Engineering Metrology
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Lecture – 24
Gears Metrology (Part 2 of 2)

Continuing with the Measurements of Tool Thickness, so when we try to take here so, the thickness the teeth right so, this is the thickness we have to measure.

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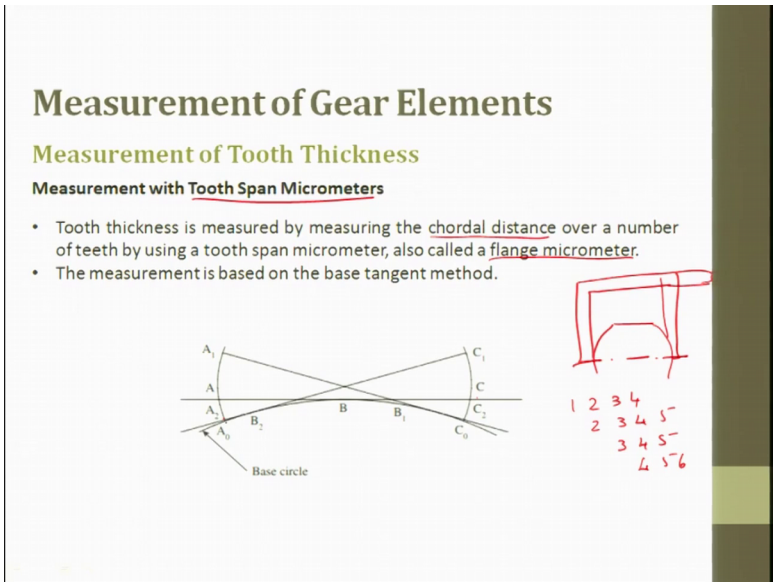

So, this is the here is a pitch circle diameter and here this is what we have to measure. So, measurement of the tooth span and micrometer so, there is a tooth span micrometer which is available. So, we will use that and try to figure out, what is the tooth thickness? The tooth thickness is measured by measuring the chordal distance over a number of teeth chordal distance over a number of teeth by using a tooth span micrometer, also called as flange micrometer.

So, here we try to measure the chordal distance over a number of teeth it is not a single teeth, we are trying to take it is like almost averaging so, but what we do suppose we do 1 2 3 4 teeth next time what we do a we do 2 3 4 5 teeth. So, it then it is 3 4 5 something

like this. So, you keep increasing and going. So, that you tried to get to measure 3 or 4 whatever it is you keep measuring that.

So, that is what we said chordal distance over a number of teeth by using a tooth span micrometer, which is otherwise called as planned micrometer. The measurement is based on the base tangent method so base tangent method. So, here what we do is we try to take this is the central line. So, we try to take a tangent a chordal, which is A B and C. Next one is going to be A 1 B 1 and C 1, next is going to be A 2 this is B 2 and then chord right. So, then it will be C 2.

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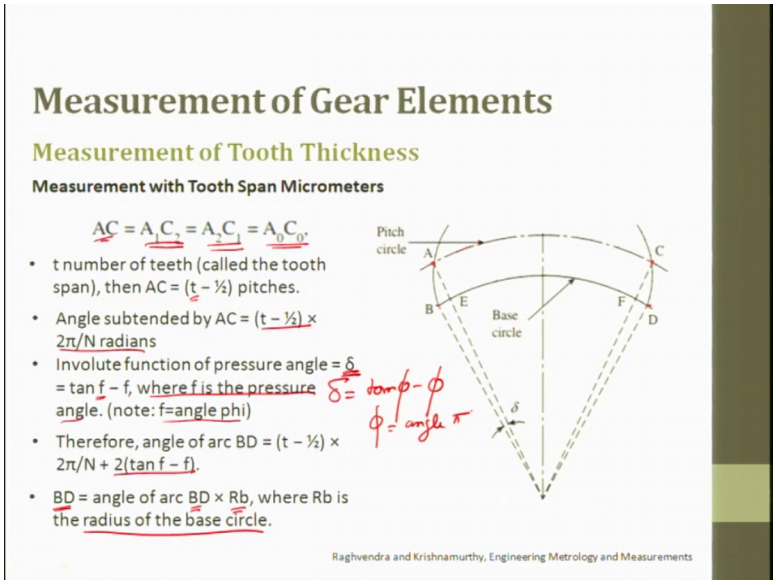

So, how do we use the measurement with the tooth span micrometer, we try to take A and C we wanted to measure. So, that is equal to so, AC right pitch circle diameter, A C is equal to what the if you go back to that figure, it is A 1 C 2 A 2 C 1 A 0 C 0. So, all this things are nothing, but the A C what we are trying to measure. So, for t number of teeth call the tooth span, then A C is equal to t minus half the pitch t is the number of teeth half the pitch.

Then, the angle subtended by A C, angle subtended by A C right is nothing, but half minus t into 2 pi by N radian show. So, the involute function of pressure angle phi or del is nothing, but tan f by minus f, where f is the pressure angle ok. This will be in given. So, note f will be angle the angle pipe f is given.

So, involute function of the pressure angle del is equal to tan f minus f, f is the pressure angle. Therefore, the arc BD is nothing, but t minus half is into 2 pi radian plus the pressure angle which is subtended. So, BD is nothing, but the angle by the arc BD into Rb, where Rb is the radius of the base circle ok. With this what we try to do is we try to find out what is BD, A C we found out then we are finding out BD.

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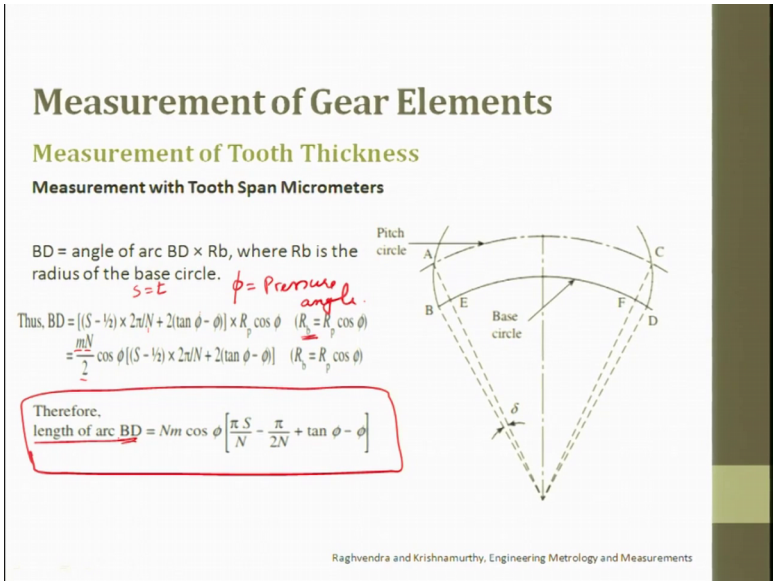

Further continue with the same BD is equal to the angle subtended by the arc BD into Rb with Rb is the base angle. So, thus BD can be figured out as S so, this S you can replace it by where S equal to you can replace it by t. So, t minus half 2 pi by N plus 2 tan phi minus phi where phi is the pressure angle R p by cos phi where R b is the radius of the base circle which is nothing, but R p into cos phi ok.

So, when you try to put it back into the equation you have module N by 2 then all the other unit you k. Now, therefore, the arc length BD the arc length BD is nothing, but N into m cos phi pi S minus N by pi minus 2 pi and this is the final equation to find out the arc of BD ok. This is the del which we were discussing about, del is the involute function of the pressure angle, where phi is the pressure angle ok.

So, this Amandeep correction [FL]; so, del is the involute function of a pressure angle that can be figured out as tan phi minus phi. So, this is nothing, but it can be written as del equal to and phi minus phi right, where phi is a angle right.

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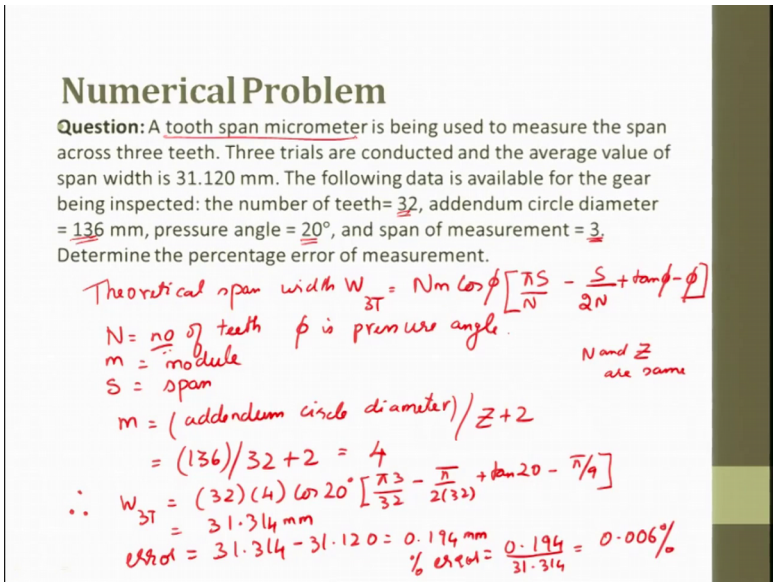

Let us try to take a problem and try to solve this, a tooth span micrometer is being used to measure the span across three teeth; we are given to treat three teeth. Three trials are conducted on the average value of the span is 31.120 millimeter. The following data is available for the gear being inspected; the number of teeth is 32, addendum circle diameter is 136, pressure angle is given as 20; the span of measurement is 3, and then determine the percentage error of measurement.

So, theoretical span width for 3 teeth's is equal to Nm cos phi by pi S N minus S by 2 N plus tan phi minus phi ok. Now, let us write down N equal to number of teeth small m is nothing but the module, S and the phi is the pressure angle right. So, m is equal to how do I find out m, m is nothing but addendum circle diameter divided by Z plus 2 right. So, this is nothing, but addendum diameter is 136 divided by Z is number of teeth 32 plus 2. So, this is nothing, but module is 4 ok. Therefore, this span is W 3 T is nothing, but 32 into 4 ok. So, here this Z and N are same, N number of teeth Z is also number of teeth ok.

So, 32 4 into pressure angle cos 20 degrees pi 3 is divided by 32 minus pi 2 into 32 and then it is plus tan 20 minus minus phi by 9 ok. This is nothing, but 31.314 millimeter. So, the error is going to be 31.314 minus 31.310, which is 0.1 9 4 millimeter, but now the percentage error is going to be 0.1 9 4 divided by 31.314, which is equal to 0.0 0 6 percentage. So, this will be the percentage error which is to be solve this problem.

So, clear it how do we use this? So, this is done by tooth span micrometer, which is used to measure the error tooth span micrometer.

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If, you look at it the composite method of gear inspection is done by Parkinson's Gear Tester, this is how is a gear testing done. You have a length to view and then you have you a you have dial gauges to measure the deviations right and then 2 gears you have so, you can mesh it and see.

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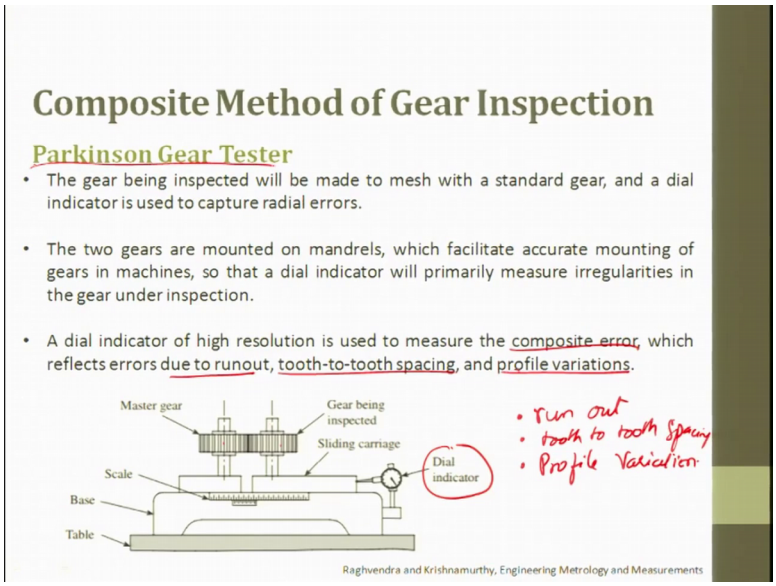

So, the gear being inspector will be made to mesh master gear, this is the gear to be inspector these 2 gears will mesh with the standard gear and the dial indicator is used to capture the radial error ok, that this is used to capture the radial error. The 2 gears are mounted on mandrel this is the mandrel, which facilitates accurate mounting of the gear in the machine.

So, that the dial indicator will primary measure the irregularities in the gear under inspection. The dial indicator of high resolution is used to measure the composite error which reflects the error due to run out, tooth to tooth spacing and profile variation, that is why it is called as composite method of gear inspection. We will measure run out run out, we saw these are the errors then tooth to tooth variation, tooth to tooth spacing and profile variation. So, this can be easily monitored through this composite gear inspection device. So, this is otherwise called as Parkinson Gear Tester.

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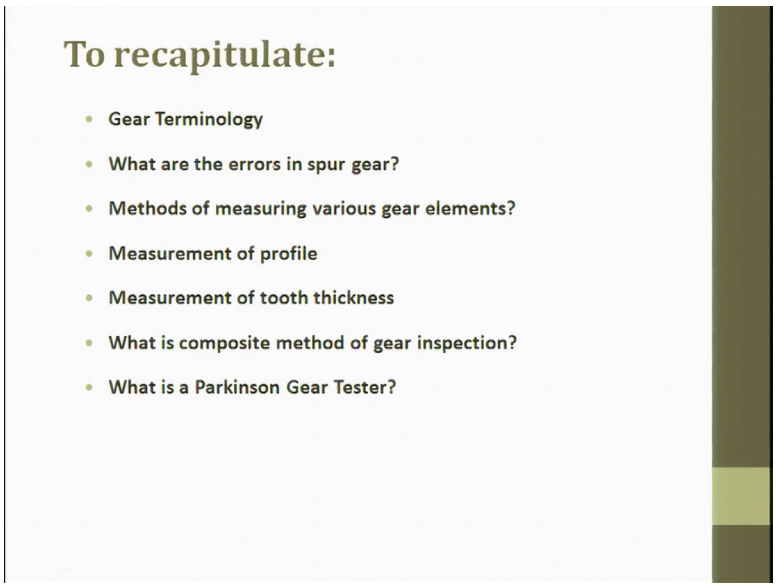

So, to recap what all we have seen in this particular chapter? We first saw gear various types of gear then gear terminologies. What are the different types of spur gear errors, where we saw run out ok? So, the spur gear why spur gear, because it is the most simplest gear and if we understand here for the other gears it will be a small variation for example, helix the teeth will be at an angle. Then various methods of measuring gears elements we saw gear profile can be measured.

So, gear pressure we can also used for measuring the profile we can use a profile projector, profile projector can also be used which is one of the comparator technique, the gear will be kept on top of a glass plate and then the light from the bottom the light will be projected, then you will have lenses. So, with this lenses you can projected on top of a screen and in that screen it will be magnified according to a requirement, then you have a master you can place it on top of the shadow whatever comes and try to see the variation.

So, here you can try to measure the thickness, you can try to measure the involute profile many things. So, that is one of the comparative technique which is used to measure the profile, then measuring of tooth thickness, then composite gear inspection, then we also saw about the Parkinson gear tester ok. Composite is where 2 or 3 errors are measured together and then we do it ok.

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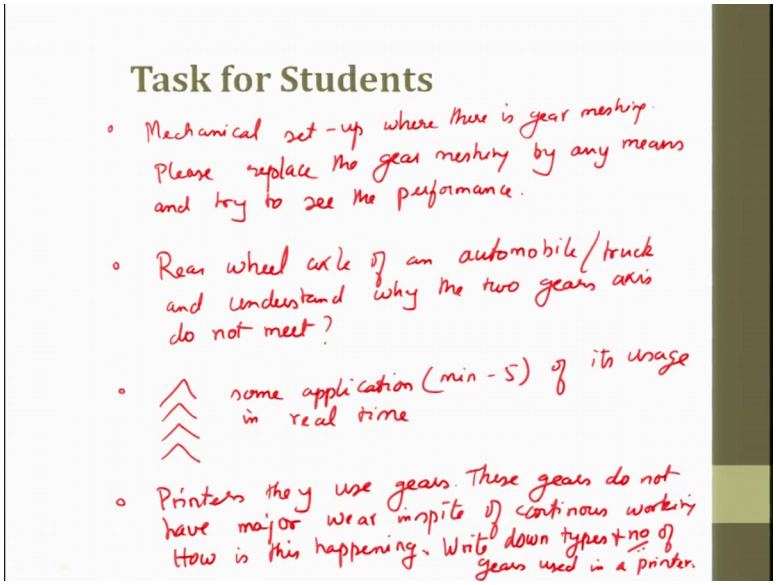

Task for Students; so, here what we do is let us try to take a mechanical set up where there is gear meshing ok. Now, what I want is I want you to replace this gear machine, please replace the gear machine by any means and try to see the performance of the mechanical setup. Next is so, we have seen I would like you to see the rear wheel axle of an automobile; that means, to stay a truck or truck and understand, why the two gear axis do not meet? Or, what is the function of non-meeting? So, this you can browse through and get to see or if you can physically see that is also encouraged.

Third thing is this, the herringbone you have gears like this herringbone. So, can you find out some application, some application means minimum 5 of its usage in real time. And, the last one is in the printers, they use gears. These gears do not have major wear in spite of continuous working. How is this happening ok?

So, these are the 5 things which are 4 things which are attached to gear. So, please look into those gear and then it will also be a good idea, if you can write down types and number of gears used in the printer. With this you can try to have a feel what is gear, what is the importance of gear? How complex is the gear profile? Where are its application?

Thank you very much.