Metrology
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Module-3
Lecture-7
Limit guage-2

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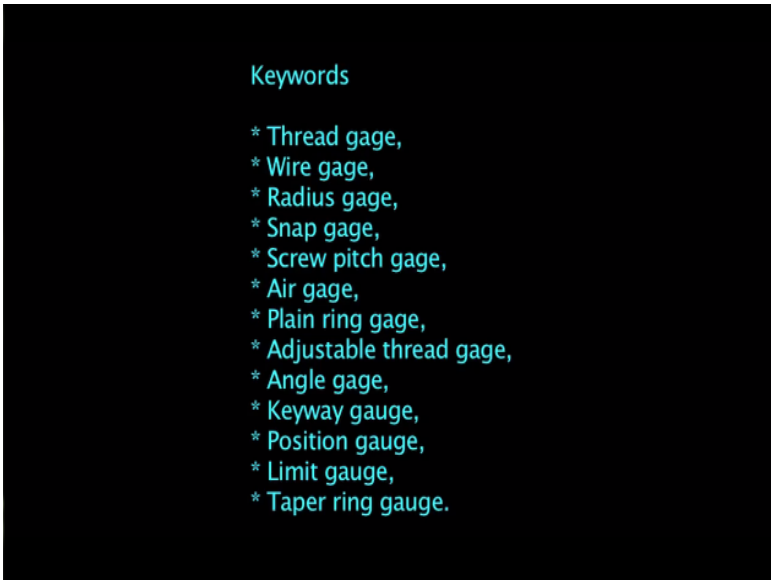

Welcome you for module3 lecture7 in the last lecture we started discussion on various kinds of limit gauges. We will continue the discussion now we have plain ring gauges see these ring gauges there used to check the shafts.

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That is the external features diameter the shaft if the external feature that is diameter of shaft is plain that means there are no threads. Then we use these kind of plain ring gauges now we can here normally there come in a pair one for go and other for NOGO limit. So, again the these are made as per IS:3455 of 1971 also one more standard that is followed is IS:3485 of 1983. So, all these gauges there made to the accuracy of IT 1 grade.

Now in these standard there mention wash should be the size of the outer portion and wash should be the thickness of these ring gauges. And it is necessary that we have to mention the size the basic size with the tolerance and then manufacturer details. All those things are to be mention as per these Indian Standard there available with different materials gauge materials if it is carbide, there available in this particular range 6 millimetre to 40 millimetre.

And in hardened steel there available from 6 to 100 millimetre and if the bigger size gauges ring gauges are needed that can be manufactured as per the customer requirement. Now we have this carbide ring gauge in a steel ring that means it will be like this so, we have this steel ring. And then inside we have carbide ring so, this is carbide ring outside is steel inside is this is only to save the material carbide is costly compared to steel.

So, the outer body is made out of steel and this gauging portion is made out of carbide, so the it becomes economical.

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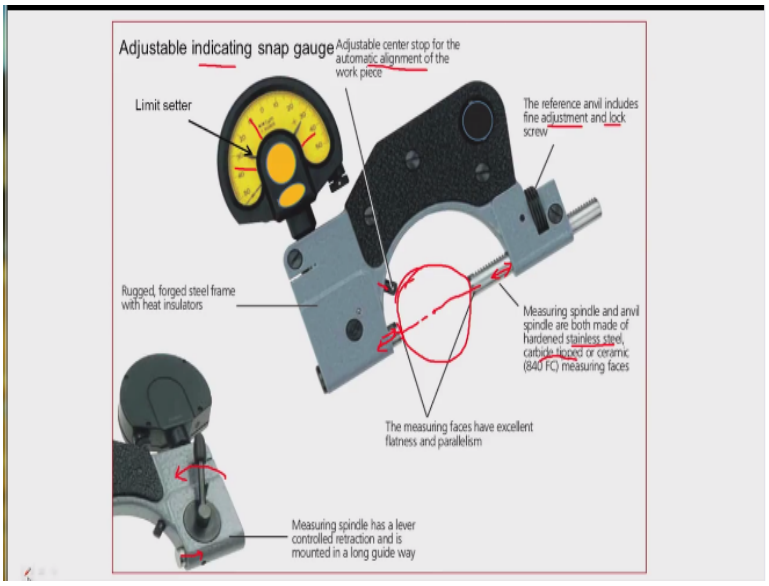

Now these are adjustable indicating snap gauge so, you can see here these are adjustable snap gauge reason is the distance between the measuring faces can be adjusted. And then indicating you can see here there is an indicator with limit sector 2 limits sectors are there. One can be set to lower limit and another one can be set to upper limit. And then when we use these adjustable indicating snap gauge.

When we insert the work piece here shaft here the pointer will move and if it is between the upper limit and lower these two limits. The work piece is accepted if it below the lower limit and above it moves after the upper this particular limit. Then the work piece is re-settled there are some special features in this adjustable indicating snap gauge the there is a lever. We can see here back side of this tool will have a lever.

So, when we operate this lever in this direction this spindle are the measuring face will move in that means this will move in and then we can inside the work piece. So, that it will come in contact with this anvil and the adjustable centre stop. And then we have to release this lever so that this moves in the reverse direction due to spring. And then it comes in contact with the work piece and then we can see the position of the pointer.

Then we can accept or reject depending upon the position of the pointer. Now this adjustable center stop is provided for automatic alignment of the work piece. So, that the center of the work piece is in line with this axis so, for that purpose this adjustable center stop is provided depending upon the work piece is this can be adjusted. And then we can adjust the range of this snap gauge by moving this anvil in and out.

We can see here there is lock there is a fine adjustment is provided here. The operating this, this can be moved in or moved out and then once the proper gap is fixed using slip gauges. This can be locked and then it can be waxed and these gauging surfaces there hardened if there stainless steel there hardened. And sometimes carbide tips are also provided.

So, that the service life will be more and another advantage is here the operator you need not have to push the work piece. You can withdraw this anvil and it can place it and if when we releases this lever the anvil moves and comes in contact. That means there is no wear of these surfaces, so the service life of the instrument is more.

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And then coming to the tapper gauges, this is a tapper ring gauge to check the tapper of work pieces, external tapper. So, this is the work piece, now we can observe here there is a step here okay. Now we have to insert the work piece into this boat tapper boat and then if the surface of

the work piece is between these 2 limits. So, this is top surface and this is the second one which is below this.

One corresponds to the go limit this is go limit and this is NOGO limit that means the work piece has an in between go limit and NOGO limit then the work piece is accepted.

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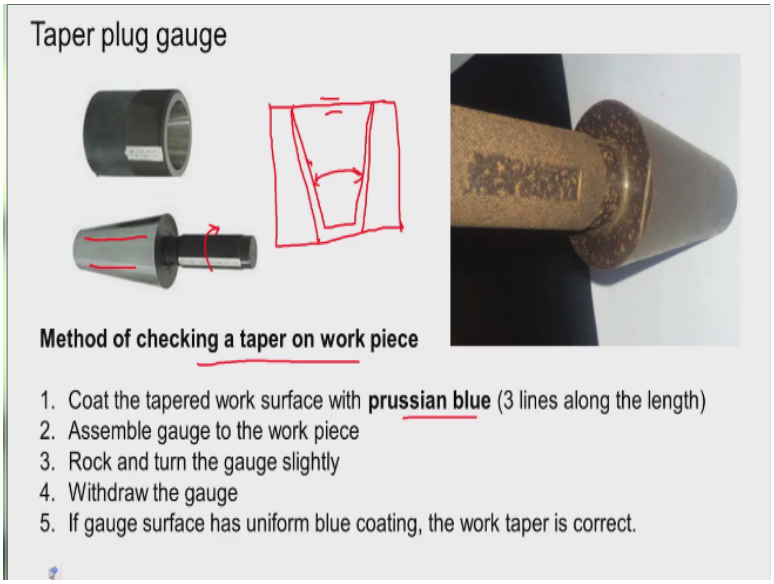

Now we have tapper plug gauge to check the internal tapper. So, in this tapper plug gauge also we can observe there is a step here. Now the tapered work piece is like this, this is the tapered work piece with the internal tapper and we have to insert this plug like this. Now if the surface of the work piece is between these 2 limits. So, this is go and this is NOGO as entered into the bore and NOGO as not entered.

If this is the case this work piece is okay. Sometimes instead of step they are tool nors will be provided and this is for go, this is for NOGO, go enters and NOGO does not enter then the work piece is accepted. So, one important thing in using these plug gauges is sometimes the see this is the work piece with the tapper and then they have the work piece like this. Now the tapper angle is more, tapper is more in the work piece.

But it is laying within the 2 steps, the tendency of the operator is we will simply accept reason is the work surface is between these 2 limits. But actually the tapper is not okay, so it is necessary

that we have to check the whether tapper is proper or not. So, for that there is a method of checking this indicates only the maximum size is okay, maximum diameter is okay that it does not guarantee whether tapper is okay or not.

So, for that there is a method of checking a tapper, so what operator will do, he will take the work piece and he will require 3 lines on the work piece using Prussian blue pigment, that means it will take that Prussian blue we will mark 1 line second line and third line on the other side. Equi distant lines are marked and then he has to insert that into the hole and then he has to rotate the gauge maybe for 1 or 2 turns and then he has to remove the gauge.

And then he should check whether there is uniform over note of the rubbing off of the line, if it is uniformly rubbed out then the tapper is okay. If it is not disturbed, the lines are not disturbed the lines are as it is without any rubbing off. Then it indicates that tapper is not okay.

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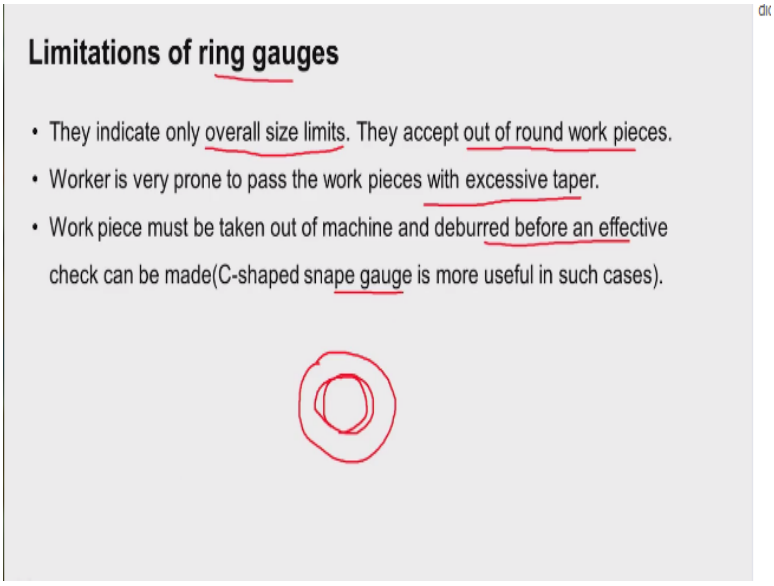

Now there are some limitations of using ring gauges. They indicate only overall size limits, they indicate the bigger diameter and minor diameter or okay. There is possibility of accepting the out of round work pieces. That means this is the work piece with the hole say there is some ovality in the work piece and we are inserting the gauge. So, now we can see this out of roundness cannot be detected by these ring gauges.

And worker is prone to pass the work pieces with excessive taper that means the checks whether the surface the work piece is within the limits. If it is u within the limit you will just accept without bothering about the taper. So, use of Prussian blue will be useful in checking the taper. And another thing is work piece must be taken out to the machine and should be deburred before an effective check can be made.

That means that work piece removed from the machine it should be clean and then you will take the ring gauge. And then you will try to enter it from one end so, time taken to gauge the work piece using ring type gauge is more where as if you use snap gauges see C-type snap gauge without removing the work piece. You can insert this snap gauge and you can check the size.

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Now coming to the thread plug gauges now you can see here these are used to check whether the threads of proper or not for checking the internal threads. We use that plug gauges and for checking the external threads we use ring thread gauges which will be discussing after a short bell. Now if you are double ended thread plug gauges, now you can see here this is go end of the thread plug gauges and this is no not go.

And you can see the length of the go gauge is more as compared to not go the reason is go gauge should fully enter into the work piece. And should check the maximum possible features like pitch and then pitch circle diameter and major diameter etc. whereas not go there not expected to

enter into the threaded hole. So, full form of thread is not provided only it some two three threads are provided other thing is as per the standard the all the details are mentioned here.

This is for metric thread 16 m16 and with pitch of 1.5 and this 6h indicates the tolerance that is provided. So, whenever there not use not in use, where to apply the protective coating like this. This is one more gauge with m10, 1.5 pitch with tolerance 6h and again we can see here the hole is provided. These are taper lock type so, whenever these gauges are we can remove them and we replace them.

This is thread roller gauge not C-type thread roller gauge one will be for go and another will be not go. And up to 30 millimetre interchangeable go and nogo thread plug gauges are **u** that means, whenever there were not we can replace them that is interchangeable go nogo gauge double ended. And 30 to 52millimetre reversible go no go that means some times this portion is used. And this is worn out in the case of reversible type.

So, the gauge is removed and then it is reversed and put into the handle so, there called reversible thread plug gauges. And over above 52 millimetre separate go and nogo gauges are used.

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And so we have adjustable thread gauges that means say the gauges the fixed type thread gauges if there worn out we cannot do anything. We have to remove them and that we use new gauges.

But here we have ring type adjustable thread gauge if there is some varying at the gauges we can adjust then and we can reuse them. So, once the adjustment is made again the screw is waxed so, that unauthorised adjustments are not carried out.

And this is ring type fixed thread gauge we can see this is go gauge and this is nogo gauge. This is for a particular case m10 1.5 and this is the tolerance that is provided. And this is the manufacturer detail again you can see there is a groove to indicate that this is nogo gauge.

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Now I am showing ring type thread gauges this is m10 1.5pitch go gauge and this one is m10 1.5 no gauge the tolerance limit tolerance that is provided on these gauges is 6g. Now we can see the length of the go gauge is more at the height of the go gauge is more. When compared to the NOGO gauge this is the work piece screw thread which is to be inspected. Now the go ring gauge should go into the work piece it should fully enter.

And NOGO gauge should not enter if that is the case the screw is accepted, now in the go thread gauges full form of threads are provided. And here full threads are not provided only 2, 2, 3 threads are provided the reason is you should not enter into the work piece. So, there is no necessity of providing full length of the thread gauge threads and full form of threads are also not required. This go gauge should check all the elements.

Most of the elements of the screw like pitch circle diameter pitch where as this will check whether PCD this is check only the pitch circle diameter of thread. Now we can see that there is a groove provided on the periphery of the NOGO gauge to indicate that this is NOGO gauge. The surface is melt to provide proper grip.

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Now I will show how to use the go gauge I am inserting the work piece into the go gauge.

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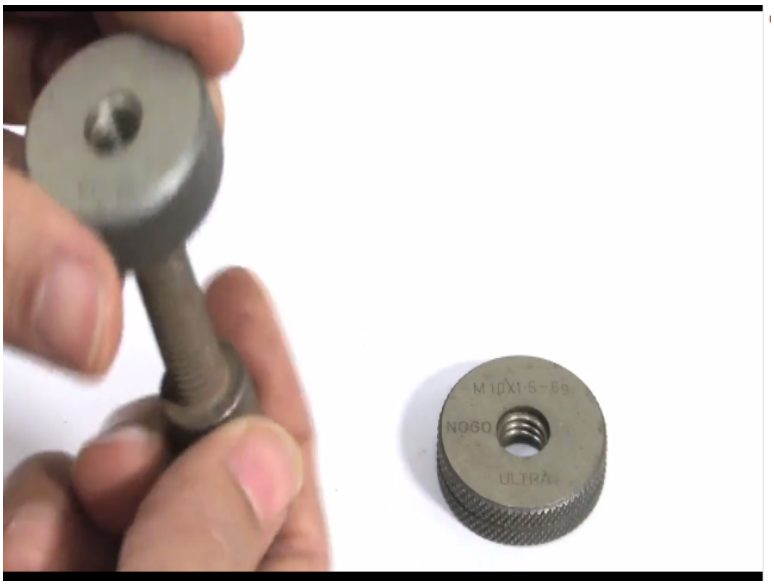

And I have turned the screw now I am rotating the screw you can see it is entering into the go gauge. So, go gauge as fully entered into the screw okay now I am removing it. Now I will use this NOGO gauge

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I am trying to insert the work piece screw into the NOGO gauge you can see it is not entering into the gauge so, go gauge entering into the work piece. And NOGO gauge is entering that means the screw is okay screw is acceptable.

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Now these are the special type of coated thread gauges there coated with titanium nitride coating is performed on such gauges. You can see the gold colour on the gauges, the they have some special this is double ended type this is single ended type. And this is again the gauge for a bigger diameter now what are the advantages of such TiN coated gauges.

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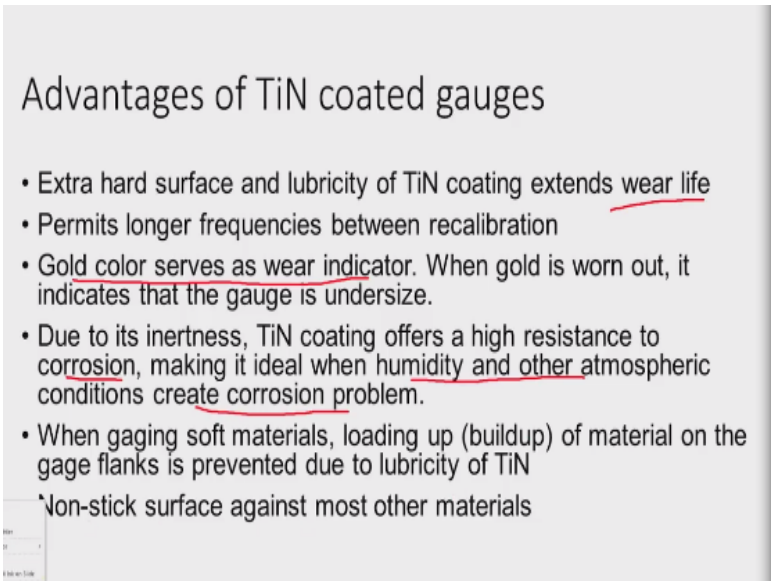

We can see here there are many advantages of TiN coated gauges so, TiN coating is extra hard surface and it has some lubricity lubricant properties are there. Because of that wear life is more so, it is service life of TiN coated gauges thread gauges are more. And the permit longer frequencies between recalibration because of the wear life extended wear life. And gold colour serves as wear indicator so, we with continuous usage of these TiN coated gauges.

What happens is that gold colour is faded out so, that indicates that the gauges are getting worn out. And then we have to replace then or we have to send them for recoating now due to inertness of the TiN they offer high resistance to corrosion, corrosion resistance is provided making them ideal for use when humidity and other atmospheric conditions create corrosion problems.

And when gaging soft materials loading up of material on the gage flank is prevented due to the lubricity of the TiN coating. And this TiN coating it is non-stick surface against most of the materials. Because of that build up problem is eliminated.

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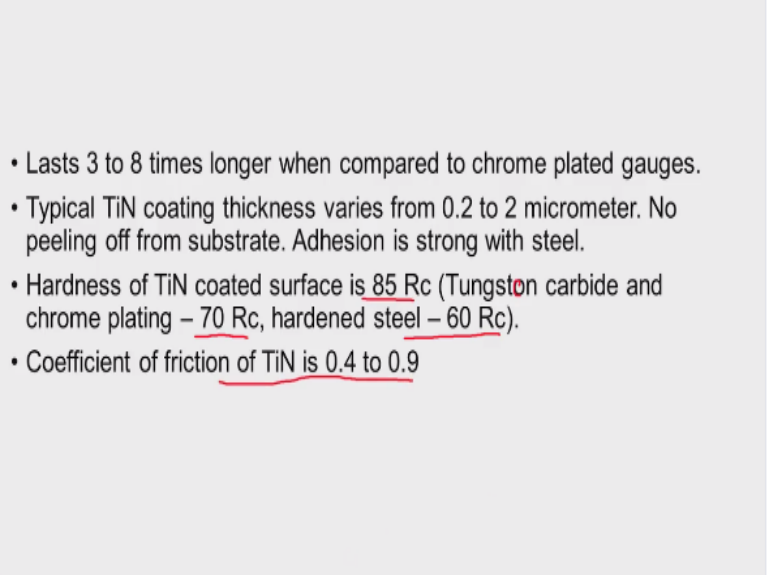

And then we have the life service life TiN coated thread gauges the last for 3 to 8 times longer when compared to chrome plated gauges. And typical TiN coating thickness varies from 0.2 to 2 micrometers since they coating thickness is very very less. There is no problem of peeling off and adhesion of TiN with steel is very good. And almost of TiN coated surface is 85 Rockwell c where as Tungston carbide and chrome plating chrome plated gauges.

In the tungsten and carbide chrome plating in that case the hardness is 70 Rockwell and if it is only hardened steel it is hardened steel is 60 Rockwell c where as the case off TiN it is higher 85 Rockwell c. And then coefficient of friction of for is very coating is very less o.4, 0.6 up to 0.9 so, because of that the wear is less.

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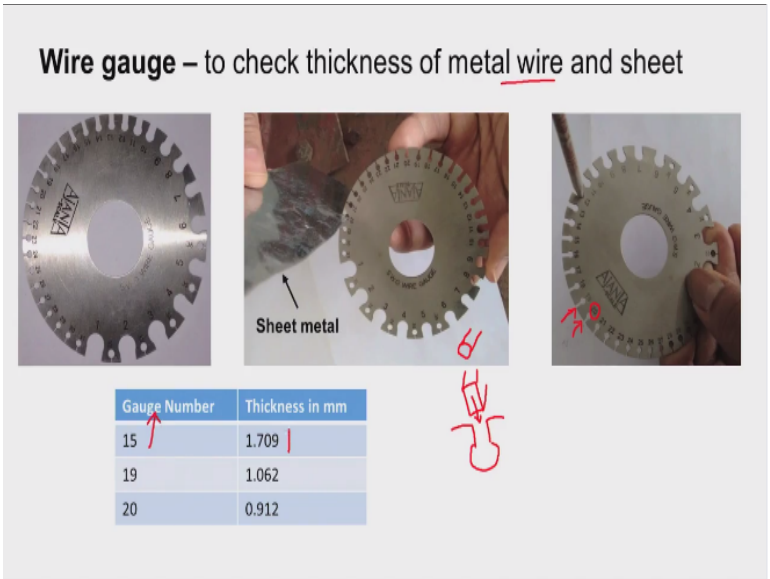

Now we will move to the wire gauge these are used to check the thickness of metal wire and metal sheets. We can see here this is wire gauge made out of hardened steel and the slots and the there made like this. Now we can see how these ware gauges are used they can be used to check the sheet metal thickness and then they can be used to check the thickness and diameter of the metallic wires now how to use this.

We have to take the work piece sheet metal and we have to insert front side we have to always insert say this is the slot, slot is like this. So, we have to take the sheet metal this is the sheet metal with some thickness so, we have to move the sheet metal in this direction. If it is rod like this we have to take the rod and we have to move in this direction. Now initially we have to take the sheet metal or rod and say.

We are trying to insert in this particular slot which is marked as 20 this indicates the gauge, gauge of this particular slot. Now say it enters now what we have to do we are to remove that sheet or rod and then we have to try to insert into the next hole marked 19 gauge. Now say it does not enter so what we have to do is see then it does not enter we have to take the previous number.

That is 20 in this case 20 as it gauge of that particular sheet metal or wire once we know the gauge during the conversional tables. We can we will come to know, the thickness of sheet metal,

or wire. If the gauge number is 20 the thickness is 0.912 millimetre if the gauge number is 19 it is 1.062 millimetre as the gauge number decreases the thickness increases.

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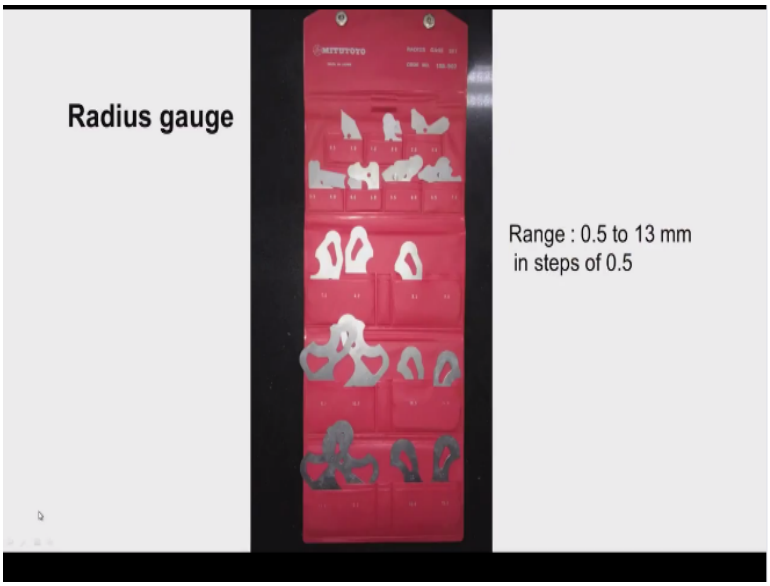

Now this a radius gauge plated radius gauge, there available in the range of 0.5 to 13 millimetre radius in steps of 0.5 millimetre. This is the sect of radius gauge

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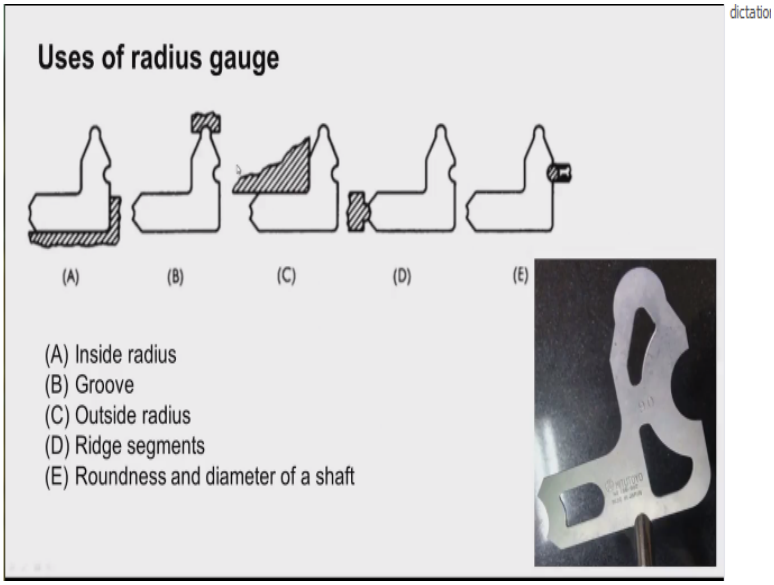

And what are the uses of radius they are mentioned here so, this radius particular radius gauge you can be used to check the inside radius this fill it. And then it can be used to check the groove radius and it can be used to check outside radius ridge segment and then roundness or diameter of the shafts.

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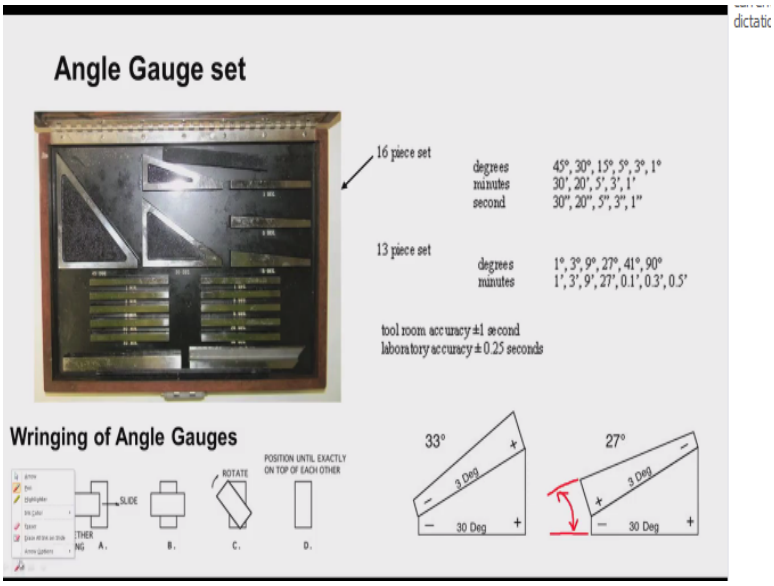

And this is the angle gauge set different types of sets are available this a set with 16 pieces. You can see here there are 6 angle gauges 45 degree gauge, 30 degree gauge, 15 degree gauge, 5 degree gauge 3 degree gauge, 1 degree gauge like that. In minutes 30 minute, 20 minutes up to 1 minute, in seconds 30 seconds up to 1 second. So, like this totally 16 piece set and 13 piece sets are also available.

And what is the accuracy of angle these angle gauges if it is tool room set the accuracy is +/–1 second. If it is laboratory type then accuracy is +/–0.25 seconds again similar to the slip gauges these angle gauges are ringed to assemble to the required angle. So, here an assembly shown here 30 degree is ringed with 3 degree to get 33 degrees. We can say + symbol is one side here it is in the reverse + is here and + is here in this particular.

So, 30–3 is 27 degrees so, this angle is 27 degrees like this to any required angle. We can assemble the gauges.

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Now we have spline gauges and serrations gauges you can see here this is a go type spline gauge and this is the NOGO type spline gauge full form of spline is provided and go gauge. And only two splines are provided and not go gauge so, this go gauge should check all the elements like width of the spline groove and height of this spline groove. All those things this will check where as not go will check only whether the spline width is proper or not.

And this picture shows how the spline gauges are used and this is the serration gauge to check the serrations the gauges are available for to check internal serrations as well as external serrations. So we should use in pair one for go and one for not go.

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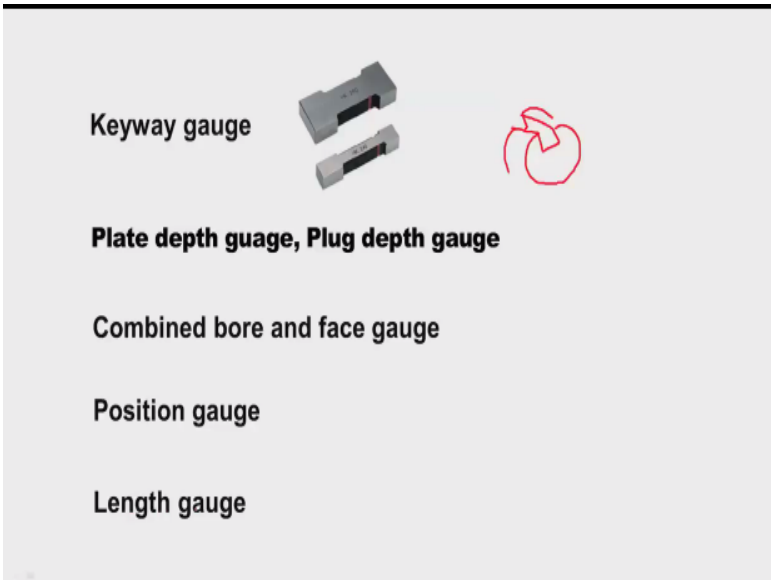

Now there are gauges like key way gauges used to check whether the key width is proper or not. For example see we have some shaft like this with the key way like this and we want to check whether this key width these okay or not. In such cases we can use this key way gauges so, one end will go which and other end not end will not go. If that is the case the key way is proper and there are different kinds of gauges like plate depth gauge.

And then combined bore, and face gauge, and then position gauge, and then length gauge, over to board.

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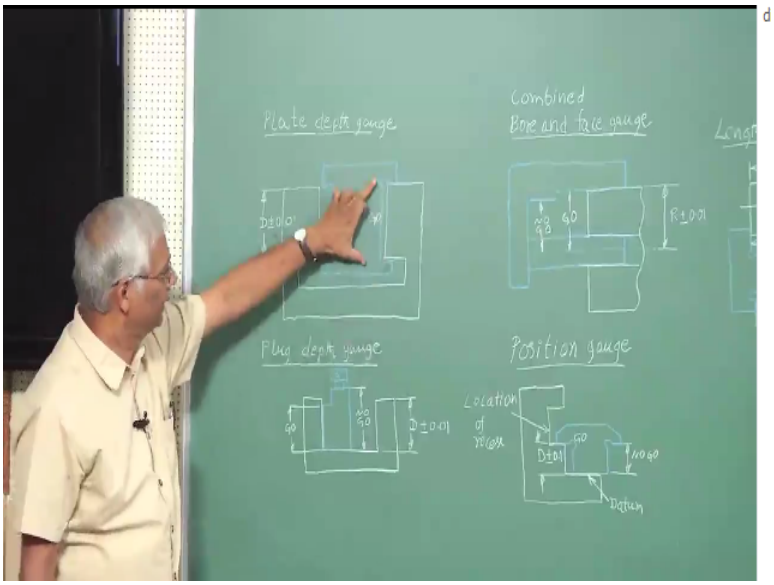

Now you can see this is a plate depth gauge and we have to check whether this particular depth is okay or not. There is certain dimension for this depth with some tolerance so, in that case we can use plate double gauges which is shown here. So, this is go side you should go into the work piece and NoGo side should not go. If that is the case the work piece is accepted similarly we have plug that gauge.

This is the plug again this depth is to be control with some dimension D with some tolerance so, this side is go side that should go into the depth. And NoGo surface should not go into that if that is the case then the work piece is acceptable and this is combined bored and face gauge now we need to control this size with respect to this axis. The radius is to be control with some tolerance so, in such cases we can use combined bore and face gauge.

This spindle will move into the bore and then you can see here there is a step here this portion should go and then this surface should not go. If that is the case then this work piece is accepted that means this go is equal to R+0.01. And this NoGo is equal to R-0.01 it is also check whether this particular surface is parallel to the axis or not. And this is a position gauge we have to control the location of the recess.

So, this is to the control with dimension D with certain tolerance + or – 0.01 millimetre in such cases we can use position gauge which looks this. This is the datum surface and this is the go side, go side should enter and NoGo should not enter. So, this is equal to go the upper limit and this is equal to lower limit.

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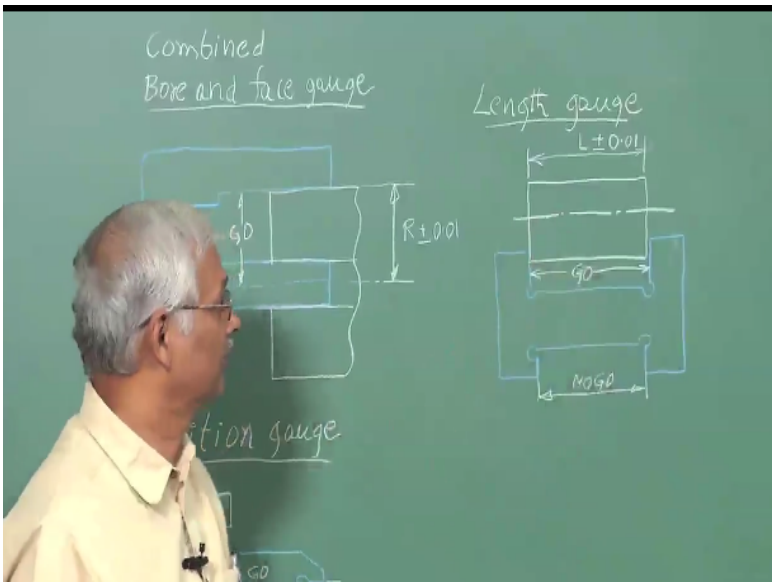

And then the in some cases we need to control the length of the work pieces so, in such cases this is the length L with +/-0.01 millimetre. This is to be control in such cases we use this length gauge so, this side it is go it should enter and this is NoGo this should not enter. If that is the case then work piece is accepted.

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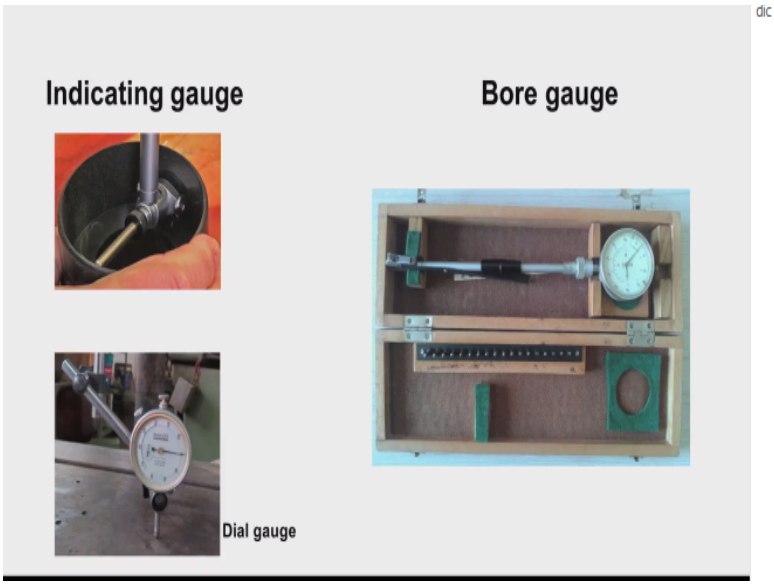

Now this is an indicating gauge example is bore gauge so, this is used to check whether the bore is within the two limits. The maximum limit and minimum limit that means using masters the two limits are fixed in the bore gauge. And then they can be used to check whether bore is okay acceptable or not an another example for indicating gauge is a dial indicator using slip gauge. We can adjust the two limits.

One slip gauge for lower limit and one slip gauge for upper limit and then we can note down what are the pointer locations for go and NoGo. And then we insert the work piece if the pointer is between the two limits then the work piece is accepted. So, like this dial indicator can be used as an indicating gauge.

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Now we will move to air gauge now in the conventional snap gauges plug gauges what happens is the work piece surface will come in contact with gauging surface of the gauge. So, because of that there is lot of friction is there, and then this surfaces are worn out. And they sizes will vary so, such problems will be there in the case of air gauge the gauge will not coming contact with work piece that means there is no frictional problems.

And there is no problem of wearing of the gauging surface that is the advantage of the air gauge. And we can also have way high magnification like 5000, 10000, 15000 magnifications are very small distances can be amplified are to 20000 times. And clean air is used for gauging purpose and this is an indicating type air gauge. You can see the pippings to supply the compressed air the pressure will be something like 2 bar 2 5 bar.

We have to use the all regulators pressure regulators filter etc... to clean the air, and then clean air is supplied here. And the air will enter into the gauging probes. We say probes and this is a snap type probe we can see here it looks like this. So, this is snap air probe so, air will enter like this and here will be nozzles. So, air will escape from here. So, when there is no work piece here there will be air will be freely flowing.

And will be certain position of this pointer when we keep the work piece here. Now air escapement is restricted so, the pointer position will change initially using masters we can said

two limits one for upper limit and one for lower limit. And then we can remove the work masters and we can use it for gauging the work pieces. So, depending upon the size if the work piece size is within the limit then the pointer will be within the two limits.

In such cases the work piece is accepted now this is advanced type of air gauge varying RS 232c facility is available. That means the variation of the work piece can be stored in the computer for statistical process control and this is a air plug gauge. And this is a air ring gauge inside will be pores and similarly here there will be outside there will be pore. This plug gauge is used to check the bores say.

We have a work piece like this with a bore and then this plug gauge can be inserted like this so, air will be moving like this it will be escaping from the nozzles. And then this instrument will give the reading whether the work piece is acceptable or not that the level will change depending upon the size of the work piece.

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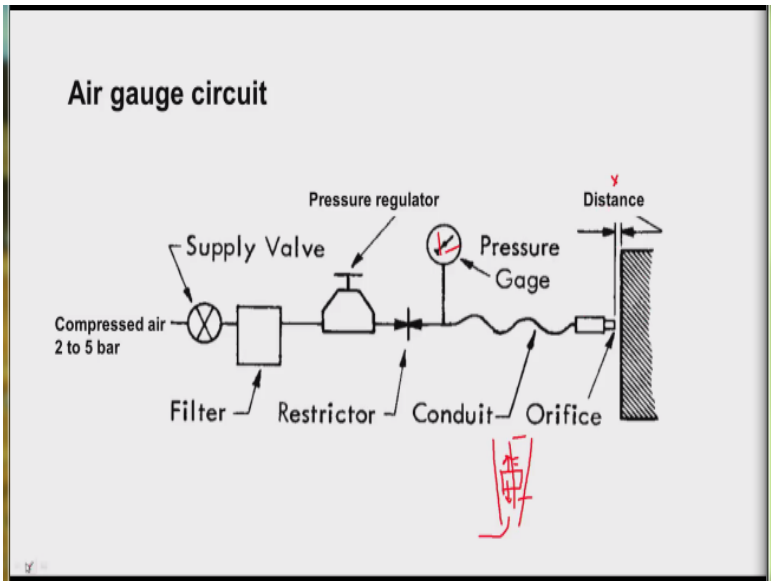

Now this is the air gauge circuitry a compressed air should be supplied to the air gauge and many valves are there to control the air flow filter is there, restrictor is there pressure regulator. And then this is flexible holes and there is pressure gauge now this is the probe air probe and then we have to keep the work piece in front of this. Now say we are checking this distance if this distance is within the limit.

Then the pressure gauge pointer will show the it will be within the two limits upper limit and lower limit. Then this distance is okay so, like this we can use the air gauge this is the pressure gauge when the work piece distance is proper the pressure will increase, and then it pointer will move. Similarly we can use the rota meter also so, there will be air flow and there will be float at a particular position.

This is the scale of the rota meter now when this distance varies then the flow also will vary say this distance is x. If this distance is less than x then the airflow is restricted so, this float will come down. If distance is more there is more air flow there is more restriction, so airflow will be more the float will move up. Now whether the float is within the 2 limits or beyond the limits, that we have to see and then we have to take the decision whether the distance is okay or not.

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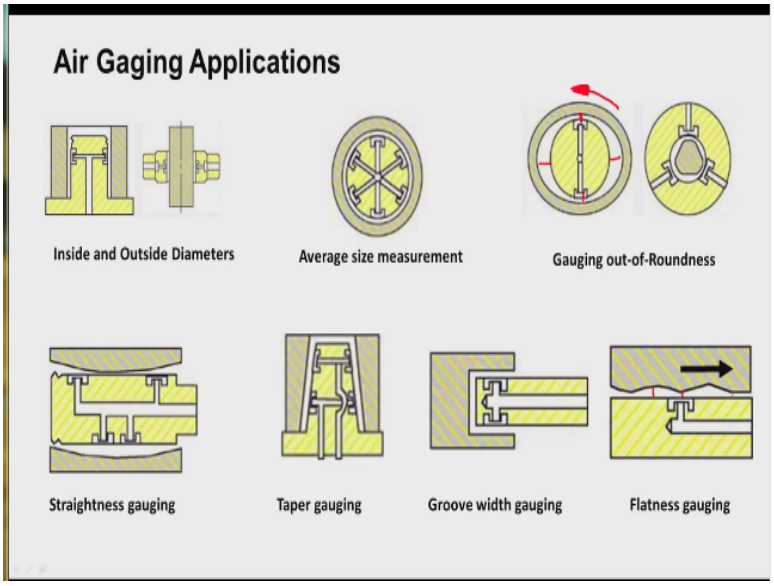

Now these air gauges can be used for various applications like inside and outside diameter measurement. We can see here this is the work piece and bore we have to check. So, the internal diameter can be check and this is the shaft the outside diameter can be check and for average self measurement multiple nozzles are there and then gauging out of roundness see here gap is less.

So, there will be particular position of the float and when you rotate this probe, now the gap is more, so the float position will change that indicates that there is out of roundness also the

whether there is any loading that as can be checked. Straightness can be check whether this surface is straight or not or any tapper is there in the hole, cylindricity can be checked, groove width can be checked, flatness also can checked.

We have to move the work piece in this direction and see the because of this error the gap is varying and then the float or the pressure gauge pointer will change that indicates that there is error some flatness error.

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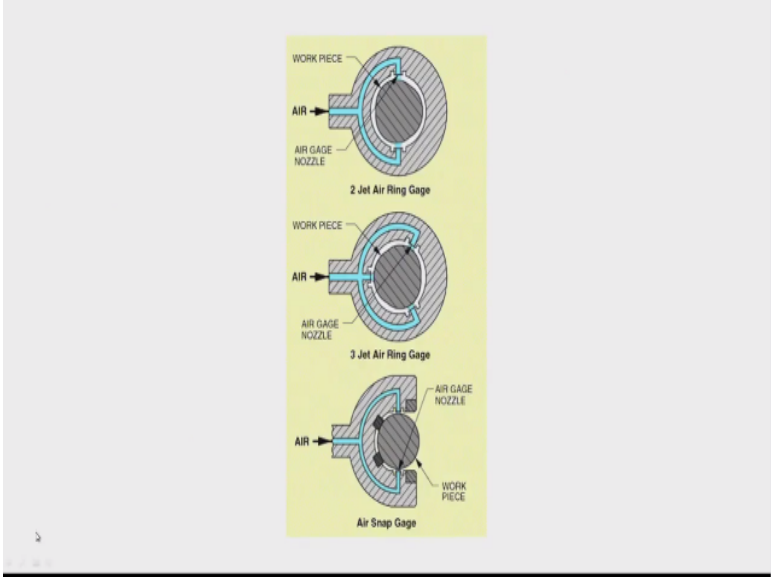

Now the different kinds of arrangements are possible 2 jet air ring gauge, 3 jet air ring gauge and then air snap gauge. So, this is see in the case of ring gauge what happens is we have to push the shaft from one end. If the shaft is too long then it becomes to check the diameter of the shaft. So, we have to one end and then from one end we have to move that ring gauge.

So, in such cases the snap air snap gauge will be very useful at any point on the shaft we can move the snap gauge and we can check the diameter and it is always necessary that we have to check the diameter at 3, 4 places and then we should find the average of the diameter.

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And these are some air ring gauges you can see the pores here and ring gauge and then plug gauges and then snap gauges these are commercially available.

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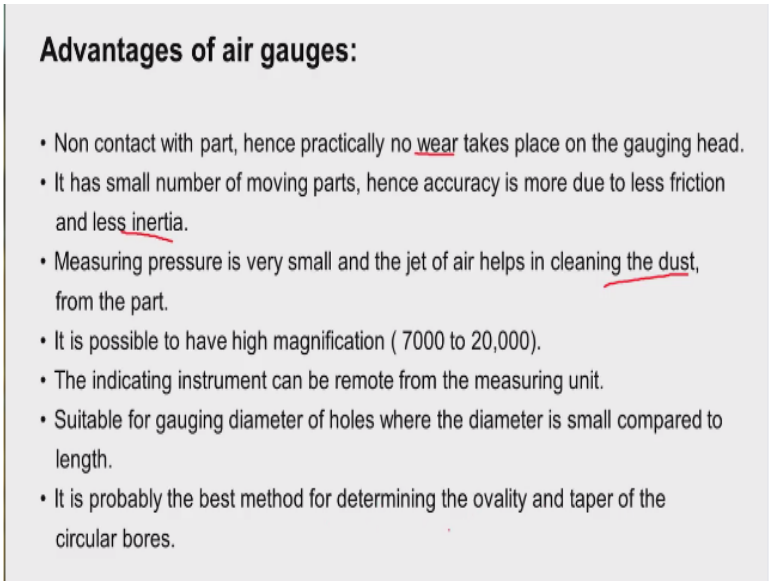

Now what are the advantages of these air gauges. Now we should understand that these air gauges they are non they not come in contact of the work part, hence there is no problem of wear. So, the replacement of gauges and such things are not there in air gauges. And this moving parts number of moving parts are very less so, the maintenance is also less and inertia since the probes are very light in weight, the inertia effects are also less.

And the measuring pressure is very small it varies from 2 bar to 5 bar. And this air, compressed air it also helps in cleaning of the work pieces is there is some dust particle in the work piece, the work pieces get automatically clean whereas in the conventional gauges metallic gauges we have to clean the work pieces and then we have to clean the gauge and then we have to use, whereas here self cleaning is taking place.

And it is possible to have very high magnification and then indicating instrument can be remote from the measuring unit. Air flow can be at 1 point and then indicator can be some other point, so remote operation is possible this is suitable for gauging diameter of holes where the diameter is very very small compare to length. And it is probably the best method for determining the ovality and tapper of the circular bores. It is very easy to check ovality and cylindricity of the bores.

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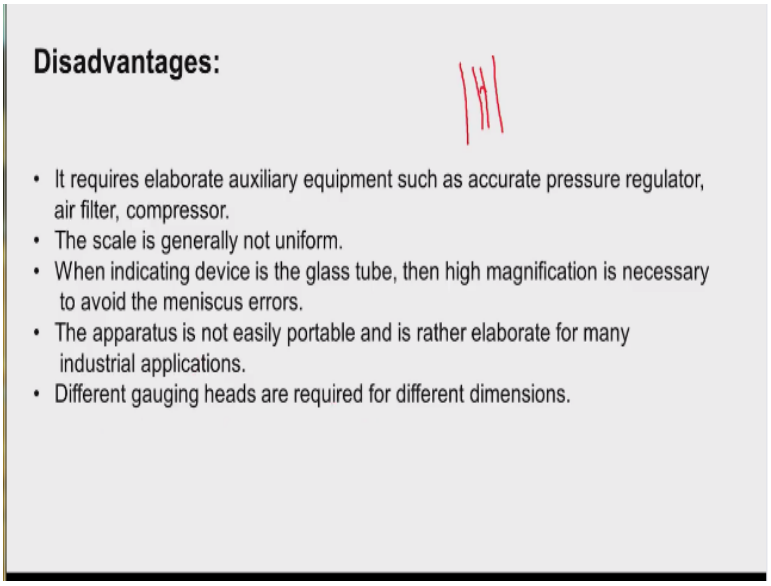

Now what are the disadvantages of air gauges see elaborate auxiliary equipment is needed that is compressor is needed and filter regulator is needed and flexible hoses are needed, accurate pressure regulators are needed. So, the investment may become slightly more compare to the fixed gauges, the other conventional gauges. The scale is generally not uniform that is another problem, only within the short small linear range, we have to operate these air gauges.

When indicating device is glass tube, Then high magnification is necessary to avoid the meniscus error see we have indicator in the form of a glass tube with a hole like this and then there is some liquid which is moving. So, there will be a meniscus error problem will be there. So, in such cases we should go for higher magnification. And operators is not easily portable, and it rather elaborate for many industrial applications.

So, whenever we want to move it the complete set we may have to move. And then different gauging heads are required for different dimensions.

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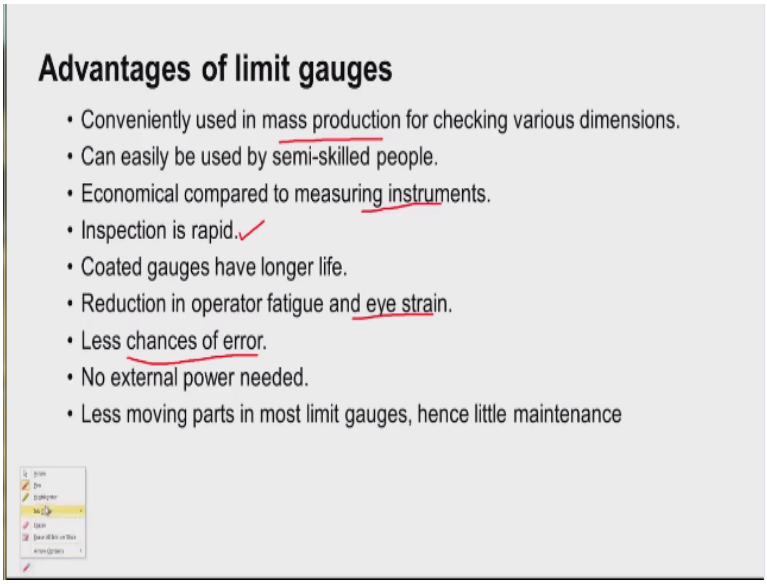

Now let us study what are the advantages of limit gauges. These gauges can be comfortably and conveniently used in mass production to check the dimensions of the work pieces and they can be used by semi-skilled operators. There is no elaborate training is needed to teach how the gauges are used. And they are very economical compare to the measuring instruments wherein they give the actual dimensions.

Since these limit gauges they give status whether it is acceptable or not acceptable and no measurement is made. So, investment in the inspection tools is very less and it is very rapid, so with the gauges can be use to check the sizes rapidly. So, inspection time is less and coated gauges have a longer life and there is no operator fatigue can be eye strain.

In the case of measuring instrument, operator eye strain is what he has to read the he has to take the reading and sometimes he may has to use magnifying lenses. So, in such case eye strain is involved whereas in the limit gauging such problems are not there and there are very little chances of making error, go should enter NOGO should not in the just decide that this work piece is acceptable.

And no external power is needed expect in the air gauges and less moving parts in most of the air limit gauges, hence little maintenance is involved.

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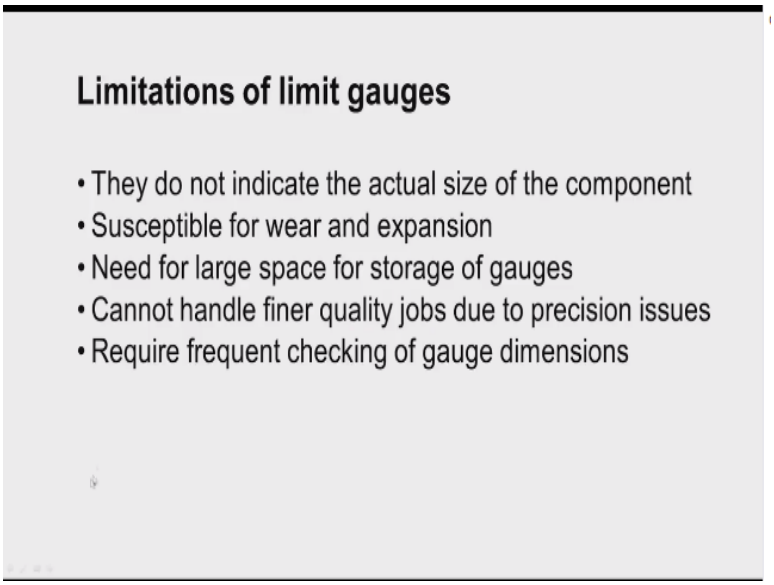

Now there are some limitations of limit gauges they do not indicate the actual size of the **com** component that is means if statistical process control is required. In such cases limit gauges cannot be used and they are acceptable for wear and expansion, for example if there is slight change in the temperature they expand. And also in the case of snap gauge the operator applies over pressure then it will expand.

And we may get some error in the inspection and need for large space for storage of gauges and they cannot handle finer quality jobs due to precision issues are that are involved and require frequent checking of gauge dimensions again and again we have to calibrate as per ISO standard also once in a quarter we have to inspect them and we have to recalibrate them.

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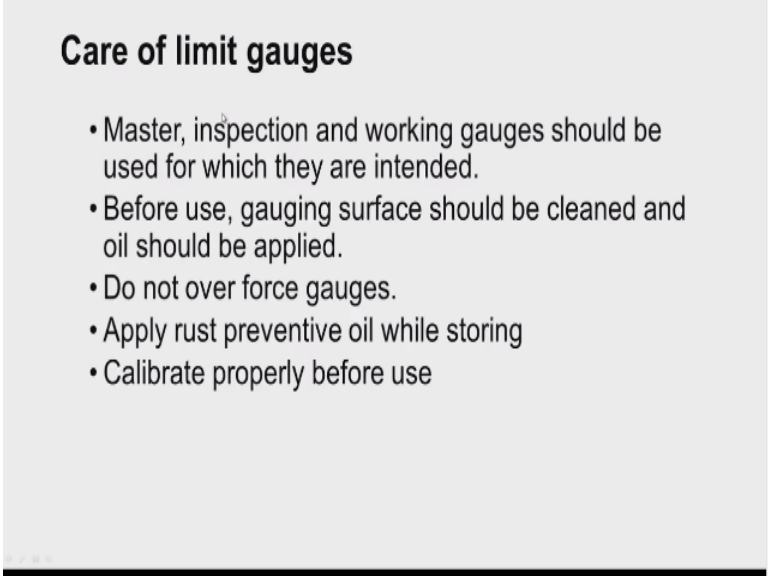

And we have to take some care while using the limit gauges and while storing the limit gauges . Master gauges, inspection gauges and working gauges these are different types of gauges there they should be used for which they are intended. That means working gauges should not be used for cannot be used as master gauge and inspection gauges they should not be use for regular inspection.

And before use gauging surface should be cleaned and oil should be applied and we should not over force the gauges and we should always apply less preventive oil while storing. When they not use not in use for a longer duration we should always conduct proper calibration before use. Now we will stop at this stage, we discussed about different kinds of gauges. We also discussed about the air gauges and what are the limitations of limit gauges.

And what are the proper what type of care should be taken in using limit gauges we will stop at this point, thank you.