Oil Hydraulics and Pneumatics
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Part 2: What causes Pressure Drop?, Minimizing Pressure Drop, Air Distribution System – Sizing of Pipes, Tubes, Materials and Fittings, Important Air Flow Parameters
Lecture – 28
Pneumatic Pressure Drop

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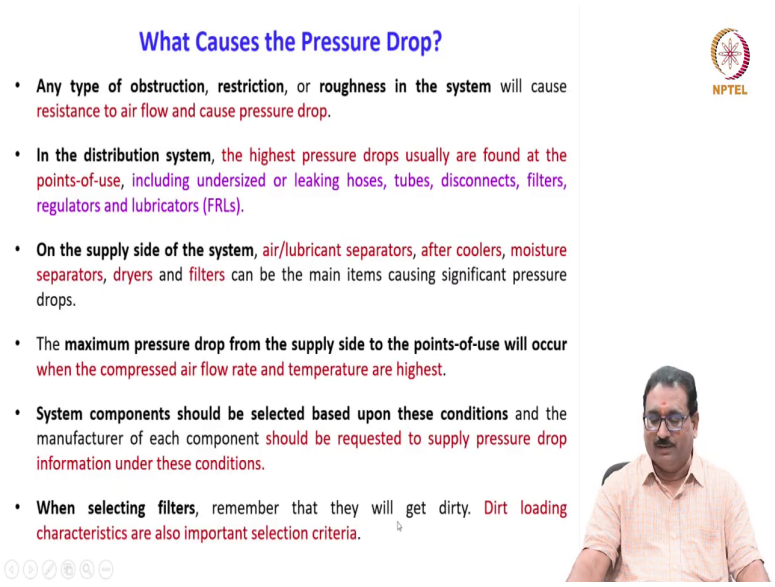

My name is Somashekhar, course faculty for this course. So, now, we know the significance of Pressure Drop. What causes the pressure drop? Any type of obstruction, restriction or roughness in the system piping and tubing will cause the resistance to air flow and results in pressure.

In the distribution system, the highest pressure drop usually are found at the point-of-use including undersized or leaking hoses, tubes, disconnects, filters, regulators and lubricators.

On the supply side of the system, air lubricant separators, after coolers, moisture separators, dryers, filters can be the main items which causes the significant pressure drop. Both at the use and at the generation you have to take much care in reducing the pressure drop.

The maximum pressure drop from the supply side to the point-of-use will occur when the compressed air flow rate and temperature are highest. System components should be selected based upon these conditions and the manufacturer of each component should be requested to supply the pressure drop information under these conditions. When selecting filters, remember that they will get dirty. Dirty loading characteristics are also important selection criteria.

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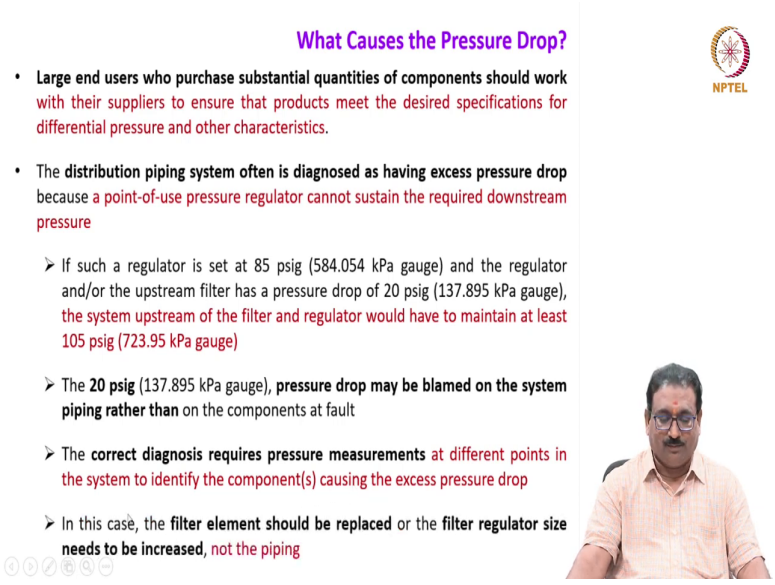

Large end users who purchase a substantial quantities of components should work with their supplier to ensure that product meet the desired specifications for differential pressures and

other characteristics as stated. The distribution piping system often is diagnosed as having excessive pressure drop because a point-of-use pressure regulator cannot sustain the required downstream pressure.

If such a regulator is set at 85 psig and the regulator or the upstream filter has a pressure drop of 20 psig, the system upstream of the filter and regulator would have to maintain at least 105 psig. The 20 psig pressure drop may be blamed on the system piping rather than on the components at faults.

The correct diagnosis require; a pressure measurements at different points in the system to identify the component causing the excessive pressure drop. In this case filter element should be replaced or the filter regulator size needs to be increased not the piping.

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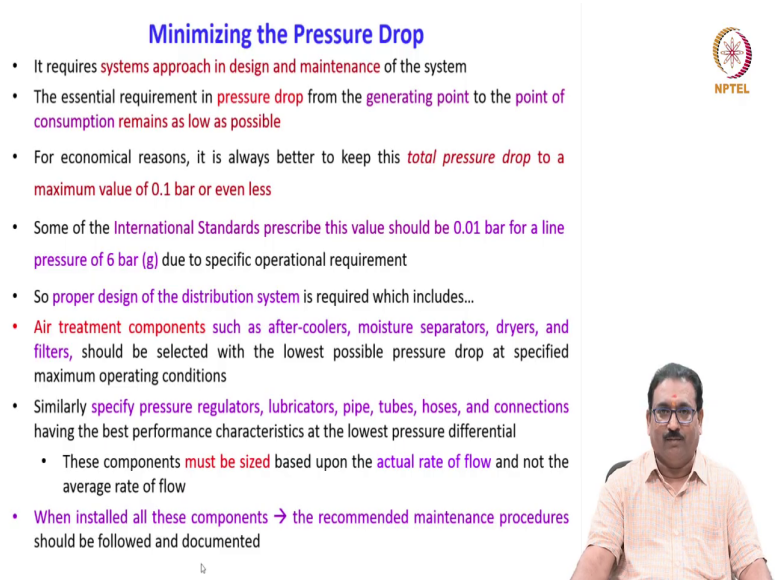

It requires minimizing the pressure drop requires always the system design approach and maintenance of the system properly. The essential requirement in pressure drop from the generating point to the point of consumption remains as low as possible. For economic reasons it is always better to keep this total pressure drop to a maximum value of 0.1 bar or even less is best.

Some of the international standards prescribed this value should be 0.01 bar for a line pressure of 6 bar gauge due to specific operational requirement. So, proper design of the distribution system is required which includes the air treatment components such as after-cooler, moisture separator, dryers and filters, should be selected with lowest possible pressure drop at a specified maximum operating conditions.

Similarly specify the pressure regulators, lubricators, pipes, tubes, hoses and connections having the best performance characteristics at the lowest pressure differential. These components must be sized based on the actual flow rate and not the average flow rate.

When installed all these components the recommended maintenance procedures should be followed and documented every time for the future references.

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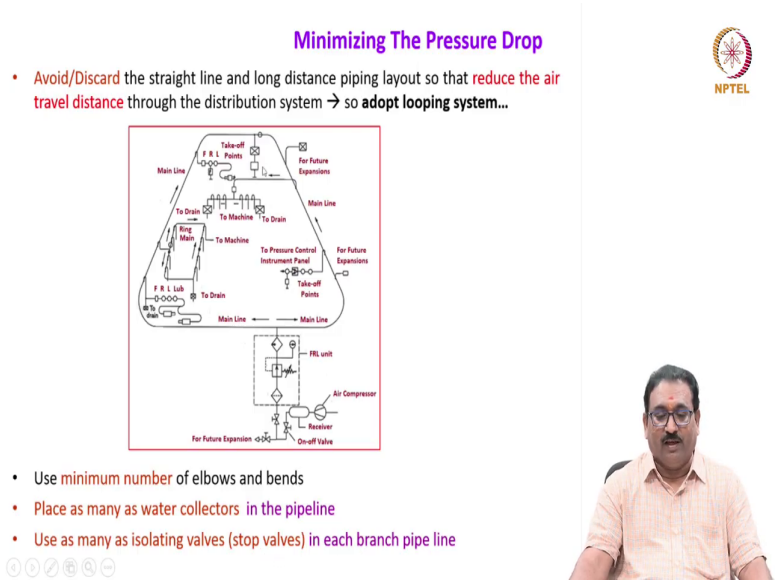

Also avoid or discard the straight line piping and tubing and long distance piping avoided, so that reduces the air travel distance through the distribution system. That is why I am telling you always adopt the looping system. You already know what is a looping system.

The compressor is here air compressor which will stores the you receiver will store the required quantity of air with required pressure, then it will supply to the various machine tools and the devices which use the air and also you will see here as many as on off valve will incorporate and, also provide the air tapping for the future expansion.

Then you will see after the receiver tank before going to the main line, it will be subjected to the secondary treatment what we call filter, regulator, lubricator units. It is a filter, regulator, lubricators then air will pass to the ring main system meaning where the air will move

through the main line to clockwise and anti-clockwise, then air will be tapped to the various stations where the pneumatic devices consumes the air.

Please take care here friends you are seen here, as much as possible you have to incorporate the filters, regulator, lubricator units along with the water traps and a filters which will ensures your efficient performance of the pneumatic components. So, use the minimum number of elbows and bends. Place as many as water collectors in the pipeline.

Use as many as isolating valves, what you will call on-off valves, stop valves each branch pipeline because this is very essential. If this branch is not working if is on-off valve is cut off this then air will through main flow it will go to the next. As and when required will open the on-off valve to the required branch otherwise no as because air losses are more in the pipe lines.

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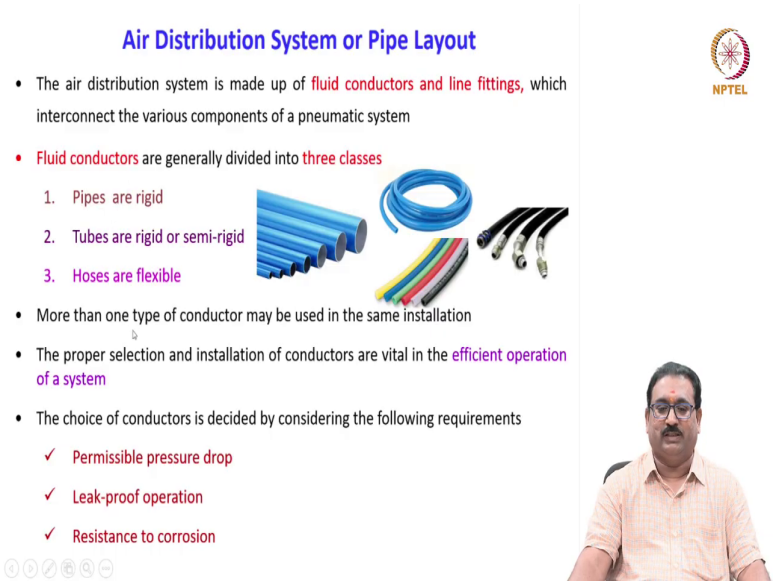

So, the air distribution system or a piping layout if we will see made up of you have seen it consists of various fluid conductors and line fittings which interconnect the various components of the pneumatic system. Fluid conductors are generally divided into 3 main classes what we will call the pipes are rigid; tubes are rigid or semi-rigid; hoses are flexible.

More than one type of fluid conductors may be used in the same installation. The proper selection and installation of conductors are vital in the efficient operation of the system. The choice of conductor is decided by considering the following important requirements: permissible pressure drop, leak-proof operations, and resistance to corrosion. These are very very essential while selecting the pipes tubes and hoses.

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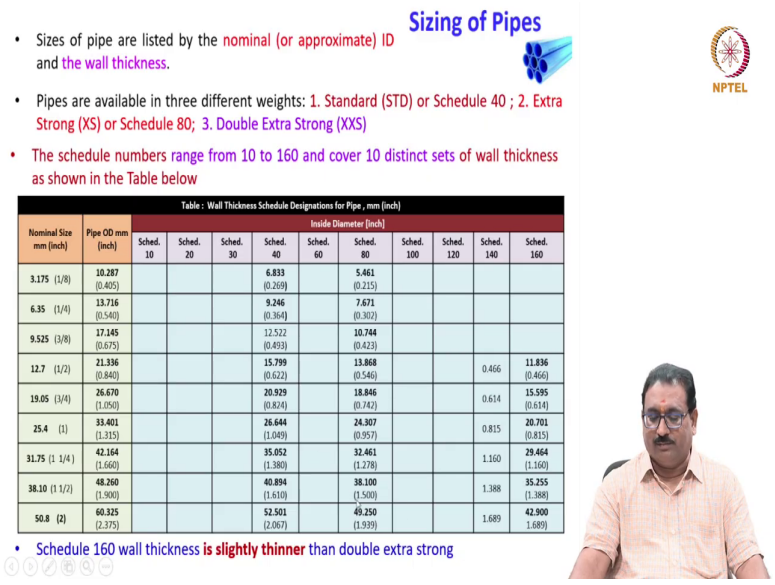

Let us we will see sizing of pipes. Sizing of pipes are listed by the nominal or approximate ID inside diameter and the wall thickness. Pipes are available in 3 different weights, what we

will call? A standard or a scheduled 40; 2nd one is extra strong or a scheduled 80; 3rd one double extra strong.

The scheduled numbers range from 10 to 160 and cover 10 distinct sets of wall thicknesses as shown in the table. You will see here this table will show you friends, the nominal diameter it is given in the millimeter and inch in the bracket, the pipe OD and then you will see here scheduled a number 10, 20, 30, 40, 60, 80, 100, 120, 140, 160.

These are the 10 distinct sets of scheduled numbers for which I have mentioned here the thickness of the tubes in millimeter as well as an inch. Here you will see some of the thicknesses if you will see here, here, here you will see compared to the value of here and here. Then what happens scheduled 160 wall thickness is slightly thinner these are the thinner than the double extra strong pipes.

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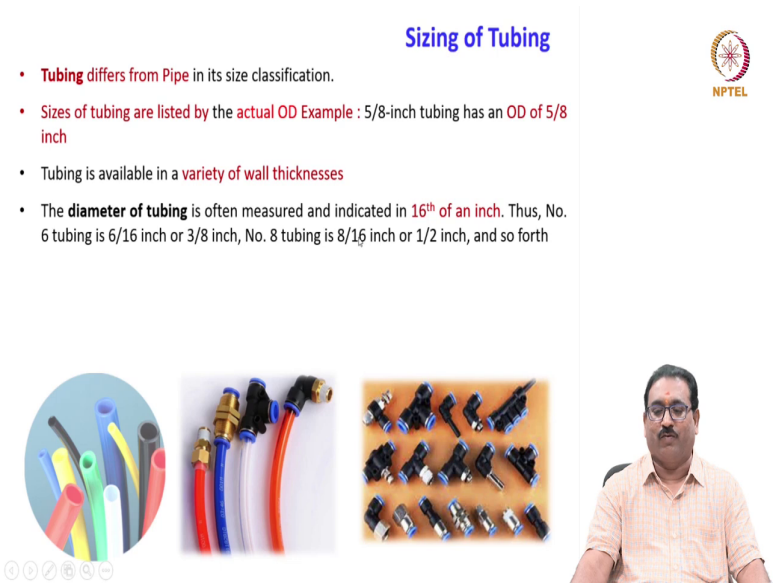

Then you will see sizing of the tubes the tube differs from pipe in it is size classification. Sizing of pipes is different, sizing of tubes are different. Here in sizing of tubes are listed by the actual OD example 5 by 8 inch tubing has an OD of 5 by 8 inch.

Tubing is available in variety of wall thickness. For example, if we will see the 5 by 8 inch of OD it has a various thicknesses under this category. I will show you the table in the next slide. The diameter of tubing is of10 measured and indicated in 16th of an inch meaning what it is? The number 6 tubing is 6 by 16 inch or 3 by 8 inch.

Similarly number 8 tubing is 8 by 16th inch or 1 by 2 inch and so forth. Meaning the diameter of the tubing is often measured and indicated in the 16th of the inch you will see 16th of an inch, it will continue.

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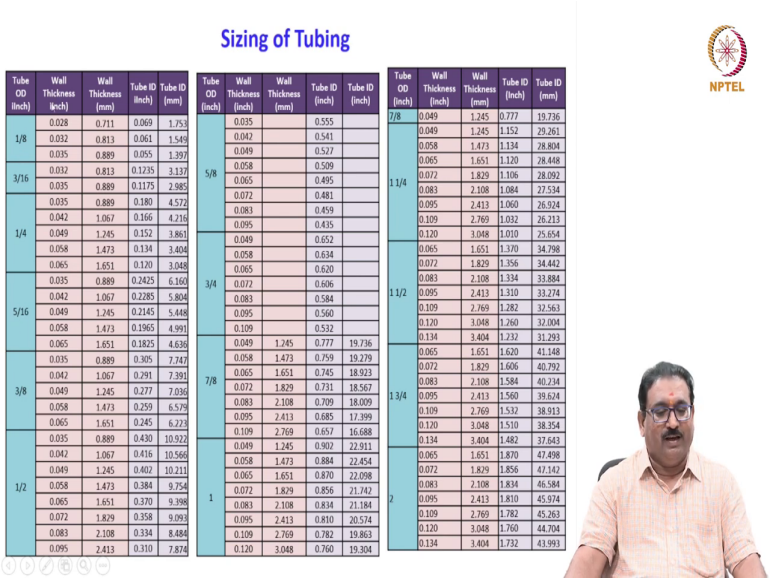

Here I am showing you the different types of tube OD wall thicknesses. Tube OD it is 1 by 8th inch, 3 by 16th, 1 by 4 different tube OD and corresponding wall thicknesses in inch millimeter. Similarly, tube ID and tube ID inch and millimeter; this these are all you will get all this information in the pneumatic manuals based on your requirement you will choose the required OD and corresponding wall thicknesses.

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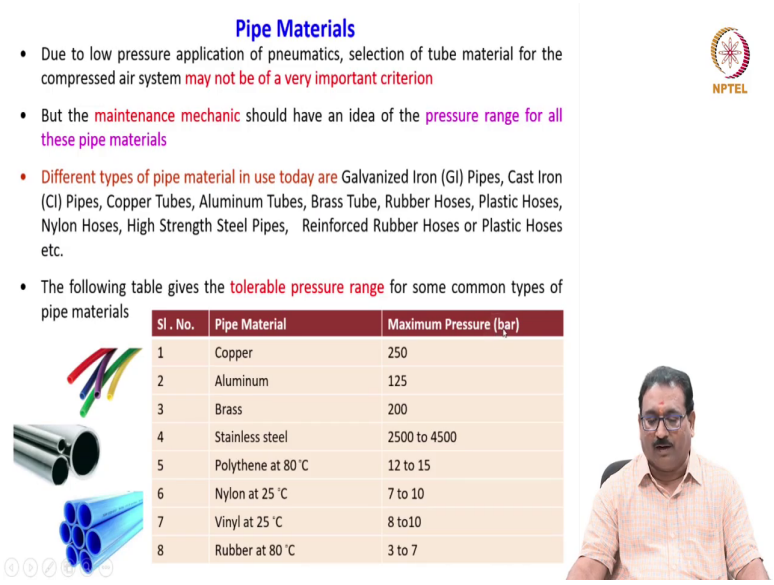

Then, materials for the pipe as well as the tubes. Due to low pressure application of pneumatics as I have told you 6 to 10 bar is a normal pneumatics the people will never go beyond 20 bar. So, due to low pressure application of pneumatics selection of tube material for compressed air system may not be of very important criteria.

But, the maintenance mechanics should have an idea of the pressure range for all these pipe materials as well as tube materials. Different types of pipe materials in use today are

galvanized iron pipes, GI pipes it is called; cast iron or a CI pipes; copper tubes; aluminum tubes; brass tube; rubber hoses; plastic hoses; nylon hoses; high strength steel pipes; then reinforced rubber hoses or a plastic hoses and many more.

The following table gives the tolerable pressure range for some common types of pipe materials. Here I am writing here the different types of pipe materials and here I am writing the maximum pressure range. Again, all these things you will get it in the catalog meaning copper pipe you can withstand up to 250 bar; aluminum 125 bar; brass 200 bar; stainless steel 2500 to 4500 bar.

Even though we are not going, you must have the knowledge of what is the pressure rating for the different materials. For example, nylon you will see 7 to 10 bar, vinyl you will see 8 to 10 bar, rubber at 80 degree centigrade 3 to 7 bar. Meaning what is very important each pipe and tubing materials having the maximum pressure range to withstand.

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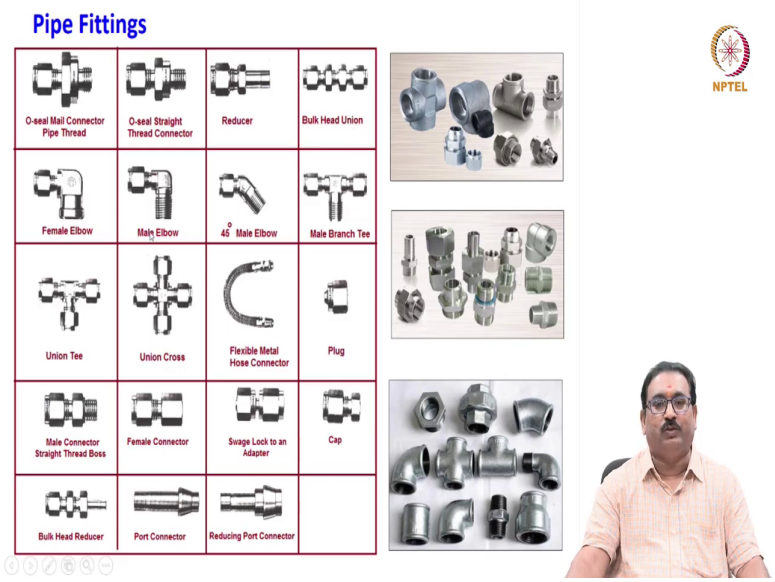

Then we will see the pipe fittings: during the air distribution system we are using the various pipes hoses correct, but so many connectors we are using, what are these? You will see there are different connectors we are using see here the O-seal mail connector for pipe thread, O-seal straight thread connector how it looks, reducers, bulkhead union, you see female elbows, male elbows, 45 degree male elbow, then male branch tees. We will see her also there are various types of pipe fittings are used in the piping's layout.

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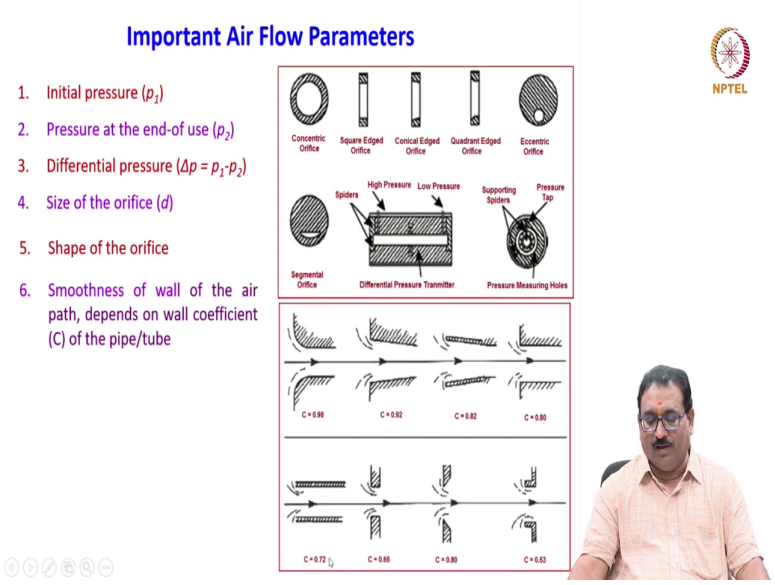

Then important airflow parameters, what are the parameter affecting to the airflow in the piping's and tubing's? Initial pressure p 1, pressure at the end of use p 2, differential pressure p 1 minus p 2, size of the orifice very important d, then shape of the orifice. There are different types of orifices are available concentric orifice, square edged orifice, conical edged orifice, quadrant edged orifice, eccentric orifice and many more; meaning shape of the orifice will also affects the airflow.

Then smoothness of the wall of the air path, depending on the wall coefficient of the pipe and tube. The tube inside surface roughness will affects to the airflow if it is a rough there is a resistance to flow then pressure drop will increases. That is why for each type of pipe or a tube inside wall roughness they will specify what is C for the various types of entry and exit of the airflow.

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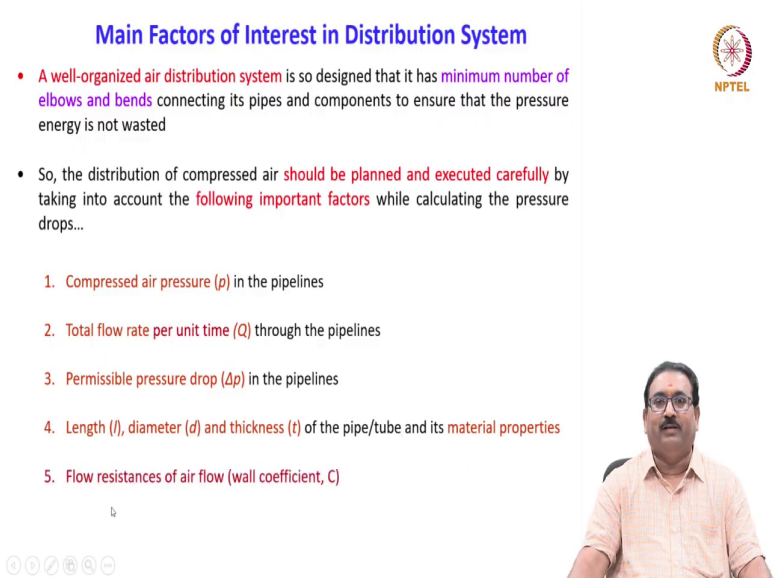

Now, quickly we will see the main factors of interest in distribution system. A well-organized air distribution system is so designed that it has a minimum number of elbows and bends, correct friends? Connecting it is pipes and a components to ensure that the pressure energy is not wasted.

So, the distribution of compressed air should be planned and executed carefully by taking into account the following important factors while calculating the pressure drop. What are those? Compressed air pressure in the pipelines, total flow rate per unit time through the pipelines, permissible pressure drop in the pipelines, length, diameter, thickness of the pipe and a tube and it is material properties.

Then as I have told you the flow resistance of air in the tube or pipe matters, meaning wall coefficient is playing a major role.