

Upstream LNG Technology
Prof. Pavitra Sandilya
Department of Cryogenic Engineering Centre
Indian Institute of Technology, Kharagpur

Lecture – 18
Pressure measurement in natural gas systems

Welcome. Today we shall learn about a few Pressure measurement techniques, which are used in the natural gas industries.

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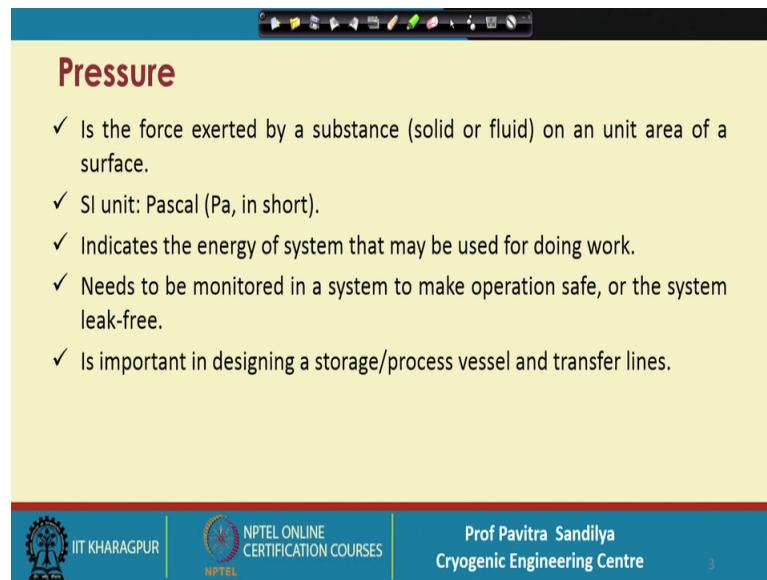
What we shall learn

- ✓ Pressure
- ✓ Fluid pressure
- ✓ Pressure measuring methods
- ✓ Manometer
- ✓ Pressure transducers

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In this particular lecture we shall be learning about the, what is pressure the fluid pressure, the various pressure measuring methods related to natural gas and then something about manometer then some pressure transducer.

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Pressure

- ✓ Is the force exerted by a substance (solid or fluid) on an unit area of a surface.
- ✓ SI unit: Pascal (Pa, in short).
- ✓ Indicates the energy of system that may be used for doing work.
- ✓ Needs to be monitored in a system to make operation safe, or the system leak-free.
- ✓ Is important in designing a storage/process vessel and transfer lines.

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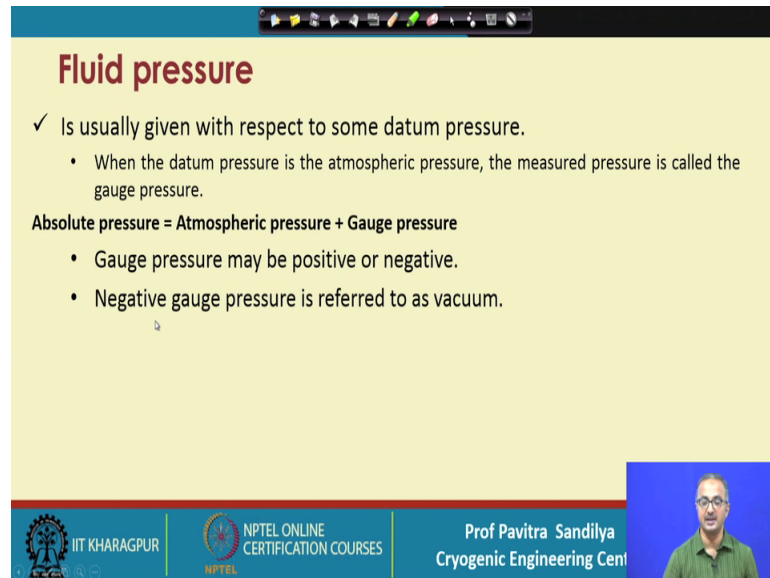
Now, first let us come to the pressure. Now, as we know the pressure is the force exerted by a substance the substance may be a solid or a fluid on an unit area of a surface. So, the SI unit of pressure is Pascal which is also the Newton per meter square, and it is given in short as Pa and pressure represents the energy that a system has to do some work. And we know that there are some various equipment like compressor; compressor takes in the pressure to takes in work to generate the pressure whereas, turbine reduces the pressure and it gives out work.

So, there everywhere you find that the pressure changes across a compressor or a turbine either to consume the work or to generate the work. Then we need to monitor the pressure in a system so, that we the system can be operated safely and without any leak whenever we are talking of any kind of storage or transfer. So, when we are whenever we are designing any kind of storage or process vessels and transfer lines, we have to take care of the pressure inside the things. Because in the storage vessel for example, if there is the pressure is certainly goes up beyond the design pressure, it may it explosion and in the process vessels many a times we are carrying out some kind of reactions on some kind of separations in process vessels.

So, we have to keep monitoring the pressure inside the vessel because the for a particular process takes place at a particular operating condition, and if the pressure fluctuates if the operating conditions goes away from the designed operating conditions, then we will not

be getting the right performance. So, that is why we need to be very careful about the pressure inside the system and so we need to have some appropriate pressure measuring device.

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Fluid pressure

- ✓ Is usually given with respect to some datum pressure.
 - When the datum pressure is the atmospheric pressure, the measured pressure is called the gauge pressure.

Absolute pressure = Atmospheric pressure + Gauge pressure

- Gauge pressure may be positive or negative.
- Negative gauge pressure is referred to as vacuum.

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Now, let us look at what is fluid pressure. Now fluid pressure is generally represented a with respect to some kind of datum pressure and when the datum pressure is the atmospheric pressure though we call it the gage pressure. And so, we have this thing that absolute pressure is equal to the atmospheric pressure plus the gauge pressure. The gauge pressure may be positive or negative, and if we have negative gauge pressure we call it vacuum.

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Fluid pressure

✓ Is usually given

- When the data gauge pressure
- Absolute pressure = P_{abs}
- Gauge pressure
- Negative gauge pressure

ure is called the

A = any point above P_{atm}
B = any point below P_{atm}

Atmospheric pressure

Atmospheric pressure

Point A

Point B

Absolute vacuum

Absolute vacuum

$P_{abs} = 0$

P_{abs} = absolute pressure
 P_{vac} = vacuum pressure
 P_{atm} = atmospheric pressure
 P_g = gauge pressure

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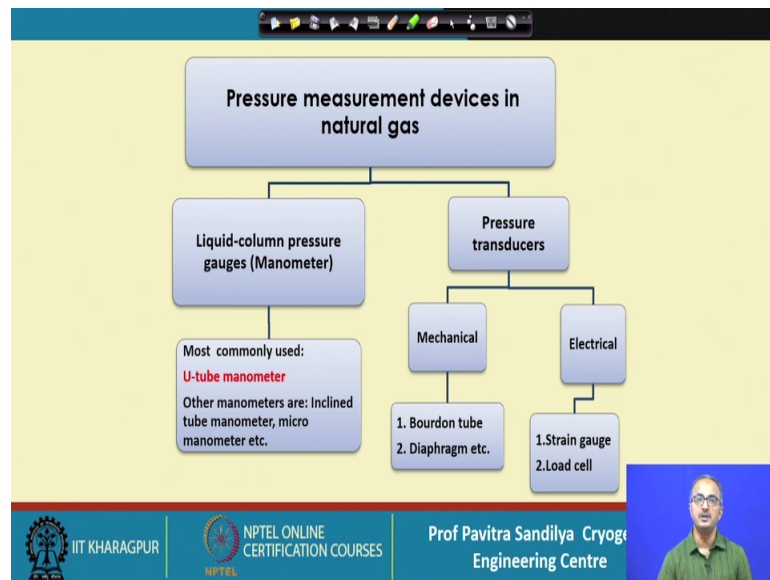
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And this can be demonstrated from this particular figure. Here what we see that there is this atmospheric pressure and there is one point A. The point A has a pressure which is higher than the atmospheric and here we call it P_g and the absolute pressure is the P_{atm} plus P_g , where P_g represents the gauge pressure. And somewhere near the bottom we are showing some kind of absolute pressure that is 0 pressure. And we can have various types of units for that here we are showing atmospheric, atmosphere bar there are various kind of units sometimes represent pressure in terms of the millimeter of mercury, sometimes in terms of inches of mercury, millimeter of water inches of water column. So, there are various types of units that are there for the pressure measurement and here in this particular figure we see the vacuum pressure.

Again we say this is the atmospheric pressure and this P_{vac} represents the negative gauge pressure or the vacuum pressure. So, the absolute pressure is equal to the atmospheric pressure minus this negative gauge pressure or the vacuum pressure. So, this is the absolute pressure. So, this is the vacuum pressure and this is the more than atmospheric pressure.

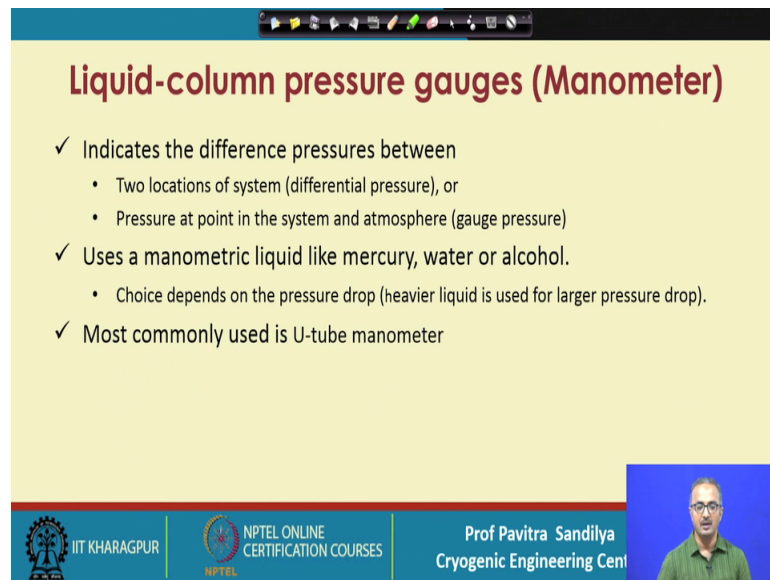
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Now, we shall be looking into a few types of the pressure measuring device cells, which are related to the natural gas processing. So, broadly all the measuring devices for pressure are divided into two types, one is the liquid column measuring gauges and there is the pressure transducer. Generally the liquid column pressure gauges incorporate some kind of fluid and this particular liquid column pressure gauges is also called manometer and there are various types of manometers available depending on the pressure ranges we need to measure.

The U-tube manometer is very common and in the natural gas industries, we use the U-tube manometer because of the large pressure differences we find in the pipelines or the storage vessels.

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Liquid-column pressure gauges (Manometer)

- ✓ Indicates the difference pressures between
 - Two locations of system (differential pressure), or
 - Pressure at point in the system and atmosphere (gauge pressure)
- ✓ Uses a manometric liquid like mercury, water or alcohol.
 - Choice depends on the pressure drop (heavier liquid is used for larger pressure drop).
- ✓ Most commonly used is U-tube manometer

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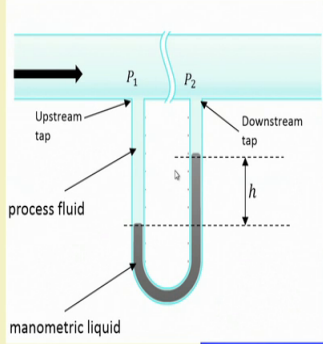
So, let us look into the manometer, first let us see that what it represents. The manometer can be used to find out the pressure difference between two locations or we call it the differential pressure. A manometer may also be used to find out the absolute pressure in a given system by putting one of exposing one of its limbs to the atmosphere. So, which we will see that in our next slide how it is based now as I told you that we use different types of manometric liquids like mercury, water or alcohol depending on the pressure difference expected.

So, we use generally heavier liquid if the pressure difference is large; if the pressure difference is small then we use lighter liquid because in that case we shall be giving we shall be getting the difference in the liquid level more, if you are using lighter liquid for small pressure difference.

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Construction of U-tube manometer

- ✓ Consists of a U-shaped glass tube containing the manometric liquid.
- ✓ Two ends of the U-limbs are connected to upstream and downstream locations.
- ✓ The difference in heights (h) of the liquid in the two limbs is used to estimate the pressure drop.



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Now, let us look at how a U-tube manometer looks like. Here it is that we have a U-tube manometer it looks like U. So, that is why the name U-tube. So, in this case we find there are two limbs and these two limbs are placed in the pipeline where we want to measure the pressure difference, in this figure we find that the flow is taking place from left to right.

So, we have in this manometer some manometric fluid that is liquid and some process fluid which is also passing through the pipeline. And the two ends of the manometer are put on the one on the upstream side and one on the downstream side. And what we find because the pressure on the upstream side is more than the pressure at the downstream side we find that the, this liquid is pushed downwards more than the other on that other limb.

So, we find there is a difference in the heights of the manometric liquid in the two limbs and obviously, when there is no flow through the pipeline, these two limbs will be having the same liquid heights. So, here we see that the difference in the heights between the two limbs is h .

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Determination of pressure drop by U-tube manometer

Applying force balance at datum BB'

$$F_B = F_{B'}$$

$$A(P_1 + \rho_f g h_B) = A(P_2 + \rho_f g(h_B - h) + \rho_m g h)$$

$$P_1 - P_2 = \rho_f g(h_B - h) + \rho_m g h - \rho_f g h_B$$

$$P_1 - P_2 = \rho_f g h_B - \rho_f g h + \rho_m g h - \rho_f g h_B$$

$$(P_1 - P_2) = \cancel{\rho_f g h_B} - \rho_f g h + \rho_m g h - \cancel{\rho_f g h_B}$$

$$P_1 - P_2 = (\rho_m - \rho_f) g h$$

Area of cross section = A

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Now we shall see that how we can find out the pressure drop using this U-tube manometer. So, here we are showing that some datum B across which we are taking the pressure force balance. So, we shall be looking at the force acting on this plane BB' and here we see that here this F_B is the force which is acting on this limb and $F_{B'}$ is acting on the other limb the downstream limb.

So, here we have the those two forces I have to be balanced, and when we are balancing the forces for this F_B ; what is happening? The forces due to this pressure P_1 plus the due to the hydrostatic height of this particular fluid; So, we are writing P_1 into A that is the force plus $\rho_f g$ into h_B into A . So, this is the total height h_B that h_B into A is the force plus $\rho_f g h_B$ into A is the force due to this particular process fluid. And on the right hand side we have thus P_2 into A due to the flowing liquid then we have this small height that is $h_B - h$ into $\rho_f g$ plus this h_B or h into $\rho_m g$ into A .

So, this is how we are getting the various forces and which are acting on this plane BB' . Now, after that this force balance we now make all these mathematical manipulations to ultimately get this particular equation, which gives us the pressure difference between the upstream and downstream side in terms of the density difference between the manometric liquid and the process fluid and the height difference in the liquid column inside the U-tube manometer.

So, once we know h once we know this density of the manometric liquid and density of the process fluid, we can find out the pressure difference between the upstream and the downstream of the flowing fluid.

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Desired properties of the manometric liquids

- ✓ Immiscibility with process fluid
- ✓ High chemical stability
- ✓ Low viscosity
- ✓ Low capillary constant
- ✓ Low coefficient of thermal expansion
- ✓ Low volatility
- ✓ Low vapour pressure

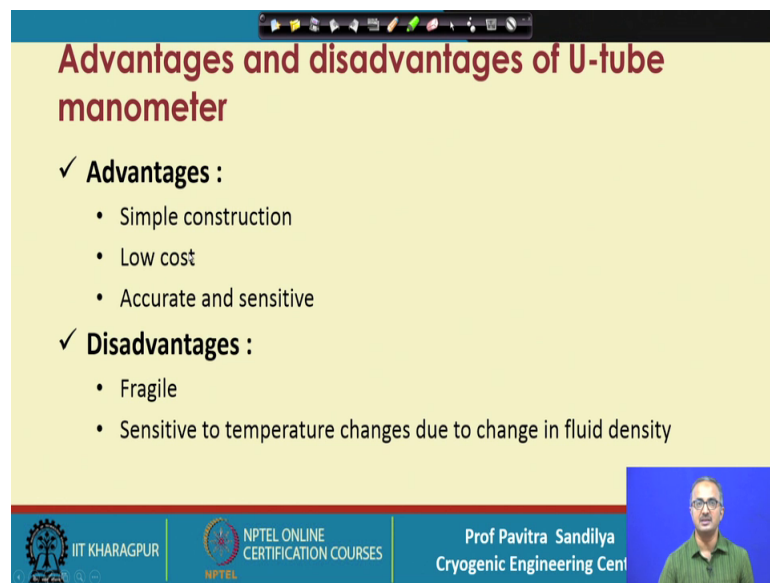
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After learning about the method to find out the pressure difference, now let us look at the various desirable properties, which a manometric liquid should have based on these desirable properties we can choose the appropriate manometric liquid for a given application. Here first is that the immiscibility of with the process fluid; that means, the manometric liquid should not be soluble in the process fluid, then it should have high chemical stability, you should not get dissociated or it should not react with any other components with the process fluid or with the surrounding glasses. So, it should be chemically stable.

Then it should have low viscosity so, that it can move in the manometric limbs very easily, it should not be having, which should not be needing the pressure energy from externally otherwise we cannot measure the pressure drops properly. Then you should have low capillary constant it is also related to is free movement through the manometric limbs. Then we have low a coefficient of thermal expansion means in the range of the operation that with temperature, it should not expand or contract too much if it expands and contract it density will change.

So, we will not be getting the right value out or we have to keep on applying some correction for the densities if it expands or contracts. Then it should have low volatility you should not if it is highly volatile then what will happen it will evaporate, it will not be able to stay in the manometric limbs. So, which expounds that this should not have high volatility and also to have low volatility low evaporation it should have a low vapor pressure because high vapor pressure leads to high rate of evaporation.

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Advantages and disadvantages of U-tube manometer

✓ **Advantages :**

- Simple construction
- Low cost
- Accurate and sensitive

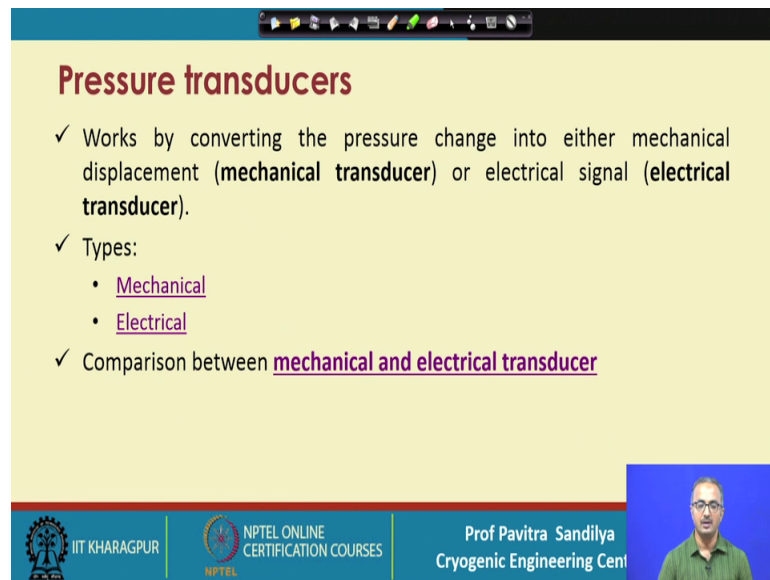
✓ **Disadvantages :**

- Fragile
- Sensitive to temperature changes due to change in fluid density

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Now, let us see what are the advantages and disadvantages of the U-tube manometer. In the advantages we have that it is quite simple in its construction, it is also not very costly and it is fairly accurate and sensitive to the pressure changes. However, the disadvantages are that it is quite fragile because most of the times it is made from glass so, that we can see through it. So, it is fragile and it is also sensitive to temperature changes due to the change in the fluid density.

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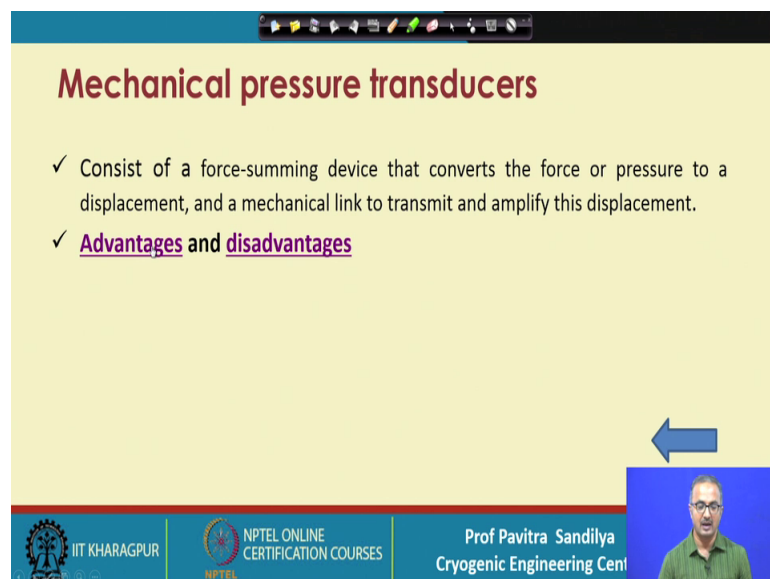
Pressure transducers

- ✓ Works by converting the pressure change into either mechanical displacement (**mechanical transducer**) or electrical signal (**electrical transducer**).
- ✓ Types:
 - [Mechanical](#)
 - [Electrical](#)
- ✓ Comparison between [mechanical and electrical transducer](#)

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Now, next we come to pressure transducers now what are pressure transducers? They are some devices which work by converting the pressure change either into some mechanical displacement or some electrical signal. Now, when it causes some when the pressure change causes some mechanical displacement, we call it mechanical transducer and if the pressure change causes some kind of change in the electrical signal maybe in terms of the voltage or the current we call it electrical transducer. So, here we have two types of transducers mechanical and electrical first let us go to mechanical transducer.

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Mechanical pressure transducers

- ✓ Consist of a force-summing device that converts the force or pressure to a displacement, and a mechanical link to transmit and amplify this displacement.
- ✓ [Advantages](#) and [disadvantages](#)

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Again we shall be confining ourselves to a very few mechanical transducers. In these particular mechanical transducers what we have? We have some pre force summing device; that means, it will be taking all kinds of forces which are acting on the device, that will be converted to some kind of displacement through some mechanical link, to transmit and amplify the displacement.

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Advantages of mechanical transducers

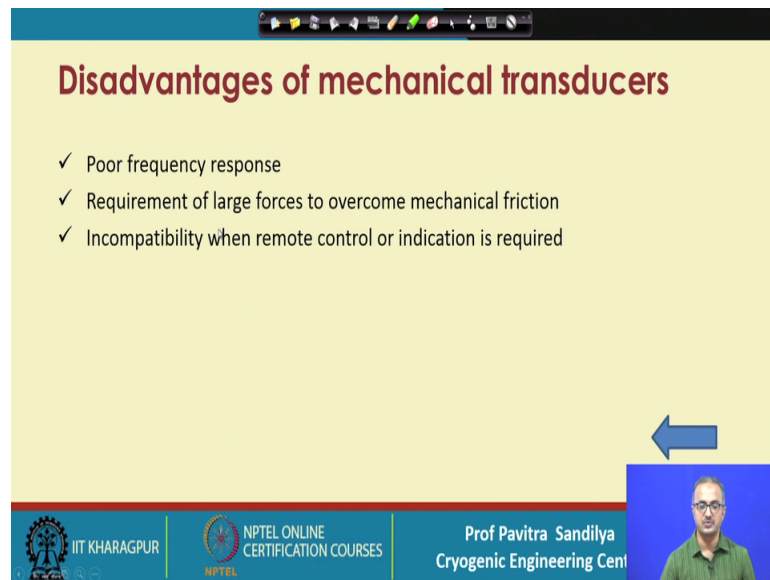
- Simple and rugged in construction
- Cheaper
- Can operate without external power supplies
- Capable of transmitting the mechanical signal over a reasonable distance.
- Can withstand high pressures
- Only react to the difference between the two applied pressures.

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Then the advantages are that these mechanical transducers are quite simple in the construction and quite robust and rugged. And they are cheaper than the electrical transducer can operate without any external power supplies; in some transducers we need some external power supplies like electric current to operate them, but in this case we do not need any kind of external power supply.

Then they are capable of transmitting the mechanical signal over a reasonable distance; that means, they need not be fixed right at the place where we are staying we can observe them from a faraway place also and then they can withstand high pressures and only react to difference between the two applied pressures.

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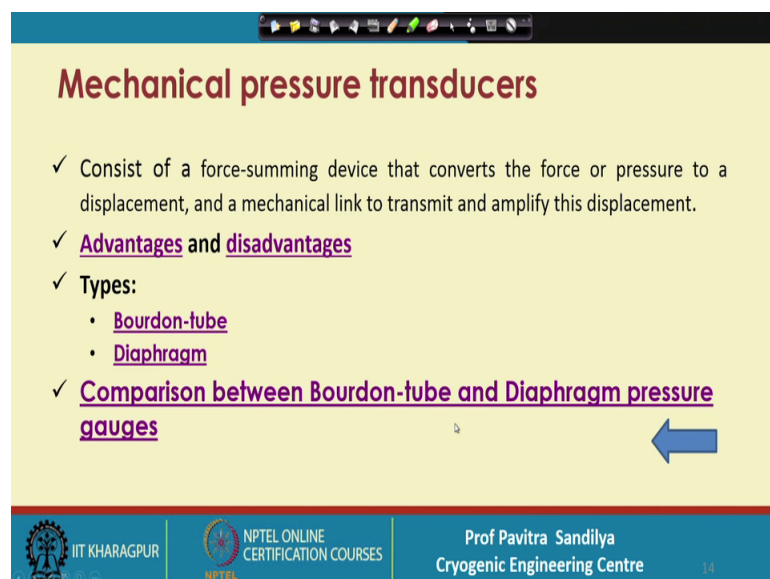
Disadvantages of mechanical transducers

- ✓ Poor frequency response
- ✓ Requirement of large forces to overcome mechanical friction
- ✓ Incompatibility when remote control or indication is required

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And coming to disadvantages of this mechanical transducers, we have they have poor frequency response; that means, they are having some kind of inertia in the when the pressure fluctuates too much. So, they cannot use cells the pressure properly if there is a lot of fluctuation and they require quite large forces to overcome some mechanical friction in the instrument and they are incompatible when remote control or indication is required.

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Mechanical pressure transducers

- ✓ Consist of a force-summing device that converts the force or pressure to a displacement, and a mechanical link to transmit and amplify this displacement.
- ✓ Advantages and disadvantages
- ✓ Types:
 - Bourdon-tube
 - Diaphragm
- ✓ Comparison between Bourdon-tube and Diaphragm pressure gauges

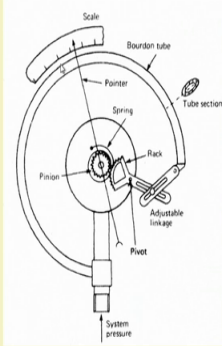
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There are various types of mechanical pressure transducers we are just listing only two of them. One is the bourdon tube which is very common and which is also found in our laboratory or in the industries quite commonly and we have diaphragm. So, let us first look into the bourdon tube mechanical pressure transducer.

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Bourdon-tube pressure gauge

- ✓ Consists of a Bourdon tube that
 - Has elliptic cross section
 - Is fixed and open at one end to receive the pressure to be measured, and
 - Is free and closed at another end, that is connected to a pointer through a pinion arrangement.
 - Is bent in the form of circular arc.



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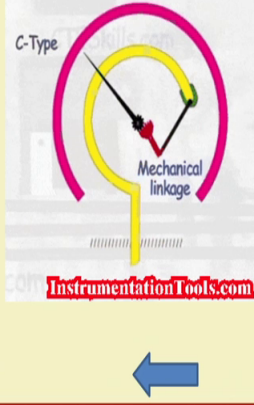
In this bourdon tube what we have that as we see in this particular figure, we have some the bourdon tube the vertical tube this tube is there this tube is then has elliptical cross section and is fixed at one end, and from this fixed end it receives the pressure signal. The other end is free to move and it is closed. So, the other end is closed and the one end is open and fixed other is free and closed and what happens? When this is when this pressure is sensed this particular tube tends to stretch out or becomes more circular.

So, when some stretch out what happens? On the other end from the other end through pinion connection there is a pointer is there, and this pointer will change its position as per the expansion of the bourdon tube and this pointer spans over the over the from particular calibrate scale.

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Bourdon-tube pressure gauge

- ✓ Consists of a Bourdon tube that
 - Has elliptic cross section
 - Is fixed and open at one end to receive the pressure to be measured, and
 - Is free and closed at another end, that is connected to a pointer through a pinion arrangement.
 - Is bent in the form of circular arc.
- ✓ Working Principle :
 - Imposition of pressure deflects the bourdon tube (at the free end).
 - The deflection makes the pointer sweep over a pressure calibrated scale.



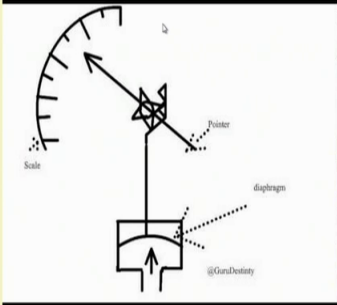
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And here in this particular figure we see that how the pressure at this at the unit pressure will stretch this board and tube and how the pointer is going to move on the pre calibrated scale due to some pressure change at this end. So, this is how a c type bourdon to work and there are many other type of bourdon gauges we are just looking at a typical bourdon gauge. Then we have another type of mechanical pressure transducer that is the diaphragm type.

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Diaphragm pressure gauge

- ✓ Consists of
 - A diaphragm whose movement senses the pressure differential
 - A push rod connected to
 - The diaphragm at one end
 - A pointer through a pinion arrangement at the other end.
- ✓ Working Principle :
 - Imposition of pressure deflects the diaphragm (upward).
 - The deflection makes the pointer sweep over a pressure calibrated scale.



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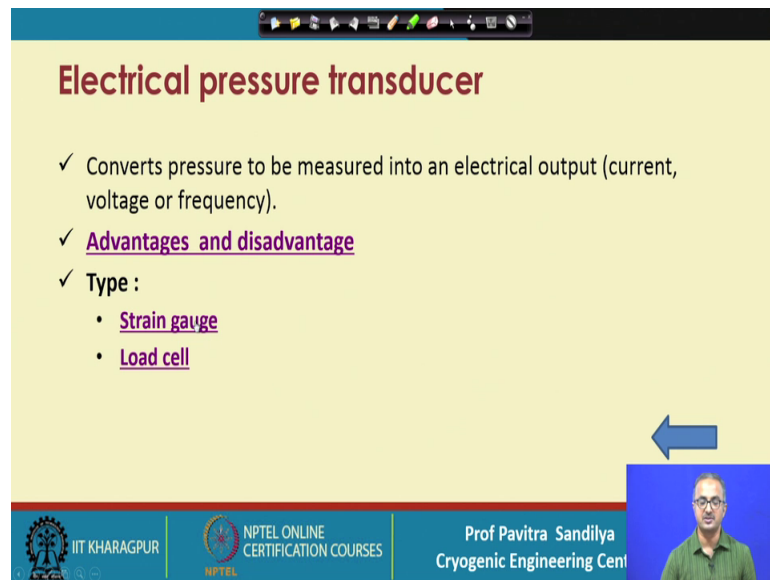
Now, in this diaphragm type what we have that, here we have a diaphragm. So, the here we have a diaphragm and there is a again like the bourdon gauge, we have another pointer here. So, what how it works that, whenever there is a pressure on the diaphragm this pressure to the pannier element this will again cause a movement to this pointer. So, depending on the pressure coming to the diaphragm this pointer will move on the left hand side or the right hand side. So, this is how the diaphragm pressure gauge works. Now, let us make a quick comparison of the bourdon tube with the diaphragm pressure gage.

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Pressure Gauge	Pressure Range	Mesurement of low Pressure	Operating in Corrosive Environment
Bourdon-tube Pressure Gauge	Higher (0.1–130 Mpa)	Not suitable	Suitable
Diaphragm Pressure Gauge	Lower (2.5 mbar–0.4 Mpa)	Suitable	Not suitable

Here we see that the bourdon gage can go for a higher pressure range about one atmosphere to about 1300 atmosphere and then it is, but while the diaphragm gage goes for a lower pressure range we can see it is goes from go up to milibar pressure range, then if we want to measure low pressure we will go for the diaphragm type. And it this bourdon gage can operate in corrosive environment whether the diaphragm is not suitable for corrosive environment.

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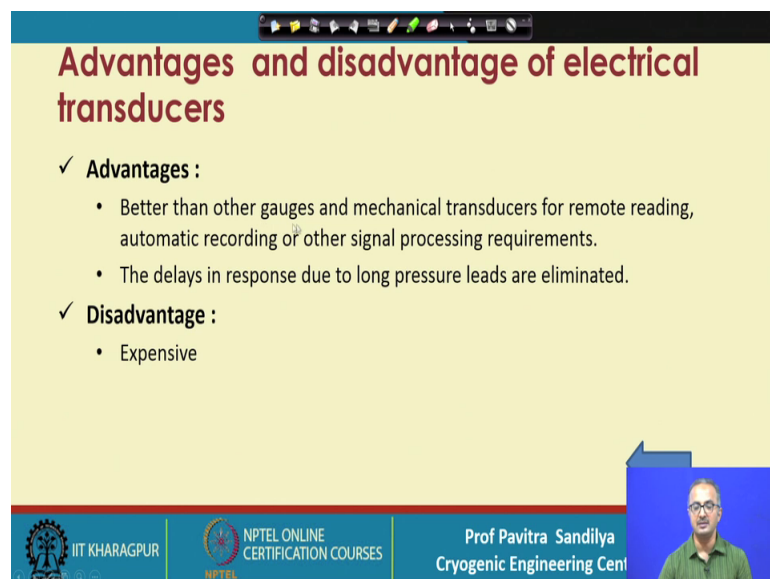
Electrical pressure transducer

- ✓ Converts pressure to be measured into an electrical output (current, voltage or frequency).
- ✓ Advantages and disadvantage
- ✓ **Type :**
 - Strain gauge
 - Load cell

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Next we come to electrical pressure transducer; in this the pressure sensed is converted into some kind of electric signal either in terms of current or voltage or some frequency. Now, what are the advantages and disadvantage.

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Advantages and disadvantage of electrical transducers

- ✓ **Advantages :**
 - Better than other gauges and mechanical transducers for remote reading, automatic recording or other signal processing requirements.
 - The delays in response due to long pressure leads are eliminated.
- ✓ **Disadvantage :**
 - Expensive

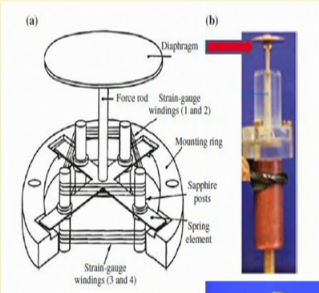
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Let us see that advantage is they are better than the other gauges and mechanical transducer for remote reading or for automatic control or for signal processing. That means, if we want to have some automation in the industry, we cannot use the mechanical transducers we have to go for the electrical transducer, because with them

only we can capture the data and also whatever control actions or automations have to be done we can transmit those signals from the electrical transducer to our control room, which is not possible for the mechanical transducer.

And the delay in the response is also eliminated almost eliminated because it is electric signal. So, there is the response time is very small. So, that is these are the advantages of the electrical pressure transducer; however, the disadvantage is that basically they are quite expensive. Next we come to the various types of these electrical transducer; first we have the strain gauge.

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Strain gauge

- ✓ Is a **sensor** whose resistance varies with applied force
- ✓ **Consists of**
 - A **diaphragm**
 - A **cross-shaped spring**
 - **Rods** of insulating material(extending above and below the spring)
 - Four **strain gauge windings** (electrically connected to form a Wheatstone bridge circuit).

Labels in diagram: Diaphragm, Force rod, Strain-gauge windings (1 and 2), Mounting ring, Sapphire posts, Spring element, Strain-gauge windings (3 and 4)

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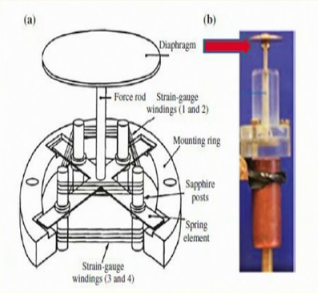
In the strain gauge what it says that it works on the straining that is the deformation of some element. Here we show the strain gauge type what we find in this figure is that we have a diaphragm, and then we have this cross shaped spring and then we have some rods over here, which will be displaced and we have the strain gauge windings.

So, these are the basic components of a particular strain gauge diaphragm, then cross cross ship spring, then these rods and the strain gauge windings. Now, how it works let us see that suppose from the diaphragm side, we are imposing some pressure.

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Working principle

- ✓ Imposition of pressure
 - Deflects the diaphragm (upward).
 - Pushes down on the cross-shaped spring.
 - Tilt all the rods inwards at the top and outwards at the bottom.
 - ❖ Changes the resistance of the windings under the cross changes .
- ✓ This resistance change is related to the strain by the quantity known as the gauge factor
 - Gauge or strain factor of a strain gauge (GF) is the ratio of relative change in electrical resistance R , to the mechanical strain ϵ .

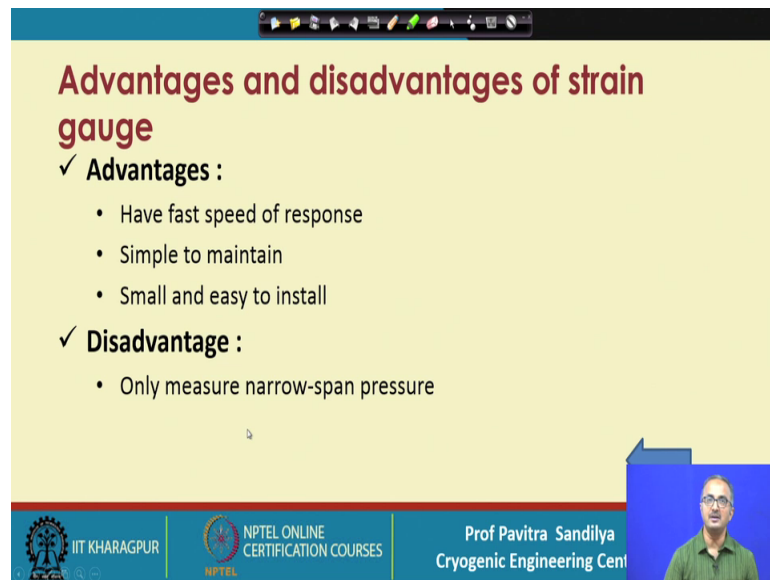
$$GF = \frac{\Delta R / R}{\epsilon}$$


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Now, because of this pressure what will happen, it will push this particular cross shaped spring downwards; and when is pushed down what will happen? These rods will be tilting inward at the top and they will be going towards the outward at the bottom side. And when these rods are getting tilted what will happen? They will also these strain gauges will also be getting some displacement and because of this resistance will change and this will send the signal to the some appropriate signal a data logger.

So, what will happen this resistance change is related to the strain by some quantity known as the gauge factor. And what is gauge factor? It gauge factor is defined like this it is the ratio of the relative change in the electrical resistance to the mechanical strain; that means, this delta R is that change in the resistance due to the deformation or the tilting of these rods, and this is the original resistance and this is the actual strain that has taken place. So, with this gauge factor we can know that what is the actual pressure, that has been imposed by some calibration.

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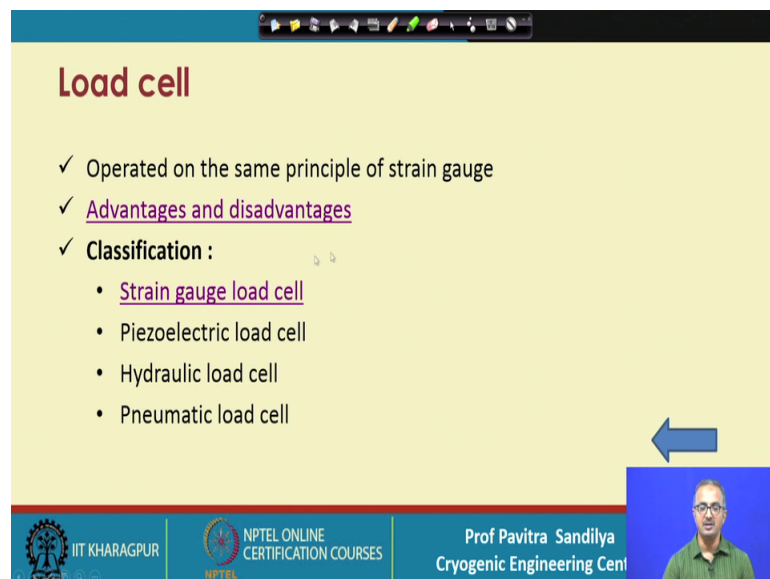
Advantages and disadvantages of strain gauge

- ✓ **Advantages :**
 - Have fast speed of response
 - Simple to maintain
 - Small and easy to install
- ✓ **Disadvantage :**
 - Only measure narrow-span pressure

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Now, the advantages of this kind of strain gauges are, that they are quite fast in response and they are simple to maintain, and they are their sizes are small and they can be installed easily. On the other hand we have the disadvantage as that they have the span or the range of pressure they can measure is small.

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Load cell

- ✓ Operated on the same principle of strain gauge
- ✓ Advantages and disadvantages
- ✓ **Classification :**
 - Strain gauge load cell
 - Piezoelectric load cell
 - Hydraulic load cell
 - Pneumatic load cell

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Next we go to the load cell; in this load cell we find that the operating principle is similar to that of the strain gauges.

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Advantages and disadvantages of load cell

- ✓ **Advantages :**
 - Easily available.
 - Have high accuracy which is $<0.1\%$ of the full scale.
 - Can be calibrated easily by the manufacturers or vendors.
- ✓ **Disadvantages :**
 - Bulky in size.
 - Rigid in construction.
 - Requires expensive electronics.

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And first let us see the advantages that they are easily available, and they have quite high accuracy which is about even less than 0.1 percent of us full scale accuracy may be obtained, they can be calibrated easily by the manufacturers or vendors. On the other end the reified bulky and they are quite rigid they dot; that means, we do not have much flexibility in their installation and they require quite expensive electronics.

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Load cell

- ✓ Operated on the same principle of strain gauge
- ✓ Advantages and disadvantages
- ✓ **Classification :**
 - Strain gauge load cell
 - Piezoelectric load cell
 - Hydraulic load cell
 - Pneumatic load cell

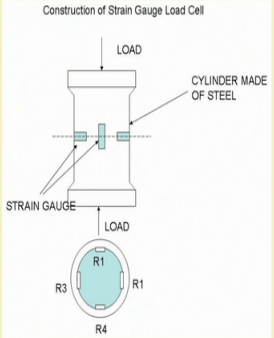
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Now, there are various types of load cells available commercially strain gauge piezoelectric hydraulic load cell pneumatic, but essentially they are working principles are almost same. So, we shall be looking into only these strain gauge load cell.

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Strain gauge load cell

- ✓ Consists of
 - A spring metal cylinder with a flanged base-plate.
 - Four resistances (made of carbon-film resistors printed on flexible insulating sheets) bonded securely on to the side of the cylinder.
 - Two are arranged horizontally and
 - Two are arranged vertically



Construction of Strain Gauge Load Cell

LOAD

CYLINDER MADE OF STEEL

STRAIN GAUGE

LOAD

R1 R2 R3 R4

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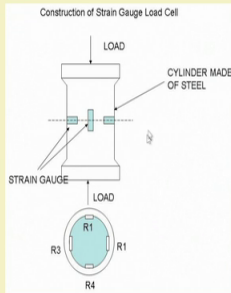
Here we find that how it works that first we see his construction. In the constitution we shall see that there is a metallic cylinder with some flange baseplate. And on this particular cylinder we are having four resistances; there two resistances are placed horizontally, and two resistances we are showing one resistance over here there is another resistance on the opposite side.

So, there are two resistances which are addressed horizontally and two resistance are addressed vertically. So, here in this top view if an we can see that these R 3 and R 1 are horizontally and R 4 R 1 are vertically.

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Working principle of strain gauge load cell

- ✓ Imposition of pressure applies force on the top of the cylinder
- ✓ The walls of the cylinder becomes barrel shaped under the load
- ✓ A slight movement causes
 - Slight stretching of the horizontal resistors and
 - Slight contraction of the vertical resistors.
- ✓ The resistance of the resistors changes .
- ✓ This resistance change is related to the strain by the quantity known as the gauge factor.



Construction of Strain Gauge Load Cell

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Now, what happens that whenever we are imposing some kind of a pressure on the top of the cylinder, this particular cylinder barrel where tends to deform and this cylinder means we are deforming it is not trying to bulge out. The when it shall bulge out what happens? These resistors change their positions and their resistances change. And these changes in the resistance of the resistors are recorded and they are related to the pressure imposed by some kind of gauge factor as we looked into the in kind of load cells. So, here we find that these strain gauges are working in a similar fashion as for the strain gauges the load cells are and still are similar in their functioning; now the we find.

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Comparison between mechanical and electrical pressure transducer

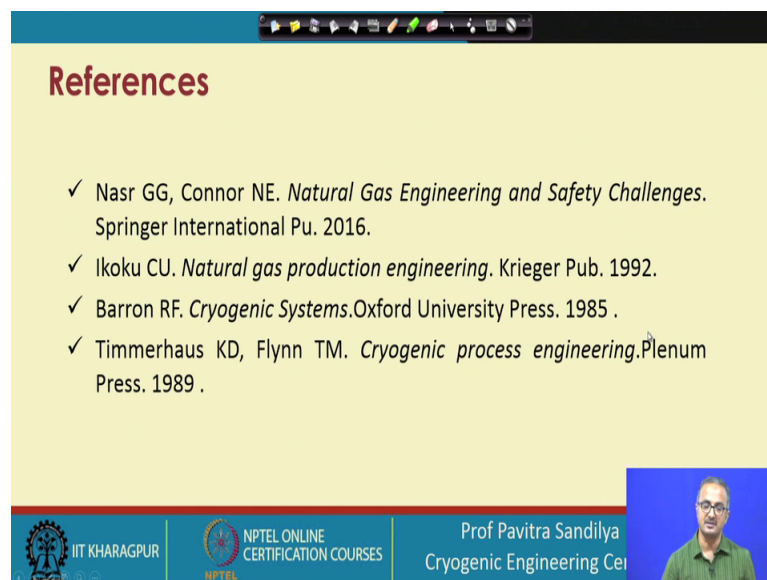
Parameters	Mechanical	Electrical
Accuracy	Low	High
Cost	Cheaper	Expensive
Size	Large	Small
Power requirement	High	Low
Mechanical failure	Yes	No
Compatibility in remote reading, automatic recording or other signal processing requirements	No	Yes

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These are the comparison of the mechanical and electrical pressure transducer, that accuracy wise we find that electrical transducer are giving higher accuracy than the mechanical transducers. Cost wise of course, mechanical transducers are cheaper than electrical transducers, the size wise also the electrical transducers are smaller than the mechanical transducers. Power requirement is higher for mechanical transducer, because the pointer has to overcome some kind of frictional resistance, which is not the case with the electrical transducers.

Then mechanical failure is more in case of the mechanical than for electrical transducers, on the other hand for any kind of automation, control or signal processing electrical transducers are preferred to the mechanical transducers.

(Refer Slide Time: 27:16)



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Now, these are the references which you may refer to for further details. Before this I would like to show you this is the thing this is the pressure transducer, here you can see there is a small hole over here which this we put in the in the transfer line wherever, there is some process fluid is passing. And on this particular hole we this fluid pressure is exerted and this particular portion is a transmitted portion through which this signal of the pressure is transmitted, and from here from this particular port we take the signal out electrical signal from the particular transducer.

So, this is how a pressure transducer looks like; and here I show you the strain gauges which are very very small these are very small there are strips are there, and these strips

are pasted on wherever we want to measure the pressure drops and these strips will change the resistance and resistance is measured appropriately to get the pressure drops.

Thank you.