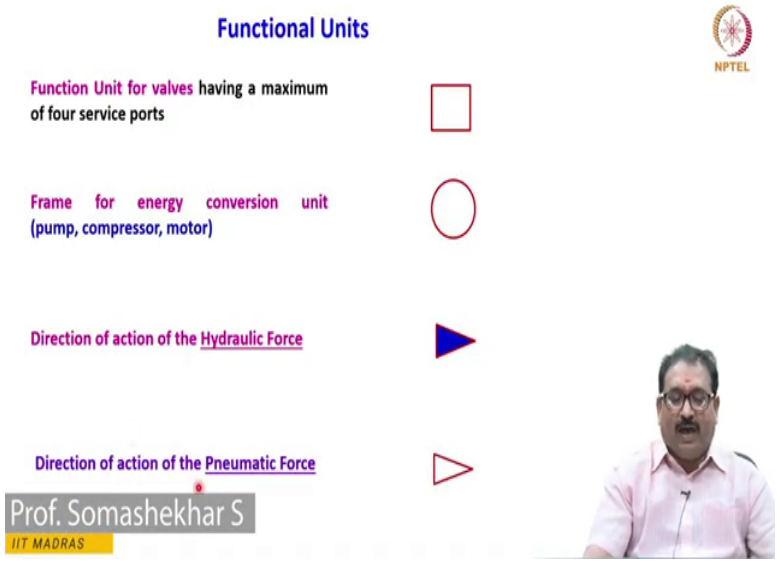

My name is Somashekhar, course faculty for this course. Now we will move on to the Functional Units, how they are representing. The functional unit for various valves having a maximum of four service ports they will represent in the square, these ports are nothing but the pressure port, tank port and a control ports; meaning, actuator ports a b or c 1 c 2.

They will represent it in the square box. Frame for energy conversion unit like a pump, compressor, motor they will use the functional unit is the circle. Direction of action of the hydraulic force is represented with arrow filled, triangle filled direction of action of the pneumatic force triangle not filled.

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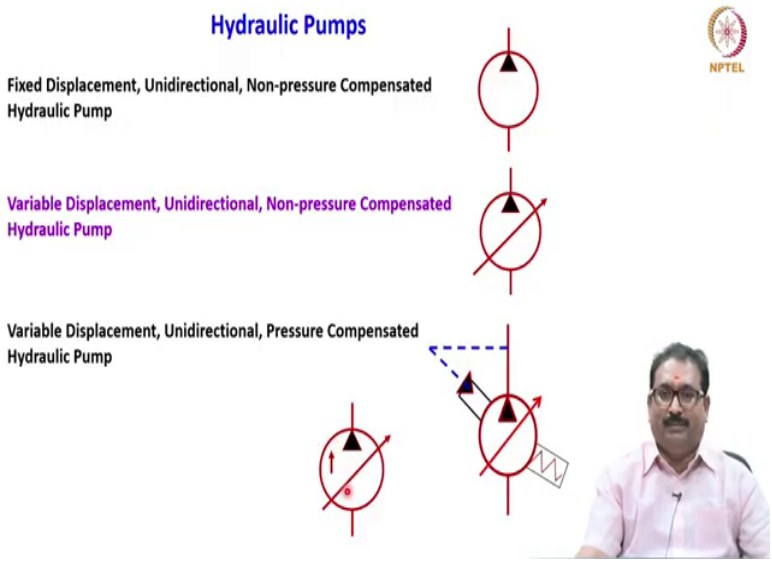

Now, we will move on to the hydraulic pumps. Already we know that the hydraulic pumps sucks the fluid from the tank and delivers to the rest of the system. Meaning, it will convert the mechanical energy received from the electric motor into the hydraulic energy.

How to represent this hydraulic pumps? See here circle with triangle filled then inlet and outlet, this is read as fixed displacement, unidirectional, non pressure compensated hydraulic pump to read completely this, see the direction of the triangle filled and how it is connected. Then if you want to represent this variable displacement unidirectional non pressure

compensated hydraulic pump, what I did here? I passed one arrow over the circle, similar same as this only here variability in the pump is represented using this.

Variable displacement pump, unidirectional, pressure compensated hydraulic pumps. Meaning when you are using the pressure compensated pump you no need to have the pressure relief valve, because pump itself will take care for the what we will call catastrophic in the system lines.

If pressure increases you will see here how they are representing here the spring is there you will set the pressure whatever you required. For example, I will set here 100 bar, then what happens here always the outlet of the pump pressure is monitored and used as a feedback.

As long as this is less the pump is sending the flow to the outlet when this is exceeding, what happened? This will push the moving element to make the flow 0 here. They are represented using the symbol you will understand this if red mark is there from the outlet, to make the flow 0 when the pressure exceeding here to the set pressure, they are represented like this.

But you will see friends some books they will represent with arrow also here we will see the arrow here. This is also you will understand it is a pressure compensated unidirectional variable pump.

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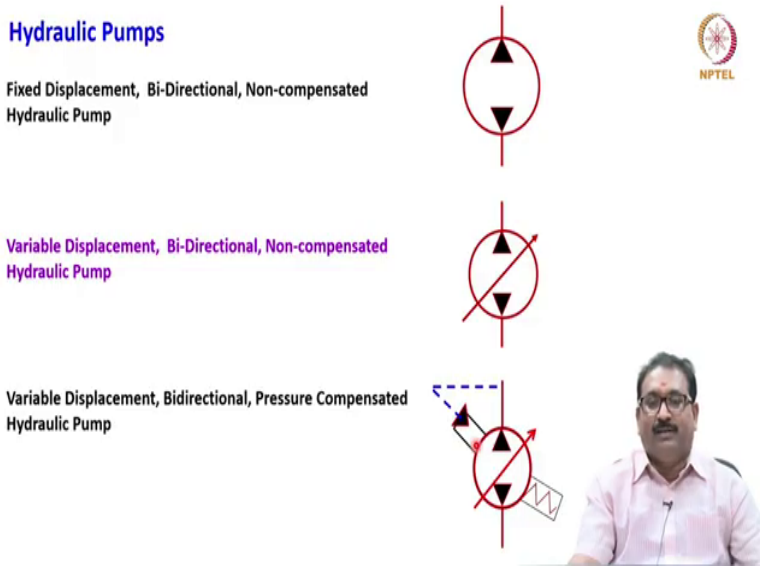

Then you will see here also we will see here 2 arrows I filled here. How we will read it? Fixed displacement, bidirectional, non pressure compensated hydraulic pump. The variable displacement, bidirectional, non pressure compensated hydraulic pump arrow same here variable displacement, bidirectional; then variable displacement, bidirectional, pressure compensated hydraulic pump see here same here, but you have to make the connections here.

Read the pressure here and fed back to the pump for the 0 flow when the pressure exceeding here.

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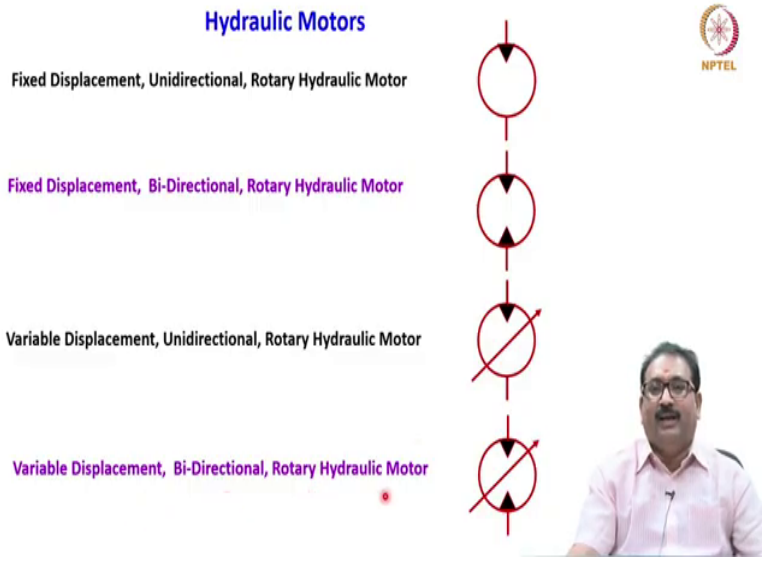

Now, we will move on to the hydraulic motors, what are these? Hydraulic motors are the actuators which will use the hydraulic energy to mechanical motions, like a force or a velocity here the hydraulic motor, what is very important here? It will gives the torque and the speed the actuators will convert the fluid energy into the mechanical parameters.

If it is a cylinder it is a force and velocity if it is a motor here it will convert the hydraulic energy into the torque and the speed. How to represent the hydraulic motors? See here friends, now will same as previous do not think here triangle is inverted you will see here please only small difference here.

It is read as fixed displacement, unidirectional, rotary hydraulic motor. See here two arrows pointing towards center fixed displacement, bidirectional, rotary hydraulic motor. If we will put arrow then it is a variable displacement, unidirectional, rotary hydraulic motor. Similarly,

if we will put here 2 over arrow, it is read as variable displacement, bidirectional, rotary hydraulic motor.

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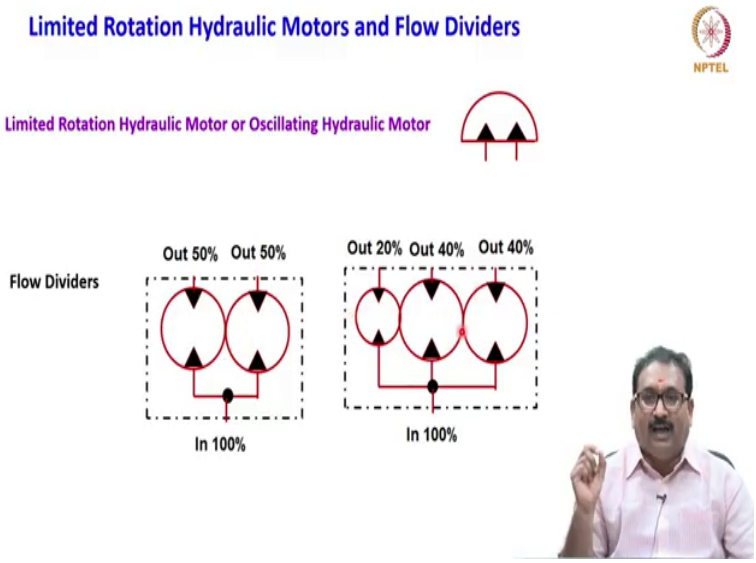

Now, we will move on to limited rotation hydraulic motors and flow dividers we will see now how to represent; limited rotation friends, how to represent? Semi circle with a triangle two triangle filled it is read as, limited rotation hydraulic motor are also known as oscillating hydraulic motor meaning, semi circle. Flow dividers, what are these flow dividers friends?

The inlet is divided into equal halves or a many divisions, how you want? How the customer want? Here what I am showing you here is, the flow is divided into 50 percent 50 percent. You see the how flow dividers are represented, please see here friends 50 50 percent dividing by 100 it will divide, it is enclosed in the one dotted line meaning it represent the complete component is a flow divider 50 50 flow divider it is.

As I have told you different division also possible 20, 40, 40, then you will see this size you will see friends how 20, 40, 40. The size of the circle and filled arrows you will see. This is a way how the flow dividers are representing dotted lines is representing all in 1 unit, 1 unit it is these are the flow dividers.

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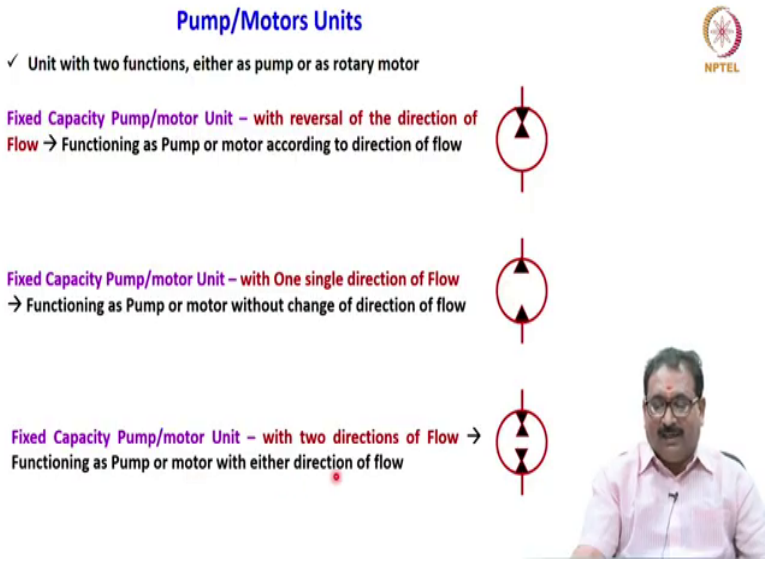

Later we will move on to the pump bar motor units you will see pump bar motor units. It is a unit with two functions, either as a pump or as a rotary motor depending on the flow that is why I am telling you. You will see here; see here friends how they are representing one arrow towards center another arrow towards out, again it is having inlet and outlet, how to read.

Fixed capacity pump or a motor unit with a reversal of the direction of flow, functioning as a pump or a motor according to the direction of the flow; now, you will see here this is a pump and this is a motor, how to read? Fixed capacity pump or a motor unit with a one single

direction of flow, meaning functioning as a pump or a motor without change of direction of flow or you will see here now how it is.

See the symbols very carefully graphical symbols you have to see how to read, fixed capacity pump or a motor unit all with a two direction of flow functioning as a pump or a motor with either direction of flow is possible here. These are all comes under fixed capacity pump or a motor units these are.

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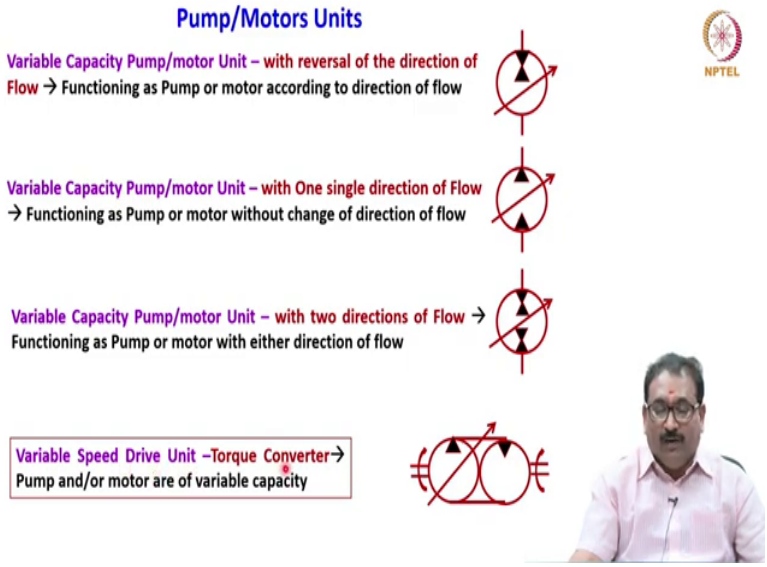

How to represent variable only it is an arrow you will see here, all are same only you will see friends arrow all whatever I have shown here variable capacity pump or a motor unit with a reversal of the direction of flow, functioning as a pump or a motor according to the direction of flow.

Whatever I had shown in the previous slide I am putting one arrow over this making it is a variable. If it will remove arrow it acts as a fixed displacements then we will see friends one more I am showing you here please understand very carefully the direction you will see here arrows filled arrows how it is.

It is read as a variable speed drive unit, torque converter, pump and or motor are of varying capacity because arrow is there here you will see pump and motor, variability is there it is known as torque converter ok. How it is represented please understand in your mind.

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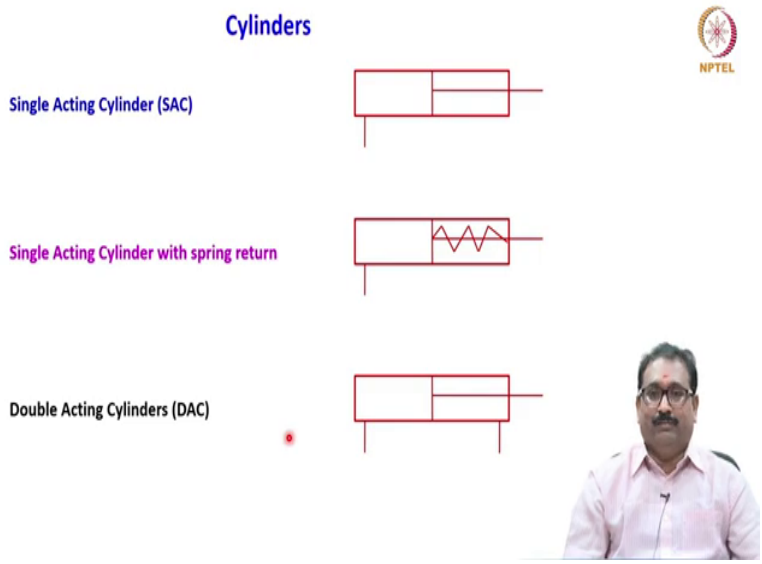

Later we will move on to the cylinders; cylinders again actuator they will convert the fluid energy into the mechanical as a force and velocity linear velocity here. Let us we will see how

to represent the cylinders. Single acting cylinder, see friends one rectangle then one line and big line, please see here I am putting one line here, what is this? What is the meaning of this?

It is a single acting cylinder, this is a cylinder then this is a piston and this is a piston rod and one port here. Here it is this is known as head side this is known as tail side, here area is pi by 4 d p square piston area here, here how it is when you will move here this is pi by 4 d p square minus d r square rod area. This is also known as single acting cylinder for vertical positioning.

Now, we will see single acting cylinder with spring return you will see here the extension is only through, the fluid the retraction is due to the spring, they will fit here. That is why we read as single acting cylinder with spring return, but here return how it is friends?

Only forward is possible return, how it will come? No fluid here you are using, such type of cylinders as I have told you use vertically mounted. Due to the self weight it will come down, only raising they will use the fluid energy return is here through the self weight.

But here no need to worry in horizontal position also you will use only extension when you will cut off the fluid the spring will push back to the normal position, how to represent you will see. Both are single acting cylinder with spring and without spring this is with spring and without spring.

Double acting cylinder same we will see friend same, but what I did here? I put one more line here meaning extension and retraction through the fluids. This is only this line will matter whether a single acting cylinder or a double acting cylinder. Here we will see is a double acting cylinder meaning, what is the double acting cylinder? Extension and retraction through the fluid flow.

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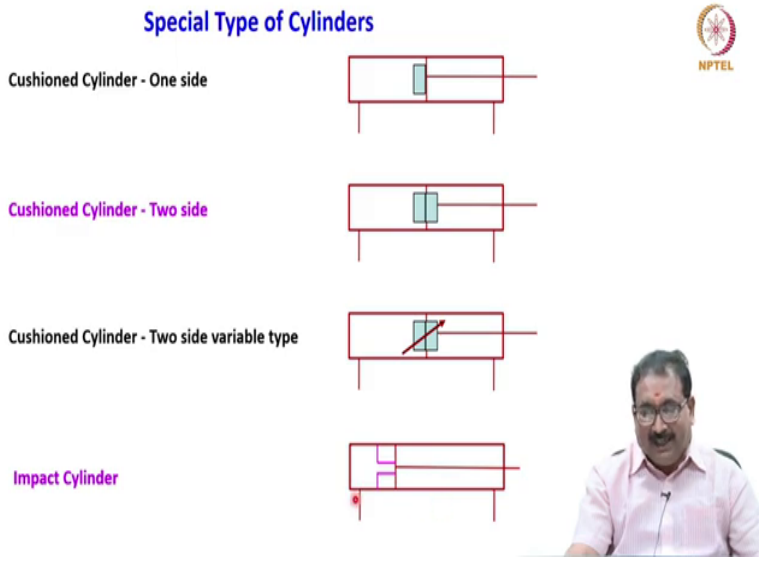

The special type of cylinders are there more frequently used, what are those? Cushioned cylinder one side, cushioning action is there they will put one pad here cushioned cylinder it is. How they will operate we will see later, but we will understand. Cushioned cylinder two side two pads they will put here or both are double acting cylinder remember here double acting cylinder, but cushion is there single side and two side.

Cushion cylinder two side variable they will put one arrow here; you will adjust the cushioning. Impact cylinder you will see how, impact cylinder similar to the double acting cylinder, but I made here from arrangement you will see here. Here this is known as the accumulator which will stores the energy.

You will see how it is made impact cylinder, they will used in pneumatics more to compete with the hydraulic presses. I will explain to you the working principle of this in the later class,

but you will understand how impact cylinders are made, here it is a one compartment they are created. This is to store the energy, fluid energy that is it acts as an accumulator to store the energy ok.

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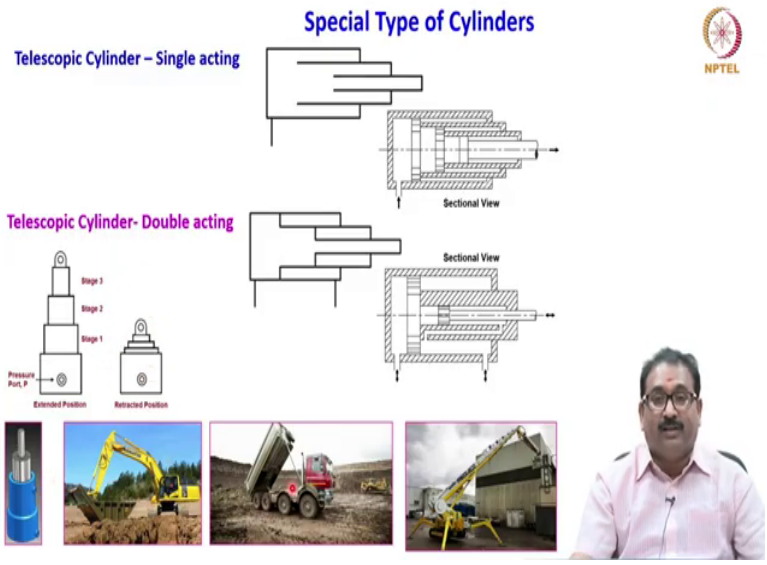

Now, we will move on to the telescopic cylinders it is a single acting you will see. What is telescopic cylinder? You will see the sectional views one tube inside the other, how the extension will takes place? Using the fluid energy; only one I will put single acting, if you will put two here extension and retraction of these tubes inside is through the fluid energy, you will see the sectional views and a fluid power symbol here.

If you will see the applications are very wide friends, you will see what is these are the different stages stage 1, stage 2, stage 3, using the fluid energy they will move one over the

other they will move for the larger stroke. When you will take it the tube inside it will looks a very compact.

This you will see the various applications are there. Earthmoving equipments are there, dump truckers they are using correct; the many places they are using, wherever you require the larger strokes you see the stroke is large these are known as telescopic cylinders.

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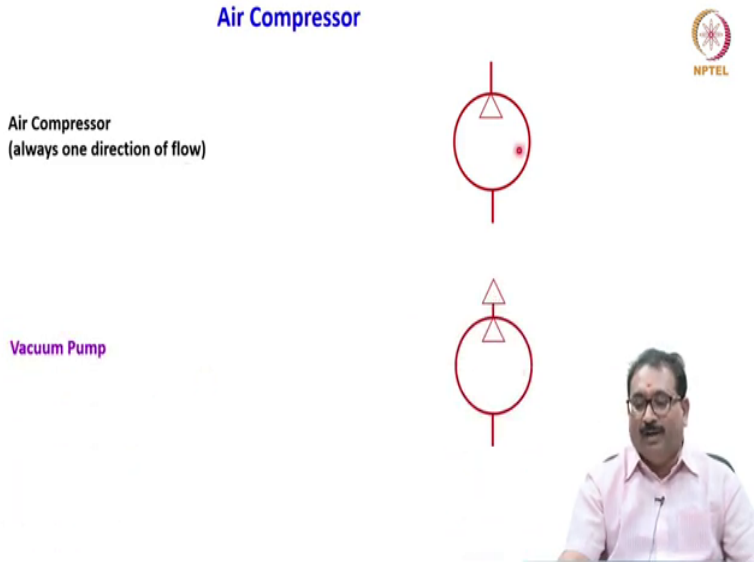

Now we will move on to the air compressor. We are seeing the pump similar to the pump in hydraulics the air compressor is playing a major role in pneumatics, what is a compressor? Compressor will sucks the fluid meaning fluid is here air from the atmosphere to the required pressure with required volume, this is a duty of compressor.

How to represent this compressor? See here you do not think pump symbol and compressor symbols are same here triangle is not filled. When triangle is not filled immediately you will see it is a air compressor, but you will remember friends one more thing always one direction of flow only here. Then you will see one more triangle I am putting here it is known as a vacuum pump similar to this, but one more triangle above I am putting it is a vacuum pump it is.

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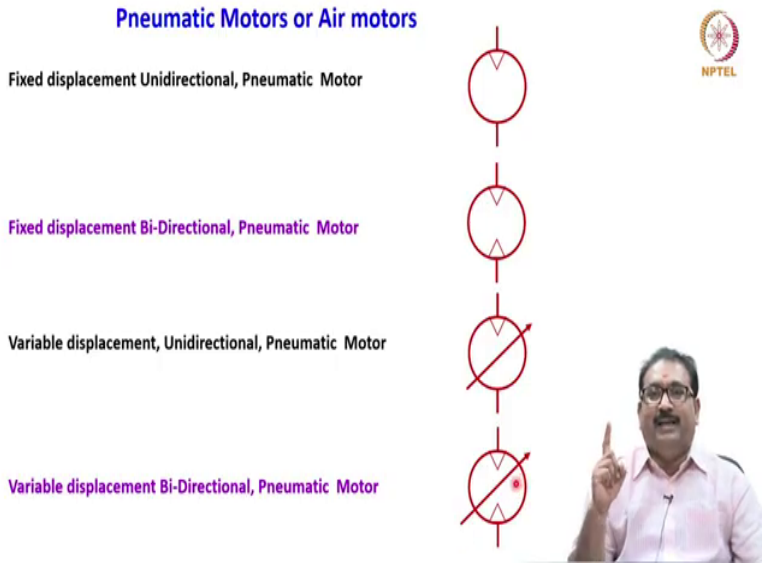

Later we will move on to now the pneumatic motors are also known as air motors, how to represent? See same previously correct, but triangle is not filled, how to read? Fixed displacement unidirectional, pneumatic motor; if we will put two arrows here triangle not filled it is read as a fixed displacement bidirectional, pneumatic motor.

Then you will put one arrow variable displacement, unidirectional, pneumatic motor. Here variable displacement bidirectional, pneumatic motor is same both if we will put one arrow, they will read as a variable displacement. You remove the arrow this arrow this is a fixed displacements, is only different friends.

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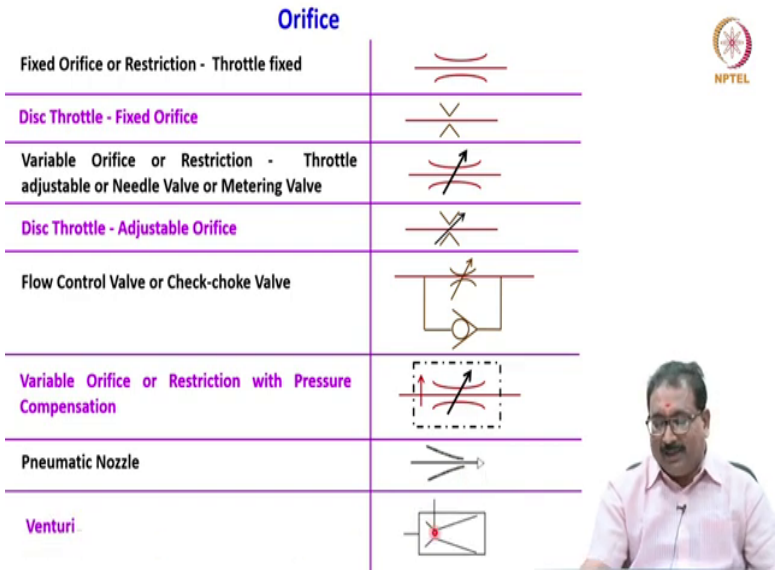

Then I will tell you the Orifice; what for orifice? To control the flow rate to the hydraulic systems or a pneumatic systems whatever it is. Now, we will see this the fixed orifice or a restriction meaning, throttle fixed they are represented like this. See the fixed restriction or a orifice, then a disc throttle they represented like this understand the symbol.

Variable orifice or a restriction what I did here the throttle is adjustable is shown with arrow here, same here fixed it is variable as I have told you in the previous symbol representation.

Now, we will see here same here when I will put arrow meaning variable displacement disc throttle.

Flow control valve or a choke valve meaning it is a check choke valve it is here how to represent, if same here we will see the variable flow, but here you will see friends. When the fluid is moving from this side to this side that time it will flow through the valve opening not through this, because it is a check valve it is unidirectional valve.

When the flow is coming from this side to this side that time it will flow through the non return valve not through the metered orifice, as because path of least resistance is only through this. Now we will see here same correct one arrow I am putting here, but I am putting full enclosed dot this is very important, because only one valve it is what I am showing, how to read this? The variable orifice or a restriction with pressure compensation.

Pneumatic nozzles how they are representing you will see. This is you will see if this is filled then it is a hydraulic nozzle that is why I am telling small differences are there, not filled it is this is the pneumatic nozzle, venturi how to represent you will see venturi how they are representing.