Engineering Metrology

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Lecture – 17
Laboratory demonstration, Thread gauge, spirit level

Good morning. Welcome back to the laboratory demonstration section of the course Engineering Metrology. So, the next instrument I will pick here is the Thread Gauge or Pitch Gauge.

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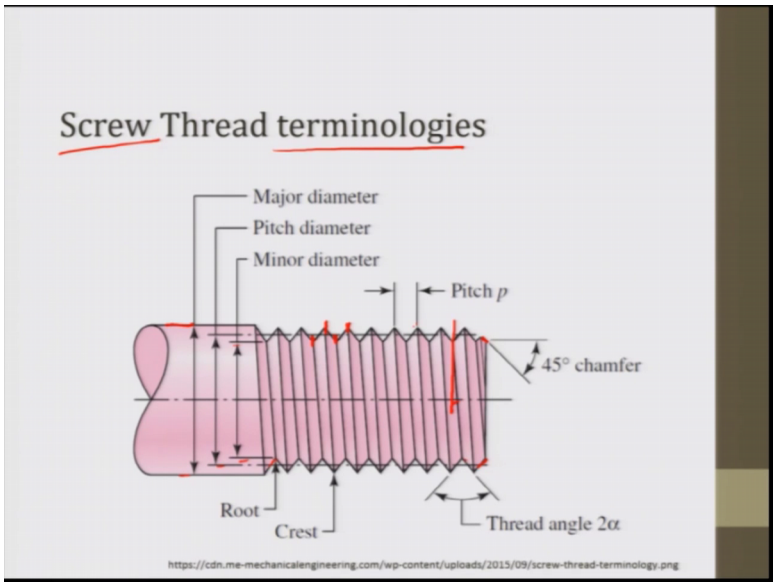

So, let us recall this screw thread terminology before I show you the actually tool here. So, this is the screw thread terminology. Here we have the major dia, the minor dia, the minimum dia and we have pitch diameter ok. So, there is root and crest, we have trough and crest.

The distance between the 2 roots or 2 crest is known as pitch. Pitch is actually with one rotation with the single start thread with one rotation, one complete rotation at that is 360 degree rotation, how much forward does our thread go? How much forward does our screw our nut go? Ok, that is our pitch. So, there is a angle here, this is known as chamfer angle at the end of the screw here we have the chamfer.

So, we have various angles here this is known as thread angle we have helix angle, this angle is helix angle ok. So, the this 2 alpha is our thread angle. So, the depth of thread is the distance between the crest and root. And major dias and imaginary largest dia of the thread, then the minor dias imaginary smallest dia; which dias is certical dia between the major and minor dia diameters. Then we have helix angle, it is on the straight thread it is the angle made by the helix of the thread with the pitch line it the it is not angle made helix angle is the angle on the straight thread which is made by the helix of the thread at the pitch line with the axis.

So, this is helix angle. So, this are various components next I come to my gauge, this screw gauge, this is our screw gauge.

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If I open it, you will see the various leaves here, which are very similar to the feeler gauge. But the difference is that the thickness of each leaf is same, but we have different profiles of threads here. I will like to correct myself it is different pitches, different pitches of the thread the profile is same it is actually a metric, it is metric thread gauge the metric thread gauge, we can have metric thread gauge, acme thread gauge, then whit worth thread gauge for all different kinds of thread we can have different thread gauges. And this is a metric thread gauge which is having range from 0.25 to 2.5 mm pitch. The smallest leaf here has the pitch 0.25 mm.

And the largest leaf is 2.5 mm. So, this feeler gauge or a the thread gauge this small gauge is which is a then instrument which is used for very quick measurement. So, very quick infancies, this feeler gauge can just tell us what is the gap. We can measure the gap in many other ways. Like, we can just use if the gap is larger we can use Vernier caliper or such another batchers could be there. We can measure the pitch of the thread using other metallurgical method, but the thread gauge is one instrument that will just give you quickly what is the pitch.

So, we can see I have a spark plug here on which I will apply this screw gauge. So, let me try to fit which of the leaf is fitting properly here. So, I know that this spark plug is having metric type of profile only. So, let me try this one, this size is.

Student: 1.1.

1.1 mm pitch. So, you can see that 1.1 mm is a little larger. This actually the pitch on the leaf of my set gauge is little larger.

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So, let us try 1 mm. It is looks like a good fit; it is fitted properly. To confirm it we will use the rule of go and no go gauges. So, it I think it is 1 mm, that pitch of this screw of this spark plug is 1 mm only. I will confirm it by using 0.9 mm also.

You can see the 0.9 mm is a little smaller. So, 1 mm is the proper pitch here. So, the screw gauge is also sometime known as screw gauge wherever the micro meter; is also

known as screw gauge, it is also known as pitch gauge. So, it is used to measure the pitch or lead of any screw thread. So, the thread pitch gauges are used as a reference tool in determining the pitch of a thread that is on the screw or in the taper hole. It may be used to measure the internal or external threads, both whatever we desire.

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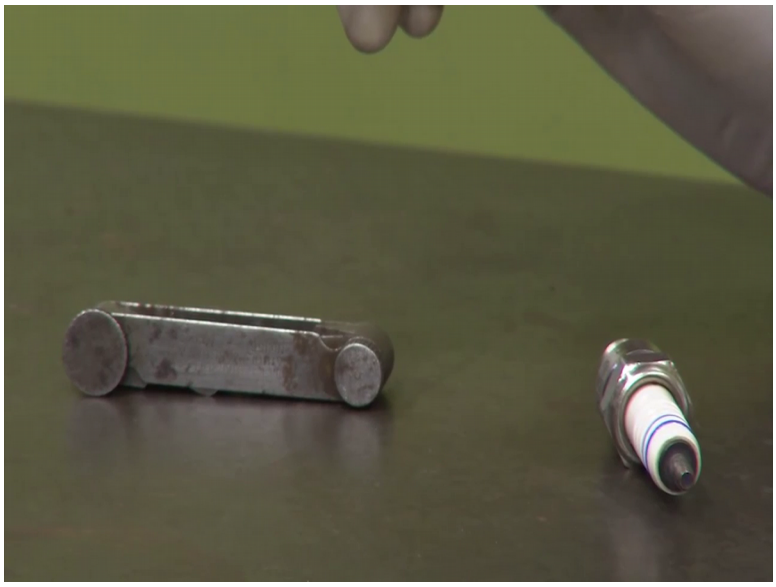

So, this is one of the instruments that we select it to show you.

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So, next instrument I will pick here is spirit level. Spirit level is an instrument or else it is a simple level or an instrument that is used to see whether a surfaces are horizontal or

vertical, or is there any difference in the level or not; which is used by carpenters, masons or the for checking the bricklayer brick line, that is the wall getting straighten or not, we can you might have seen that. And in mechanical metrological lab it is also used sometimes.

So, this spirit level that we have here is a 12-inch spirit level. The length is 12 inch; it is having various components. It has a bubble in the voile. This whole component is known as voile; this cylinder, in which we have this bubble.

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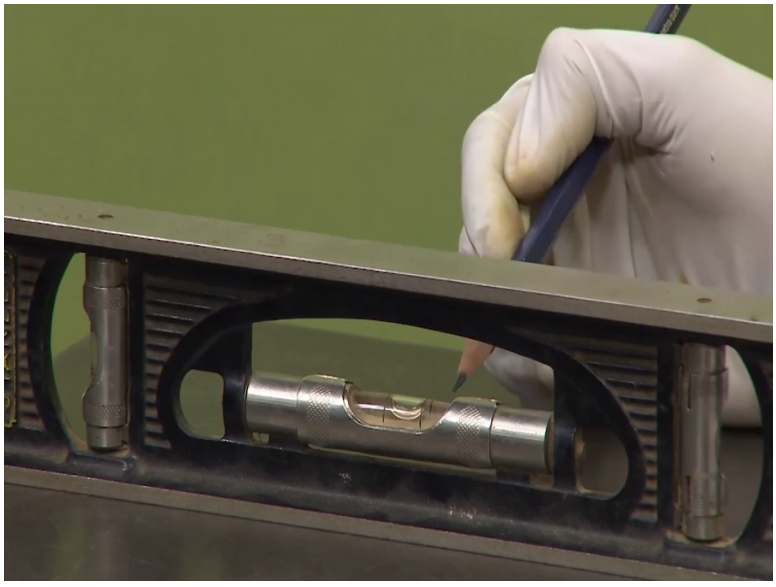

And in this we have a viscous fluid. This fluid is generally some and ethanol, something anything that is colored ok. It is a fluid that is low viscosity fluid, and it generally some alcohol like ethanol.

So, it is colored so, as one can clearly see that the is the bubble is the bubble in the center or not. So, this spirit level is sensitive to the temperature. It sensitive to the temperature is from minus 20 degree to 60 degree centigrades. So, it is minus 20 degree to 60 degree centigrade. Actually this fluid, fluid is also known as spirit. That is why it is known as spirit level.

So, it is colored and also a lumination reflector is kept behind the voile. So, as the observer can clearly see, clearly see or light it illuminates and it can be clearly seen. So, the spirit level has a small principle in it is suppression, see when we move it. When we

move it you can see the bubble is changing it is position. And also the 2 voiles for the vertical level as well 2 voiles to see the vertical level as well.

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So, it is calibrated based on this surface and this surface. So, actually this specific instrument is calibrated for both the surfaces, in general spirit level is calibrated based on only one surface. And if it is this surface, or which is the reference surface based on which it is it is calibrated, it has to be always used based on the surface and often. Instance if I need to see a level from the bottom side. And this is not the calibration this is not the reference surface, it wouldn't be a good practice to use like this. If I need to see at the bottom side because this is the reference surface, we have to turn it upside down, and this reference surface as to be touched with the base to see the spirit level ok. So, there is a principle for a voile, actually the voile is not always is not a straight surrender. The voile is little convex in the shape.

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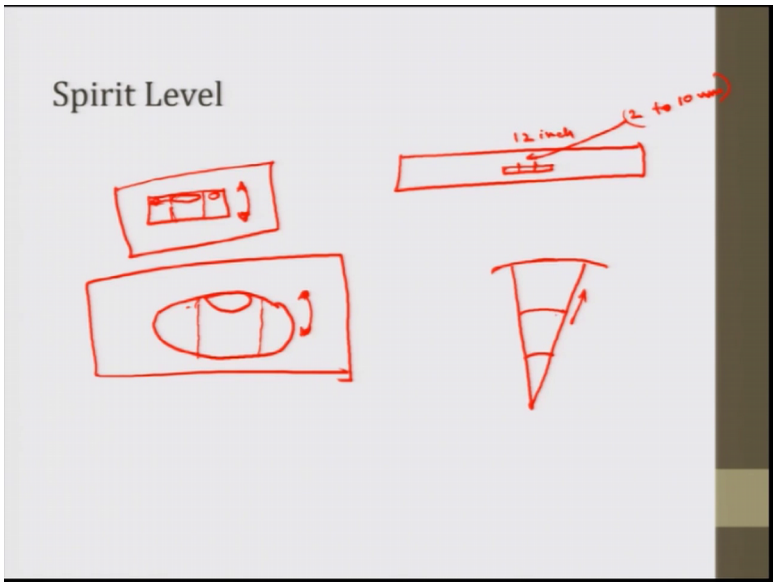

So, if I draw this as my sprit level this is 12 inch, and this voile the distance between the 2 lines, you can see the 2 markings are there, 2 black lines are there on the voile. You can see closely that there 2 black lines ok. The bubble has to remain within this black lines, there is not has to be any parallax error. So, let me make it very parallel to the camera ok. Now you can see the bubble is exactly in the 2 lines ok.

So, because of the parallax error it was it looked like that it was not aligned properly ok. It look like it is aligned on little this side, this direction ok, but if I make it parallel to the camera on the straight perpendicular to the camera. It is touching properly. That is, made that made a surface plate is properly grounded or not properly grounded is actually straight or parallel to the ground. So, this markings are generally from 2 to 10 mm. Now, the voile is not a straight cylinder like this, there markings here. And there is a bubble here, if it is a stationed you know if we tilts like this on this, the bubble wouldn't find a space to stay here. It would just keep on moving here and there. So, the shape of the voile is something like this. It is a kind of an oval shape, and the bubble would always try to find the stable space.

So, when you move it up and down, not up and down when you tilt it actually at some angle, the bubble would change it is position, but when it is at a level when it is parallel bubble will stay at this position; however, it is not sure, if it had been straight surrender, it is it wouldn't be share it would stay here or here over wherever it could go, the 2

markings here. So, the larger is the radius, means the bubble can move more easily and reacts to the smaller movements sensitivity more sensitively. You can take it to as a reference to the sel regiono, you know, if this is a center point. So, this is a center point and this is a circle here.

So, let me say this is another circle this another circle here. So, larger this radius the more sensitive is the spirit level.

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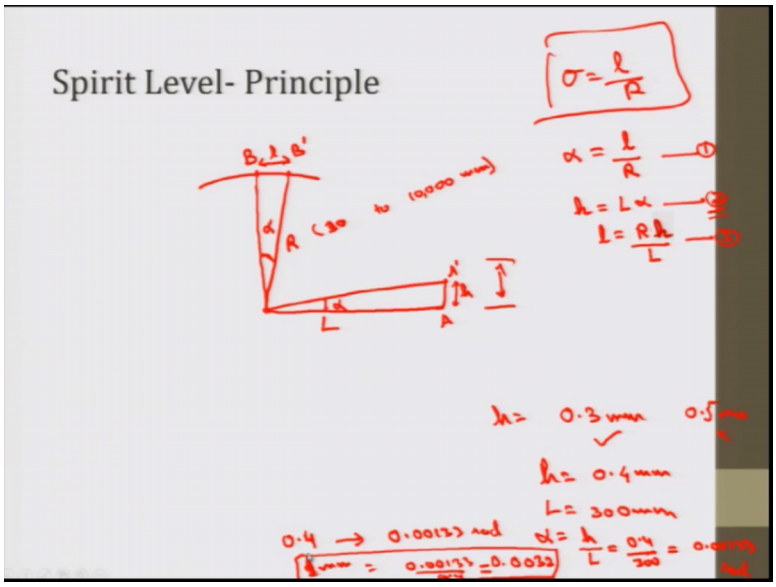

So, I can explain this using the principle of the spirit level here. So, what happens? If my bubble is here, this is my bubble ok. It changes it is position from B to B dash, and this changing position this length is l. And the radius of the voile is let me say R, this is center the radius is R. This angle is the angle that the 2 ends of the bubble 2 ends of the line make with the center of the circle. I call this angle as alpha.

Now, what happens? When a spirit level is parallel to the ground here, there is movement. If I make some movement, let me say this movement is alpha actually this movement is because of this alpha is same because this line is perpendicular to the base. So, whenever it is moved at an angle alpha, the bubble will move an equivalent angle, when I moved at some angle the bubble will also make the same angle with the center of the voile. So, this angle alpha and this angle with the base this is same.

So, this angle, this angle that is angle at which the spirit l is level is tilted if I tilt it like this ok. I will keep my pencil stationary I make it straight ok. This angle alpha and this angle that the bubble makes with the center of the voile, this angle is same. This alpha ok, with the center line and this alpha this spirit level. Based on this principle the spirit level works, and this if this is line l and it changes at any point let me say at the end it changes it is position from A to A dash. And this height is h, you know that theta equal to l by R ok.

The arc length, this is an arc actually l is arc here, arc length is the is equal to a length or the movement by radius. Or this is the general formula. So, here the angle is alpha, this alpha is equal to l by R ok. This l is arc length, R is the radius. So, also we can see that h is equal to L into alpha. So, this makes l is equal to R h by capital L. So, this is equation 1 and this is equation 2. So, that derives the equation 3, with this we can find the sensitivity of the of our spirit level. The sensitivity can be in the of the order of seconds. So, it might be some seconds ok. So, the we can just see when does this bubble moves? So, as you know we had that wire, the dalf which we measured using venire caliper this wire the dia of the wire is 4 mm.

Let me try to put this wire on the end of the spirit level. So, it is put at the extreme end. So, do you find any movement in the bubble? So, has the bubble cross the marking? Yes, it has crossed. So, that means, this 4 mm is quite a large height to quite a large to make it move. So, the sensitivity is that at what point at what movement does the bubble starts moving? So, you know if I do make it small movement like this. I make a very small movement. It is not moving; it is not marking the line. So, I can check it using the feeler gauge as well.

So, this was the feeler gauge, we had various the measure set is 5 to 80, 5 by 100 to 80 by 100. So, the finite leaf here is 5 by 100. So, let me try to put this 5 by 100 leaf here at the end. Do you find the movement in the bubble? There is no movement, that is 5 by 100 mm, it does not moves. So, let me try to increase the thickness this one. So, this length I have put another leaf here. This is actually 25 by 100, this 0.25 it is still not moving, I will take it off.

So, let me try to put the thickest leaf, the coarsest leaf here, which is of the order of 80 by 100. 80 by 100 is 0.8, 80 by 100 ok, the coarsest leaf. Do you find any movement in the

bubble? Yes, the bubble has touched or, it is trying to cross the line here. It is trying to cross the line here.

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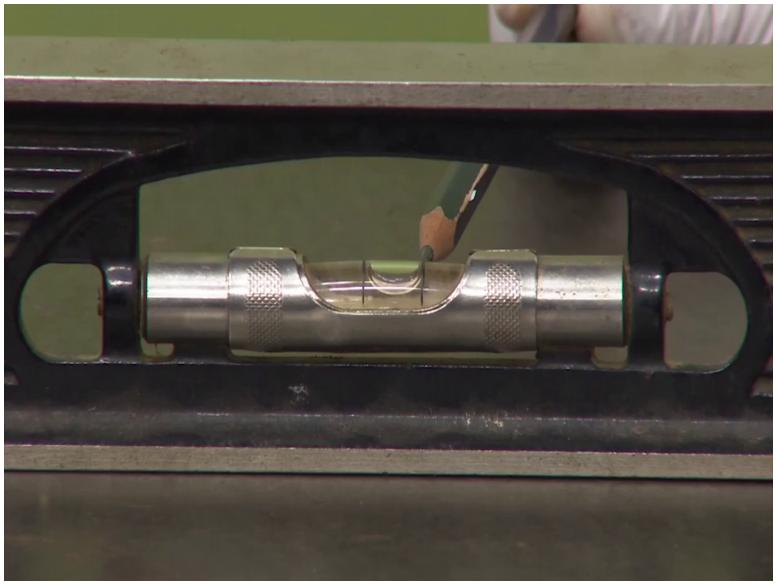

So, that means, 0.8 is not acceptable and 0.25 is acceptable. Let me try to pick some, I am just doing heat and trial method let me try to pick 0.5. 0.5 is ok; let me try to pick 0.5. 0.5 is it is not acceptable. It is making some movement here. So, let me try to pick 0.3 here. It is acceptable I suppose. So, 0.3 acceptable 0.3, sorry 0.3 ok, 0.3 acceptable 0.5 not acceptable, 0.4 leaf we do not have here.

So, we can find 0.3 mm, this movement this is length of h actually you know I am moving it up and down this height ok. 0.3 mm is acceptable and 0 0.5 mm is not acceptable. So, I can take an average 0.4 mm ok. Then h is equal to 0.4 mm. This length l is equal to 12 inches which is equal to 300 mm ok. Alpha value we haven't calculated ok. We can calculate alpha using the equation number 2.

We can calculate alpha is equal to h by L. Now this is 0.4 by 300 which is equal to 0.00133 radians ok. So, this much radians and this is alpha ok. The value of R, the value of R that is the center the curvature the curvature of the voile, this is the curvature of the voile, when it meets the center point that it meets this varies the so, the radius of curvature if this is the voile, this is the surface of the voile. The radius of curvature this R value that is given here, this varies from 30 to 10,000 mm.

Sometime the curvature is not; sometime it can be certain 100's of meters as well ok. I have just put it here 10 meters ok. It generally it varies like this ok. So, we can calculate the sensitivity while moving 0.4 or while 0-point mm movement it is the angle that is covered is 0.00133 radians ok. So, for 1 mm, for 1 mm movement the angle would be 0.0133 by 0.4. This would be equal to 0.0032.

So, this can be the kind of sensitivity of this instrument ok. Or this is not the exact calculation we have just made a hit and trail method. So, this sensitivity of the instrument can be calculated using this relation or this principle, or this is the spirit level. Another precautions of guidelines for spirit level is that, whenever we need to use this spirit level, we can check the level in this direction, and also we turn it 180 degree to check if that position of the bubble changes. So, this will tell us that is does spirit, this instrument properly calibrated or not. This was one thing.

Second thing I have thought you I always said that, if this is the reference surface, we need we cannot use this surface from the bottom. It has to be like this. So, we have to see that it is betweens the line properly. So, these are certain precautions we can so it can be used to mark a lines, vertices lines using this proper vertical lines ok. Vertical markings, and sometime a few voiles in the spirit level said 45 degree here.

Sometimes the voiles are also at 45 degree here. So, this 45-degree angle would let us to mark the 45 degree angle that lead. So, this is the use of the spirit level. This was the discussion about the spirit level that is one of the instruments that we discussed. So, I will take a break here and we will meet in the next part of a laboratory demonstration; where I will discuss another instrument.

Thank you.