Fundamentals of Industrial Oil Hydraulics and Pneumatics
By Professor. R. Maiti
Department of Mechanical Engineering
Indian Institute of Technology, Kharagpur
Lecture41
Symbols in Oil Hydraulics

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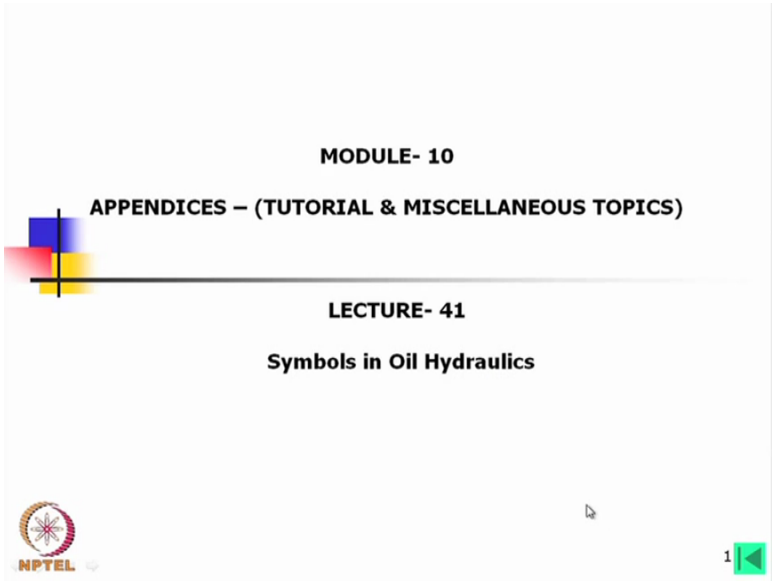

Welcome to the lecture, this is on the symbols in oil hydraulics. In lecture 2 we have already discussed about this. How the hydraulic symbols are built and against a components what is the symbols. Also in the last lecture this earlier to this in the tutorial section I have also discussed that ISO symbols and the glossary and here we will so some simplified symbols those are not strictly the ISO standards, but used in industries.

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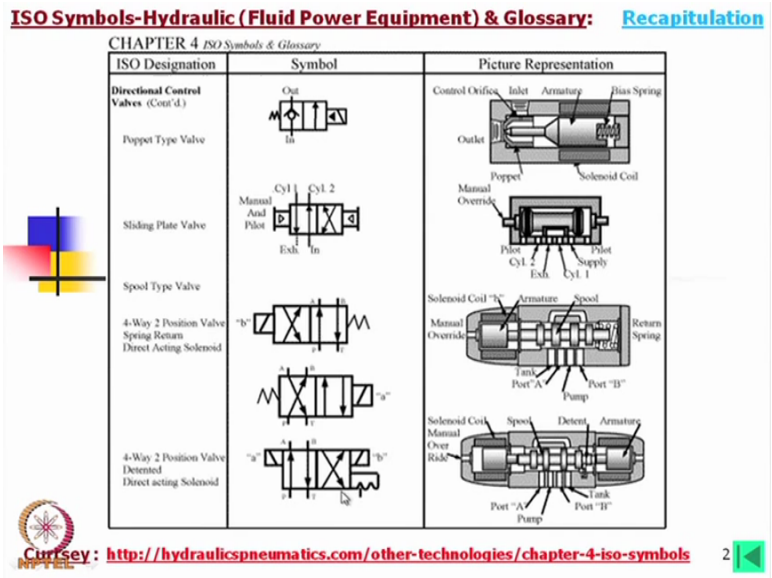

Now first of all we will recapitulate the some symbols that as I have told, this is a poppet type check valve, but it is pilot operated so that we can make the line through. That means the normally oil is coming from this side and it cannot go from this side whereas, we can move this poppet to have the flow in this directions, so which is operated actuated by a in this case, it is a armature means it is a solenoid operated if we move this one is one in this directions then, oil will go from this to this. If the oil come from this sides and if you do not move this one then oil cannot go in the other sides, okay and this is a single plate valve and it is a pneumatic valve or pneumatic actuator not pneumatic valve may be pneumatic actuator to have these 4 by 2 position valve, okay and this is uh 4 by 2 position valves and spring return and may be solenoid ya it is solenoids, solenoid operated and this is just the opposite of this one and in this case, this is solenoid operated no spring return, no spring positioning whereas, some detent positions are there.

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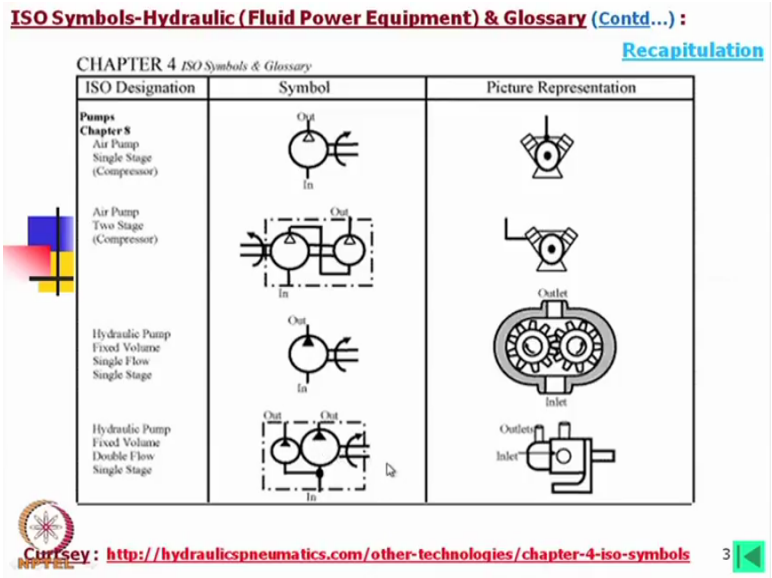

Similarly if we look into the rotary actuator which I have discussed earlier that this is a symbol for rotary actuator. In this case, the triangle is not filled means this is for the gas or air. This means that this is an compressor. In this case, this compressor of two stage, in the first stage it is the gas or air is uh pumped with a certain pressure and then it goes through the second stage and ultimately the output is of high pressure and to make such develop such pressure in a single stage size of the compressor will be huge. In this case, this is rotary pump and hydraulic pump and this is a fixed displacement. This is a double pump by a single shaft both the pump is being operated one is of low flow, one is of high flow and this has a usually to off the load when there is high flow is required or sorry, low flow is required, such pump are used or even for low flow both the pumps are sorry, high flow low pressure both the pump are working and high pressure relatively low flow either of this pump is working. So this is basically used with a proper circuit for energy saving.

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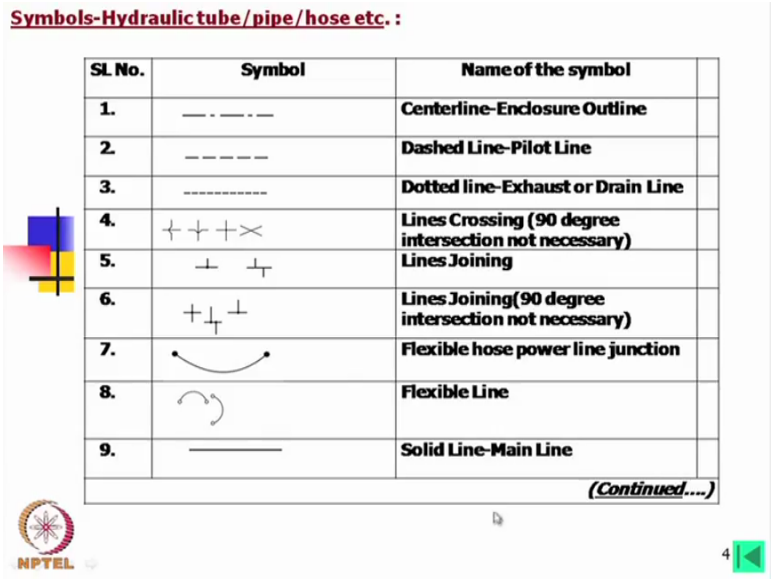

Now we will go for much simpler symbols which are strictly may not be iso standard, but used in industries. Now first of all we shall consider the symbols for hydraulic tubes, pipes, hose etcetera. Now this is of course not the symbol for the hydraulic symbol component symbols rather this is the centerline in a system if we would like to maintain a centerline usually this line is used, dash line is pilot line also, this is the sorry, the top one is used enclosure outline. That means if we sometimes we would say that there are a manifold. Actually manifold means it consist of few valves together and sometimes the symbols is like that all the symbols for all the components like a pressure relief valve, direction valves. These are drawn separately and then it is put in an envelope enclosed by this line. This means that it might be an manifold. If we look into the components this as if a single component, but inside that there might have a directional valve a check valve and a pressure relief valve, pressure control valve and so on.

Now this dash line means, this is usually pilot line. Why usually I would say this pilot line? Now there is a dash, but small dotted lines exhaust or drain line. So in a drawing suppose only these two lines are given, you may not be able to distinguish which is the exhaust and which is the pilot line, but in a drawing if these two lines are used careful study will save that this line is for pilot line and this line for drain line. Now a very often we have to use the line a one pipeline is crossing other while we are drawing the circuits. In physically we can say this has separate two pipes.

Now suppose a line is like that and a line some lines are like that. What does it mean? Line crossing 90 degree intersection not necessary. This means that these are usually suppose these

two lines are crossing each other, but they are not intersecting in that case we present like this or we may present like this. So this line is crossing over this line like this depending on which one is crossing over this, but as well sometimes, these are presented like this and of course, this is a confusion if we use this one and this one, we may think that this might be a connected lines, but if these lines are basically not connected, they are crossing each other even this one is also like that.

If we would like to show that there is a junction point 4 lines from 4 direction are connected we should better use this one. This indicates they are actually connected at a point. This is a single point you can say where they are connected. This might be also like this. This is 3 point connection is like this, of course suppose if we do not provide this dot and line is like this. This means that this is connected if we increase the line then there will be confusion whether it is a crossing point or connecting point, but if simply without dot if we mean this that 3 lines are connected at a point. So that you should understand and on sometimes looking into the components and function we shall not confuse that this one whether is a crossing or junction point. This is usually crossing point not a junction point. So these are for all junction point you can say these few are and then if it is a flexible hose, it is like that okay.

Now this is a flexible line. Now this is usually this flexible line means it is I would say not the main hydraulic lines. This might be even electrical lines or some other lines, which is flexible, but in system particularly in hydraulic system if we use the flexible lines it is presented like this. However, while we are making such a drawing then you will find that this line is also a straight line not like this and while we are mentioning this components, so looking into a line straight line, it does not mean whether it is a flexible or a solid line, I mean solid conduit pipe, only thing we have to mention that component separately, but one can use such symbols. Now this solid line mean usually main line.

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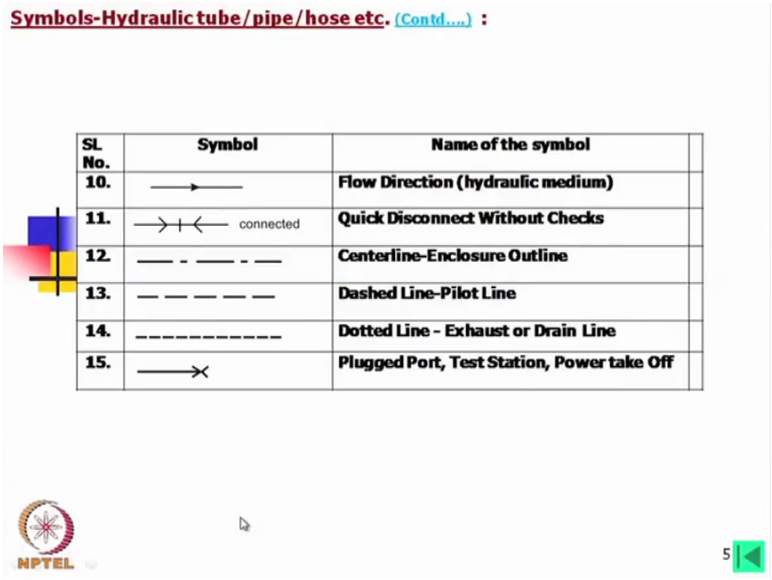

Then if this arrow is given this is a flow directions usually hydraulic medium. Why usually if it is filled with hydraulic sorry, if this triangle is filled then this is hydraulic and if it is not filled then, it should be air or gas. Now this is a connected usually this quick connected quick connected or disconnected, it is like that called so that is symbolized like this say, quick connected means usually you will find that when the machine is under operations particularly for training purpose we need to open a line and it is connected and again need to connect it.

Now this hydraulic line connections which must take care so that there is should be know leakage and other things and also in many cases we have to use the properly by connections solid pipes connections in that case to just dismantle that connection and to give a new connections, it may take lot of time. So instead of that usually such ends are with a flexible hose and a quick connector. What is quick connector? It is like that even if this is under pressure in operating conditions if you connect then these two will be connected first of all in the connections that outer leakage path will be prevented then internal connection will occur to give through passage of the oil from one side to other side. That means a good mechanic say good user, he can quickly connect this connector without a single drop of oil to the outside and the so this already I have discussed these 3 lines and then this is a plug point, if we many in circuits sometimes we will find that a line is there and then this is a cross. So looking into this we can say just a plug point. Usually such plug points are kept not very often, but sometimes we can have an other system to be connected there or may be some measuring point we can some gauge there and we can measure the pressure etcetera.

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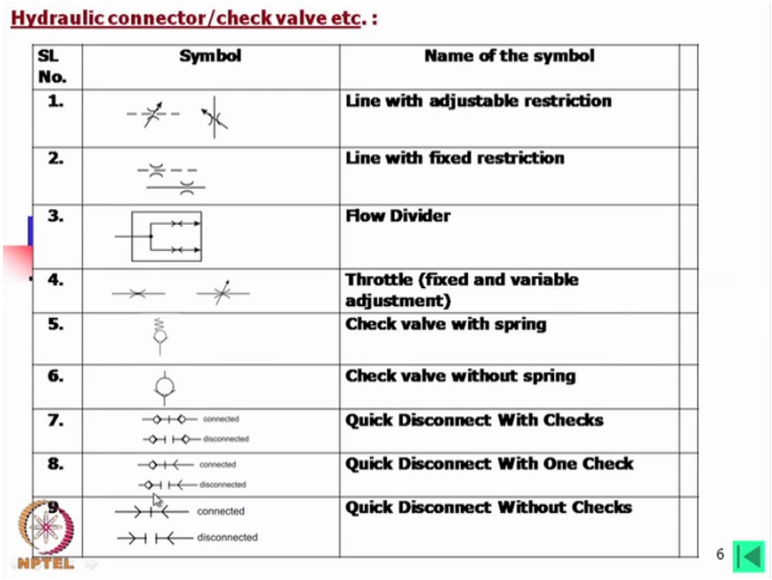

Now other symbols which is hydraulic connector check valve etcetera. Now if in the line such arrows are given then this flow can be restricted that flow can be regulated. Now solid lines means mainlines and this is usually for the pilot lines, okay and this is with a fixed restriction, okay and this one is the flow divider. This flow is being divided into two directions. Now what is there you can say that any T connections can be done, but this divider is designed in such a way, there will be equal resistance, okay. So if the pressure demand and both the line are same then flow will be exactly divided into two parts equal parts. So flow divider is used for that purpose.

Now this is a throttle valve, in that case just a restriction. In that case, this is a throttle fixed or variable adjustment. These are usually used to control the flow. Now this is a check valve with a spring return. This is check valve without spring return and this is again quick disconnect with check valves this one. The quick connector and check valve and this is a connected and this is disconnected. This means that in a circuit if we present this one that means that line is connected by quick connector and if we show that, these symbols this means that normally it remains disconnected.

Now in this case what we find that this is a same as before only thing, this is only one check valve is there and other has no check valve. Then this is quick disconnect without check valves there is a no check valve, okay and depending on the purpose in this valve used say for example, if we use this one in a line then, normally what we find that oil from this side cannot move this side and oil from this side cannot move the other side, then what is the use of such connections. Usually these valves are being operated by an external operation is there

pilot operated that means in normal condition, it is a check valve but if you send the signal through the pilots then, it will be connected, okay. In this case, suppose we do not need such pilot operations simply connect and to disconnect then this will be used.

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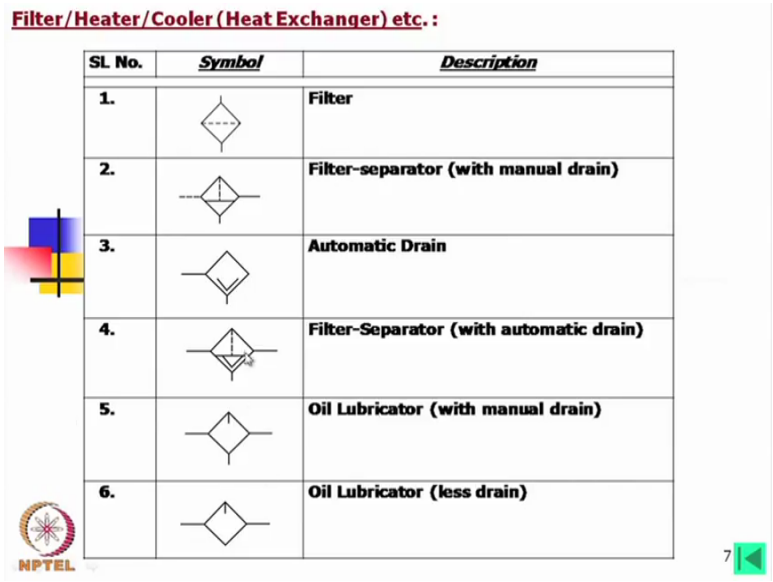

Now filters, in the filter we have not shown that ISO glossary, but in case of this filter or even simple strainer filter or strainer we use this diamond like a clock. This line is the through line and here one dotted lines. Now in this case, this filter separator with manual drain. This is basically a separator and manual drain is there, okay and this is automatic drain. If we put this one automatic drain and if we use this is filter separator with automatic drain, okay and this one oil lubricator with manual drain and this one oil lubricator less drain. There is no drain is there. This one, one of that should be drain line means dotted line should be there I think so.

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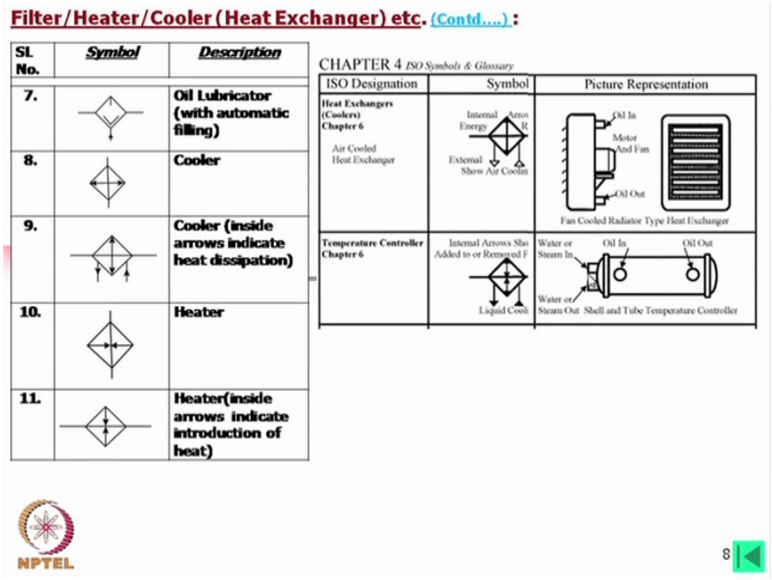

This is oil lubricator with automatic filling. This is a cooler when you see this arrow is going outside it will be cooler. This is also cooler but, this is basically it is also shown that some liquid is flowing through why liquid, because these arrow are completely darken. Now when these arrows is going inside then heater, just look at the difference between the heater and cooler. This is also heater inside arrows indicates introduction of heat ya it might be like this or it might be like this we can put any directions. These are basically heater.

Now if we look into this what we have already studied in ISO symbols and glossary you can see, this is a cooler, because the arrow is outside, the heat is going out. So you can compare with this only think, in this case this is filled and this is not filled that means this is air cooled or something like this. In this case as we find this we can again compare with this one, but we get some additional two lines here and then this must be either cooler or heater and then we can see these are the two components what it looks like. This is the main system oil in and out and this is the cooling is in or out.

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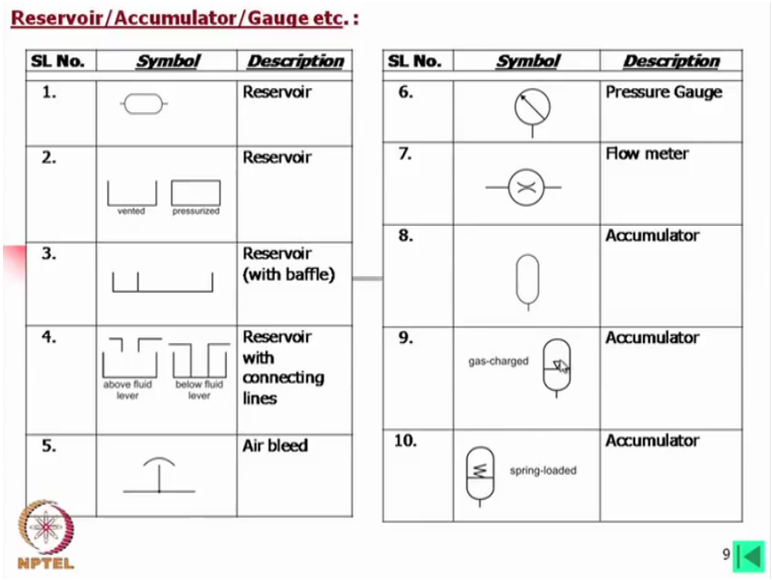

Now a reservoir may be a simple tank, do not confuse with this the accumulator, because accumulator will have no line in the other directions and this is a small reservoir and these are reservoir. So if it is if it is shown that it is open then it is usually vented no reservoir will be without any cover, there will be cover has to be, because when the oil is exposed to the air, so more oxidations and more deterioration will be of oil will occur. To prevent that it should be closed, but usually it will be vented that means inside if there is a gas that gas will automatically come out when certain pressure will increase, but in some cases we need to this reservoir is pressurized and closed and there venting is only may be it is again regulated by some pilot system, some system signal is there, which will vent. A normal venting is not there, so for that pressurized we can show that the reservoir is like this.

Now this reservoir is baffle. What is baffle? Usually you will find inside the separator is there. So first oil is coming over here and then it is going this side. So many contaminants will remain at this side and suction is usually in the opposite sides. So return in one side and suction is other sides and again such baffles are like that say, this is connected at the bottom then you will find another baffle is and the top portion is clear oil can flow this. The next baffle you will find, it is connected with the top and oil can flow like this. So these baffles are used with a one is connected with the top and one is bottom so that return oil when it is coming over there, first of all the heavy particles that will be remain here, then oil will flow and then it will flow like this then again flow like this by that process, first of all the better heat exchange will be there. Secondly, the eration will be removed that mixing of the air that will be removed. It will also act somewhat antifoaming and in other sides you are getting

relatively stable fluid for again for the suction, okay. So when you would like to mention that reservoir with baffle is required you can preserve like this.

Now this is reservoir with connecting line. The connected lines are there above fluid level sometimes the connections are above fluid level and if you show this below fluid level not lever. This is this would be level. Now this connections you can show then you can mention here that one is for suction, another is for return and such things, but you should remember in both cases both the suction and suction has to be within the oil obviously, but return line also to be within the oil otherwise there will be too much foaming, but this is a special case where you are keeping some lines above the oil some special purpose, okay. In that case you have to indicate like this. This is air bleeding, in this case if you present this one the air bleeding is necessary.

Now this you see, do not confuse with this pump, other thing this is pressure gauge the narrow inside the circle. This is a pressure gauge, again if you draw a straight line and with this symbols means it is a flow control, but once you present like this, these two lines in a circle and this inside it this is flow meter, okay. Now accumulator will be will look like this, look at this reservoir and accumulator if we add one line there that will be reservoir, if you do not add a line there, if you simply put like a (())(24:59) then, this will be accumulator. This is also an accumulator, but it is a gas charged. This side a gas is there.

Now this accumulator is spring loaded then in that case this line and there be spring. Accumulator means that this will be gas or air and here the liquid. So while we are trying to present an accumulator either you can put simply and you can specify this or if we are specific about this to show that this is a gas charge, you can use this one. If it is spring loaded, you can use this one, okay.

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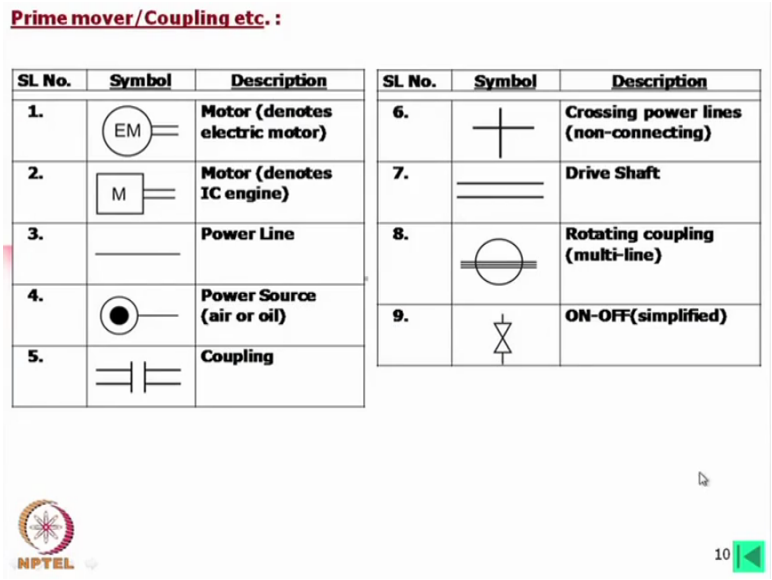

Now as well we have to present the prime mover. Normally you will find in most of the cases this electric motor, then you can just put like that EM or if you use that engine then you put M you put M, engine we call engine, but usually it is also called motor electric motor and IC engine is also a motor. So you can specify like this and you can see this not much difference, but it is a power line. Usually you will find with a pump sometimes this symbol is given. Power source, oil or air or oil no this is a power source with air or oil. So this will be filled in case of oil or not filled in case of air and whereas power line this is a line is like this, but very very difficult to distinguish with this main hydraulic lines. A coupling is shown like this, okay. Then the crossing power lines we have learn earlier we can use this one, this is non-connecting. If we would like to show at a junction point connector what we have to do move one of that slightly right side or left side and so the connection. That means this is a junction point otherwise this is a crossing line, but best way is that you can cross like this or you can cross like this, okay.

Now this is a drive shaft not some other so much meaningful but this is a drive shaft and rotating coupling is designated by this one and this is a on-off simplified switch that means this one off switch usually not pilot operated, it is normally manual operated and this is just to stop the line you will find that either it is a just single lever a ball joint is inside, a ball is inside ball with a hole that if you make the line connected to the hole then, it is being operated or you just simply rotate in the 90 degree directions it is off. So this is sometimes used in the hydraulic lines.

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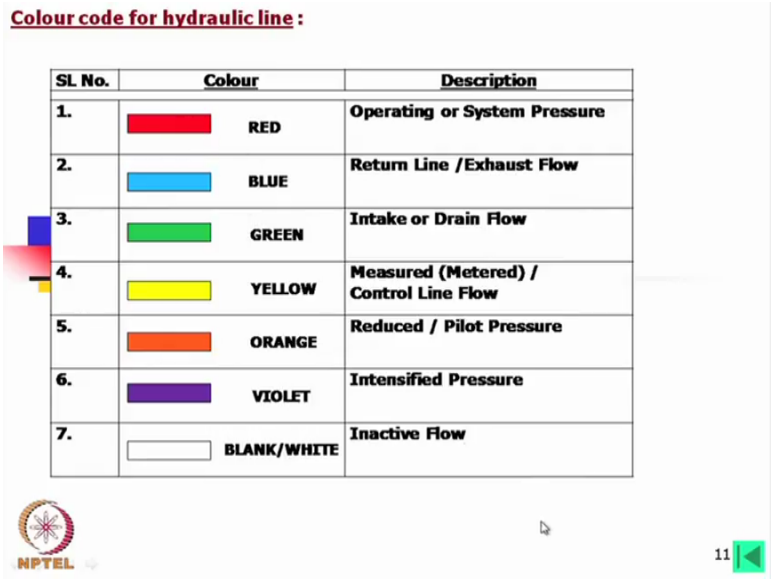

Now another important aspect in many cases the color codes are used. Red means operating or system pressure. Blue means return line or exhaust flow, green means intake or drain flow, yellow means measured usually meter flow or control line flow and then if we use orange then it is reduced pilot pressure a reduced pilot pressure and violet means intensified pressure very high pressure and if there is a blank that usually inactive lines. That means this is filled with water sorry, filled with liquid but no pressure is there. This is mainly used for hydraulic lines. Now we have to make this orange and difference between orange and red, usually you will find in a same drawing this you can understand the difference, but where only say suppose red line is there. Do not confuse with the orange looking into a little study into the components will give you the idea whether it is pressure line or the ordinary line.

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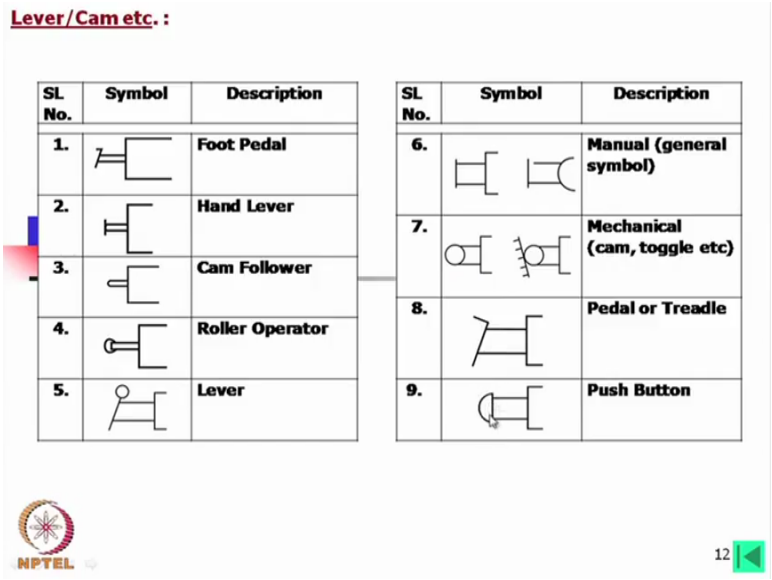

Now the then the lever cam etcetera, these are designated by as you have seen say this with this double lines with a components say this is the main component with that if this symbols is added. What it is this is a practically rectangular box with one line is going outside that is a hand lever, say in earlier when we are learning the ISO symbols and glossary I was telling that this extended alignments handling or so this is an indication of hand lever. Then if it is slightly inclined and one line is left side, in this is a foot pedal and when this rectangular is just rounded the end is rounded then it is a cam follower. Now if it is a bottom sort of things then it is a roller operator, okay.

Now if it is with a symbol like this then it is a lever. This lever is fitted over there. Now this hand operated means in many cases, you will find that lever say a manual valve there a lever is given. The lever means that usually one point it is fixed and some intermediate point or may be the extream point is there to move the other component, the one is foll cam (()) (31:24) point another is to move the component. So that is lever and hand lever may be that one also. So hand lever may include this type of lever also, but hand lever means it is for operation a lever is there, it might be a simply shifting or with a foll cam like that okay. Such details you have to mention perhaps by writing or showing the detail design.

Now this is again this may be this general symbol is that manual it is like that. So I think this line will be completed upto this point, but only important is there the other side is extended this line is extended and say this is a cam or toggle it is made by this one. This is again pedal, this is a foot pedal. This is any sort of pedal or treadle. So this is indicated by this one and

this is push button. This and this has a difference if you say this is actually cam roller, roller operator and but this one is a push button say reverse D you can say.

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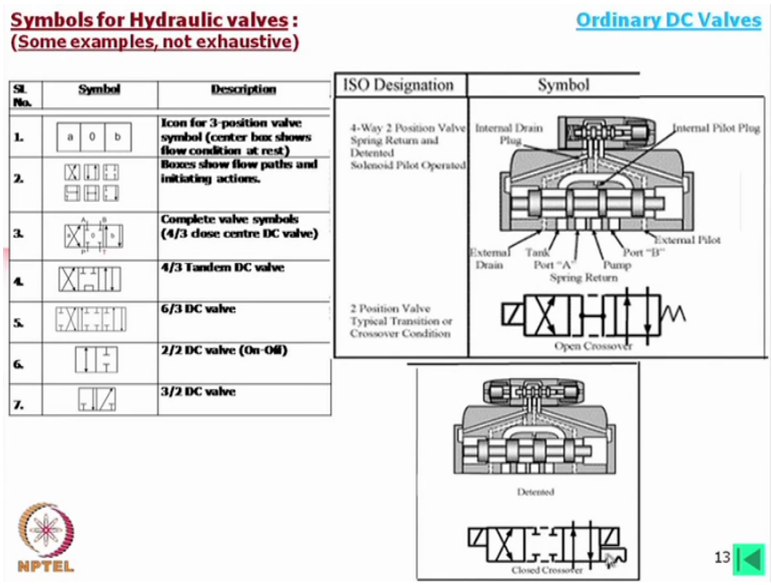

Now hydraulic valves particularly direction control valves. In that case earlier in second lecture we have learned, first of all we can have three icons like this. In that icons intermediate one is having 0 that means this is the neutral positions, a is one operating condition, b is another operating condition. Usually any valve either it will be on-off type that means either a or b no intermediate positions, but in most of the cases hydraulic systems and direction control valve where we need to stop the systems for a while or we need to keep the idle system for a while, then there must have a neutral positions. So first we can have while we are designing a valve then the middle one is the neutral then a and b and then there are few icons from there we can select say, in neutral conditions it might be like this. All are not connected, so bring this one and put here. So we are trying to construct a symbol for dc valves.

Suppose it is complete fully opened then we can put it here. This one we can put here we can have also that only supply line is closed other three are connected. That means the two ends of the actuator and the reservoir is connected. So we can take this symbols here and most popular you will find say suppose this is a closed centre keep this one at the centre. This is a and this is b or open centre, keep this one at the centre. This is a one end, this one at other end. So this will give 4 by 3 closed centers, 4 by 3 open centre, 4 ports 3 positions. Now you can put this one also at the middle sometimes this is put at the middle, suppose you can choose this one. This is at the at one end and then this is at the other end or this one at this

end and this one at the other end. This is for one specific requirement, but most common you will be find either with the closed centre or with the open centre then cross connection, straight connection. So in that way which these two groups of icons we can build several valves.

Now say for example, this first one what we have seen. The T indicates it is going back to tank, P indicates this is for pressure line, usually A connected the P means not pump usually pressure line. It is called pressure lines, A and B two ends of the actuator, this capital A and this capital B, you can mention AB or may not mention you can simply make this valve. This is called 4 by 3 tandem valves what is tandem? That this connection is there that means when it is in the idle conditions, the all will go to the tank without any resistance. In this case what happens? This the usually with this pressure lines there is a relief valve. So relief valve is set at a maximum system pressure. So what will happen in this neutral condition the oil pressure will be up to the maximum system pressure and then it will go through the tank through the relief valve. So it is a huge power loss, but the advantage is that oil is always ready for work and such systems will be closed centre is usually required for when the very quick stop and on and off on and off we are operating some system like that, then this system is preferred, okay.

So depending on that requirement also we have to select a proper valve. Now this is you see this 6 by 3 dc valve. What does it mean? In that case say this is neutral position that means there is this oil is actually these two are connected together. The oil is going from this side to this side and it is doing some main system work what you can do you can give this line that system main system is off and you can divert this for these operations to a only particular size and also you can use this one, the when the means system is off, say for example, this valve you can use for a forklift truck. In the forklift truck main line is going for the hydro (()) (38:30) which is moving the car okay.

Now you want to lift something once you move the lever, first of all the car will be stopped then it will start operating lift and while again you are lowering that moment will be off and then this is for an example, say it can be made like this. However, in fork lift tracks many times it requires that slight moment of the vehicle when it is being lifted or lowering say you would like to take something from the rack, so you have to take it and move out while you are lifting or lowering you have to take out. In that case definitely this valve will not be suitable, but I have given an example where the 6 by 3 valves is used.

Now this is 2 by 2 valve say simply it is a on off valve. Now this is also two position, but as you see these 3 ports are there that means if we consider the main port then main port this pressure port, in that case when this pressure port is stopped, this oil from the actuator going back to the tank and when you are connecting to this actuator then your drain connection is off, okay. So you may need such valve for some operations.

Now here of course I have shown this valve, but none of this can compared with this one, only thing say this is basically 4 by 2 position valve spring return and detent solenoid operated forget about detent part. This is 4 by 2. This is one position, this is other positions, but what we can do by (())(40:29) we can make the all ports are connected, say in a detent positions we can make this one otherwise normally either this or this positions. Now if we would like to compare with these valve, suppose with this connections let us consider this connection is here and these two what is a difference. In that case, if you leave the valve then automatically this will come back to this position suppose we are using full open centre, but in this case it will be full open centre only if we use the detent positions that means you have to regulate this actuator in a such a way that it will be at the detent positions. So it is operating conditions no neutral positions either this position or this position only in detent positions, it will be there.

So for that what is there this will be find that this is not a full line whereas, in this case this will be a full line, okay. the difference between this and this is there and apart from that these we are using only the showing the valve operation we have not using this symbols that is whether it is spring return or the armature driven that we are not showing that of course always to be added to so the full form of the valve and this is a other one which I have also discussed. This is closed cross over this is this one actually. This is having also detent.

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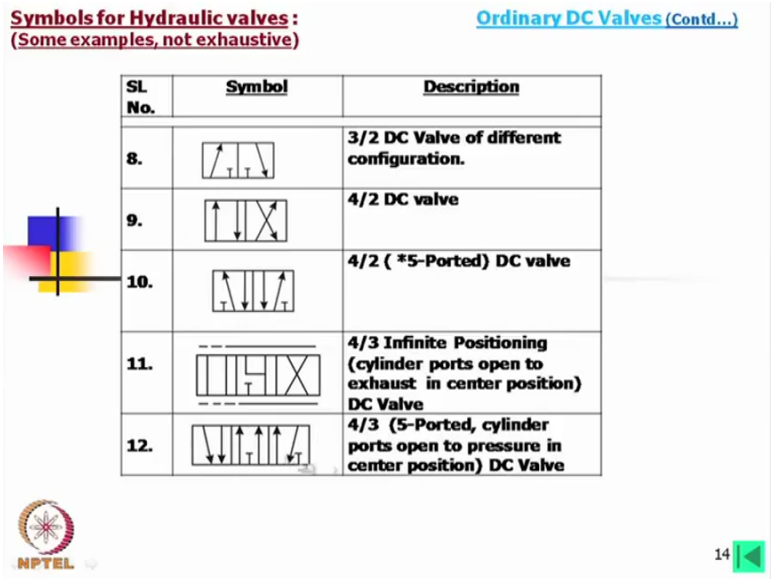

Now 3 by 2 dc valve of different configurations, the other configurations and this is this configuration different you have to depending on the applications you have to select this. This is also a 3 by 2, okay. Now 4 by 2 valve have these two, this is basically not off either this condition or this say if we connect to a rotary actuator then that case either it will rotate in clockwise direction or anticlockwise direction may be it is like that this valve is directly fitted to the actuator we are operating this way or that way, if we would like to off the machines then hole main line is disconnected by some other valve, okay. So this is as you see this 4 by 2, 5 ported DC valve. As you see we have 5 ports. How? 1, 2, 3, 4, 5 the 5 ports, but basically this is 4 by 2 valves, because we have two positions and we use 4 ports. So sometimes it is called 4 by 2, 5 ported valve. Now in that case, the pressure line is blocked. In this case the drain is blocked, the other for cross connections are there from some applications.

Now you see this another interesting thing is that these valves as you see, this we have not used any arrow here, not to show any directions, but say suppose if we take this block that means basically 3 icon together and then if we put an arrow then this will indicate that at neutral position pressure is connected and pressure line is closed and other 3 ports are interconnected that means reservoir and two sides of that actuator inter connected and this is for cross connection and this is for straight connections, okay. So that is simple valve. Now what we find along with that these two lines are there. This indicates this is infinite positions valve. Now this is usually for copying machines and other things. It is you can say this is a some sort of servo valve. So infinite positions means this is some sort of servo working valve.

Now here again 4 by 3, 5 ported cylinder ports open to pressure in centre positions DC valves as you can see this one 5 by 2. So depending on the purpose this valve is also used.

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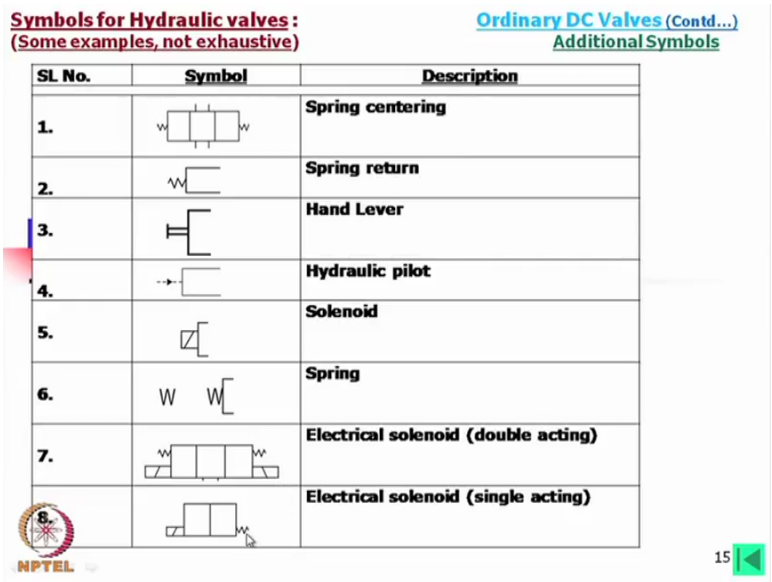

Now symbols for hydraulic valves again some examples and are not exclusively have exhausted not this one. This is again some repetition of that only thing that you can use this spring say, these symbols are repetition, but once it is shown that if you add this one this is called spring centre. If you add spring one side it is called usually spring return, okay. If you show this one this is the hand lever. If we show this dotted line with filled arrow hydraulic pilot and if you show this symbol this is solenoid operated and you can use this spring like this or may be with a cap like this and this is obviously, spring centered and solenoid operated both side and here spring return solenoid operated one side.

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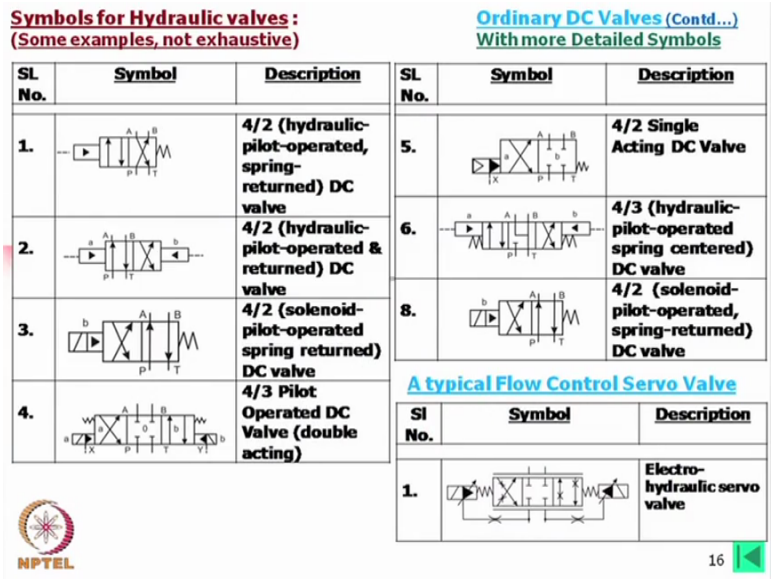

So with this addition with more detail symbols what we can add we can add this is basically 4 by 2 DC valve and we have used one spring. Here what we have used a triangle plus a triangle filled with completely filled and this is in a box and then a dotted line that means this is pilot operated and may be hydraulic driven also together. It is hydraulic pilot operated spring return valve that means this is hydraulic operated hydraulic pilot as well as spring return. In that case both the side hydraulic driven and hydraulic pilot operated. Here this is solenoid pilot operated and there is also hydraulic actuation is there, but this is spring return. In that case as you find in both the sides we have added this one. So by adding such symbols with this main valve symbols we can also indicate how it is being operated whether it is spring centre or not so many things and as you can see this is the 4 by 2 single acting DC valve. In this case hydraulic pilot and pneumatic operation might be there. In that case solenoid is there and as well as hydraulic pilot is there.

Now in case of servo valve as you see. In case of servo valve you will find that with these arrow a flow control is also shown, because the variable orifice in case of with respect to the directional valve direction control valve the servo flow control valve will have the variable orifice that is made by these adding these, okay. Now also we are adding this one that means this is also pilot operated and this is also variable as well as there is a solenoid, okay. Apart from that we have to put two other lines. So once we put these two lines along with such things this means that it is completely two stage electrohydraulic servo valve. Why two stage there will be pilot stage, there will be main stage and it is a servo valve okay. So for that we can use this symbol.

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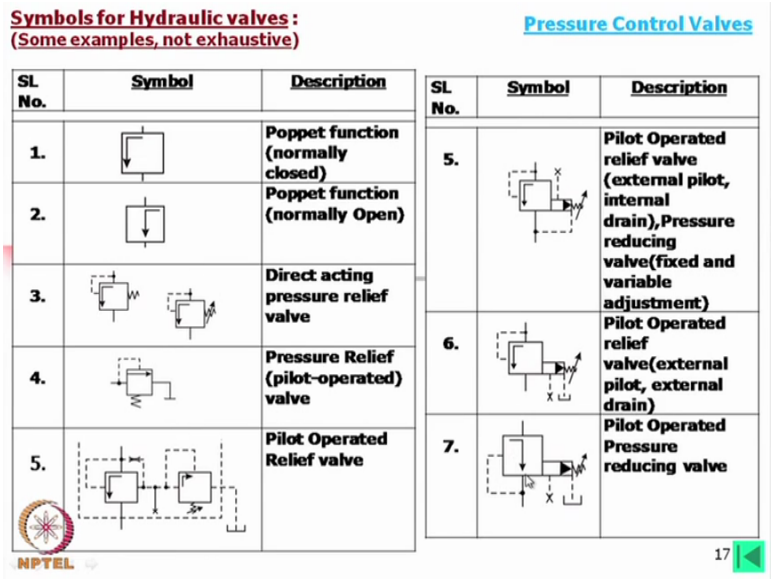

Now say we are coming to the pressure control valve. In case of pressure control valve, the simplest one is that poppet function. Now first of all we will show this poppet functions, you will find that in many cases a valve is drawn like this. That means it is normally closed. In some cases you will find this is there and it is shown like this. That means it is normally closed. In some cases you will find this is there and it is shown like this. That means this is open normally open. Now the direct acting pressure relief valves are shown like this. So this will be there normally closed and along with that there will be a symbol like this and this is you can adjust the capacity and in this case if it is a pilot operated in that case you will a straight lines which can come here and here. Here means it is open and here means at the top not on that line is closed.

Now this is again a pilot operated pressure relief valve, but this one is having one is that this is a closed one. This is also another closed one, but this is operated by the pilot as well as it is a flow control. This is a special feature, but you can show with this together this is a complicated one, but better maintains better pressure relief conditions, okay. Now this one is that pilot operated relief valve external pilot internal drain. This is pressure reducing valve. This is fixed and variable adjustment. This one indicates pilot operated relief valve pressure reducing valve fixed and variable displacement that means once you use these two sign pressure reducing valve is also a pressure control valve. Pressure relief valve is also a pressure control valve.

in case of pressure relief valve oil is flowing from this side to this side, you will find that the pilot line is from the upstream, okay, but there is no pilot from the downstream if there is a

pilot from the downstream also then, this is a pressure reducing function. In all reducing functions you will find that it is acting as a pressure reducing valve as well as pressure relief valve. So a pressure reducing valve with pressure relief valve totally meant by this one. Usually you will find wherever you are using a pressure reducing valve; there is also a separate relief valve which is connected near the pump. So forget about that part, but then again where the pressure reducing valve is there this will be a relief valve inbuilt there, because some flow has to go through this pressure relief valve there.

Now what is the difference between this and that? In that case pilot operated relief valve external pilot external drain, you see there is no line from the downstream. So this is a relief valve, but it looks alike only thing this line is not there, external pilot is there as well as external drain is there and this one pilot operated pressure reducing valve, in that case the relief valve function is not shown. So this is a pressure reducing whenever this pilot connection is from the downstream, it is a pressure reducing valve.

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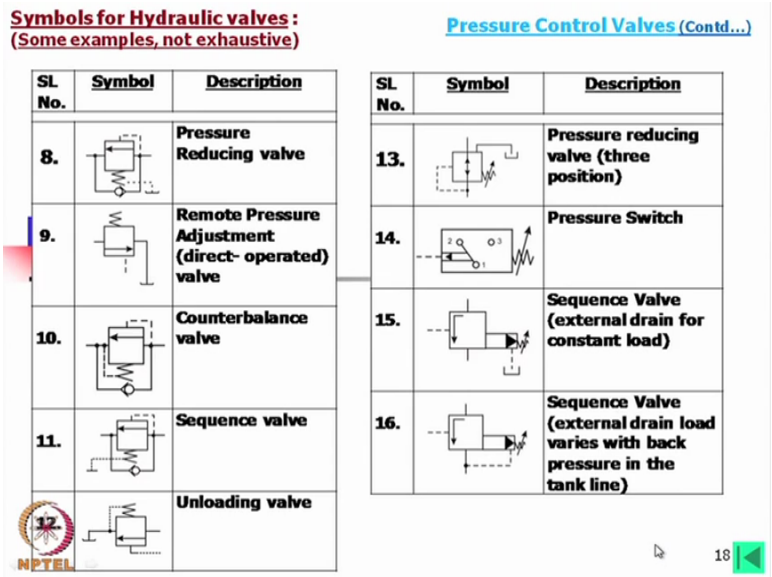

And it is very difficult to remember all such symbols we do not expect that you will remember all such symbols, but it is just to have an idea. Now this is as you can see this pressure reducing valve with check valve here. This is remote pressure adjustment direct operated and counter balance valve looks like this one, sequence valve looks like this ones and unloading valve. So while you are trying to study such valve you should study the circuit along with this and you should spend more time to study such valve. This is for your instruction I am just going through that, but you should spend more time to learn how these symbols are just defined with their function.

Now as you find that pressure reducing valve 3 positions. This is pressure switch as you can see this is 1, 2, 3 positions, it is either connected with two or connected with one and three. So this is a pressure switch depending on the pressure, this will be connected this way or other way. The sequence valve external drain load varies with back pressure in the tank line. So there are many things to understand and then to remember such symbols. However, if you go for circuit design this will be available in your hand and you can simply put there, but you have to know where to use which one.

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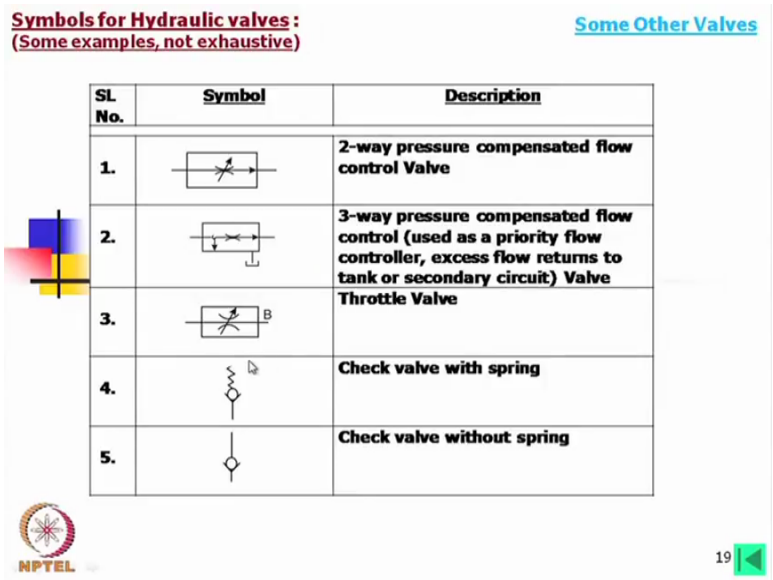

Now this is a flow control valve. It is a two way pressure compensated flow control valve. So this line this arrow is there means this is the directions of the flow and this is the three way pressure compensated flow control valve. If the box is there perhaps this is a pressure compensated and if it is used without this box, perhaps it is not pressure compensated. This is a throttle valve. Throttle valve and the flow control valve is almost with a same function, but in case of throttle valve you may not find it is a simply a flow restrictor. So that is called throttle valve whereas, flow control valve there is some device the control is there and the excess flow will go to the tank from that valve. In that case, this throttle valve that excess flow has to go through this pressure relief valve which is said again a system pressure. That means in between this throttle valve to pump the pressure will be always to the system pressure. It is something like that, so we have to study in details while we are designing such circuits. The check valve with spring, check valve without spring which I have shown earlier also in that case.

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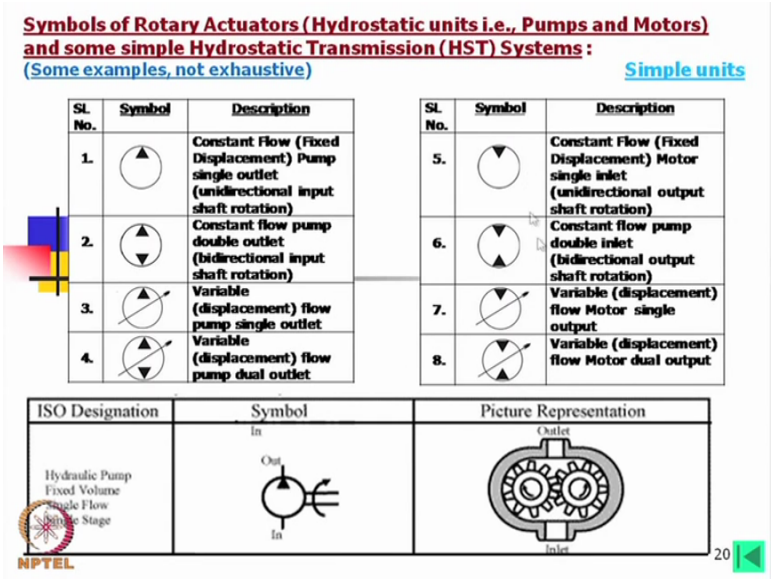

Now we come to the pump. In this pump what we find a circle and a triangle inside is completely filled end. This is constant flow fixed displacement pump single outlet, unidirectional input shaft rotations and with this one we have not shown shaft, it is not necessary always. Now in this case, it is double outlet that means bidirectional input shaft rotation. This is usually either bidirectional shaft rotation is also possible or bidirectional flow is possible simply by changing the (())(57:25) angle. This is complicated, but you can once you find this symbols you can think of this designation. Now with this if we use an arrow then with this feature this will be variable displacement in that case in this case it is a fixed displacement. Here it is the bidirectional with variable displacement and you can see, this is the ISO symbol is like that for a pump we can compare this with this one. Now the motor is just reversed the arrow are put in the opposite directions other designations are remains same. This is motor, arrow going out means pump arrow going inside means motor hydraulic motor.

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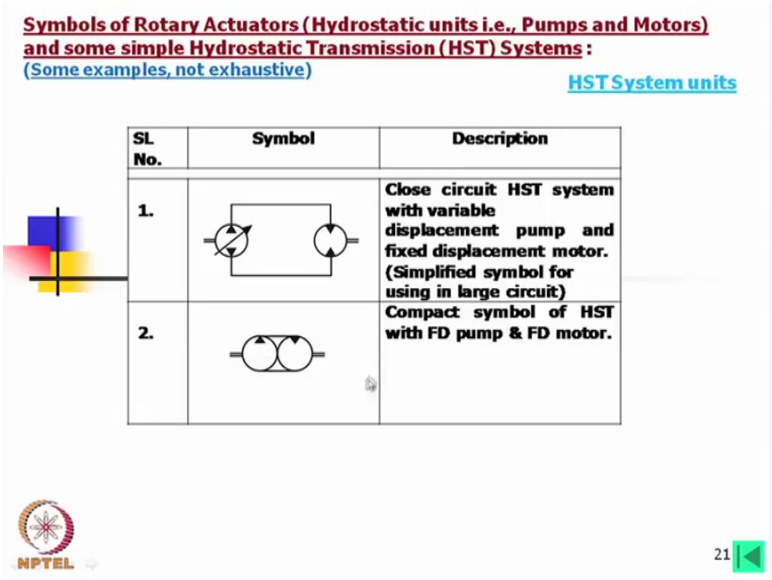

Now very often we use the term HST that hydrostatic transmission. Now a total hydrostatic transmission this term meant there is a pump and there is a motor. Now if it is connected like this, this is closed circuit. All systems are say, there is a pump and actuator with a directional valve that is also a hydrostatic transmission, but that is open circuit. Now this is a closed circuit with a variable pump and fixed displacement motor. Now if in many cases you will find that instead of piping connections are there, this has simply one input and another output and you will find that this is a pump side you have connected to an prime mover, it is rotating at a constant speed where by switch by manipulating something in between you may find variable output also. So that is basically inside there is a pump and motor. So this constructions is also possible.

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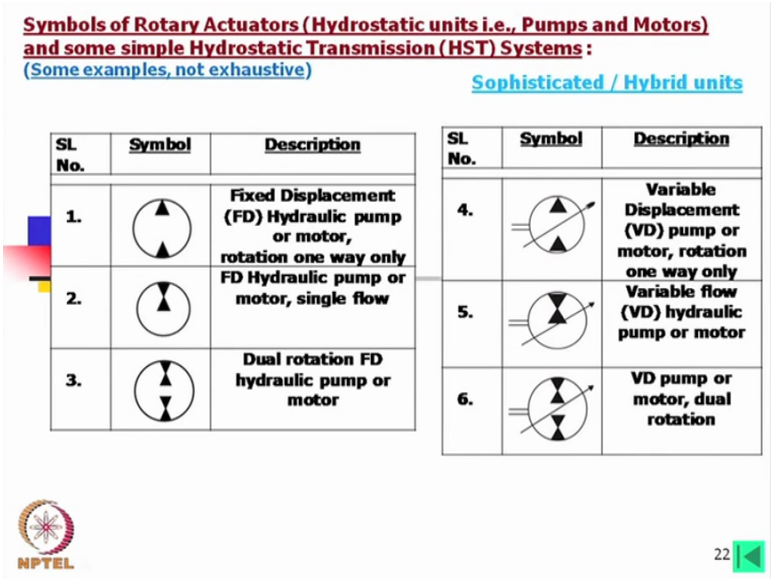

Now some sophisticated and hybrid units are like that. That both pump and motor you can use this as a pump as well as motor, but this is only unidirectional whereas, this is hydraulic pump or motor single flow that means this is either you can use for pump and motor if you just reverse the flow directions here. In that case you can use perhaps for both directions to have this pump and motor features. There is some difference between this and that. This is detailed you have to study in details with a component and machine.

Now in this case, this is dual rotation, no perhaps this one I will tell you this one perhaps that if you rotate in one direction, it will act as a pump. If you rotate in the opposite directions that means with the same flow directions if you use the flow and try to have the output then, it will act as a motor. In that case you rotate in one way and you can have this as a pump and also this can be used as a motor by changing the valve configurations like that, but this is you can say this is added together. If you this both side is pump and motor so this will be this will work for dual rotation and also we can have such configuration with variable displacement.

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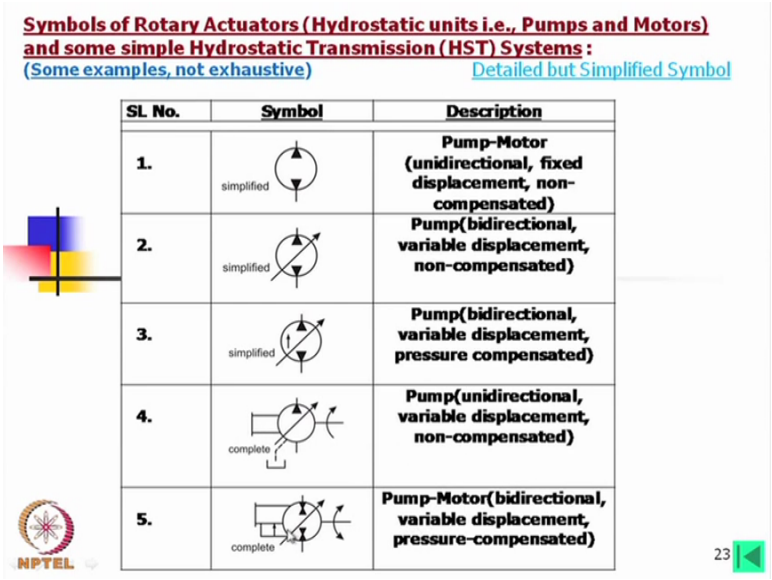

Then there are some a more that is the some simplified symbols are there. These are usually say for example, this already we have learned in that case this is a bidirectional variable displacement pressure compensated. So pressure compensated means there will be a arrow like this, in that case there is an external drain and this is a pump unidirectional variable displacement and this is of course non-compensated. In this case, this is compensated arrow is there and this is bidirectional, okay.

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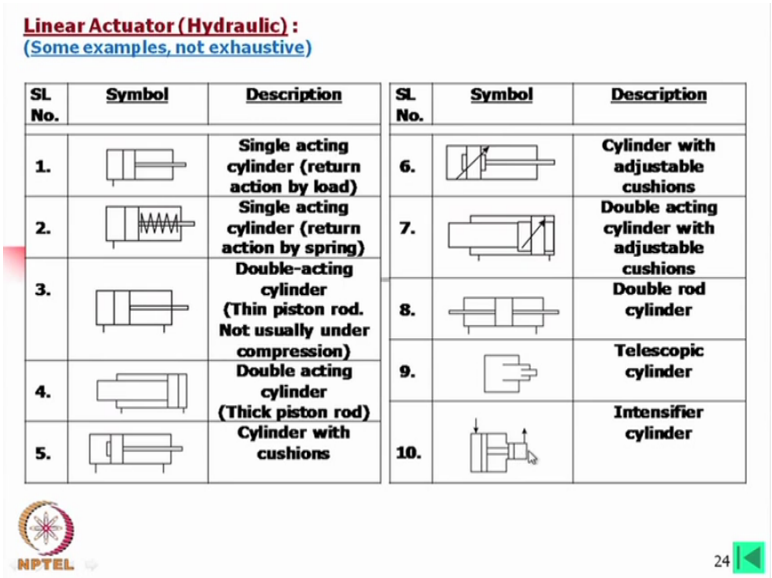

Now these are the actuators. In this actuators, there no spring return. Here is a some spring is there in that case double acting cylinders, thin piston rod, not usually under compressions. So this one we do not use for under compressions, but this we can use for used in under

compression. Now if we add something like this then these is a cushion effect. This cushion effect means physical cushion may not be there, it is like that when it is reaching towards the end of the pistons then, there will be a flow restrictor through which the flow will be in such a way very slowly that piston will touch the cylinder. So there will be some cushioning effect.

Now this is cylinder with adjustable cushions. This cushion can be adjusted that means you can allow to collapse faster or later. Now this is again double acting cylinder with adjustable cushions you can see that if it is a single acting cylinder with adjustable cushions only no mention whether it is a single acting or double acting, usually it is a single acting, because the no compressive force is applied here for thin rod, in that case this is double acting you will find both the lines are here and this is a thick cylinder, because this can give compressive load as well as tensile load.

Now in this case, double rod cylinder. Now this cylinder again may be very thick or thin, okay. Now this is a telescopic cylinder. In that case, it is like that if you allow the oil to go inside then first this one will move, because this is having a larger area. So with a small pressure it will work then when this will fully extended pressure will gradually increase and with this, because this is handling the same load. So with the smaller cylinder it will, so this is a we will get telescopic action. Where it is used? Where we are need very long extension in that case we use the telescope and this is intensifier. What we find that if we allow the flow this side with a low pressure we can have much higher pressure this side, okay.

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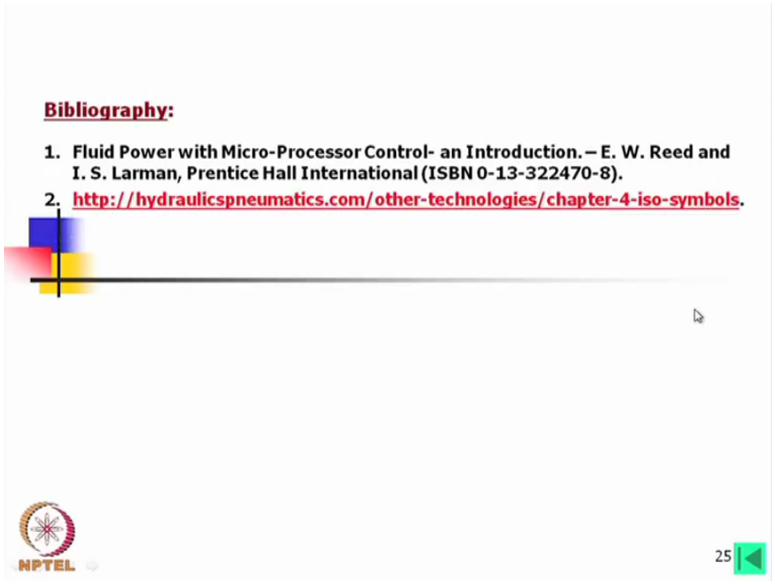

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