Metrology
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Lecture – 26
Measurement of Gear Elements

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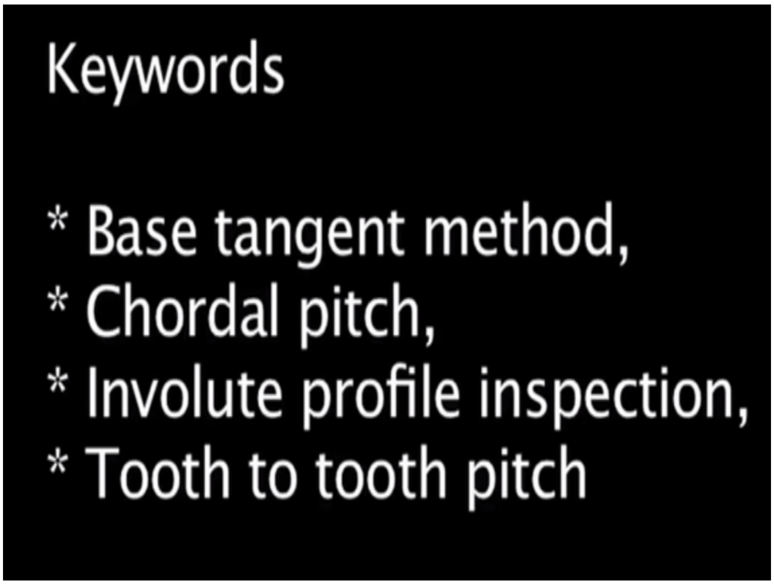

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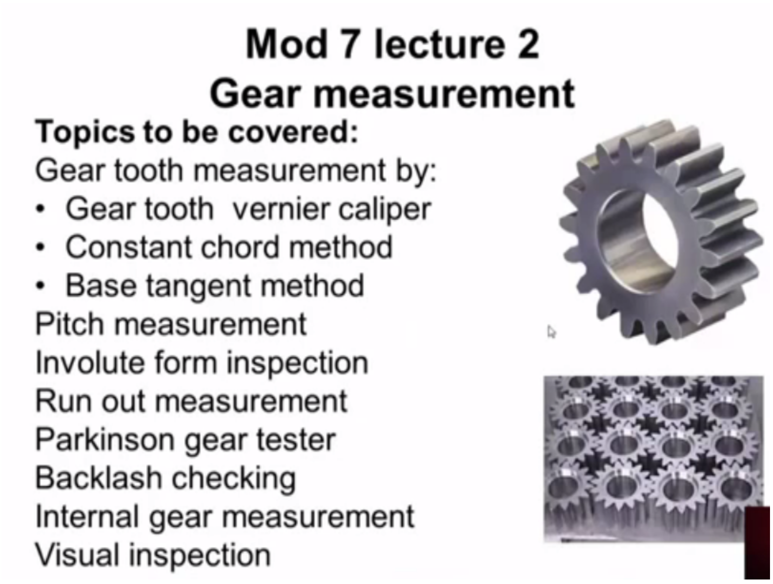

I welcome you all for module number 7 and lecture number 2 on gear measurement in this lecture number 2, we will cover the following topics gear tooth measurement by gear tooth vernier caliper, constant chord method, base tangent method, pitch measurement, gear tooth involute form inspection.

Then gear run out measurement also we will discuss about Parkinson gear tester backlash checking internal gear measurement and finally we discuss about visual inspection of gears.

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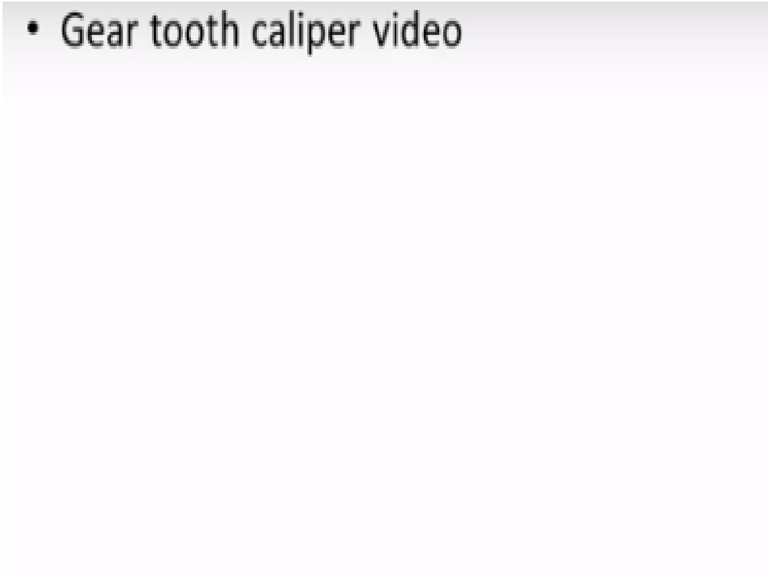

We will study how to use gear tooth caliper for measurement of tooth thickness.

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Now we can observe the gear tooth vernier caliper in horizontal scale of the caliper the main scale and vernier and now we can observe the vertical scale of the gear tooth vernier the main scale and vernier of vertical scale of gear tooth caliper. We can see the full view of vernier caliper.

Now we can observe how to measure the tooth thickness using the gear tooth Vernier caliper theoretical values should be calculated the vertical blade should be moved and then the gear tooth vernier caliper is placed on the gear tooth and then the horizontal movable jaw of the horizontal scale should be adjusted and then thickness can be measured.

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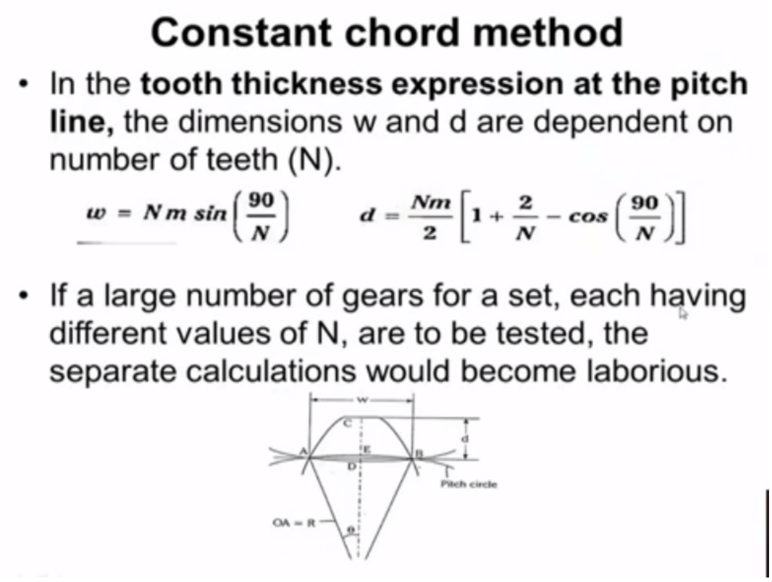

Now let us move to the another method of measurement of tooth thickness that is constant chord method in this diagram we can see the w is chordal thickness is measured at the pitch line at depth of d now the expressions chordal thickness expressions and the depth expressions used for measurement for calculated for tooth thickness these expressions contain the value N that is number of teeth.

Both the expressions w and depth contains the number of teeth N if a large number of gears for a number of set each having different values of N are to be tested then separate calculations would become laborious.

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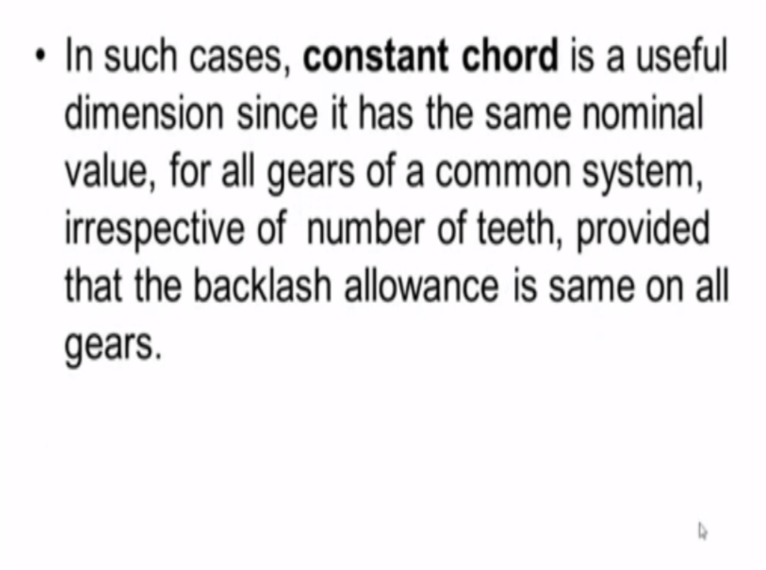

In such cases the method of constant chord is useful method so this constant chord is used in dimension since it has the same nominal value for all gears of a common system irrespective of number of teeth provided that the backlash allowance is same on all gears.

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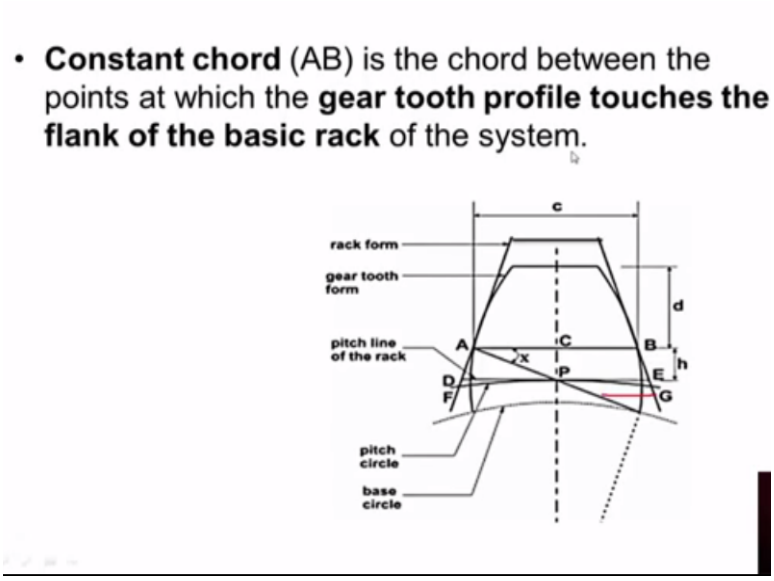

Now in the diagram we can see C is the constant chord it is the distance between point A and point B we have the point A here and we have point B here. A constant chord is a chord between the points at which the gear tooth profile touches the flank of the basic rack of the system and here you can see basic rack of the system this is the gear profile they meet at point A here and point B here the distance between the these2 points AB is the constant chord.

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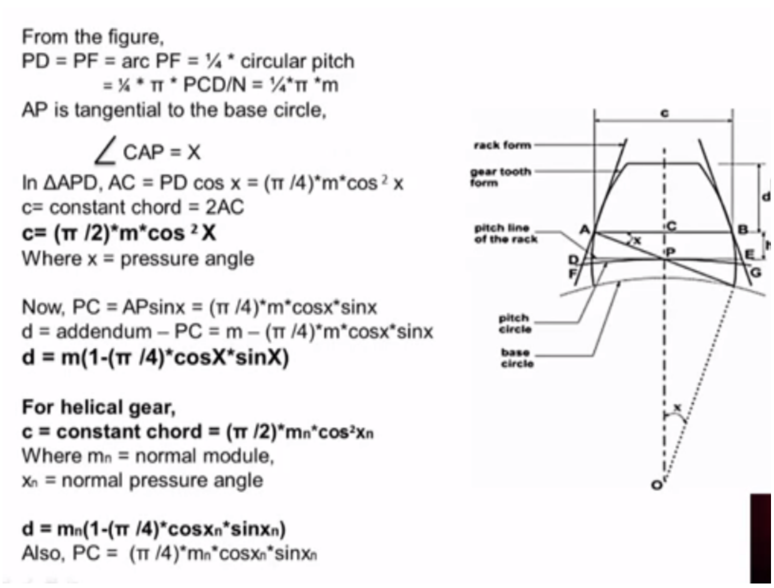

Now from this geometry we can derive the expression for constant chord is =2AC that is distance from A to C from C to B =2AC this is the constant chord C from this geometry we can derive the expression C=(pie/2)m cos squared X is the pressure angle and similarly we can derive the expression for depth d that is d=addendum-PC so this gap we have to detect from addendum so d=addendum-PC.

So the final expression is d=m(1-pie/4)cos X x sin X where X is pressure angle so these 2 expressions are for spur gear for helical gear we can get the expressions for constant chord =pie/2Mn x cos square Xn, where Mn is normal module, and Xn = normal pressure angle and d =Mn (1-(pie/4) cos Xn x cos Xn x sinXn).

Now we have to fix the value of d in the vernier caliper after finding the value of d and then we can measure the value of C that is constant chord and the measured value can be compared with the theoretical value to find error.

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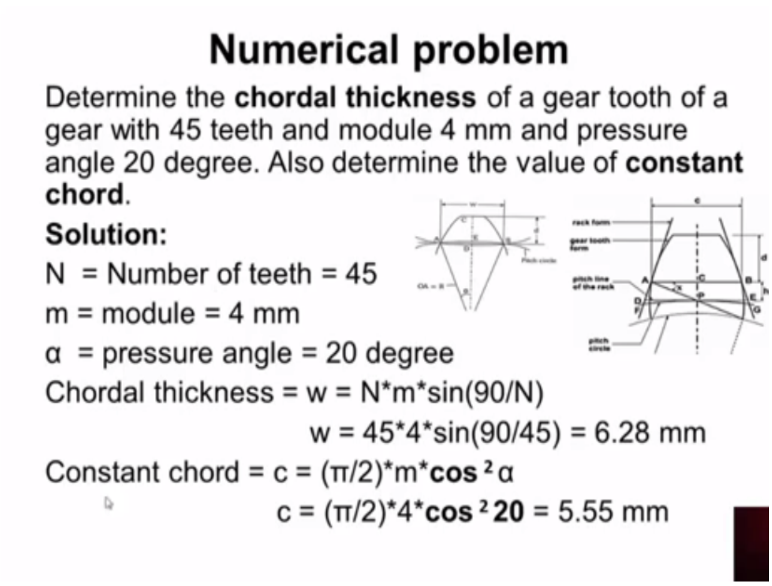

Now we will have numerical Problem we required to determine the chordal thickness of a gear with 45 teeth and module 4 millimeter and pressure angle 20 degree also we have to determine the value of constant chord.

Now the data that is given is N = 45 and module = 4mm pressure angle = 20 degrees, so chordal thickness which is measured and the pitch line, so this is the chordal thickness this is =N x m sin(90/N) so N is 45 and module is 4 millimeter and N is again 45 so this value of chordal thickness is 6.28 millimeter and constant chord c = (pie/2) x m x cos square alpha so alpha is 20 degrees and m is 4 millimeter so we get the value of constant chord that is 5.5 millimeter now for this diagram we can see the constant chord is measured slightly above the pitch line so that is this AB is the constant chord, whereas the chordal thickness is measured at the pitch line this is the pitch line, so the constant chord value will be < the chordal thickness.

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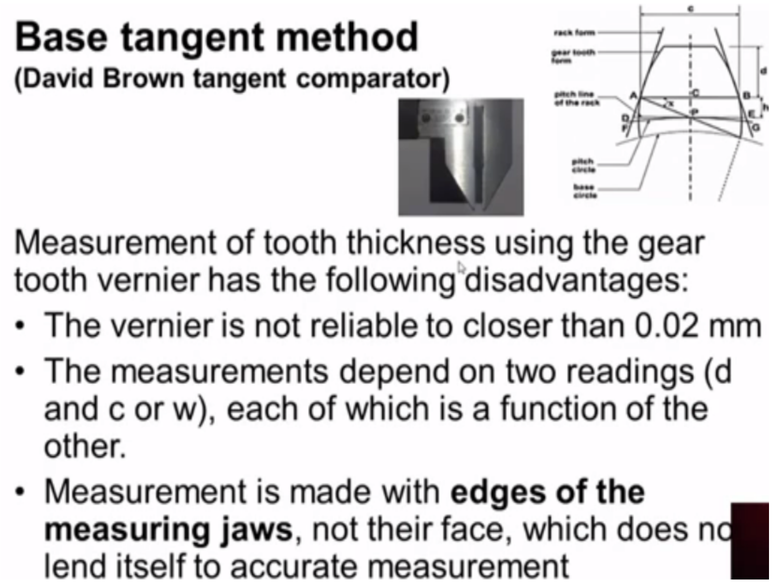

Now we will move on to another method of measurement of gear tooth that is base tangent method. This method uses an instrument called David Brown tangent comparator or we can use a flange comparator the measurement of tooth thickness by using the gear tooth vernier has some disadvantages.

The vernier is not reliable to closer than 0.02 millimeter the measurement depend on 2 readings d that is depth and constant chord or chordal thickness each of which is a function of the other measurement is made with edges of the measuring jaws so we can see here the tooth thickness is measured using the edges of the gear tooth not their face so which does not lend itself to accurate measurement.

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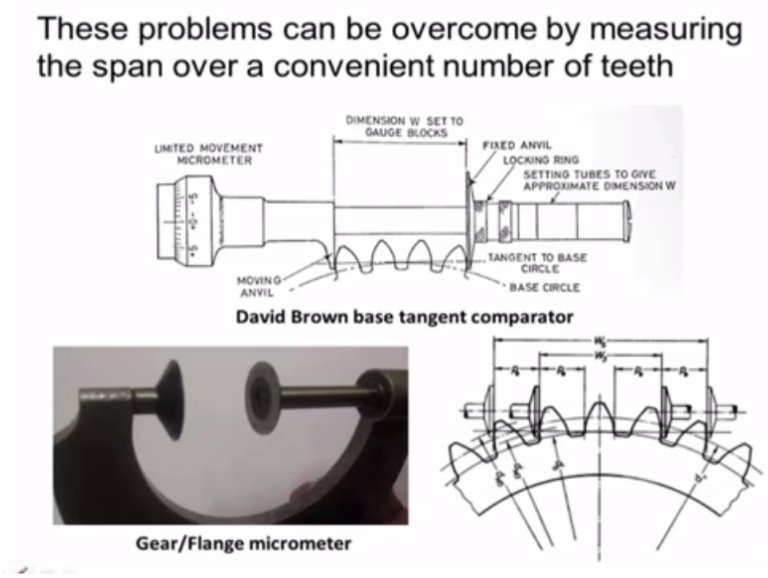

These problems can be overcome by measuring the span over a convenient number of teeth we can see here we can select some number like 4 teeth or 3 teeth or 5 teeth, so we can select the spam over the convenient number of teeth and we can measure the width we can use David brown tangent comparator which consists of limited movement micrometer.

So this is the moving anvil and this is the fixed anvil the distance between the moving anvil and fixed anvil can be set using slip gauges and then we have locking ring to lock the position of fixed angle setting cubes will give approximate dimension w this is the base circle so this is the tangent to base circle, so we can always use gear flange micrometer also for measurement of width over the convenient number of teeth.

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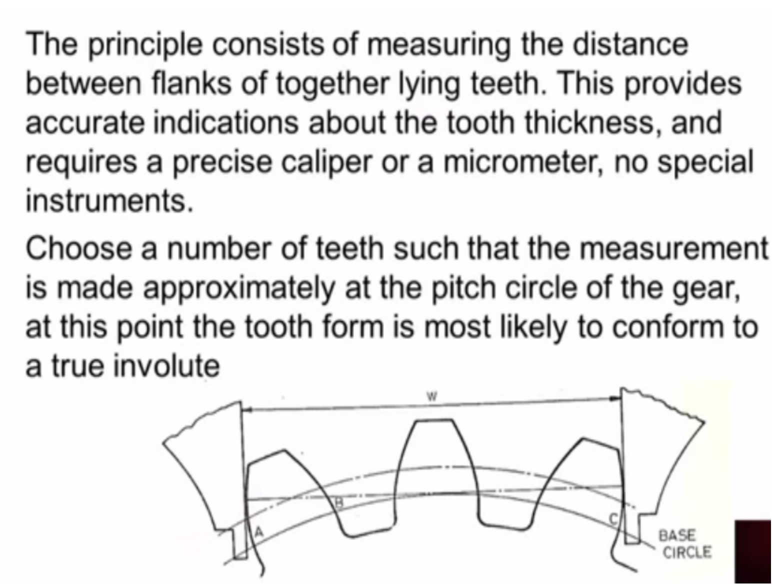

The measurement principle consists of measuring the distance between flanks of together lying teeth this provides accurate indications about the tooth thickness and requires a precise caliper or a micrometer no special instruments are needed we should choose a number of teeth such that measurement is made approximately at the pitch circle of the gear you can see here this is the base circle and this the pitch circle.

So the measurement is we should select the number of teeth such that the measurement is made approximately at the pitch line so this is the pitch line of the pitch circle of the gear at this point the tooth form is most likely to conform to a true involute.

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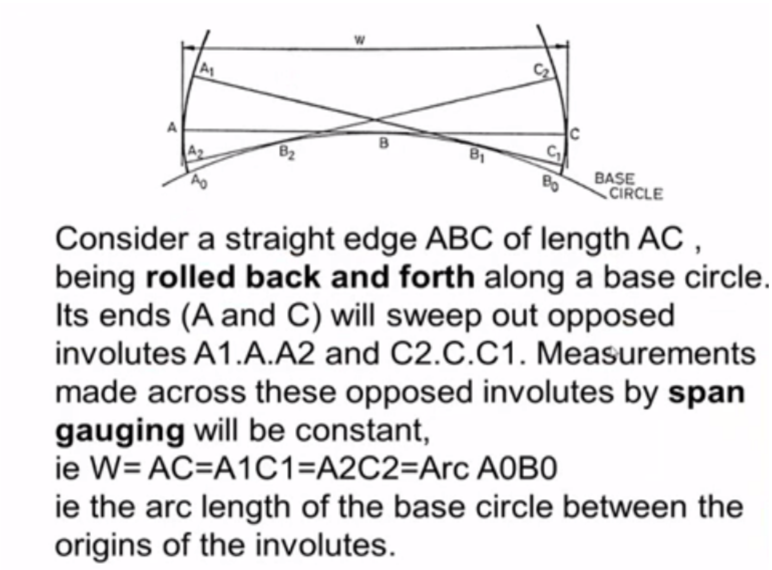

Now we consider a straight edge ABC so this is the straight edge A, B, C of length AC being rolled back and forth along a base circle that is line A,B,C is rolled back and forth like this along a base circle this is the base circle its ends A and C this is the end A and end C its end A and C will sweep out opposed involutes A1AA2 and this is A1 A A2 and C2CC1.

There is C2 C C1measurements made across these opposed involutes by span gauging will be constant that is W= AC=A1C1=A2C2=Arc A0B0 that is. the arc length of the base circle between the origins of the involutes.

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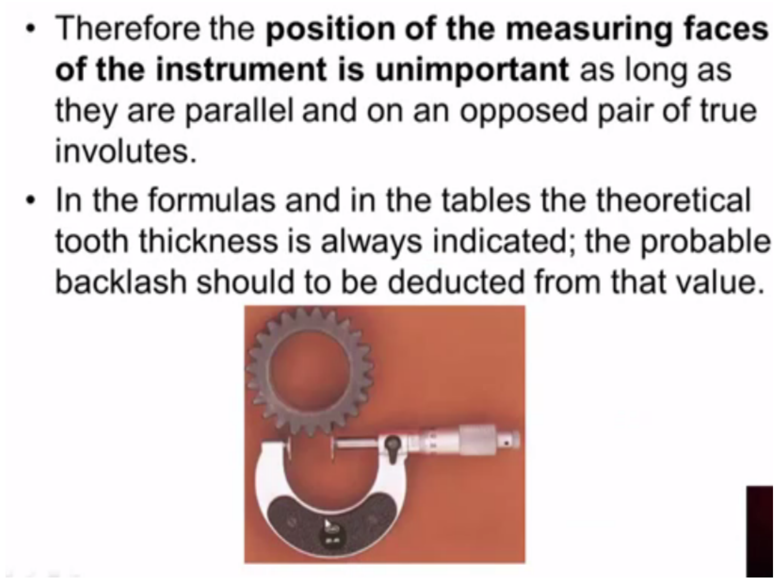

Therefore, the position of the measuring faces of the instrument is unimportant as long as they are parallel and on an opposed pair of true involutes in the formulas and in the tables the theoretical tooth thickness is always indicated the probable backlash should be deducted from that value In this picture a gear is being inspected by flange micrometre by adopting base tangent method.

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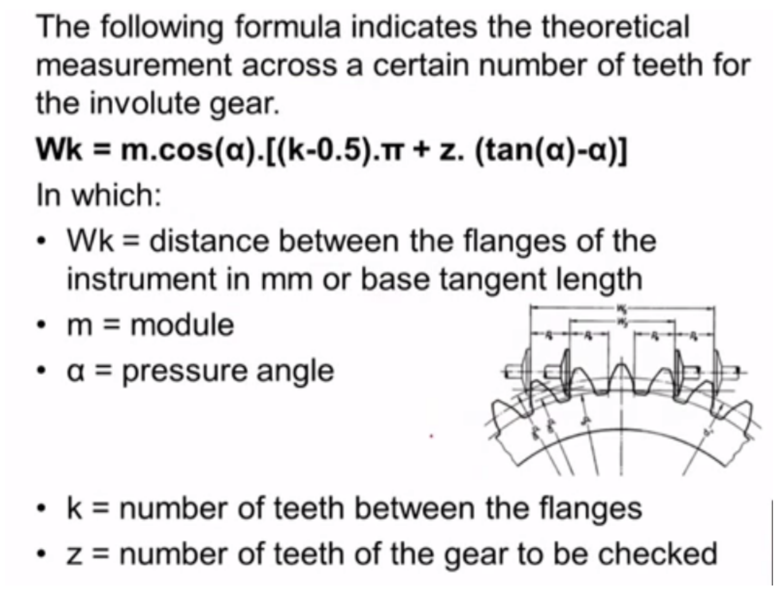

The following formula indicates the theoretical measurement across a certain number of teeth for the involute gear, so Wk is the base tangent length=m cos (alpha) [(k-0.5)pie+Z(tan (alpha)-alpha)] in which Wk is the distance between the flanges of the instrument in millimeter or base tangent length m is module and alpha is the pressure angle.

k is number of teeth between the flanges you can see here w3 is the base tangent length for number of teeth = 3 and w5 is base tangent when the number of teeth selected are 5 and z=number of teeth of the gear to be checked.

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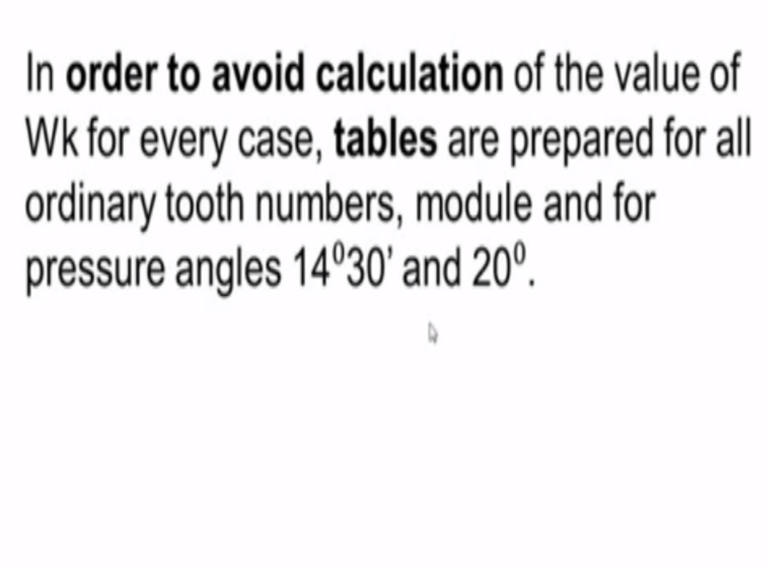

In order to avoid the calculation of the value of Wk for every case tables are prepared for all ordinary tooth numbers module and for pressure angles 14degree 30minutes and 20 degree.

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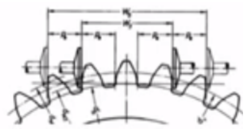
TABLES

α = Pressure angle 14°30'
z = Number of teeth of the gear
k = Number of teeth between lips of the caliper
Wk= Theoretical dimension with module 1



z	k	Wk	z	k	Wk	z	k	Wk
5	2	4,589129	49	4	10,908382	93	8	23,310686
6	2	4,594498	50	4	10,913751	94	8	23,316055
7	2	4,599866	51	5	13,960644	95	8	23,321423
8	2	4,605234	52	5	13,966013	96	9	26,368317
9	2	4,610602	53	5	13,971381	97	9	26,373685
10	2	4,615971	54	5	13,976749	98	9	26,379053
11	2	4,621339	55	5	13,982117	99	9	26,384421
12	2	4,626707	56	5	13,987485	100	9	26,389790
13	2	4,632075	57	5	13,992854	101	9	26,395158
14	2	4,637443	58	5	13,998222	102	9	26,400526
15	2	4,642812	59	5	14,003590	103	9	26,405894
16	2	4,648180	60	5	14,008958	104	9	26,411262

Now, we can see here the prepared table, which will give directly the value of Wk theoretical value of Wk alpha is pressure for alpha of 14 degree 30minutes and for different value of z equals number of teeth of the gear and for different number of teeth between the flanges so k is number of between the flanges and Wk is theoretical dimension with module 1.

So for different z values 5, 6, 7, 49, 50, 60, 102, 103, 104 different values of z for different values k values k=2, k=4, k=5, k=9 so like this different k value and for module 1 this table will give the base tangent length.

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Numerical problems:

1. **Determine the base tangent length of a spur gear having 5 teeth, module 1, pressure angle 14.5° and number of tooth spaces contained between the lips of instrument is 2**

Solution:

$k = 2,\ m = 1,\ \alpha = 14.5°,\ z = 5$

$Wk = m.\cos(\alpha).[(k-0.5).\pi + z.\ (\tan(\alpha)-\alpha)]$

$Wk = 1*\cos\ (14.5°)[(2-0.5).\pi\ + 5\ (\tan(14.5°)\ -\ 14.5°/57.296)]$

$Wk = 4.59$ mm

Now we have the numerical problems we are required to determine the base tangent length of a spur gear having 5 teeth, module1 pressure angle 14.5 degree and number of tooth spaces contained between the lips of the instrument is 2 that is k= 2 module=1 alpha=14.5 degree z=5, so we use this relationship expression for finding the tangent length so after inserting the values we get the base tangent length of 4.59 millimeter.

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2. **Determine the base tangent length of a spur gear having 60 teeth, module 1, pressure angle 14.5° and number of tooth spaces contained between the lips of instrument is 5**

Solution:

$k = 5,\ m = 1,\ \alpha = 14.5°,\ z = 60$

$Wk = m.\cos(\alpha).[(k-0.5).\pi + z.\ (\tan(\alpha)-\alpha)]$

$Wk = 1*\cos\ (14.5°)[(5-0.5).\pi\ + 60\ (\tan(14.5°)\ -\ 4.5°/57.296)]$

$Wk = 14.01$mm

Now we have another numerical problem determining the base tangent length of a spur gear having 60 teeth, module 1, pressure angle 14.5 degree and number of tooth spaces contained between the lips of instrument is 5 K is 5 m module is 1 pressure angle is 14.5 degree Z=60.

So by using the expression and by inserting the values we get base tangent length of 14.01 millimeter.

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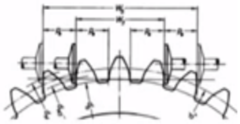
α = Pressure angle 14°30′ TABLES
z = Number of teeth of the gear
k = Number of teeth between lips of the caliper
Wk= Theoretical dimension with module 1



z	k	Wk	z	k	Wk	z	k	Wk
5	*2*	*4,589129*	49	4	10,908382	93	8	23,310686
6	2	4,594498	50	4	10,913751	94	8	23,316055
7	2	4,599866	51	5	13,960644	95	8	23,321423
8	2	4,605234	52	5	13,966013	96	9	26,368317
9	2	4,610602	53	5	13,971381	97	9	26,373685
10	2	4,615971	54	5	13,976749	98	9	26,379053
11	2	4,621339	55	5	13,982117	99	9	26,384421
12	2	4,626707	56	5	13,987485	100	9	26,389790
13	2	4,632075	57	5	13,992854	101	9	26,395158
14	2	4,637443	58	5	13,998222	102	9	26,400526
15	2	4,642812	59	5	14,003590	103	9	26,405894
16	2	4,648180	*60*	*5*	*14,008958*	104	9	26,411262

From the tables we can directly get the Wk values you can see for z =5 and k=2 the Wk value is 4.59 millimeter and for z = 60 and k=5 Wk value is 14.01 millimeter.

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α = Pressure angle 20° TABLES
z= number of teeth of the gear
k= number of teeth between lips of the caliper
Wk= theoretical dimension with module 1

z	k	W_k	z	k	W_k	z	k	W_k
8	*2*	*4,540241*	44	6	16,852967	80	10	29,165692
9	2	4,554247	45	6	16,866972	81	10	29,179697
10	2	4,568253	46	6	16,880978	82	10	29,193703
11	2	4,582258	47	6	16,894983	83	11	32,159840
12	2	4,596264	48	6	16,908989	84	11	32,173845
13	2	4,610269	49	6	16,922994	85	11	32,187851
14	2	4,624275	50	7	19,889131	86	11	32,201856
15	3	7,590412	51	7	19,903137	87	11	32,215862
16	3	7,604417	52	7	19,917142	88	11	32,229868
17	3	7,618423	53	7	19,931148	89	11	32,243873
18	3	7,632428	54	7	19,945153	90	11	32,257879
19	3	7,646434	55	7	19,959159	91	11	32,271884
20	3	7,660439	56	7	19,973165	92	12	35,238021
21	3	7,674445	57	7	19,987170	93	12	35,252027
22	3	7,688450	58	8	22,953307	94	12	35,266032
23	3	7,702456	59	8	22,967313	95	12	35,280038
24	4	10,668593	60	8	22,981318	96	12	35,294043
25	4	10,682599	61	8	22,995324	97	12	35,308049
26	4	10,696604	62	8	23,009329	98	12	35,322054

Now this table shows the base tangent length values Wk theoretical values in millimeter with module 1 and pressure angle 20 degree and different values of z and different values of k the z value are wherein from 8, 9, 10, 61, 62, 97, 98 like this the different z values and k values is 2, 3, 4, 6, 7, so for different k values and wk values are obtained from this table.

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3. **Determine the base tangent length of a spur gear having 8 teeth, module 1, pressure angle 20° and number of tooth spaces contained between the lips of instrument is 2**

Solution:

$k = 2, m = 1, \alpha = 20°, z = 8$

$Wk = m.\cos(\alpha).[(k-0.5).\pi + z. (\tan(\alpha)-\alpha)]$

$Wk = 1*\cos (20°)[(2-0.5).\pi + 8 (\tan(20°) - 20°/57.296)]$

$Wk = 4.5415mm$

z	k	W_k	z	k	W_k	z	k	W_k
8	*2*	*4,540241*	44	6	16,852967	80	10	29,165692
9	2	4,554247	45	6	16,866972	81	10	29,179697
10	2	4,568253	46	6	16,880978	82	10	29,193703

Now we have numerical problem we are required to determine the base tangent length of a spur gear having 8 teeth module 1 pressure angle 20 degree and number of tooth spaces contain between the lips of instrument is 2 that is k=2 module 1 pressure angle is 20 degree and z=8 there using expression we get the base tangent length of 4.54millimeter, so this can directly obtained from the tables z=8 and k=2 and the base tangent length that is Wk is 4.541 millimeter.

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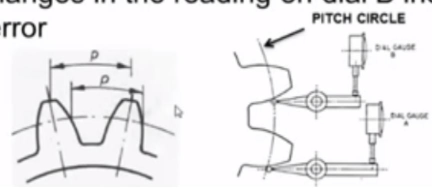
Tooth to tooth pitch measurement

- Pitch (p) is the length in between two successive teeth
- Circular pitch (CP): It is the distance from a point on one tooth to a corresponding point on the next tooth and is measured on the pitch circle.
- Two dial gauges on adjacent teeth can be used to check pitch errors.
- The **gear is indexed** through successive pitches to give a constant reading on dial A.
- Any changes in the reading on dial B indicates the pitch error



Now let us discuss about tooth pitch measurement Pitch is the length in between 2 successive teeth gear so this gear tooth pitch is also known as circular pitch it is the distance from a point on 1 tooth to a corresponding point on the next tooth and is measured on the pitch circle you can see in this diagram we have gear teeth.

Now this is the pitch circle so we have a point on the profile of the gear tooth the point is on pitch circle and corresponding point on the next tooth is available here so this distance along the pitch line is known as circular pitch How we can measure the tooth pitch so we have an arrangement here 2 dial gauges on adjacent teeth can be used to check pitch errors.

We have dial gauge A and we have dial gauge B and we have 2 stylus pivoted at this point now the stylus tip is in contact with flank of the tooth on the pitch circle that we can observe here the gear is indexed through successive picture to give a constant reading A what we have to do we have to initially place 2 stylus on the point here.

Then we should see we should make arrangements such that dial gauge A reads and what is the reading in this dial we have to note down and then we have to withdraw the 2 dial gauges we should have such arrangement to withdrawing the stylus and then we should index the gear and again.

We should move the 2 dial gauges in and we should see that this stylus contact the point on the flanks on the pitch line and we should again adjust the reading A to read 0 and what is reading B that we should note down that will give the error in pitch any changes with reading on dial B indicates the pitch error.

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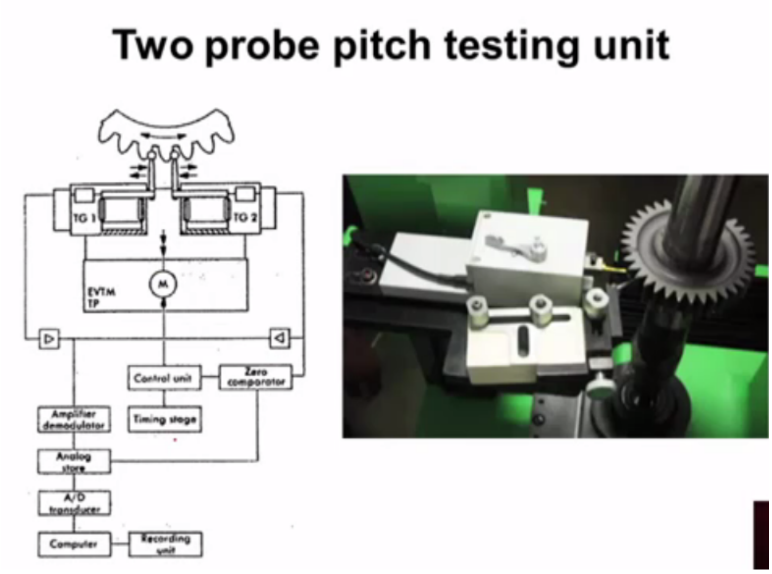

Now we can see here a pitch measuring machine there is a spindle on which gear to inspected are placed and 2 stylus are there which will make contact on the flange of the gear on the pitch line there is an arrangement for indexing the gear and there is an arrangement for movement of stylus in and out the schematic diagram we see the gear has to be indexed and 2 stylus are there and then 2 transducers are there necessary hardware and software are there and recording unit to record the pitch errors.

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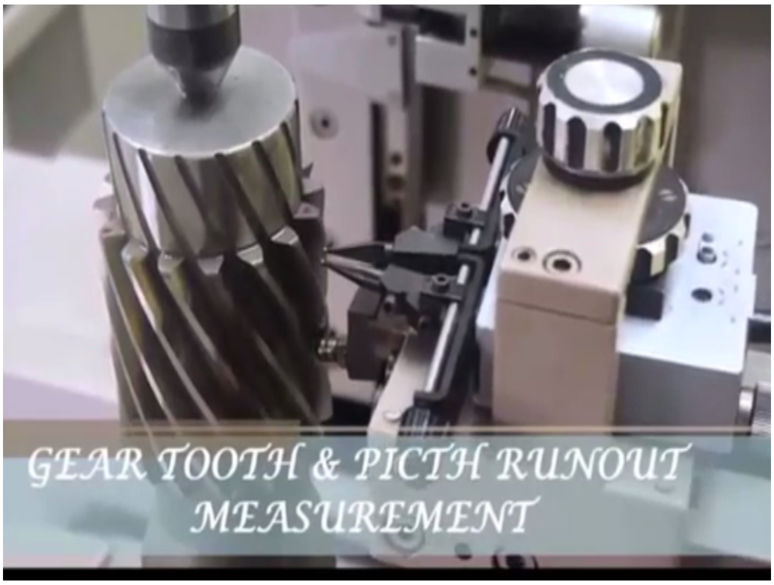

Now we observe the pitch measurement process now we observe the pitch measuring machine in action the gear to be inspected the arrangement for mounting the gear to be inspected it is mounted between centers it can observe the movement of measuring head which has 2 probes mode in between the space which has 2 probes in between part to measure the pith the gear is rotated and the pitch is measured.

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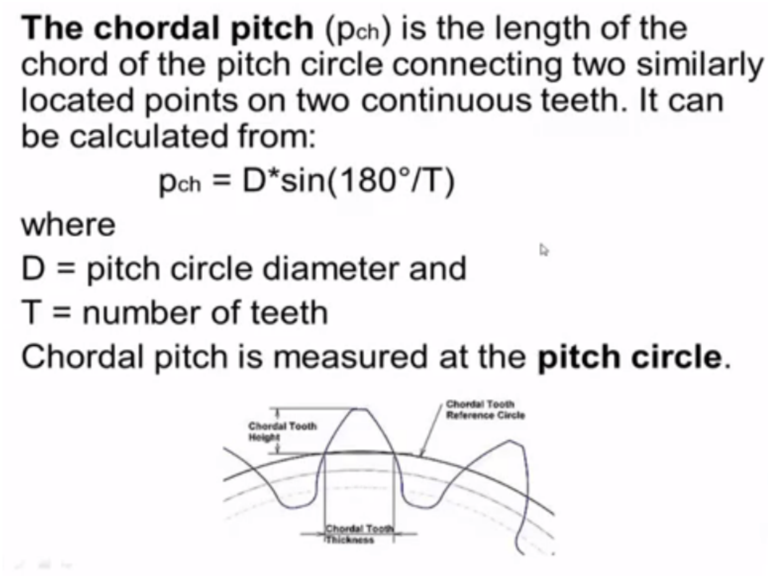

Now we frequently use another term called the chordal pitch associated with the terminology chordal pitch is the length of the chord of the pitch circle connecting to similarly located points on to continuous teeth we can see here so we have point on the reference circle the similarly located points in next tooth we have selected here the distance between the these 2 points is known as chordal pitch.

It can be calculate using these expression chordal pitch=D x sin(180/T) where D is pitch circle diameter and it is number of teeth of the gear, so these chordal so this theoretical chordal pitch is compared measured pitch to check error in the pitch circle.

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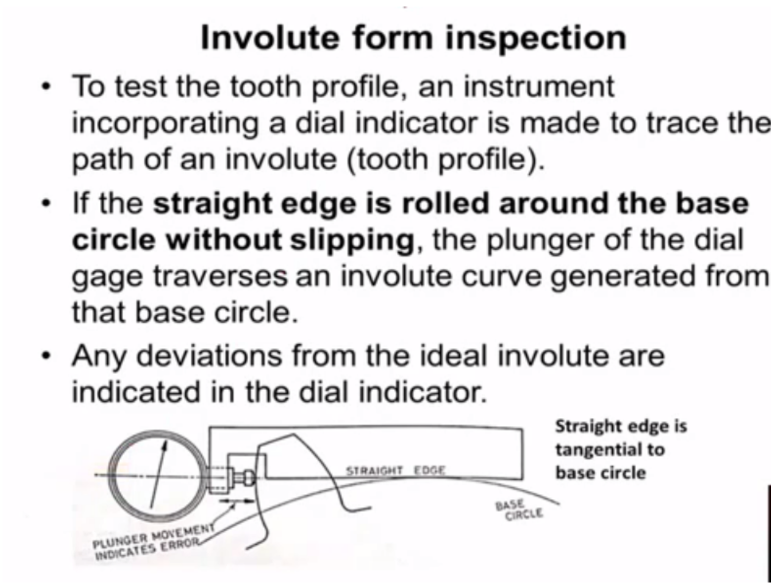

Now let us discuss the involute form inspection to test the tooth profile and instrument incorporating a dial indicator is made to trace the path of an involute tooth profile we can see here this is the base surface circle of the gear and then this is the gear tooth and this is the profile involute profile in the arrangement.

We have a straight edge and at one end of the straight edge we have dial indicator and plunger of the dial indicator is contacting the tooth involute profile now if the straight edges rolled around the base circle without slipping the plunger of the dial gauge traverses an involute curve generated from that base circle now you can see here this straight edge is tangential to the base circle and it is rolled around the base circle.

When the straight edge is rolled the plunger of the dial indicator traces the path of involute curve generated by the base circle now if the involute profile of the year to be that is being inspector is perfect then there will not be any reading in a dial indicator, if there are any variations deviations from the true involute profile then that will be indicated by the dial indicator any deviation should be ideal involute are indicated by the dial indicator.

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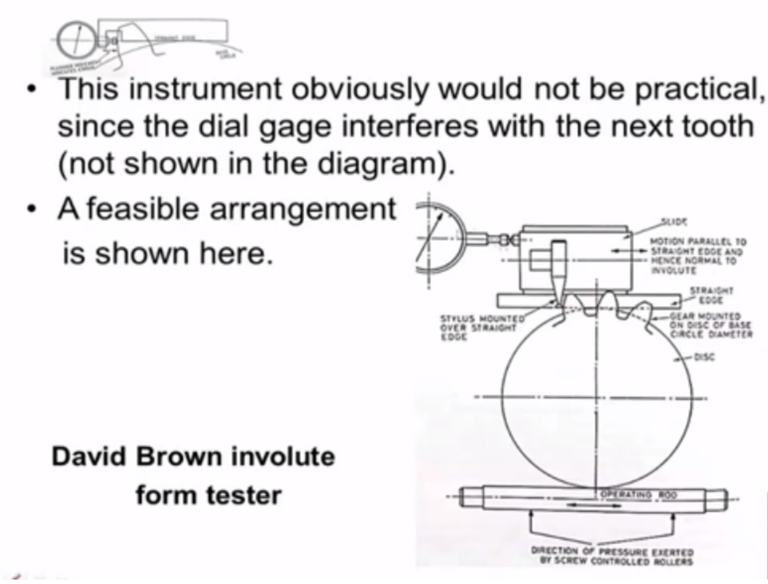

Now this instrument that is shown here obviously would not be practical since the dial gauge interferes with the next tooth so there will be another gear tooth here, so it will be obstructing the dial indicator so this is not a practical instrument a feasible instrument is shown here this is known as David Brown involute form tester you can see here.

The disc the gear is to be inspected is mounted here on this disk the diameter of this disk is equal to the base circle diameter of the gear to be inspected and this is the straight edge which is placed tangential to the disc and then there is a slide on the straight edge there is a provision for motion of the slide parallel to the straight edge and hence normal to involute the stylus is mounted over the straight edge.

So when the slide most parallel to the straight edge this stylus will trace the involute profile and any deviation from true involute profile will indicate by this dial indicator now for rotating the disc there is an arrangement operating rod when moving the rod we can rotate the disc and hence we can rotate the gear to be inspected.

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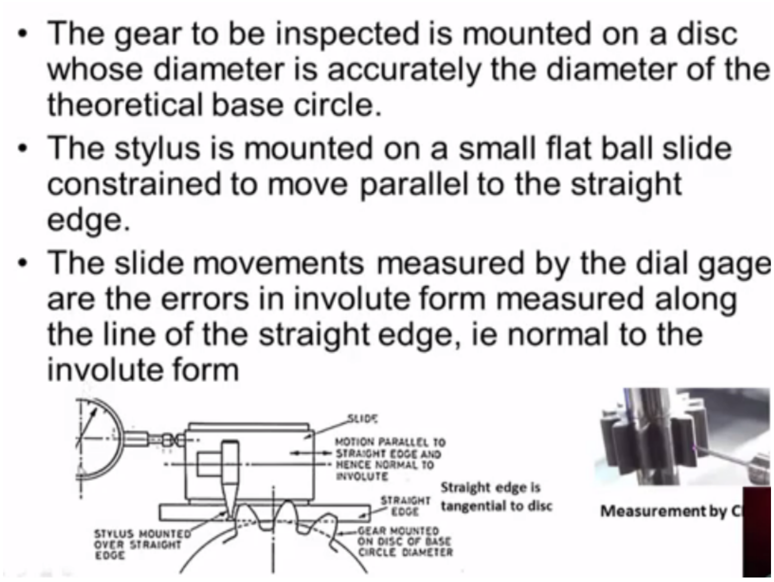

The gear to be inspected to be mounted on a disc whose diameter is accurately the diameter of the theoretical base circle the stylus is mounted on a small flat ball slide constrained to move parallel to straight edge the slide movements measured by the dial gage or the errors in involute form measured along the line of the straight edge that is normal to the involute form nowadays the involute profile of flank profile are measured by using coordinate machine.

(Video Starts: 32:42)

Now we can observe the profile of the involute coordinate measuring machine, now we can observe the profile involute impression by the coordinate measuring machine the gear to be tested to be mounted in the centers and the probe of CMM is scanning the involute profile of the gear tooth it can observe the rotation of the gear as well as the movement of stylus of coordinate measuring machine the profile is being scanned now we can observe the profile result left profile and the right profile.

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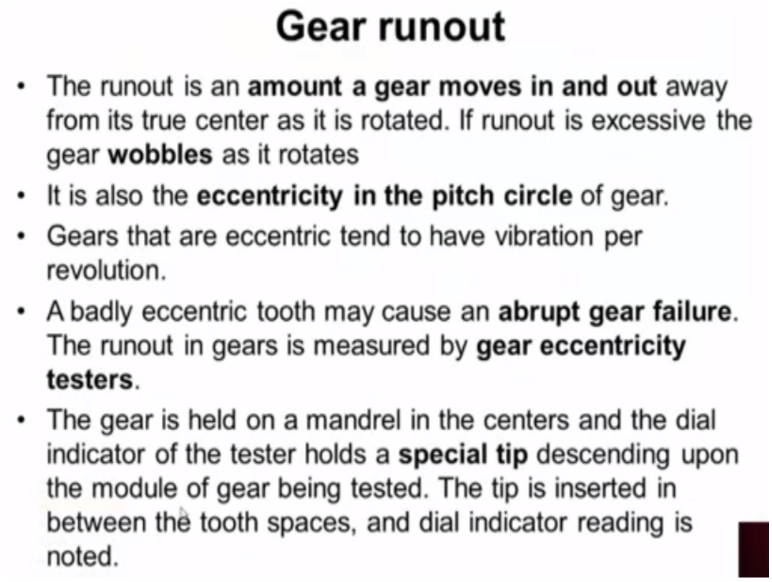

Now we will move on to the measurement of gear run out the run out is an amount as your moves in and out away from it true centre as it is rotated if runout is excessive, the gear wobbles as it rotates. Runout is also the eccentricity in the pitch circle of gear gears that are eccentric tend to have vibration when the gear rotate a badly eccentric tooth.

May cause an abrupt gear failure, the gear runout is measured by eccentricity testers the gear is held on the on a mandrill in the centers and the dial indicator of the tester holds a special type depending upon the module of gear being tested. That is inserted in between the 2 spaces and dial indicator reading is noted.

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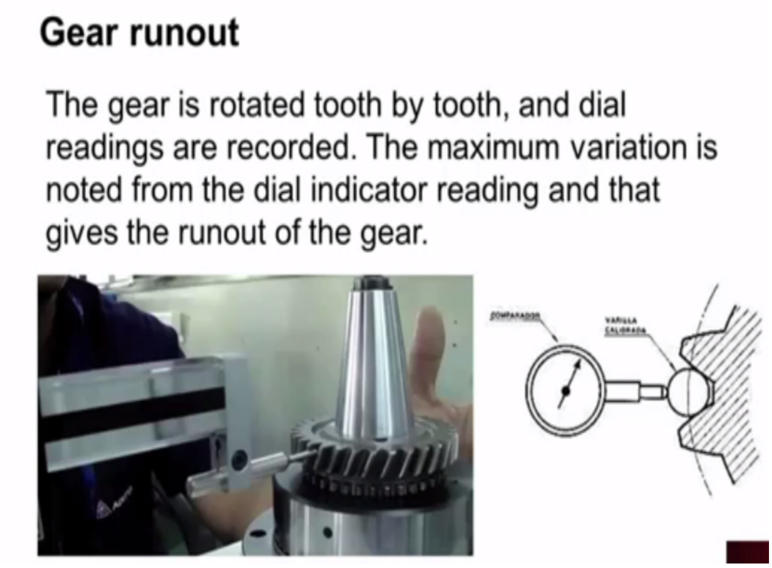

The gear is rotated tooth by tooth and dial readings are recorded the maximum variation is noted from the dial indicator reading and that gives the run out of the gear so in this picture we can see the arrangement used for measurement of gear run out there is a spindle on which the gear to be inspected is mounted and a special tip.

Which will move in between the tooth space and the dial indicator reading is noted the special tip of the stylus is moved in between the teeth and a dial indicator is noted the tip is withdrawn and gear is rotated and special tip is inserted in between a next tooth space and again dial indicator reading is noted like this gear run out is measured.

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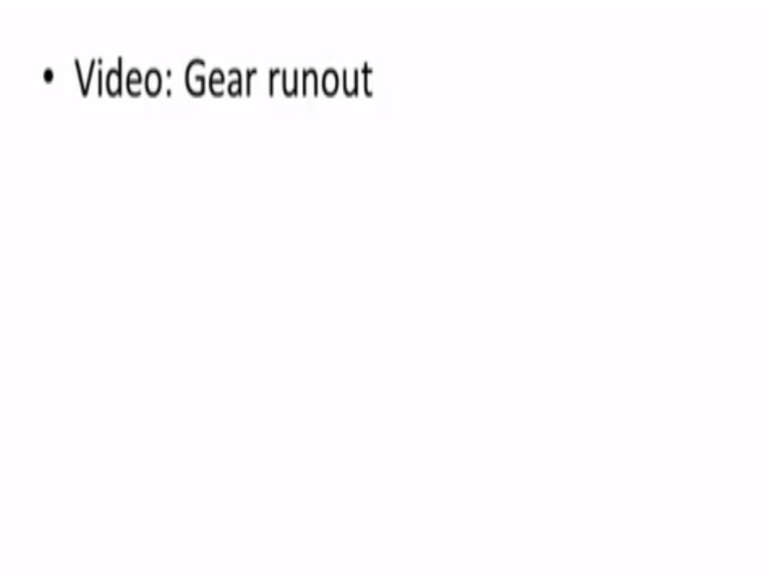

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Now we can see the process of measurement of gear run out, now we can observe the measurement of gear run out we can see the gear to be inspected is mounted on a particular spindle we can also observe the stylus with spherical end and there is an automatic movement for stylus to move in to the tooth space and move out of the tooth space now.

We can observe the ball type stylus enters in to the tooth space and then the digital display reading is recorded and the stylus is withdrawn and gear is rotated and then stylus again enters in to the tooth space and again display is recorded so the processing of all display value we can calculate the clear run out.

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Composite testing of gears

- It consists of measuring the **variation in center distance** when a gear is rolled in tight mesh (double flank contact) with a master gear. In composite gear checking two types of checking are made :
  - (a) Total Composite Variation,
  - (b) Tooth to Tooth Composite Variation.
- **Total composite variation is the center distance variation in one complete revolution** of the gear being inspected; whereas **tooth to tooth composite variation is the center distance variation as the gear is rotated through any increment of 360 degree**.
- A uniform tooth to tooth variation shows **profile variation** whereas a sudden jump indicates the **pitch variations.**

Now let us discuss about composite testing of gears the gears consists of measuring the variation in center distance when a gear is rolled in tight mesh with a master gear is also known as double flung contact method in composite gear checking 2 types of checking or made one is total composite variation and the second one is tooth to tooth composite variation.

Total composite variation is the centre distance variation in one complete revolution of the gear been inspected where is a tooth to tooth composite variation is the centre distance variation as the gear is rotated through any increment of 360 degree..Uniform tooth to tooth variation shows profile variation various acid and jump indicates the pitch variations.

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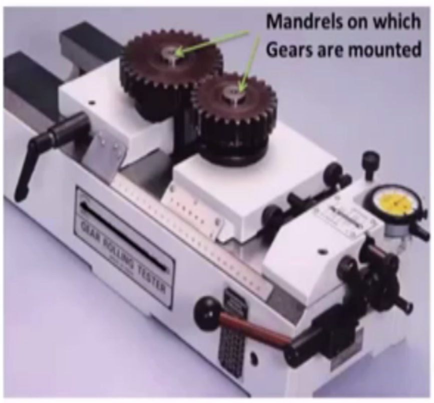
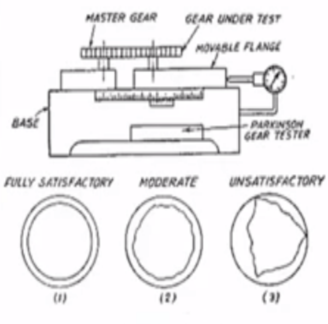
Parkinson gear tester (Rolling gear test)





Charts for radial errors

Now in order to conduct composite testing a tester known as Parkinson gear tester is used and it is also known as rolling the gear tester it consists of the base is sturdy base with guide ways on which 2 flanges are mounted which is fixed flange and moving flange this fixed flange can be moved on the guide ways and it can be clamped on any location and this movement is necessary for mounting the gears of different sizes.

Now this is the movable flange which has got a vernier scale and main scale is fixed to the base the schematic diagram shows the arrangement of Parkinson gear tester this is a fixed flange vertical spindle is there and which master gear is mounted movable flange again vertical spindle gear and test is mounted which has tight mesh because of spring pressure the 2 gears are able to rotate in the tight mesh if there is any center distance variation.

The movable flange will move like this and this movement is measured by dial indicator so this dial indicator indicates the variation of center distance and we can fit an recording device here and we can obtain charts for radial errors we can also fit an record for radial chart for radial errors of gears so this particular circular chart indicates the gear under inspection is satisfactory this is moderately ok and this chart the gear under inspection is not satisfactory since there is variations in center distance.

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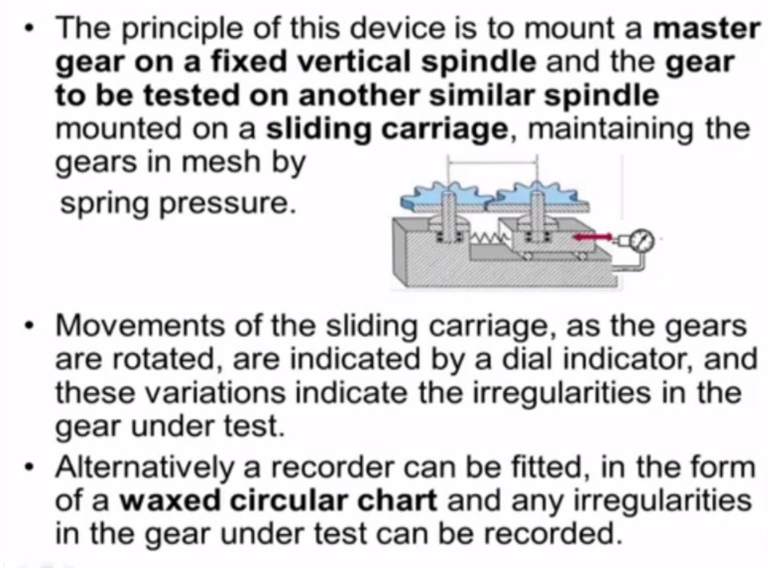

The principle of the rolling gear tester to mount a master gear on a fixed vertical spindle and the gear to be tested on another similar spindle mounted on a sliding carriage maintaining the gears in mesh by spring pressure movements of the sliding carriage as the gears are rotated are indicated by a dial indicator and these variations indicate the irregularities in the gear under test alternatively a recorder can be fitted in the form of a waxed circular chart and any irregularities in the gear under test can be recorded.

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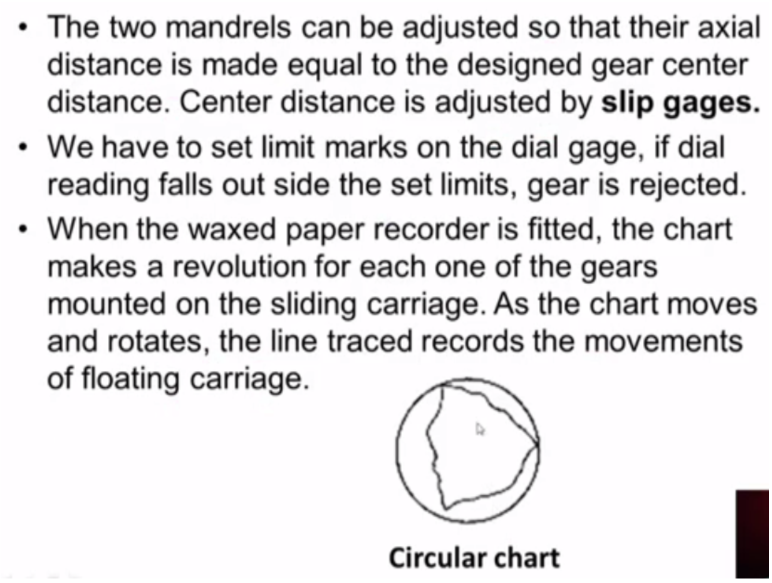

The 2 mandrels can be adjusted so that their axial distance is made equal to the designed gear center distance center distance is adjusted by slip gages we have to set limit marks on the dial gauge if dial reading falls outside the set limit gear is rejected when the waxed paper recorder is fitted the chart makes a revolution for each one of the gears mounted on the sliding carriage.

As the chart moves and rotates the line traced records the movements of floating carriage in the form of circular chart and this line indicates the variation in center distance that is composite error in the gear.

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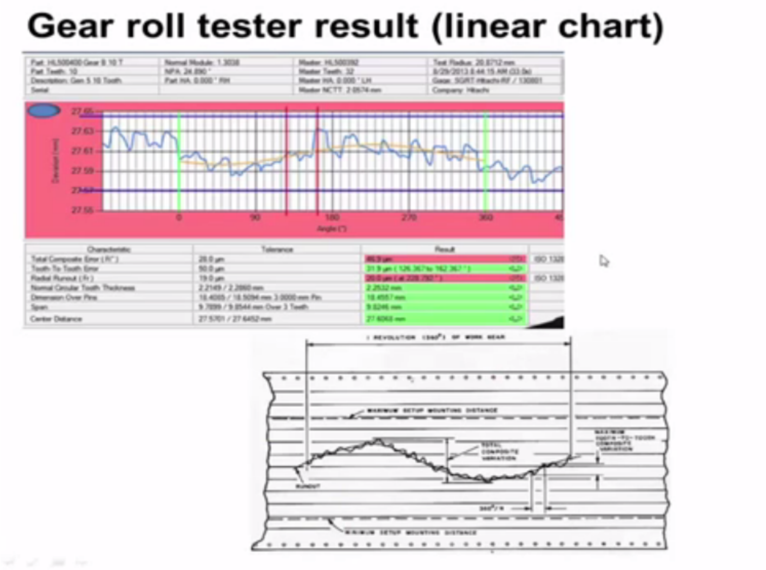

Now this picture shows the linear chart we can see the variation in the center distance is recorded in the form of line here so this linear chart will indicate the peak and total composite variations clear under test this various chart also indicates tooth to tooth error indicator and radial run out. We can observe a Parkinson gear tester and how it is used for checking the gears that can be observed.

(Video Starts: 46:23)

Now we can observe the Parkinson gear tester we can see the inductive pick up which sense the center distance changes between the 2 gears we can see the floating slide we can see the motor which drives the gears we can see the lever which is used to engage the 2 gears the master gear and gear inspection is seen and gear can be mounted on the mandrel or between center and we can see the arrangement used for gears mount and inspection.

The arrangement used for mounting the gear and inspection this is the fixed slide which can be moved and can be clamped at any desired location and it is used for mounting the gears of different sizes now we can observe the control unit which is used to control the operations using this control unit.

We can adjust the speed of rotation of gears and duration of rotation of gears duration can be adjusted for whether for 2 revelations and one revolution is adjusted and now we can observe the recording unit and electric printer.

We can see the electric printer electric distance is printed on paper the switch for the printer horizontal movement of paper can be adjusted we can select the vertical magnification and horizontal magnification selecting appropriate magnifications now we can see here center distance changes printer head is printing the composite error on the paper we can see the movement of a printing unit the composite error is printed on the paper.

We can observe the complete view of the gear tester the base arrangement for mounting the gears floating carriage and fixed carriage printer control unit and now we observe the master gear for inspection we can see the lever is used to move the master gear so that engaged gear under inspection the 2 gears are in contact they are in w flange contact we can see the movement of master gear 2 gears are contact mesh contact.

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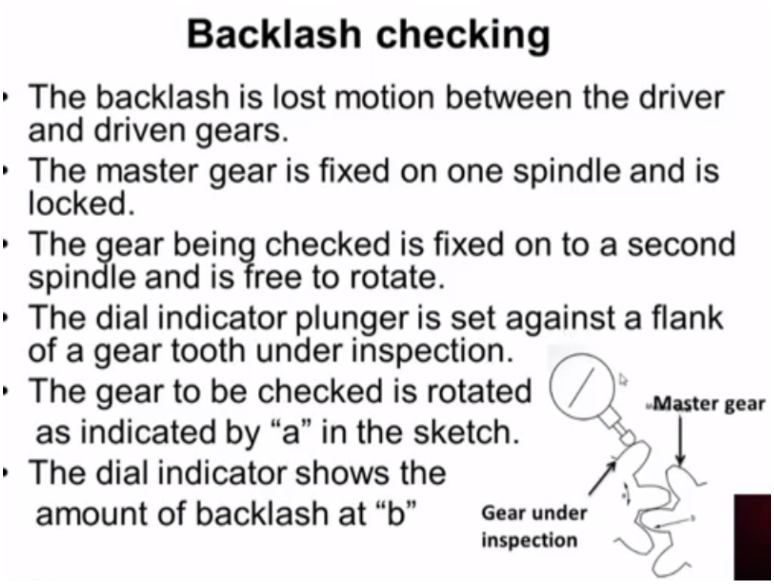

Now let us learn how backlash is tested in gear assembly the backlash is lost motion between the driver and driven gears the master gear is fixed on one spindle and is locked the gear being checked is fixed on the second spindle and is locked the gear being checked is fixed on to a second spindle and is free to rotate the dial indicator plunger is set against a flank of a gear tooth under inspection the gear to be checked is rotated as indicated by a in the sketch.

The dial indicator shows the amount of backlash at b so this is the amount of backlash is indicated by dial indicator if there is no backlash there will be no backlash then there will not be any indication the dial indicator reading is zero this is how we measure the backlash.

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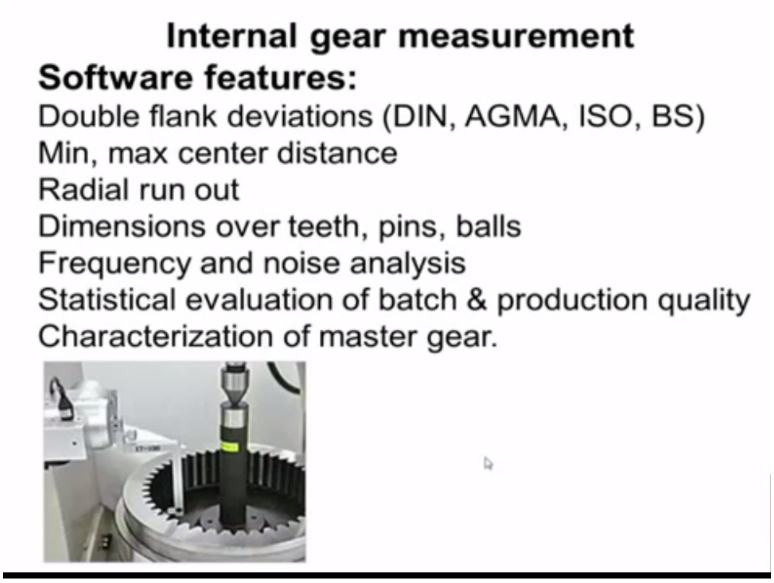

Now for measurement of internal gears computerized machines are available with integrated software these computerized machines can check composite errors and then variation center distance radial run out dimensions over teeth pins balls and also we can check frequency and noise analysis the soft wares can gear the statistical evaluation of batch and production quality.

Such machines are used for characterization of master gears also so one such machine since machining is seen here internal gear and inspection mounted on spindle and measuring on measuring machine and stylus is used for measuring various features.

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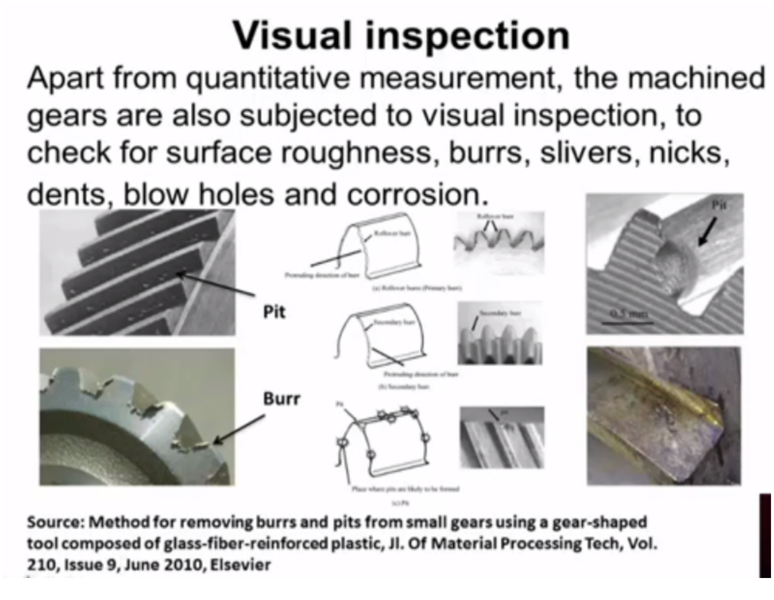

Now apart from quantitative measurement discussed so far the machined gears are also subjected to visual inspection to check for surface roughness, burrs, slivers, nicks, dents blow holes and corrosion in gears different flaws of gear are shown here, we can see the burr per tunings the burrs in this direction and per tuning particular direction and tooth and we can see the pit on the flank surface and the corrosion pit on the gear flank surface and burrs here and then pits.

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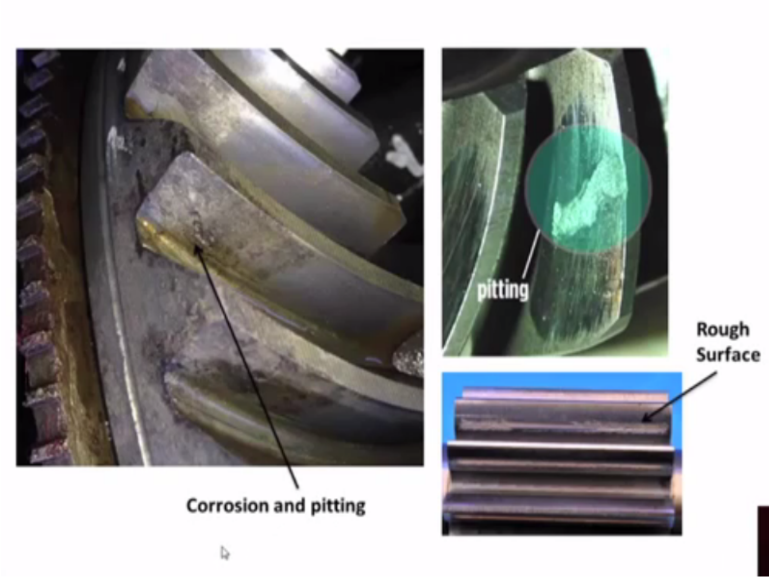

In this Picture we can see the corroded flank and pit and the pit on the flank surface and rough surface all this flaws will definitely affect the performance of gears we should take proper care while designing gear itself we have to select proper material is selected which is having corrosion resistance and pitting can be avoided by selecting good raw material.

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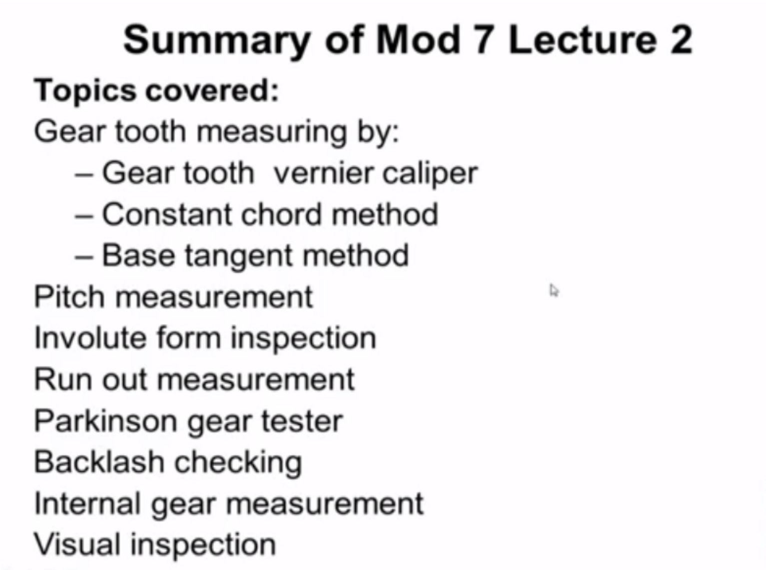

Now let us summarize module 7, lecture number 2, in this lecture we discussed about gear tooth measurement by using vernier caliper we also discussed about constant chord method base tangent method and tooth to tooth pitch measurement involute form inspection run out measurement and then we discussed about composite gear testing in Parkinson gear tester.

And we discussed about backlash checking how the backlash is inspected in gear assembly and we also discussed about internal gear measurement and visual inspection with this we conclude this lecture. Thank you.