Metrology
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Lecture – 35
Geometrical Tests On Lathe

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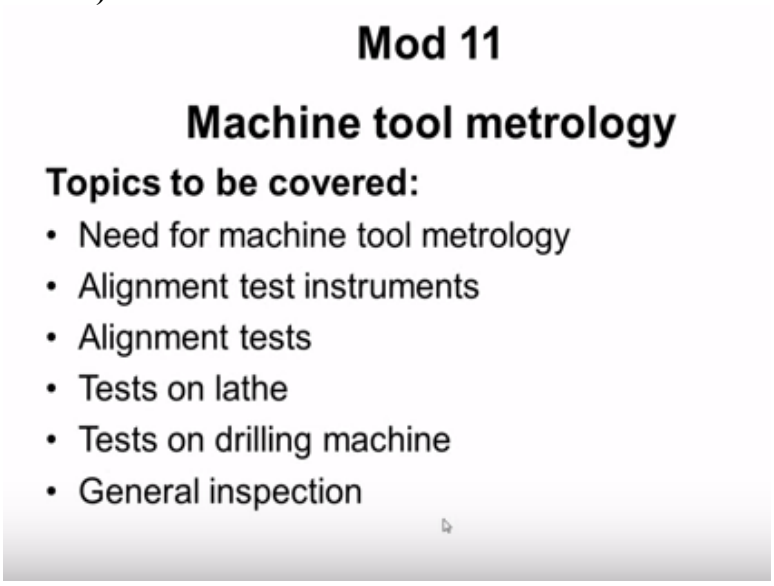

Welcome back to the lecture series on metrology. Now we will start module 11 on machine to metrology in this lecture we will be covering the following topics, what is the need for machine tool metrology, what are the various instruments used for conducting the alignment test on machine tools and what are the different alignment test conducted on machine tools and then we will cover some test on lathe and some tests on drilling machine and then we will discuss about general inspection of machine tools.

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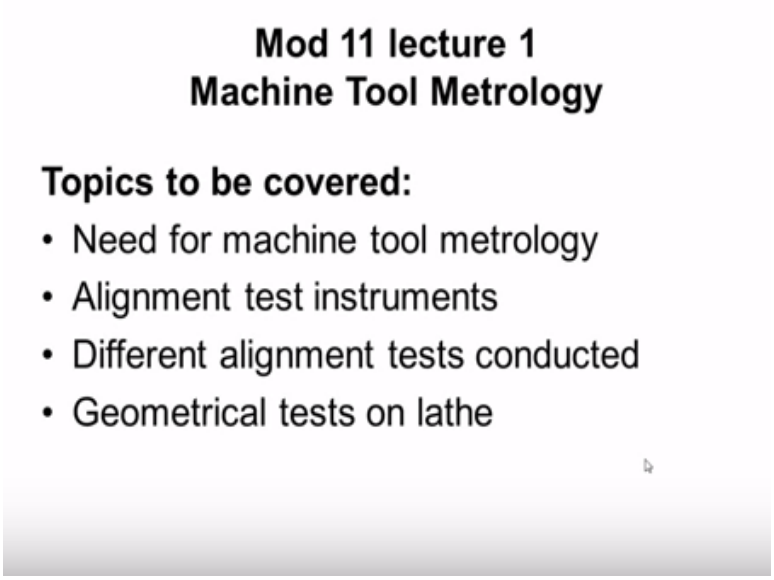

Now we will start lecture number 1 in module number 11 in this lecture we will be covering the following topics what is the need for machine tool metrology what are the various instruments used to conduct alignment test and what are the different alignment tests normally conducted on the machine tools such as flatness test of table sparing some tests perpendicular to it is etc. Then discuss about some specific geometrical tests conducted on engine lay.

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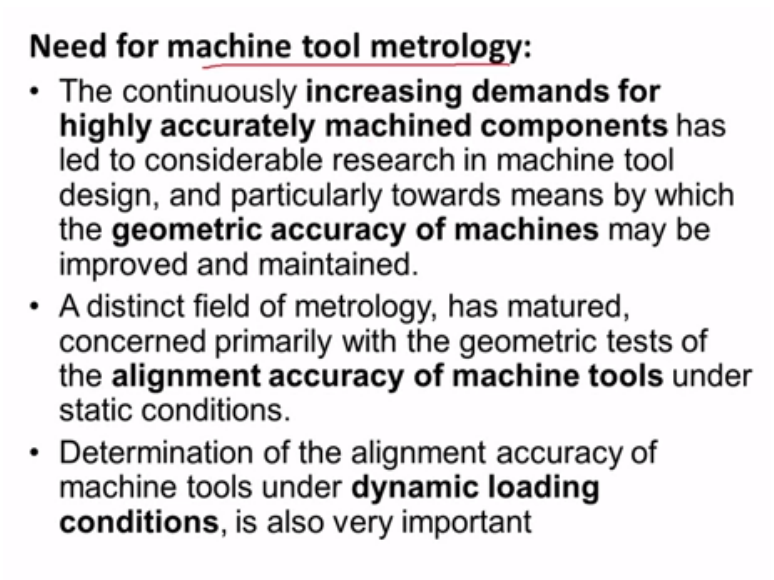

Now let us try to understand what is the need for machine tool metrology there is a continuous demand for highly accurately machined components because of this considerable research in machine tool design has been carried out and machine tools are being built up with high geometric accuracy.

A distinct field of metrology has matured which is concerned primarily with a geometric tests of the alignment accuracy of machine tools under static conditions and there is a need for conducting the alignment accuracy test with a machine tool is being loaded that is when the machining is being carried out whether the alignment is proper apart so far the practical tests are being conducted.

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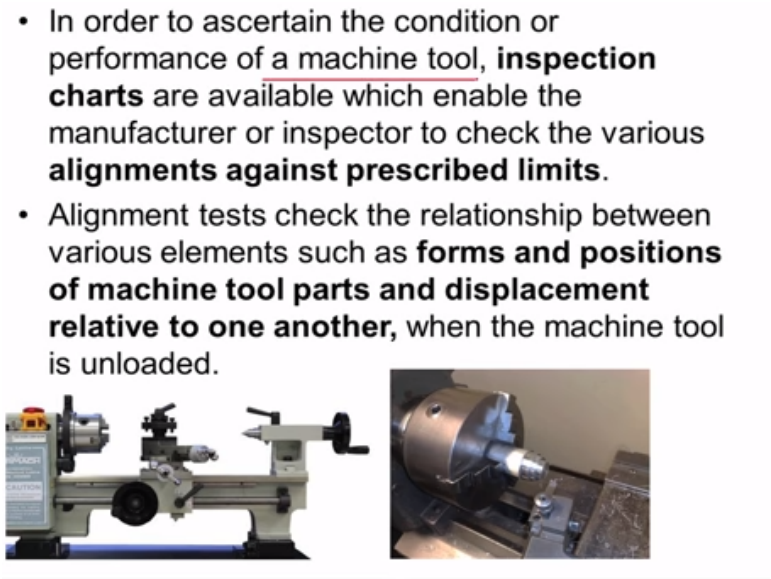

Now in order to ascertain the condition or performance of the machine tool inspection charts have been developed by a standards organization these charts will enable the manufacturer or inspector to check the various alignments of machine tools against prescribed limits alignment tests check the relationship between various elements of the machine tool such as force and positions of vision toolbars and displacement related to one another.

When the machine tool is unloaded for example whether positioning of the tail stock with respect to the spindle axis is proper or not whether the saddle movement is parallel to the lathe axis is okay whether the movement of the tool slide is parallel to the spindle axis whether it moves perpendicular what is the perpendicularity of moment of the cross slide with respect to lathe axis such things are checked during the alignment test.

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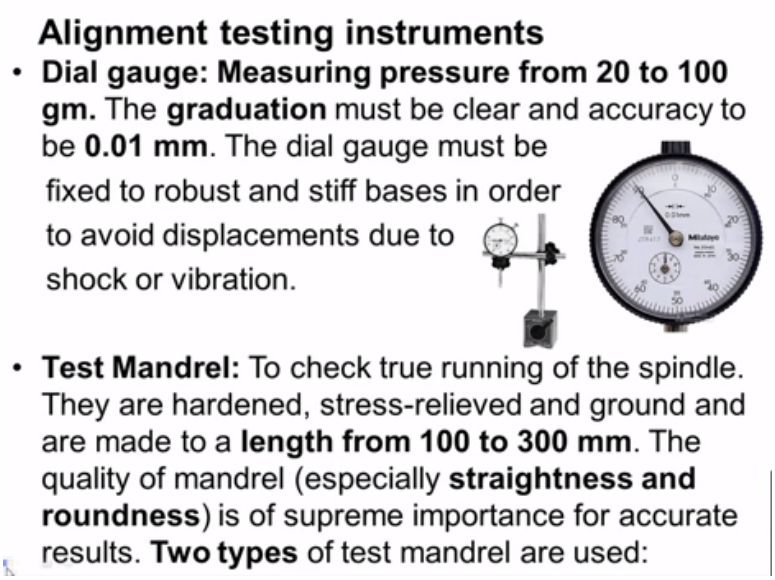

Now let us discuss the various instruments used to conduct test on machine tools alignment test on machine tools very first instrument is the dial gauge I should have a minimum measuring pressure we should not exert too much of pressure on Machine tool part the measuring the pressure ranges should be between 200 to 100 grams the graduations on the dial must be very much clear and accurate to 0.01 millimeter.

We can observe a dial indicator with the least count of 0.01 millimeter and range of 0 to 10 millimeter. The dial gauge must be fixed to robust and stiff bases in order to avoid displacements due to shock or vibration a magnetic stands normally used for mounting the dial indicator on machine tool parts test mandrel is a very important instrument used while conducting alignment tests.

These are used to check the true running of spindle and to check whether the movement of slide is parallel axis and these test mandrel are not only made of steel they are hardened stress related and ground and they are made to a length 100 to 300 millimeter the quality of the mantle especially the straightness and the roundness of the mandrel is very important in order to get accurate results.

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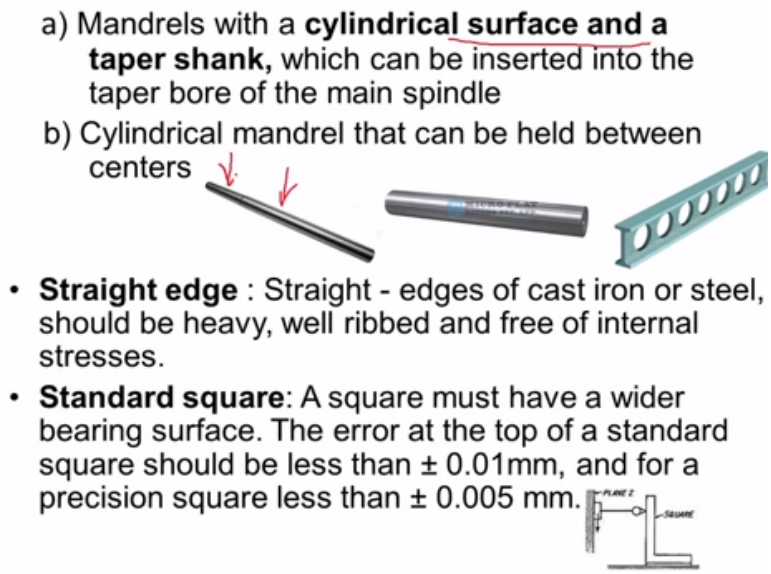

Two types of tests mandrels used the first one is the mandrel with the cylindrical surface and a taper shank this portion is cylindrical and at the end there is a tapered shank which will go into the taper bore of the spindle other type is the cylindrical mandrel that can be held between the Centers we can see the centers are provided on both ends of for the cylindrical mandrel to fix the cylindrical mandrel between centers.

Now another important instrument is straight edge, so these are normally made of cast iron or steel we can see the view of straight edge these should be heavy well ribbed and free of internal stresses the 2 surfaces the tops surface and the bottom surface surfaces should be parallel to each other, the another important instrument is standard square the standard square must have a wider bearing surface.

The error at the top should be <+/-0.01 millimeter, so when we move the from the bottom to top at the end the error should be <+/-0.01 millimeter and for a precision square the error at the top should be <+-0.005 millimeter.

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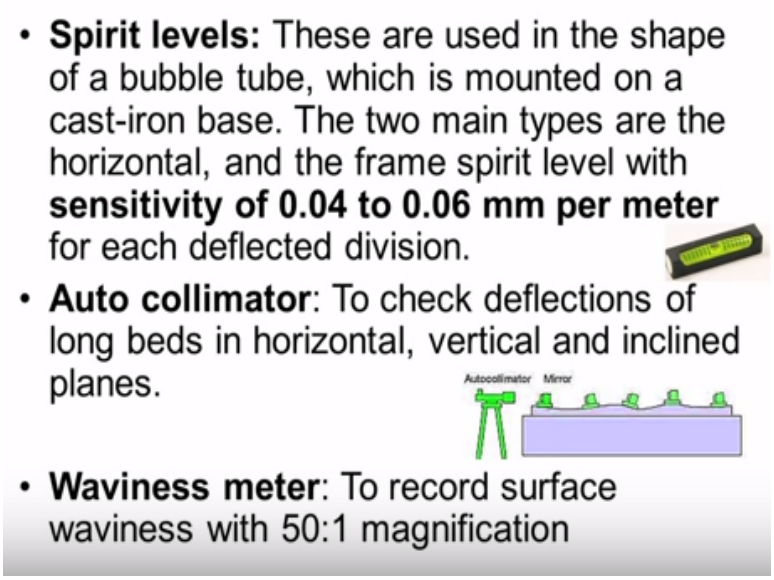

The spirit levels are also used while conducting alignment test on machine tools to check the flatness of bases and tables and to check the straightness of gateways, so these are used in the shape of a bubble tube which is mounted on a cast iron base we can see a view of spirit level 2 main types are used one is horizontal type another one is frame spirit level with a sensitivity of 0.04 to 0.06 millimeters per meter for each deflected division.

Other important instrument used is autocollimator which is used to check the deflections of long beds in horizontal, vertical time with inclined planes we can check the deflection of gateways using auto collimator as shown here waviness the meters are used to record the surface waviness of the bed and the tables with a magnification of 50:1.

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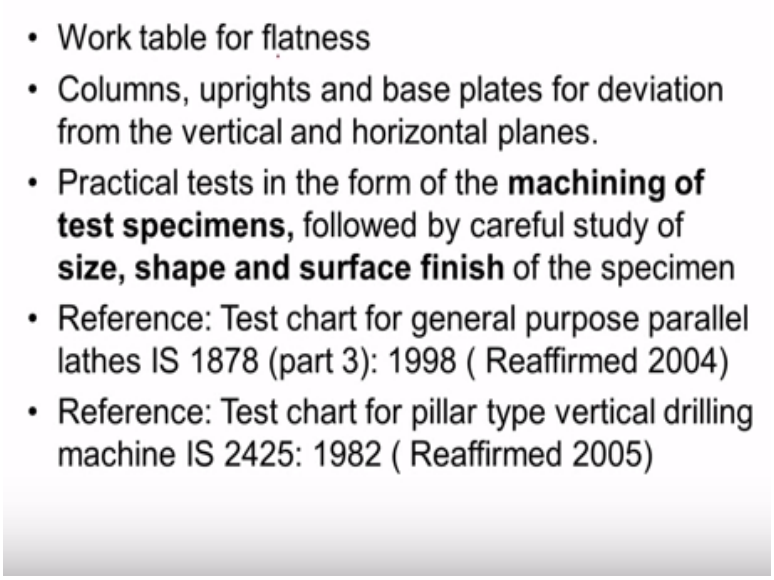

Work tables checked for flatness using the straight edge or spirit level the work table should be a flat or concave if the table surface is convex like this what happens is we keep the work piece on the table and when we clamp work piece using clamps because of the clamping force the thin work pieces may deflect or bend like this to avoid that we work pieces work tables are made flat or if there is any deviation I should be in the form concavity.

So this is check using the spirit level and straight edges columns uprights and base plates are checked for deviation for the vertical and horizontal planes that means the columns of the machine tools whether perpendicular to the base plates are not so that is check using dial indicators and squares.

Practical tests are conducted by machine the work pieces and appropriate feeds and spirits rates used for machine and then the work piece after machining is checked for size, form and surface finish whether the sizes are okay or not, if there is any larger a deviation from the shape and size whether we are getting the cylindrical objects or tapered objects or drum shaped objects.

So all those things are checked by conducting practical and also we can check the surface finish that is obtained using the surface tester we can refer IS 1878 part 3 for test chart for conducting tests on lathes and we can refer IS 2425 test chart for pillar type vertical drilling machine for conducting an alignment test on drilling machine.

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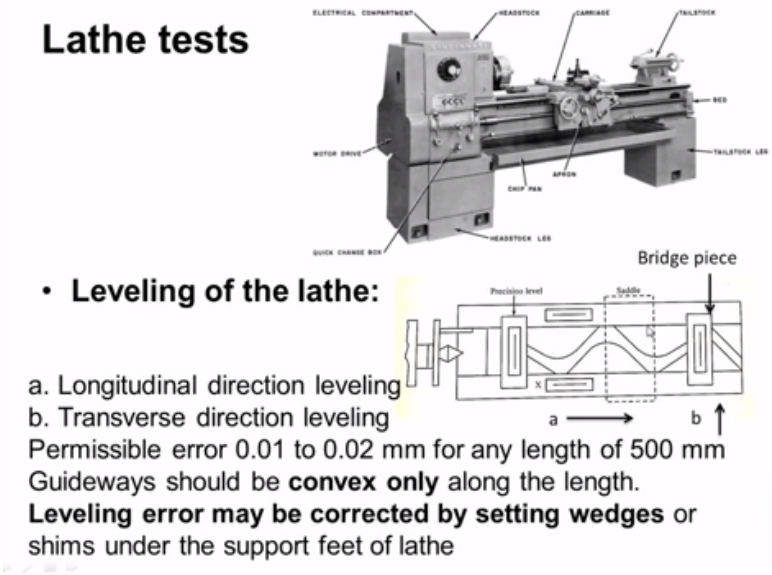

Let us discuss on the alignment test conducted on engine lathe. We can see the picture of engine lathe there are many sub assembles so we have bed assembly carriage for saddle sub assembly and then we have the tail stock sub assembly head stock sub assembly and then we have quite change gear box here apron.

So now during the assembly we have to carry out various alignment tests on these sub assemblies to check whether they are aligned properly and once they are assembled we have to check whether all these sub assemblies are aligned properly to each other whether the moments of various of assemblies is parallel to main spindle axis whether the moment of tail stock is parallel.

The axis and then saddle moment whether it is parallel to such things we have to check and if there is any error by scraping the appropriate surfaces we can change the alignment and we can set the alignments now one alignment test that is before conducting any alignment test it is very essential that the leveling of the machine should be checked whether the lathe is properly leveled.

Installed that we have to check we have to check leveling in both the directions longitudinal direction as well as the transverse direction so along the length of the bed where to check the

alignment that is longitudinal direction and perpendicular to the length bed we have to check the leveling transverse direction.

Now approximately saddle is kept at a middle of the guide ways and then we have to use a precision a spirit level at various positions we have to keep the spirit level and we have to note down the reading this procedure we have to repeat for both guide ways and if there is any error you should not exceed 0.01 to 0.02 mm for any length of 500 millimeters.

So this is the length of the bed, similarly alignment I should be checked in the transverse direction for that we have to keep a bridge piece on the guide base and then we have to place the precision level and then we have to note down the reading again in the transfer direction also the error should not exceed upon 0.01 to 0.02 mm for any length of 500 mm also this experiment of this check will give whether the guide ways are straight or not.

So when we keep the spirit level at various positions along the bed the guide way we have to keep the spirit level along the length of the bed at various positions and then we should note down the reading and this will indicate whether guide ways straight or is there any deviation from straightness if there is any deviation I should be in the convex direction only it means the guide way should be convex.

The reason is because of the weight of saddle and because of the action of cutting forces the guide way tends to become straight, so that is why initially it should be convex, if it is concave then the effect of concavity will increase with the action of the weight of a saddle and fitting force also other reason is if the guide way is convex because of the continuous movement of saddle the surface of the guide way will worn out and it becomes straight.

Now if the leveling is not proper it may be corrected by putting a setting wedges or shim plates under the support feet of lathe that means adjust we can insert the shift plates or wedges for leveling purpose.

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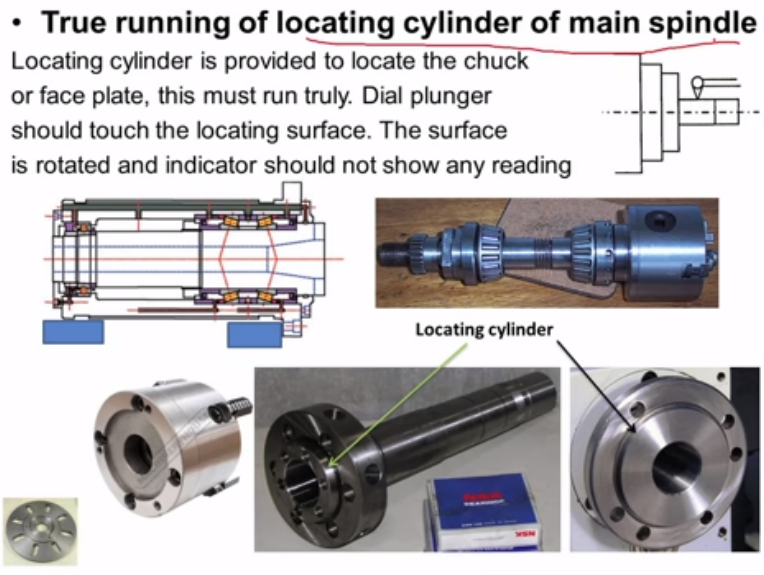

Now true running of locating cylinder of main spindle this test is conducted to check whether the locating cylinder is running truly or not we can see the assembly drawing of the main spindle of the lathe it is supported by bearing at the both the both ends different end and rear end you can see the photographic view of assembly of main spindle the check the spindle supported by baring.

Now you can see the locating cylinder surface here locating cylinder surface I can also see the rear view of the chuck and also the face plate the locating the cylinder is provided on the main spindle to locate the chuck or face plate so this face of the check will go and fit on the locating cylinder the locating cylinder should run without any run out if there is any run out of locating cylinder then the chunk and face plate will also run without trueness.

So we do not get proper geometry on the work pieces now to check the run out of the main spindle locating cylinder we have to use a dial indicator the plunger of the dial indicator should touch the locating cylinder surface that means the plunger should touch the locating cylinder surface and we should slowly rotate the locating cylinder and then we should note down the reading of the dial indicator.

For true running the locating cylinder there should not be any reading in the dial indicator, if there is any out of running then the indicator will show the readings in that case again we have to

finish the machine the surface of locating should be finished again and then again the true running should be checked and then finally it can be assemble into the headstock.

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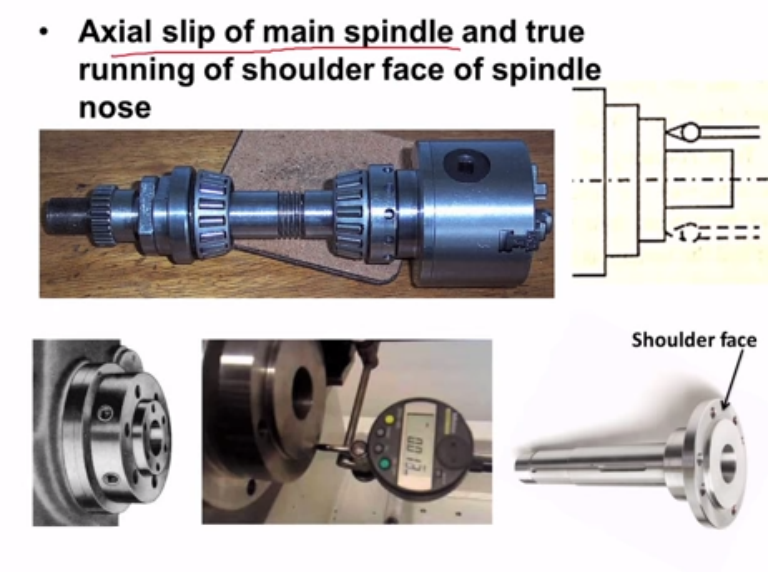

Now we will discuss about axial slip of main spindle and true running of shoulder face of spindle nose, again we can see the Assembly of the spindle the check is mounted on the spindle nose we can see the bearings which support the main spindle. Now we can see here this is the shoulder face this locating cylinder.

This is the shoulder face of spindle nose the check will be it will come in contact the back surface of the check or face plane will come in contact with this shoulder face it is essential that there should not be any axial slip of this spindle so if there is axial slip then it is nothing but the axial moment of spindle then the check will also move axially and that will affect the machining accuracy particularly.

In case of a screw cutting and it is very essential that this shoulder face should be perpendicular to the axis. Now by measuring we have to mount the dial indicator on some fixed part of the machine and the plunger should touch the shoulder face that means the plunger should come in contact with the shoulder face and we have to take readings at 2 diametrically opposite positions one reading here and slowly.

We have to rotate the shoulder face and then second reading we have to take here the difference will be axial slim.

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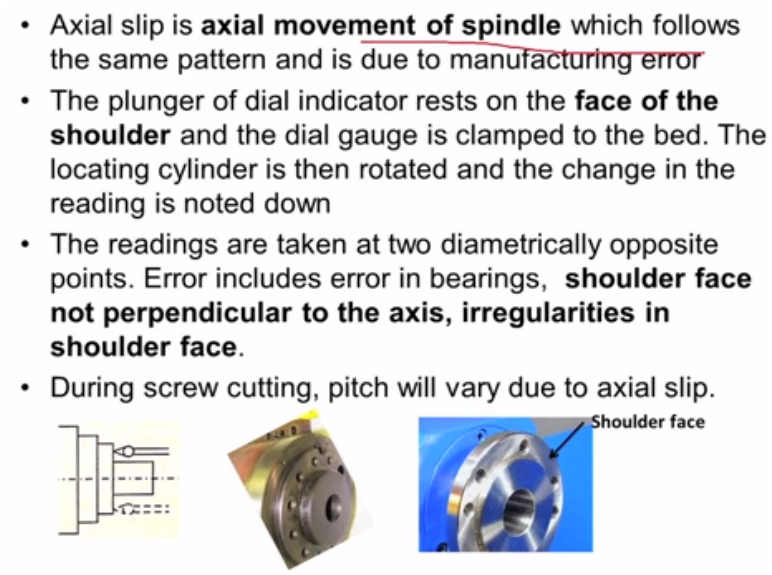

Now axial slip is the movement of a spindle which follows the same pattern and is due to the manufacturing error of the shoulder phase the plunger of the dial indicator rests on the face of the shoulder as shown here and the dial gauge is clamped to be bed the locating cylinder is then rotated, so this locating cylinder is slowly rotated and 2 readings are taken from their dial indicator one reading here and we have to rotate it through 180 degree side the second reading we have to take the dial indicator difference will give the axial scale.

The readings are taken at 2 diametrically opposite points the error includes the error in bearings if there are any error in bearing then also there will be a axial slip and the shoulder face not perpendicular to the axis I can see here if this shoulder face is at some intonation like this so then also we get when we rotate it the axial slip and we get the reading here and sometimes the face the shoulder face.

This is the locating cylinder and this is the shoulder face maybe there are some irregularities in the shoulder face because of that also we get axial slip, so particularly during the screw cutting pitch of this crew cut will vary due to the axial slip, so it is very essential that the machining of the shoulder face is very important.

A lot of care should be taken and decision finish me should be used for finishing the shoulder face and we should see that it is surface is perpendicular to the of the spindle of axles.

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When the shoulder face is not perpendicular to the spindle axis there is some inclination like this then when we do the locating cylinder when the mount the check or face plate so there will be some inclination like this the Chuck we had some a inclination with respect to the spindle axis because of this when we mount the work piece in 3 jaw chunk again the axis of the job will not coincide with the axis of spindle.

There will be some inclination because of this may be gear cuts so we get tapered surfaces so to avoid this it is necessary that the shoulder face should be perpendicular with respect to spindle axis.

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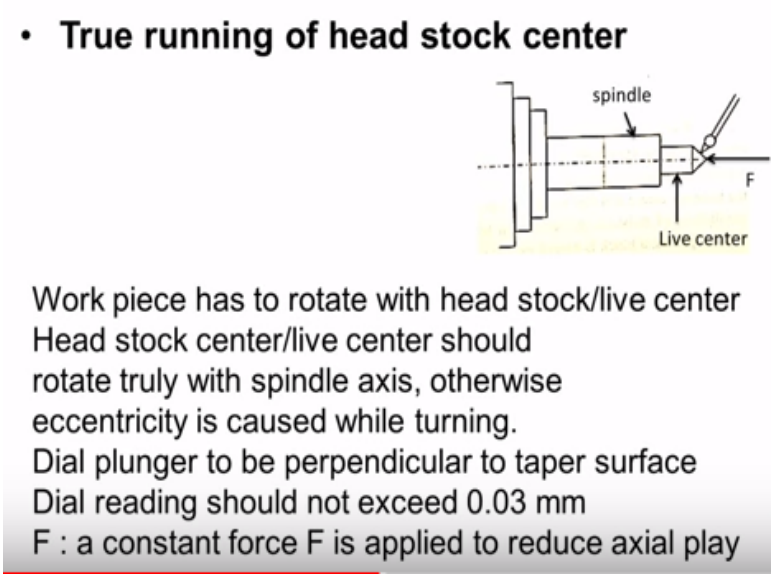

Now the next test is true running of headstock centre so the spindle inside there will be or tapered socket will be there and we mounted the live center or head stock centre in this taper socket now the what the rotation of this live center should be true there should not be any wobbling of the live center if it wobbles then the work piece will also wobble along with the live center because of this the eccentricity will result on the work pieces.

In order to test the true running dial gauge plunger should be placed on the tapered surface the plunger should be perpendicular to tapered surface of the live center as shown here and they slowly realizing that live center should be rotated and dial reading are taken the dial reading should not exceed 0.03 millimeter while conducting their this experiment if force F is applied on to the spindle Center in order to reduce the axial play.

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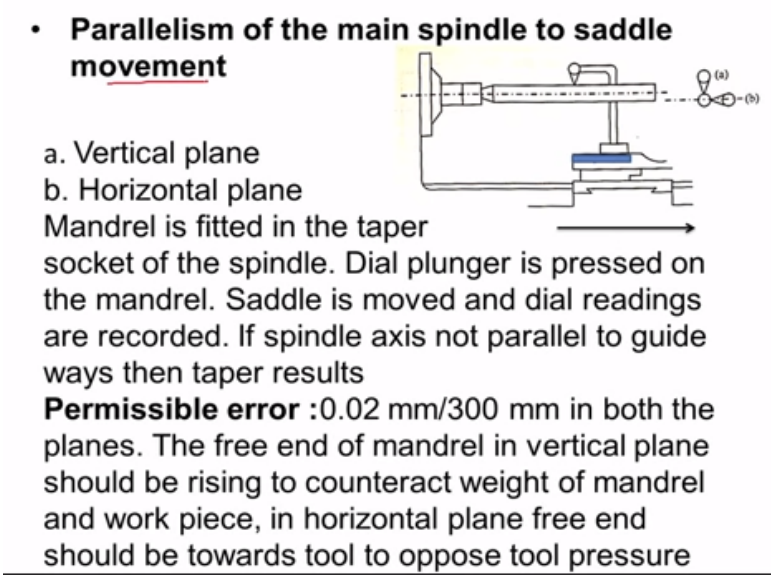

Another very important test is parallelism of the main spindle to saddle movement in the both cleanse this test is conducted in horizontal plane as well as vertical plane we can see here we have the spindle and the mandrel with the taper shank it is mounted the taper socket of the spindle and the plunger of dial indicator is pressed on the mandrel and the saddle moved slowly and dial indicator readings are recorded.

If the spindle axis not parallel to gateways taper results of a work piece, so when we move the dial indicator from one end to the other end in the vertical plane, so the dial indicator will show whether the Gateway's are moving in with spindle axis or not. Now the permissible error is 0.02 millimeter per 300 millimeter length of the movement in the both the planes.

So when the content of this experiment the free end of the mandrel in the vertical plane should be rising, so in a vertical plane this free end should be upwards like this if there is any error the free

end should be upward compared to this end in order to counteract the weight of mandrel are work piece because the self work piece it will tend to bend like this.

So that will mollify the effect of parallelism error if this ends free end is upwards, similarly in the case of horizontal plane the free should be towards tool to opposite to the horizontal plane the free end should be towards the tool, so when the cutting action takes place because of the cutting force tool pressure the work piece will bend in the other direction against. Now in the horizontal plane the free end should be towards the tool to oppose the tool pressure.

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Parallelism of the main spindle to saddle movement

Measurement in vertical plane, free end upwards

I can see the photographic views of the test the Mandrel taper shank mandrel is inserted into the spindle and the dial indicator plunger is in contact with the surface of the mandrel and it is mounted on the saddle now slowly at this place that is near the spindle nose the reading is set to 0 and slowly the saddle is moved to the longitudinal direction and what is the reading at other end.

So that is recording so the difference will be, what is the amount of error so this experiment shows the parallelism test in the vertical plane.

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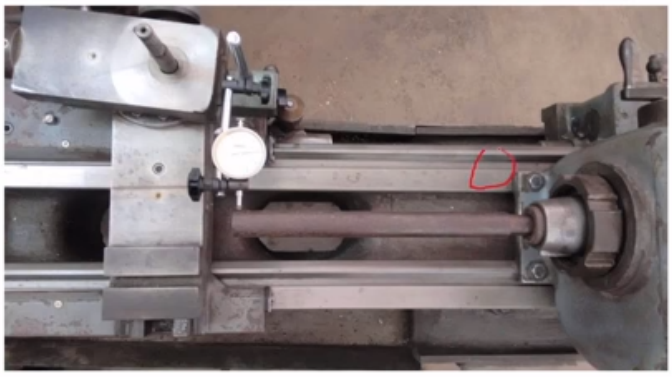
Parallelism of the main spindle to saddle movement



Measurement in horizontal plane, free end frontwards

Now here we can observe the parallelism the main spindle to saddle moment in the horizontal plane so the saddle so the plunger will in contact with a matter like this in a horizontal plane then the saddle will slowly move here the reading is set to 0 at the other end we have slowly move saddle at the other end what is the reading of the dial we have to record the difference will give what is the amount of error parallelism error.

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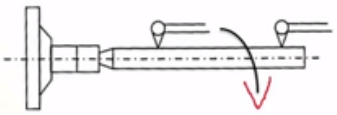
- **True running of taper socket in main spindle**

If the axis of tapered hole is not concentric with main spindle axis, eccentric and tapered jobs will be produced.



To test it, a mandrel is fitted into tapered hole, it is rotated slowly and dial gauge readings are taken at two extreme places: near the spindle and at a distance of 300 mm from spindle.
Error not to exceed 0.02 mm at both the places

Now another test that is normally conducted is true running of taper socket in the main spindle, so now we have the spindle nose the axis of spindle and there is a tapered socket inside now whether the axis of this taper socket is concentric with the main spindle axis so that we have to check sometimes this tapered taper socket axis may be at some angle like this.

So this is the main spindle axis that taper socket axis may be at some angle with respect to the main spindle axis or sometimes the table socket axis is parallel but there is some offset like this. Now I can see this is the axis of the personalities offset with the main spindle axis because of these errors eccentric and tapered jobs will be produced.

Now we have to check whether true running error is within the prescribed limits to conduct this test a mandrel is fitted into the tapered hole you can see here we have the mandrel with a taper that is fitted into the tapers socket of main spindle and then slowly the matter is rotated the spindle rotates and so that the mandrel is also rotated and dial gauge readings are taken up to 2 extreme places that means initially we have to keep the dial near the spindle.

We have to slowly rotate the spindle and what is the amount of error that we have to note down and then we had to move the dial equator to another place at a distance of 300 mm from the spindle and we have to see that plunger is contact with a mandrel and again the mandrel is rotated and the reading is taken, so in both the cases error should not exceed point 0 2 mm AT the both the places.

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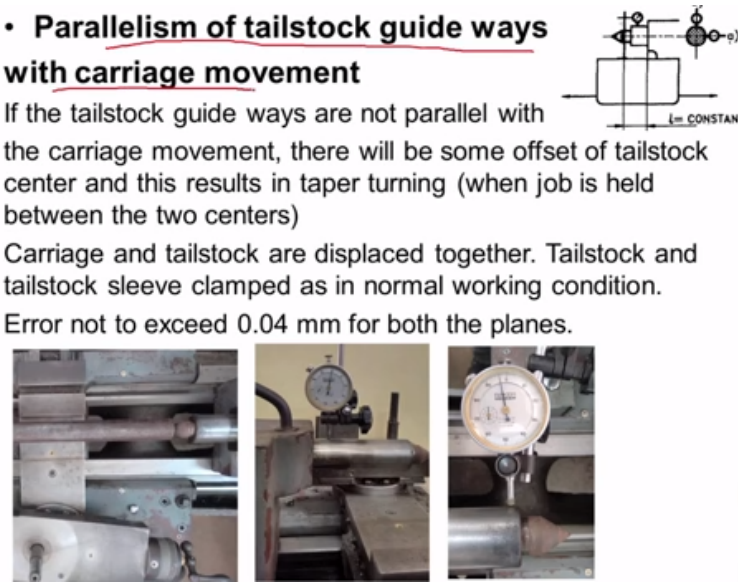

Now let us discuss about the parallelism of tailstock guide ways with the carriage movement so in his picture we can observe that we have one set of guide ways that is the inverted be a guide

way and one flat guide way for the movement of the tail stock and we have one flat guide way and one inverted guide way the second set of guide way for the movement of the carriage.

Now these 2 sets of guide ways should be parallel to each other if the guide ways tailstock guide ways are not parallel with the carriage movement that is if the tailstock guide way are not parallel with the guide ways of saddle then there will be some offset of the tailstock center and this results in the taper turning when the job is held between 2 centers in order to carry out this experiment.

We have to mount the dial indicator on the carriage and then the plunger should touch on the extended quill of the tailstock and then we have to clamp the tailstock as well as tailstock sleeve and then we have to note down the reading and then we have to unclamp tailstock we have to move the saddle and tailstock together.

So that this distance is kept constant and then at the in a second place on the bed we again we have to clap for the tailstock and tailstock sleeve and then we have to take it like this 2, 3 places along the length of the bed to take the reading and the maximum error should not exceed 0.04 millimeter, so this experiment we have to conduct you to put the planes and in the body planes vertical plane as well as horizontal plane here should not exceed point 0.04 millimeter.

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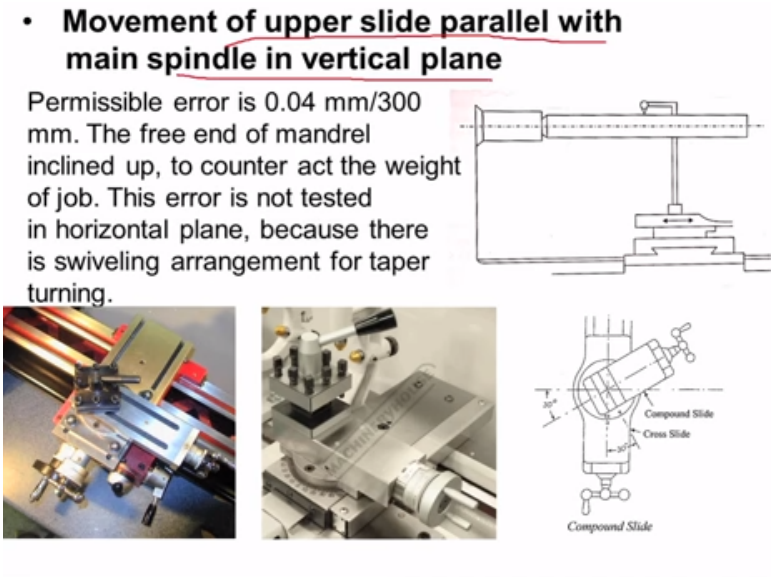

Now let us discuss about movement of upper slide parallel with the main spindle in the vertical plane we can observe this photograph we have the guide ways the guide ways on the bed and then we have the saddle and then the cross slide cross line and then the above cross slide we have another slide which is a upper slide or tool slide.

Now the movement of the upper slide should be parallel to the spindle axis otherwise the tapered components will result so this test is conducted only the vertical plane reason is we can observe here there is a provision in the horizontal plane there is a provision for adjusting the swiveling in order to get the taper the upper slide can be swiveled like this, so the protractor you can see here we can swivel this upper slide to any angle required in order to get tapers.

So this test is conducted only in the vertical plane so we have to keep the stand on the upper slide and the dial indicator should tough the mandrel as shown here and then we have to take the reading they have to slowly move the upper slide and we have to take the note on the readings.

The difference in readings will give the amount of error the permissible is 0.04 millimeter per 300 millimeter and we should see whether the free end of the mandrel should be in the upward position to counter act the weight of the job.

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Now we can see how to conduct the tool slide movement parallelism with main spindle the mandrel is fitted into the spindle and the dial indicator plunger is in contact with the mandrel the magnetic stand is placed on the tool slide, now slowly tool slide is moved and the dial equator readings are taken the difference in readings give the error.

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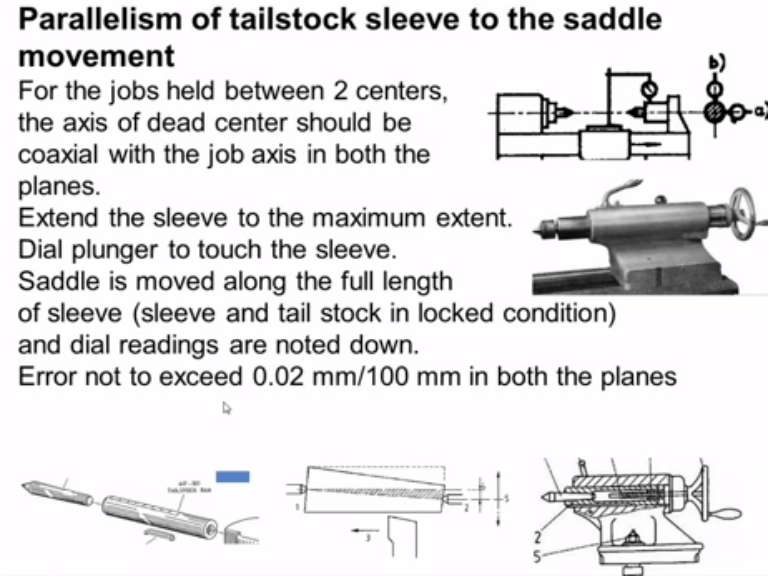

Now we will discuss about other important test that is conducted the parallelism of tailstocks sleeve to the saddle moment we can see here we have the body of tailstock inside we have the sleeve tailstock sleeve and it has tapered socket inside in which the dead center can be inserted we can see assembly drawing here the dead center and then we have the sleeve tailstock sleeve

Which can be moved in and out using this wheel we can see the photographic view this is the tailstock sleeve and dead center for the jobs held between the 2 centers that is a lie center and dead center the axis of dead center should be coaxial with the job axis in both planes that is horizontal plane as soon as vertical plane.

Now if this is not there then the tapered work pieces will result we do not get the cylindrical objects because of this shift now how do we test with this parallelism, so we have to extend the sleeve to the maximum extent and then we have to put dial indicator stand on a saddle as shown here.

The dial indicator plunger should touch the sleeve and then we have to lock this sleeve as well as the tail stock as normal operating condition and slowly they saddle should be a moved and the readings are taken, so the error should not exceed 0.02 millimeter/100 millimeter movement of saddle in both planes.

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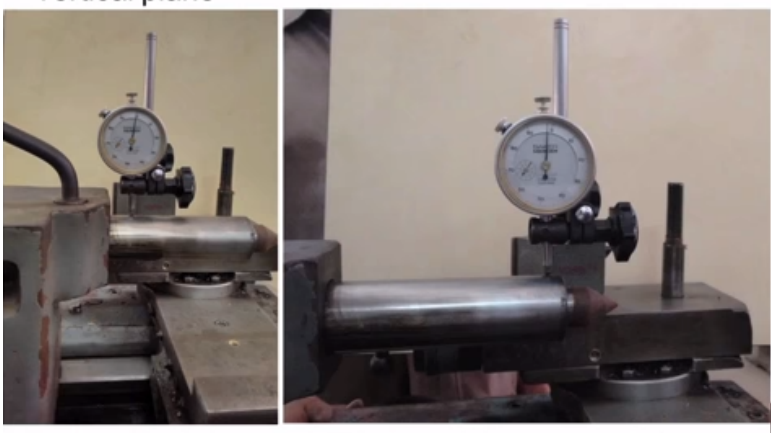
Parallelism of tailstock sleeve to the saddle movement – vertical plane



Free end of sleeve should be raising upwards in vertical plane to counteract weight of work

I can now see me photographic views here, so we have the tailstock body and the sleeve of tailstock it is fully extended and the dial indicator plunger is in contact with the external surface of sleeve and the dial indicator stand is placed on the saddle and after locking the tailstock body and sleeve near the body we have to keep the dial indicator and we should adjust the reading to 0.

Then we have to slowly move the saddle so that the dial indicator moves to the other end of this sleeve and then the reading is noted, so this should not exceed 0.02/100 movement of saddle and the free end of the sleeve should be raising upwards to the vertical plane to counteract the weight of the work.

So when we load the word peace between centers because the weight of work piece will be acting on this Center and sleeve tends to move top, so initially the free tend should be raising upwards before loading the work piece.

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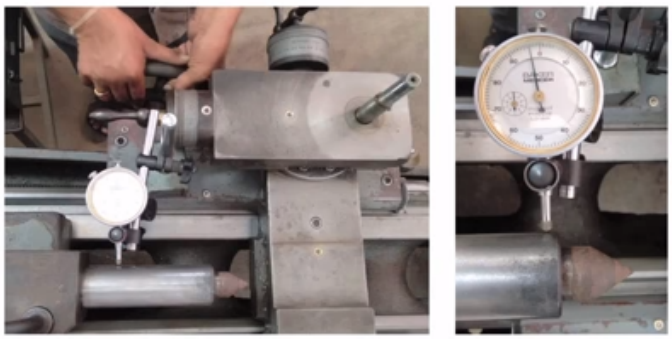
Parallelism of tailstock sleeve to the saddle movement – Horizontal plane



Sleeve should be inclined towards the tool in horizontal plane to oppose tool pressure

So similarly the horizontal plane also testing are conducted you can see here the plunger is in contact with the sleeve in the horizontal plane and then slowly the saddle is moved and at the other end the reading is taken and this reading should not exceed 0.02 millimeter/100 millimeter and sleeve should be inclined towards the tool in the horizontal plane to oppose the tool pressure.

So the pressure will be acting like this so if there is any parallelism error this free end should be towards the tool.

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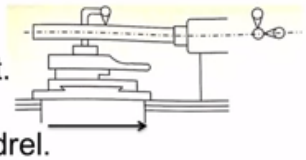
Parallelism of tailstock sleeve taper bore to the saddle movement



Mandrel is fixed in taper bore.
Dial indicator is fixed to tool post.
Plunger is pressed on mandrel.
Saddle is moved along the mandrel.
Dial readings are recorded, in both the planes
Tail stock and sleeve are locked as in normal working condition.

Error not to exceed:

0.03/300, free end towards frontwards in horizontal plane
0.04/300, free end towards upwards in vertical plane

Now we will discuss about the parallelism of tailstock sleeve taper bore to the saddle movement we can see here we have the tailstock and then we have tailstock sleeve, so the tailstock sleeve

has a tapered bore, so this is the access of sleeve and then we have the taper bore and we can fit the tapered dead centers the both.

Now it is necessary that the axis of taper bore should be parallel to the saddle movement otherwise tapered work pieces will result now in order to conduct this test mandrel is fixed to be a taper bore that we can observe here mandrel is fitted into the taper bore of sleeve and the dial indicator is fixed to the tool post and plunger the dial plunger is pressed on the mandrel and then we have to lock the sleeve as well as tailstock as in normal working condition.

Then we have to slowly move the saddle and we have to note down the dial indicator readings the error should not exceed 003mm/300 movement of saddle and the free end of the mandrel should be towards frontward in the horizontal plane to counteract the tool pressure the error should not exceed 0.04millimeter/300 mm the free end of the mandrel towards upwards in the vertical plane to counteract the weight of the work piece.

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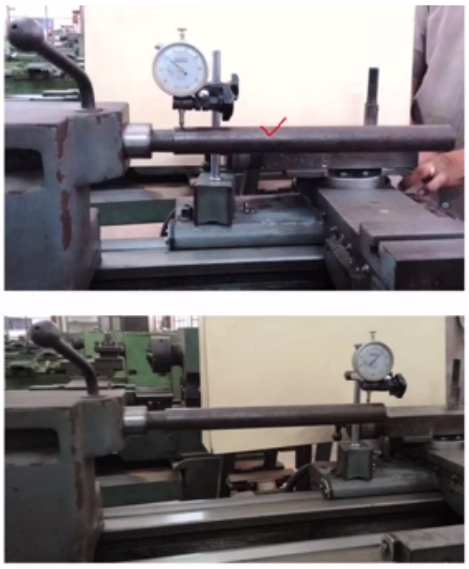

I can see here the photographic views of the test the mandrel is fitted into a tapered bore of the sleeve the plunger is in contact with the outer surface of for the mandrel and the dial indicator is fixed to the saddle, so this position the reading is adjusted to0 and then slowly the saddle is moved after locking the tailstock and sleeve and then the dial indicator is moved to the other end of the mandrel and again reading is taken.

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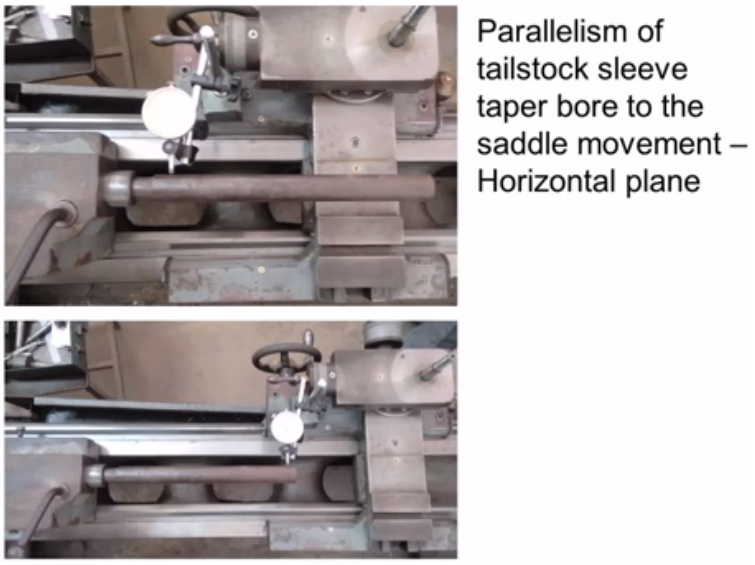

Now in the horizontal plane is also the test is repeated you can see here the dial indicator in contact with plunger the reading will adjusted to 0 and then slowly the saddle is moved now the plunger is in contact with the mandrel at the end so again the reading is taken the difference is the amount of error in the horizontal plane.

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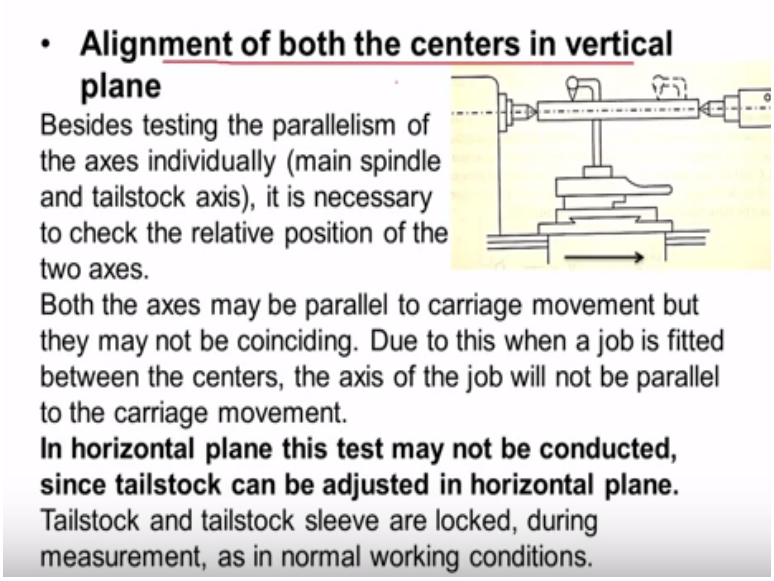

Now let us discuss alignment of both the centers in the vertical plane that is the headstock centre height from the guide ways and tailstock centre height from the guide base should be seen if the height are different then again the tapered components result individually both the axis that is main spindle axis and tailstock axis.

Maybe parallel to the spindle axis but both the axis may be parallel to carriage moment but they may not be coinciding that means the heights may be different from the guide ways so due to this when a job is fitted between the centers the axis of job will not be parallel to the carriage movement and tapered components will result now this test may not be conducted to the horizontal plane.

Since tailstock can be adjusted in the horizontal plane so while conducting this experiment that is during taking dial gauge readings tailstock and tailstock sleeve should be locked as in normal working condition the magnetic stand of the dial indicator is placed on the tool post and the plunger of dial indicator should be made to touch the mandrel surface and then slowly.

The saddle is moved to the other mandrel and then the reading is taken the difference in readings gives the alignment of centers in the vertical plane.

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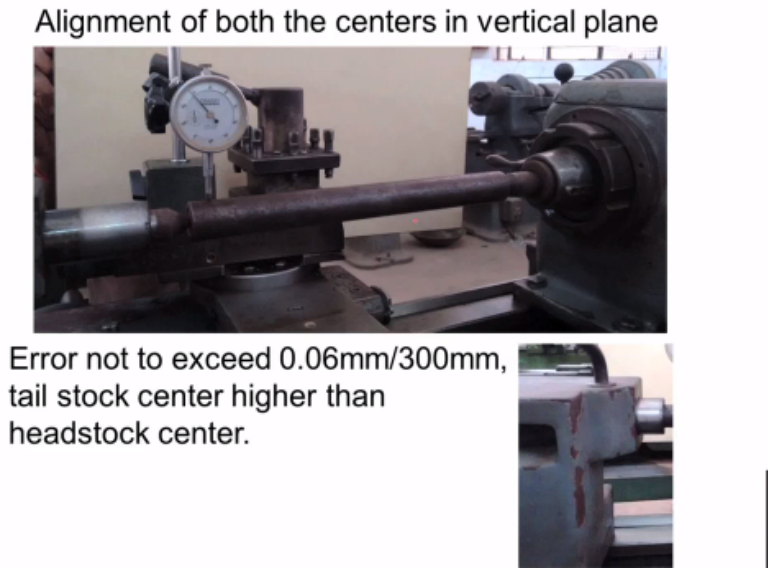

Now you can see in this photograph the mandrel is placed between the line Center and dead centre the magnetic stand is placed on the tool post and the plunger is in contact with the surface of the mandrel and then slowly the saddle is moved to the other end and then again reading the dial indicator reading is taken difference is the amount of error so this error should not exceed 0.06 millimeter/300 millimeter.

Movement of the saddle and if there is any difference in Heights tailstock centre should be higher that the headstock centre the reason is with the continuous the uses of tailstock the bottom surface of the tailstock will get and the height of tailstock center will reduce now if the error is more than0.06m millimeter then the bottom surface with tailstock is scraped and error is brought within the limits.

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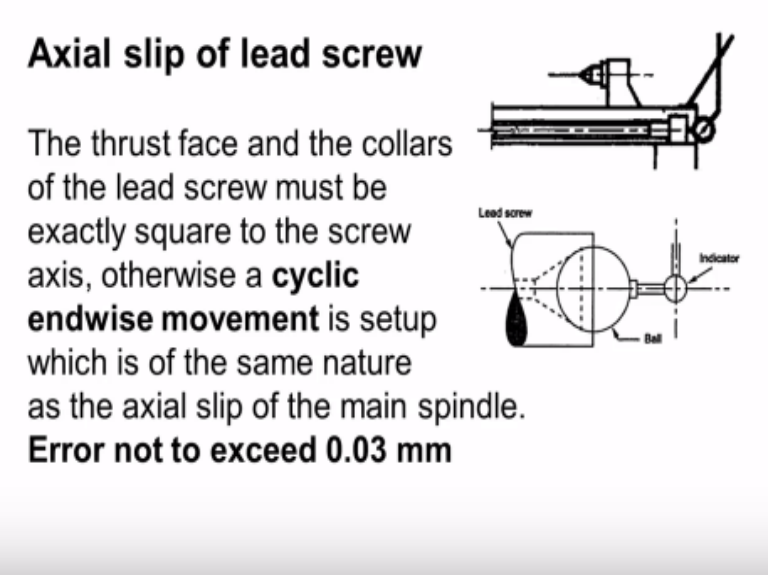

Now we will discuss about the axial slip of the lead screw. The lead screw which is used during the thread cutting the thrust face and collars of the lead screw must be exactly square to be a screw axis that means the thrust face should be perpendicular to the axis of the lead screw.

Normal errors may be this face thrust face is not perpendicular to the axis that means there is some inclination like this or maybe some irregularities like this because of this cyclic endwise movement is setup which is of the same nature as the axial slip of the main spindle because of this axial slip a periodic pitch error will be additional to any true periodic errors in the pitch of the screw.

So during the screw cutting there will be error in cut screws now in order to test this we have to put a steel pot as shown in this diagram the plunger should touch a steel bar and the dial indicator

will indicate we have to slowly rotate this screw and the dial indicator will indicate if there is any error the axial slip should not exceed 0.03 millimeter.

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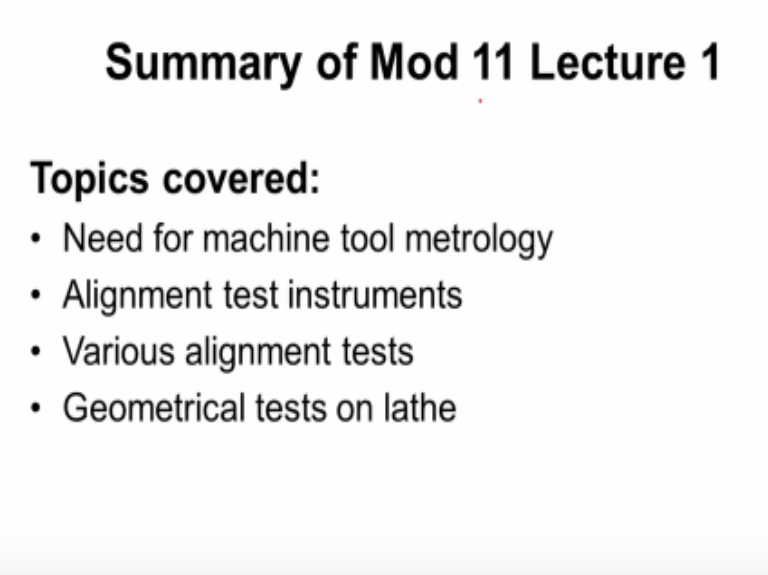

Now in this, we will conclude module 11 lecture number 1, in this lecture one we discussed about the various aspects of machine to metrology the need for machine tool metrology what are the various instruments used device conducting the machine tool metrology and what are the different types of tests alignment test that is parallelism perpendicularity and then whether the movement of the various elements is parallel to be lathe axis such things.

We discussed and geometrical tests on lathe various tests conducted that also be discussed with this we will conclude lecture number one if we continue the discussion of the machine tool metrology in lecture number 2. Thank you.