Metrology
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Module-2
Lecture-5
Dial indicators, thickness gauges, depth gauges

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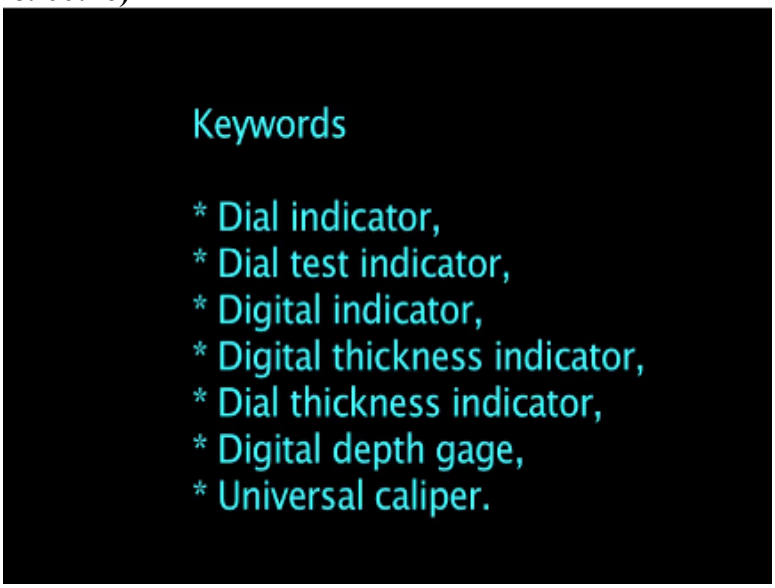

I welcome you all for this session. In this session we will continue the discussion on the linear measuring instruments. We will discuss about the dial indicators, dial test indicators, digital indicators, digital and dial thickness indicators, digital depth gauge and universal caliper.

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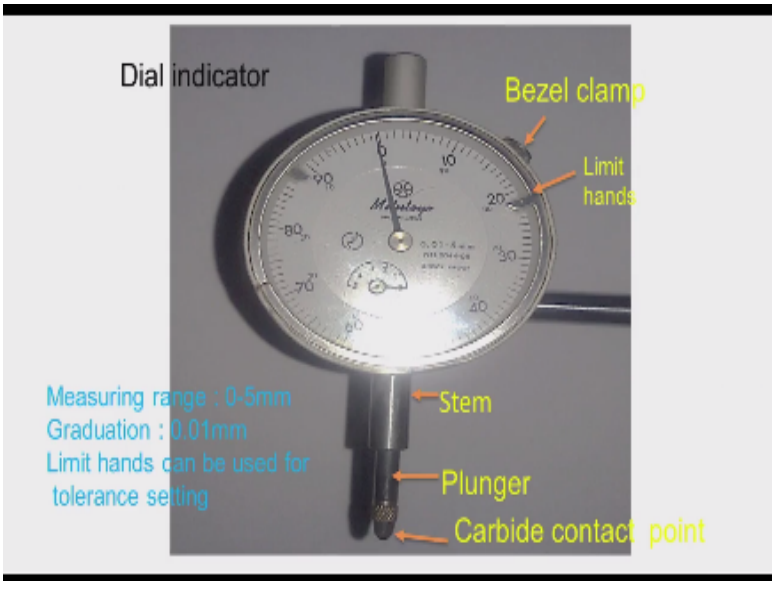

First let us discuss about dial indicators. This figure shows the commonly used dial indicator, I can see the various parts of dial indicator, this is Bazel and Bazel lock and if you dial we have bigger than and smaller dial. The resolution of this dial is 0.01 millimetre and for each evolution of the pointer this pointer will move by 1 digit 1 graduation. So the range of measuring instrument is zero to 5 millimeter with resolution of 0.01 millimetre.

And we can set limit hands for upper and lower limit on to send a tolerance whenever the painted goes beyond the limits then the work piece can be rejected. So this can be used for limit catching purpose for comparing the dimension of the work piece with nominal value and this stem and pleasure and this is carbide contract point. Most of the parts are made out of high strength stainless steel. So that it will be steady.

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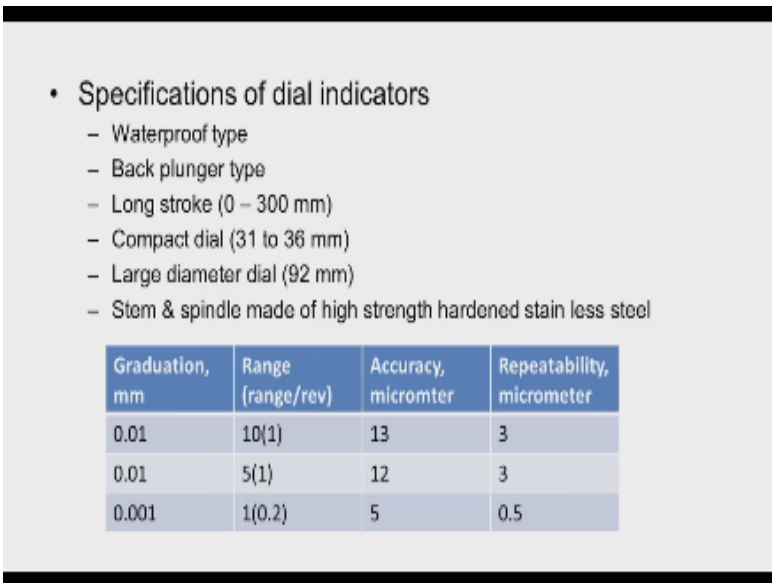

Now what are the specifications of dial indicators. Now these dial indicator are available to work in normal working condition as well as in condition where is cool and cool and so waterproof type also available and back plunger type also available in some cases we have to use the dial indicator where in the plunger back and then there long stroke ah dial indicators are available with the range of 0 to 300 mm.

And dial size can be 31 to 36 mm for a very compact dial indicator have a space is not available such compact dial type indicator can be used and large diameter dial also there are also available with 92 millimetre for easy reading. Now you can see their graduation available in 0.00001 mm, 0.001 mm with range of 10 mm, 5 mm, 1 mm like that and in bracket we have indicated range for revolution.

For revolution is the range is 1 mm and then accuracy of these dial indicators overall accuracy is 13 microns for this particular range, and it try for 0.001 graduation the overall accuracy will be 5 micrometre and repeatability will be like 0.5 micrometre, 3 micrometer, so depending upon our requirement we have to select the appropriate dial indicators.

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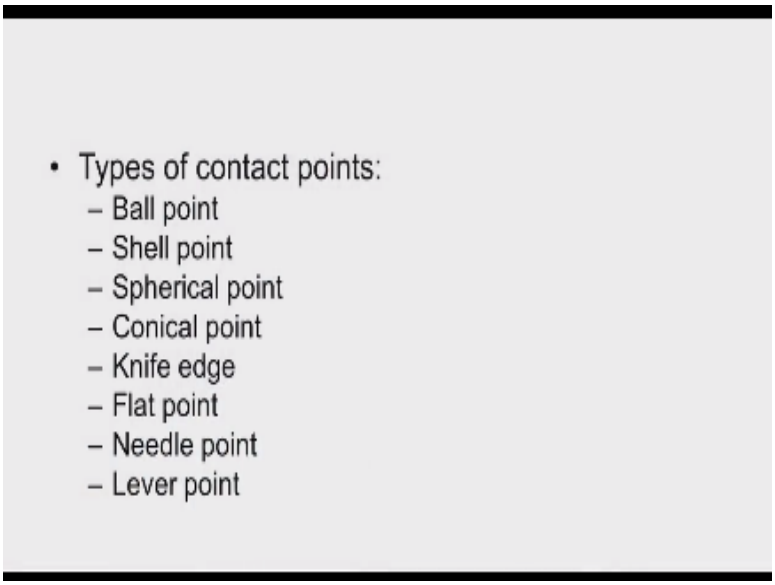

Now there are different types of contact point lens are available like ball point and shell point, spherical point, conical point, knife edge, so depending upon the application we have to select the proper contact point. For example we have a very narrow grove like this, so we have narrow grove like this. In such case we have to go for knife edge, so it will enter into the grove comfortably.

So similarly the spherical type say the contact point of the lenses ledge or radius and when the work pieces are push from side base, then such a spherical type of indicators will be very useful. Also there are lever type indicator which we will be discussing after sometime.

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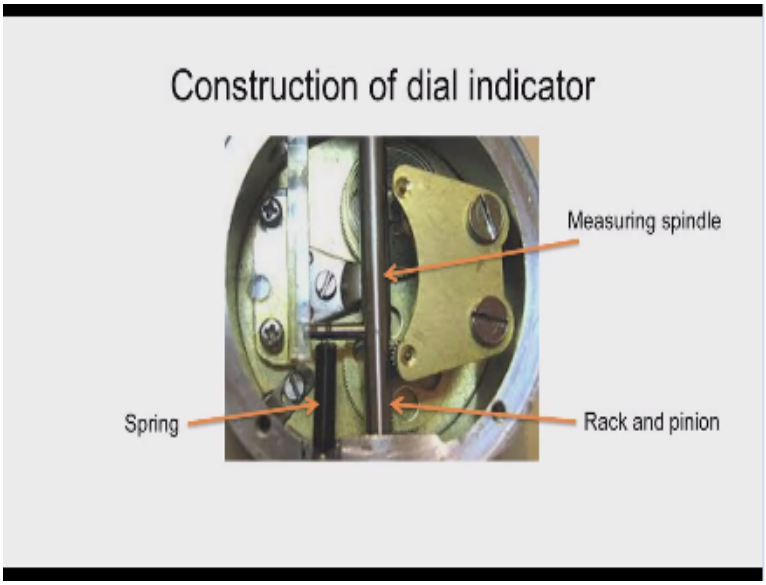

Then let us see the construction of the dial indicator, I can see this is the measuring spindle or plunger. There are built in rack in the spindle and we can also see the pinion, so when the plunger moves this pinion will also move and the set of gear train this pinion is fixed to the gear and this is in contact in a mesh with another smaller like this there is a train of gear. So the displacement gets amplified.

So now see this dial indicator one thing is it senses very small distances of the order of maybe 0.001 millimetre 0.01 millimetre with small displacement which we cannot sense, so this type of dial indicator senses the very small displacements as well as the amplifies like for example 100x200x300x amplifies and finally at the pointer depends upon the pointer length also we get some magnification.

So in the dial we can comfortably note down the reading. For example if the plunger moves by 0.01 millimetre, the pointer will move by approximately 1.5 to 2 millimetre. So finally we get magnification of 100 or 200 times. So that we can comfortably record the displacements. Now we have a spring here, so when the work piece is removed the measuring spindle will come down because of this spring force. We can also see there is a air spring for balancing the purpose.

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Now we have another dial indicator this measuring range is 0 to 1 millimetre and resolution is 0.002 millimetre. So one complete revolution we can see here it is 0 to 100 and again 0-100, so for one complete revolution the smaller pointer will move by to indicate 0.2 millimetre displacement.

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Now this is we can see the mounting arrangement here back we have a hole is available, so using this we can fix this dial indicator to the magnetic stand and we can do the necessary work.

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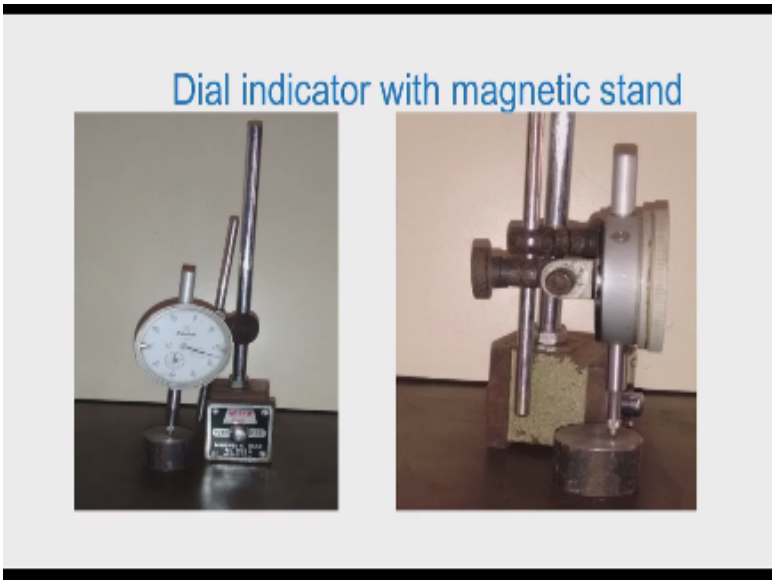

Now this shows dial indicator with magnetic stand, we can see the magnetic stand and we can also see how the dial indicator is fixed to the magnetic stand.

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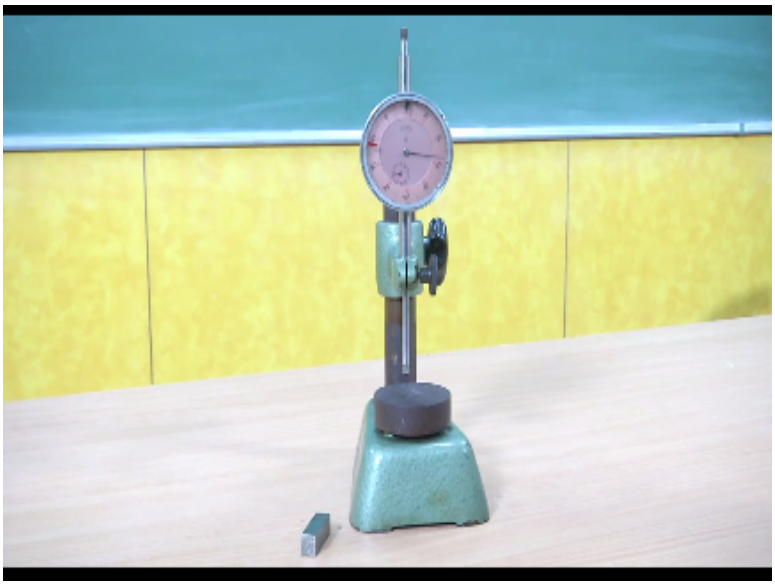

Now I will explain how to use dial indicator for comparing the size of the work piece that means the dial indicator is used as a comparator. Now this is the dial indicator, dial of the dial indicator and then this is stem. So this stem is used for fixing the dial indicator to the stand. Now this is a plunger and this is the carbide tip of the plunger or spindle. Now this is the stand of dial indicator and this is reference surface datum.

And now initially we should know what is the approximate thickness of the work piece and then we have to set the dial indicator for that the approximate size of the work piece is 10 millimetre and I am taking a slip gauge of 10 millimetre. I can see the slip gauge, this is a 10

mm slip gauge, I am putting it on the datum surface after cleaning and then now I have to set the dial to read 0.

Now it is reading 0 I just lift the spindle I will remove the slip gauge and then I will put the work piece, that is suppose the thickness of this work piece is to be measured and keeping that on the datum surface. Now have to take the reading. So now when we lift the spindle it moves in the clockwise direction ok. Now when we keep this work is now the dial indicator reading is the resolution is 0.01 mm.

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So the dial indicator reading is 0.2, 0.4, 0.5, 0.588 of 0.59. So the size of the work piece is 159 millimetre greater than this slip gauge setting, that means slip gauge setting is 10 mm and size of the work piece is greater by an amount of 0.59 millimeter. So the thickness of this work piece is 10.59 millimetre, so like this we can use dial indicators as comparators.

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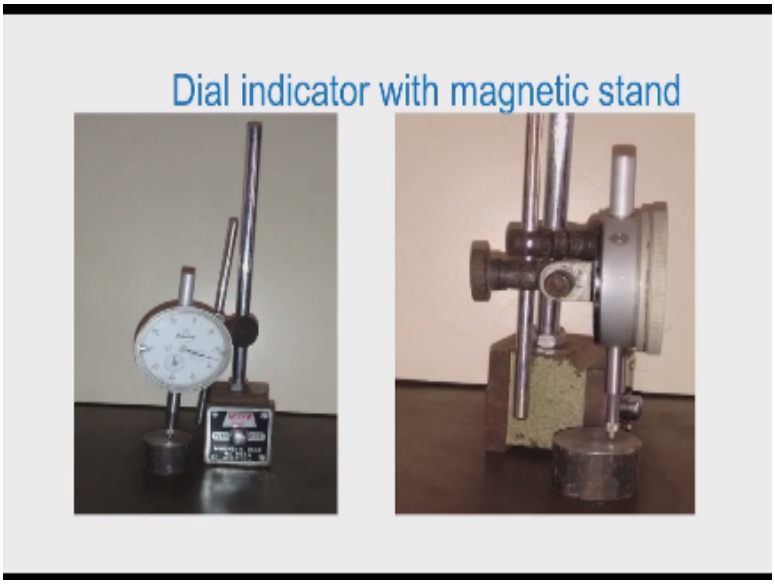

For direct quantitative measurement within the range for example dial indicator is having 0 to 10 millimetre, within that range we can use it, we use this instrument for direct measurement. So we can keep the work pieces below the plunger and between pleasure and the datum surface. The plunger will move up and it directly gives reading whether it is 2 millimeter or 5 millimeter or 8 millimeter.

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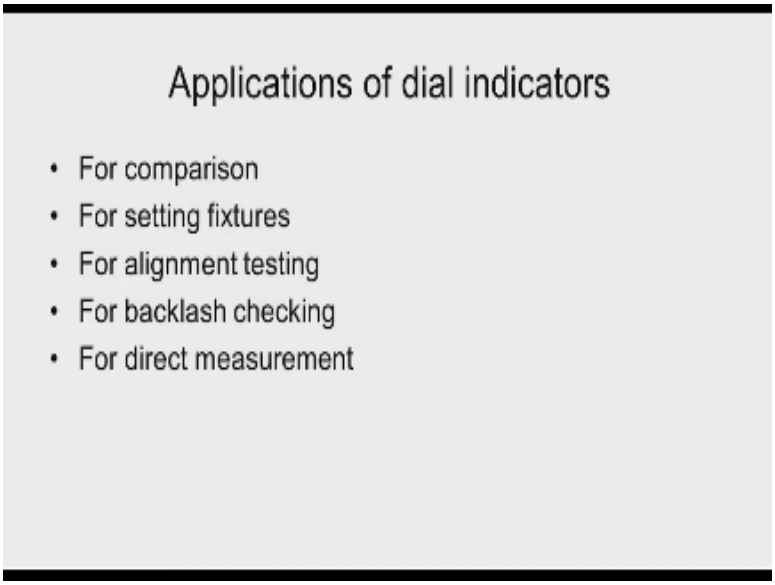

What are the various applications of dial indicators. So we discussed about this the can be used for comparison purposes, comparison of work pieces with the set the level and then this can be used for setting fixtures, so we want to set the Jigs And Fixtures on the machine. So whether it is properly fixed or whether that is properly aligned or not, checking that we can use this and also for some tests on various kinds of machine.

For example we want to check whether this slides various slides like (()) (12:41) parallel whether they have parallel movement with respect that is not there, of there is error what amount of error, and if there is run out the spindle of we can check using dial indicator. So for alignment testing we can use this dial indicator and also for backslash checking we can use dial indicators and also by direct measurement this can be used.

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Now we will move to dial test indictor with universal swivel. This is also known as lever type dial indicator, we can see we have dial here with the pointer we can have we see graduation. In this case graduations resolution is 0.01 mm and this is the lever of this indicator. This can be used for alignment purpose setting purpose or for comparison purpose. So one arrangement is shown here.

The slip gauge is required height is used for initial setting, this is set to 0, for example 40 minutes if they have kept and reading is adjusted to 0 and then get remove this and work pieces can be inserted and then readings can be read, in that case the height gauge scale will not be using only will be reading dial test indicator readings.

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Now this shows the another view of the dial test indicator. This is the carbide tipped stylus.

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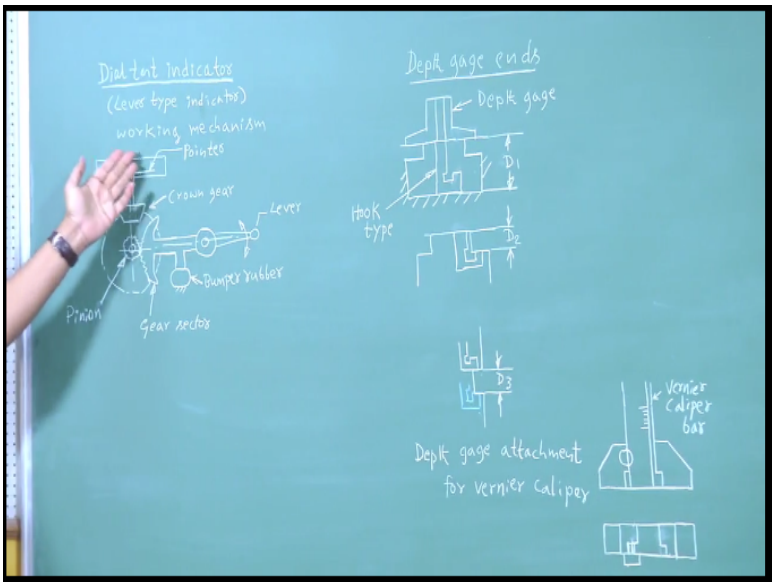

Now you can see here we have the day working mechanism of dial test indicator this is the lever which will move like this, so this will move to approximately some 30 degree, so this can set at any angle and then it can be still level like this that is why it is known as a universal swivel dial indicator and then this is the this lever is attached to the near sector and then this is in mesh with pinion.

So when the lever moves like this or tilt like this, this gear sector will move and then pinion will rotate. So this pinion is fixed to the crown gear pair. So the to this smaller crown gear will rotate like this and which is fixed to the pointer and pointer will move and dial and then

we can take the reading. So this is the working mechanism of dial test indicator, and we can also see there is bumper rubber.

Bumper made out of rubber, in case it is most beyond the limit, so this lever will come and hit the bumper rubber bumper and prevent damage to the internal mechanism, so when we use these dial test indicator the angle between the work piece surface and lever plays a major role, we should always see that we should always try to minimise the angle between the lever and the work piece surface.

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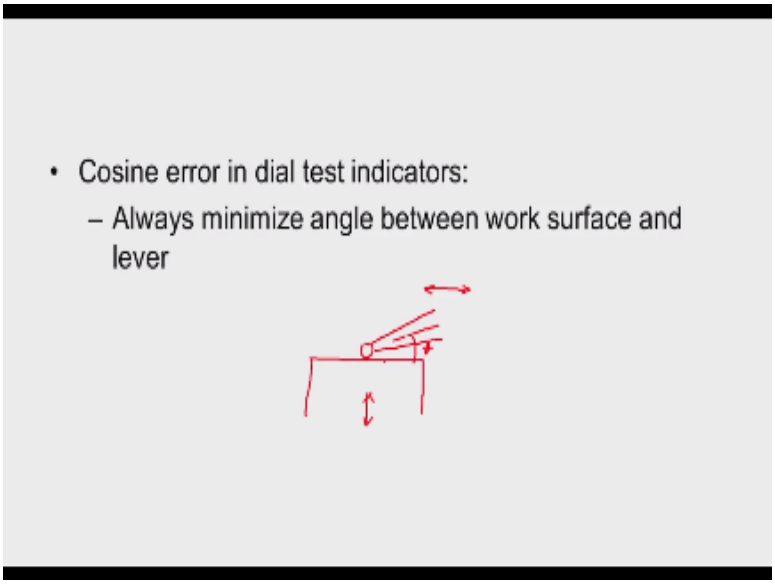

Otherwise the cosine errors will happen, so that can be seen like this, we have the work piece surface and then we have this ball and lever. So this is the access, this is the angle inclination theta. Now we always see where the work piece will be moving like this, so we can insert the different work pieces. So this will be the moment of the lever one and we can also move the dial test indicator in this fashion.

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So whatever movement of indicator or work piece we should see that this angle is always minimum, so that cosine error effect is minimised. Now moving to the digital indicators, now this shows indicator and different functions are available on, off function and then hold function, so and then the selection between the English system or metric system. All this things are possible.

And then the data transmission data transfer is possible using Rs232C for transmitting data to computer for statistical process control and then we can see here this is the stand dial indicator stand and the digital indicator digital indicator is fixed to the stand and then we can keep the work pieces here for measurement purpose. We can see this stand is very robust.

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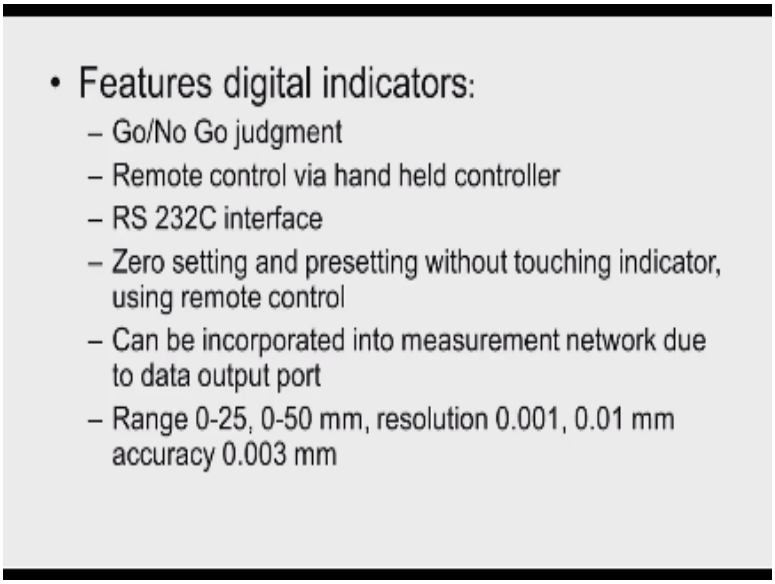

Now what are the features of digital indicators. Now we can set the tolerance limits using that tolerance option and go and nogo judgement is possible. That means when the digital indicator used for checking the work pieces, if the dimension is within the limits it will say work piece can be accepted by way of displaying the green colour. If the work piece dimension is outside the limit tolerance limit it that will be indicated by colour red colour by the indicator.

And other important and very interesting feature is remote control by a handheld controller. The dial indicator maybe at any place maybe 1 m or 3 meter, so that can be controlled by using remote controller, we need not have to go to near the indicator and will not have to physically touch the indicator for fitting purpose and RS 232C interface is possible, since remote control is possible or 0 setting and presetting without touching indicator is possible.

See normally what happens if there is not control option is not there for setting we have to go near the instrument and physically we have to touch the body of the indicator and we have to adjust the indicators. So during that time the setting may change, when we are doing the measurements of very very big size and maybe micron level measurement. In that case that setting the also we should maintain.

So we physically touch the indicator the setting may get disturbed. So our measurement there may be some error in the measurement. Since this remote control is available can always use for very very accurate and precise measurement is required and these digital indicator incorporated in the measurement network maybe there are two 100 to 1000 thousands of instruments are there.

All the data can be sent to the host computer for analysis purpose and these instruments can be networked into such an arrangement and there are available in various ranges like 0-25 and 0-50 millimetre, longer ranges are also possible with resolution of 0.001 mm, 0.01 mm, with an accuracy measurement accuracy of 0.03 mm.

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Now these are digital thickness gauges, so we can see there is a angle and spindle and this will show the reading and there is vernier there is no directly gives digital display to lift the plunger and to insert a work piece we have the plunger lifting arrangement, we have to hold this instrument and then using our thumb we can pull this. So that plunger moves up and then we can insert the work piece here.,

And then we have to release this lever and then the dial indicator can be directly taken and there are various kinds of spindles and angles interchangeable angles and spindles are available for various applications. Now the graduation it can be 0.01 or 0.001 mm and range is 0 to 10 mm, 0 to 12 mm available and these two pictures show dial type sheet metal thickness gauge.

Again we have a lever here, we have to hold this body in our hand and then we have to pull this, and then we have to pull this, and then we have to insert the work piece here, and this directly give the reading. So in this case the graduation is 0.1 milometer and range is 0 to 10 millimetre.

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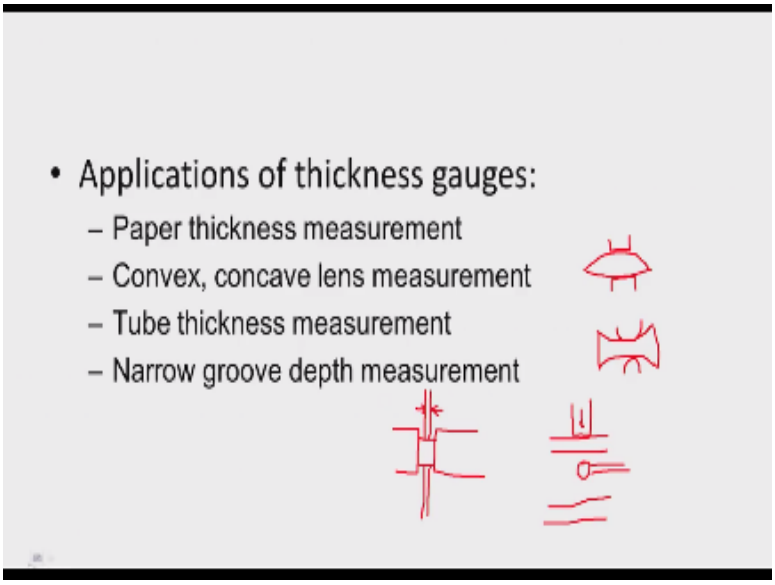

And what are the various applications of thickness gauge, so you can be used for paper thickness measurement, see in that case we can use a very short range thickness gauges like 0-5 millimetre thickness or 0-2 millimetre thickness range, as such narrow range gauges are available. So we can also use thickness gauges for measuring the convex lenses and concave lenses. In such cases interchangeable angles and spindles will be of much use.

For example say we want to measure the convex lens like this, so in that case we can use both flat angle and flat spindle. But when we want to measure a concave lens, so we have a concave lens like this in that case we cannot use a flat angle and flat plunger. So there will be error. So spherical type or ball type plunger and ball type angles are available. So such things can be used.

Also this can be used for tube thickness measurement, for example we have the flat plunger and then we can use the ball type angle like this and then tube can be inserted here. I am inserting the tube and then we have to move the plunger down and then this will make contact and then we can directly take the reading and then narrow groove measurement is also possible, say we have a very narrow groove like this say 2 millimeter or 2.5 millimeter groove.

So in such cases we have to use a blade type plunger and angle, so which will comfortably going to the narrow groove. So blade type plunger and angle is available with thickness of 0.75 millimeter, 1 millimeter, 1.5 millimeter like that, so appropriate blade we have to select and can be used for thickness and measurement.

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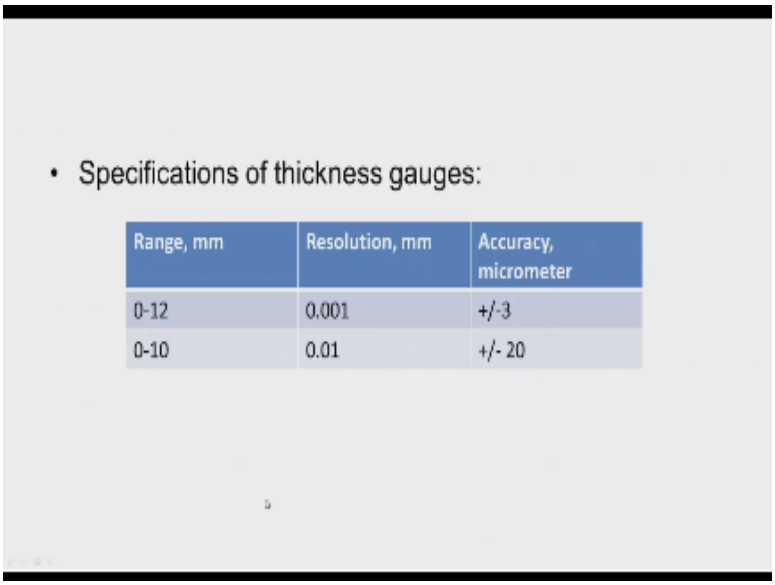

Now what are the specifications of thickness gauge, they are available in various ranges like 0-12 millimetre range, 0-10 millimetre range and then the resolutions of 0.00001 mm, 0.001 mm and then they can offer the accuracy of +/-3 microns, +/-20 microns, so depending upon our requirement we can select the instrument and use it.

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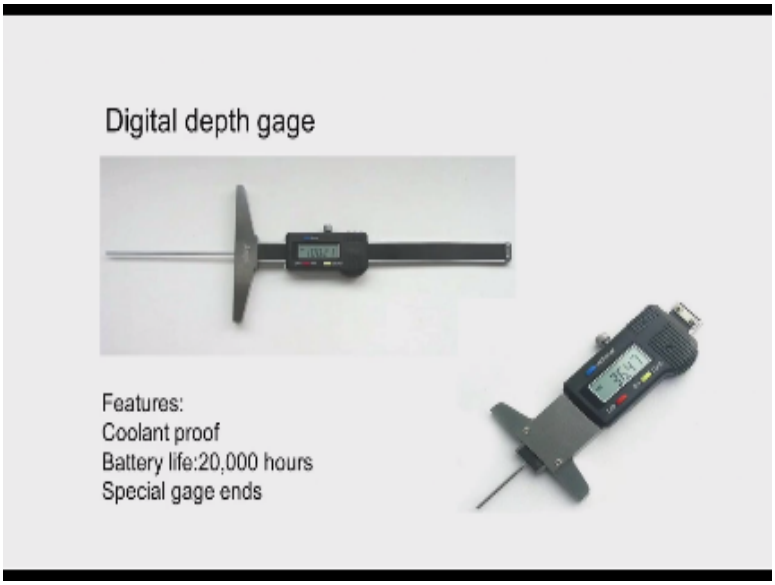

And then now we will move to digital depth gauge, digital depth gauges gets very excellent features are available, coolant proof digital depth gauge are available which can be used in very harsh machine shop environment and different rangers and different resolutions are possible and they are fitted with battery and battery life will be like 20000 hours continuously we can use.

And recently solar type digital depth gauges are also available and so the where to put this moving rod with this the measuring rod.

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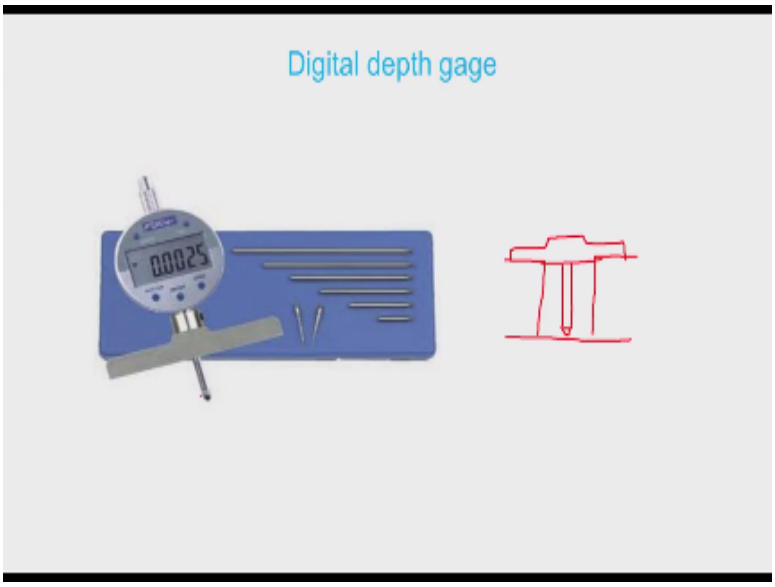

So this is the work piece and then we have to take this digital depth gauges and we have to keep like this and then this rod will where to make the rod to move in and then that carbide tip will contact the bottom and then this indicator will directly give the reading and then an extended rods are also available depending on the depth of hole or the height of the work pieces can select appropriate tension rods and then we can fit them and we can use them.

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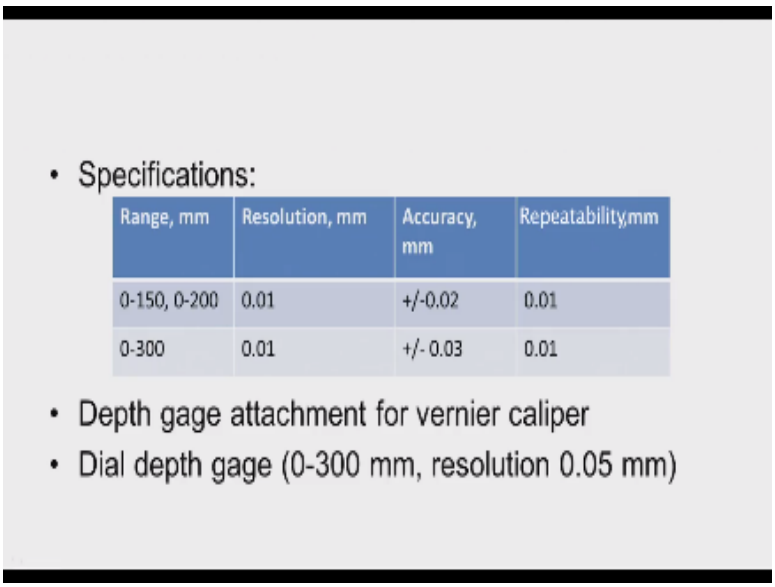

Now various kinds of depth gauges digital depth gauges are available with the range of 0 to 150 mm, 0 to 200 mm and 0 to 300 mm also available with resolution of 0.01 mm and accuracy of +/-0.02 mm, 0-0.03 mm and they can offer a repeatability of 0.01 mm and

repeatability of 0.01 mm and then they have very good accuracy of +/-0.02 mm and for this particular range is +/-0.03 mm.

Now depth gauge attachment for vernier, so some attachments are also available now we can see that sketch of death gauge attachment. Now we can see here depth gauge ends with different kinds of ends are available. Now this is a type then this is road of depth gauge and it is shaped like this type shape is there. Now we say we have a hole of this shape in the work piece.

Now I want to measure total depth, so that is possible even with ordinary dial depth gauge or vernier caliper we can measure this. Now I want to know this thickness, so this is not possible with ordinary depth gauges, so there this foot type depth gauge will be of much use, now I can see that we have to move this depth gauge towards this end and then we have to lift this end. So that this end comes in contact with the work piece undersurface inside surface.

And then we can directly read this depth and sometimes will be having a projection in the workplace like this I want a get this a dimension D3. If it is outside surface we can use that the other instruments like Vernier caliper and micrometre. But now this is inside the projection is inside the deep hole. So in such cases this hooked hook and will be of much you can see here to take reading yet this surface of the hook will be in contact with the surface we have to take the reading.

And then it is more like this then again where to increase the death and then now this upper surface will come in contact with the bottom surface of that projection. So again where to take the reading and its difference gives the thickness D3. So like this we can have different kinds of ends dependable on the application and then we can use. Now for ordinary Vernier caliper dial type depth guess we can have the attachment.

That gauge attachment for Vernier caliper. Now we can see here the Vernier caliper can be inserted there is a slot here or groove here, so through that we can insert and then there is a screw you can clamp it and then we can use that complete assembly for depth measurement purpose, by using this attachment to the caliper we can comfortably measure the depths and also the dialled types depth gauges are available with range of 0 to 300 millimeter and resolution of 0.05 millimeter.

So depends upon our requirement we can say either vernier type depth gauge or dial type depth gauge or digital depth gauge. So before we select instrument we should make a survey of the instruments, the economic aspect of that and what are the various features, whether the coolant proof type is required or not, so such things we have to what is the accuracy that is needed.

What us the resolution that is needed, what kind of repeatability is expected, so all such things we have to see before making a selection.

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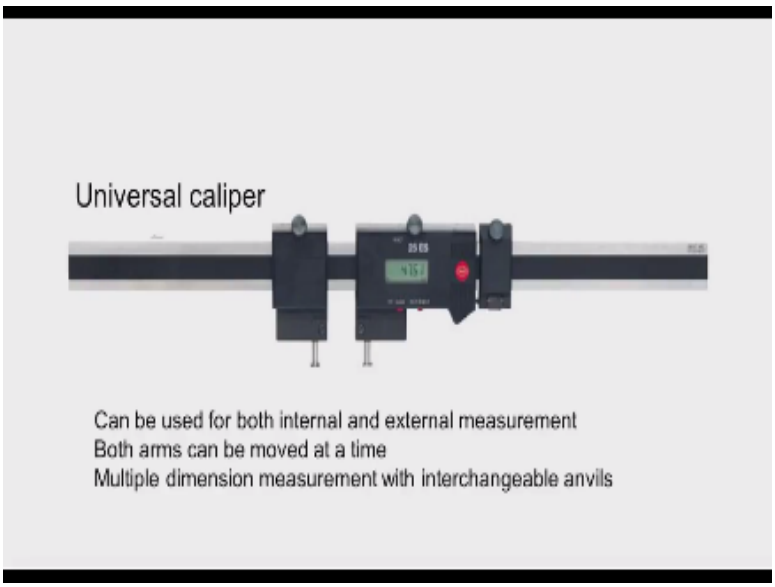

Now they will move to a special type of caliper we have studied Vernier caliper and different types of calipers, inside calipers like that. This is a very special university caliper where in we have the bar, ok this is the main bar of the instrument on which we have measuring heads. This is the one hand and his other and digital measuring head and this is a second handle.

In the case of ordinary mechanical type one vernier caliper what happens is there is one fixed joint another moving jaws, whereas here both these RM jaws can be made at a time. So this can be moved in this fashion like this. So this can be move like this and this can also be moved. Now you can keep the peace between these two and we can take the reading. Now multiple dimension measurement with things all these anvils can be the set of anvils are available.

Depending upon the application we can have we can change this anvils and we can use it for example for the measurement of thickness. For example we say we have a work piece like this and we want to measure the thickness. So in that case we can use 2 flat type anvils and say we want it tube or a pipe then one can be flat and one can be a ball type or round this type like this type this type ends.

So when we have both this type ends, so that can be used for measurement of thickness and as well as for measurement of pipe also we can measure, is the pipe and this can be more than that will make contact you and thickness can be measured and then the internal dimension measurement is also possible and centre distance are the distance between two holes. So that centre distance can be measured and then the distance from edge of the work piece to the centre of the hole.

So that is also possible one the anvil can be like a spherical anvil and another can be conical like this. So we have to fix this spherical type here and anvil type here and then using this combination we can find the edge to centre of hole distance. Similarly if they have two hole and we want the distance between this centre and this center. In that case they both conical type we should use.

So it will give directly the centre distance, so like this various kinds of measurements are possible and their available with a wide range of you mean wide range is like 0 to 150 mm, 0 to 300 mm with resolution of 0.01, 0.001 with an accuracy of 2 microns, 3 microns. So depending upon our requirement we can select this type of instrument, all functions like hold function, on, off function and then conversion from inch to mm.

Selection of inch system and mm selection and then they are data transfer possibility like RS 232C all such things available in this universe caliper. Now we will conclude this session. In this session we have studies about different kinds of dial indicator digital, dial indicators, then dial type dial indicators with varied range, varied resolution, selectable resolution.

And then we study about lever type dial indicator dial test indicator we also studied about thickness gauges and what are the features of thickness gauges and then what are the various applications of dial indicator. We also discussed about universal caliper, what are the various features of universal caliper. So with this we will conclude this session, thank you.