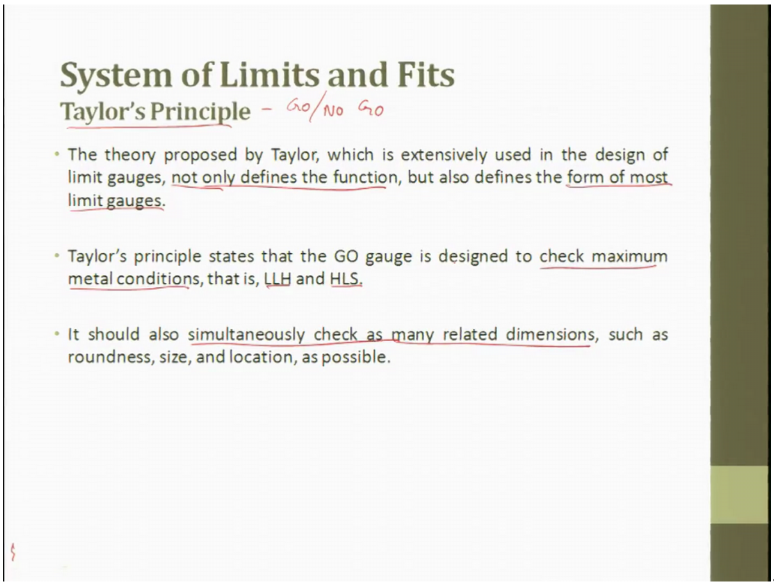
Engineering Metrology

Prof. J. Ramkumar
Dr. Amandeep Singh Oberoi
Department of Mechanical Engineering & Design Programme
Department of Industrial & Production Engineering
Indian Institute of Technology, Kanpur
National Institution of Technology, Jalandhar

Lecture – 08
Limits, Fits, and Tolerances (Part 4 of 4)

(Refer Slide Time: 00:15)

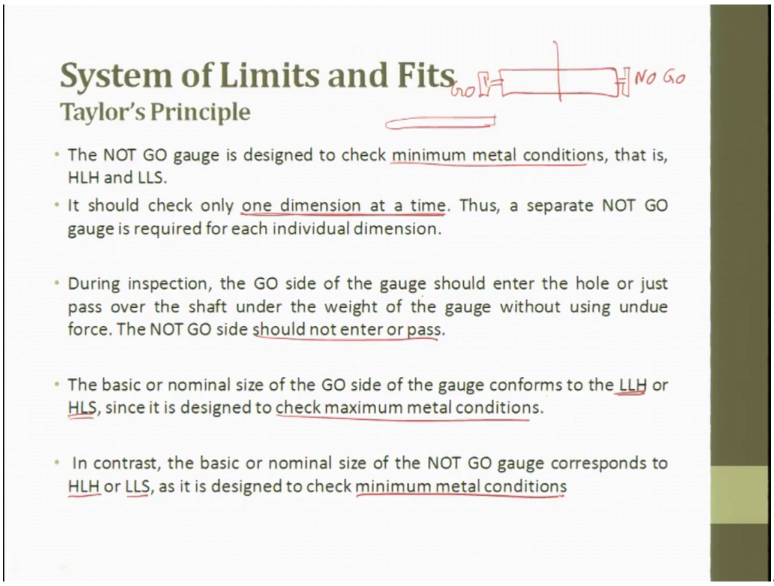


Continuing with systems of Limits and Fits; so, we will now look at Taylor's principle which is a very important principle, which is used for this go gauge and no go gauge; go gauge no go gauge these gauges are indicator gauges. So, here we just try to figure out whether the component is ok or not. The theory proposed by Taylor which is extensively used in the designing of limit gauges, not only defines the function, but also defines the form of most limit gauges.

Please underline defines not only defines the function, but also defines the form of most limit gauges. Taylor's principle states that the go gauge is designed to check maximum material condition that is LLH and HLS. So, lower limit of hole higher limit of shaft.

It should also simultaneously check has many related dimensions such as roundness, size, location and other possible things. So, two important points it should check for maximum material condition when you say maximum material condition for two mating surfaces. So, that is LLH and HLS right. It should also simultaneously check as many related dimensions thus possible; that means, to say I try to take a hole on a component and then I try to take a gauge. So, this is a go gauge. So, when I insert the go gauge I should check for all for the all features such as roundness, size, location as well as the maximum material conditions.

(Refer Slide Time: 02:09)



The no go gauge is designed to check minimum material condition or minimum metal condition that is HLH or LLS right. So, it should check not one dimension at a time thus a separate low gauge is required for each individual dimension. It should check only one dimension at a time; in the previous case it should check simultaneously as many related dimensions as possible, but here it should check only one dimension at a time thus a separate no gauge no not go or no go gauge is required for each individual dimensions.

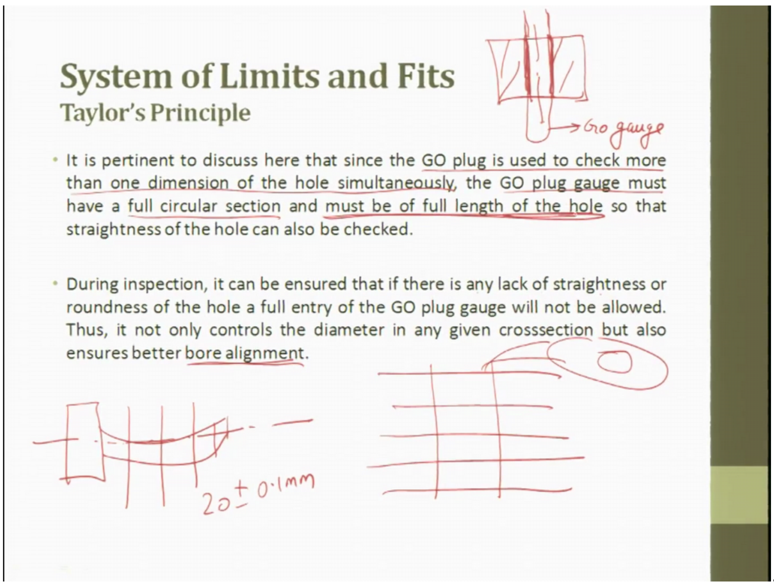
During inspection the go side of the; so, basically what we are trying to do is we are trying to have this side will be go gauge this side will be no go gauge. So, rather than having two gauges it can be plug gauge or it can be snap gauge or it can be plunging type which can just push inside the hole and see. This can check for small aspect ratio hole if you have a large aspect ratio holes; that means, to say the length of the of the mandrill will be larger.

So, this also can be checked this when it is pushed into it checks for the geometric parameter. So, one side will be go one side will be no go you can always have independent gauges, but the problem is maintaining will be a problem. So, retaining both gauges will be a problem. So, what people have come out with a beautiful idea is let us have one side go one side no go.

Go gauge it will try to check simultaneously as many features or as many informations as possible, here it will check only one at a time. During inspection the go side of the gauge should enter the hole or just pass over the shaft under the weight of the gauge, without using undue force. The no go gauge side should not enter or pass these are checking for a hole. The basic or nominal size of the go side of a gauge confirms to LLH or HLS; what is HLS? Higher limit of Shaft ok. Since it is designed to check for maximum metal condition in contrast the basic or the nominal size of no go gauge corresponds to HLH or LLS as it is designed to check minimum material condition.

So, Taylor's principle is used for designing go gauge and no go gauge. So, go gauge will be on one side, no go gauge will be on the other side. Go gauge will simultaneously check for roundness, size as well as maximum material condition; no go gauge will try to check only one dimension at a time and it will used for checking the minimum material condition.

(Refer Slide Time: 05:22)



It is pertinent to check here that since the go plug is used to check more than one dimension of a hole simultaneously, the go plug gauge must be fully circular cross section and must be for full length of the hole. So, suppose if you have a hole you have a hole and if you are saying that I have a go gauge. So, this go gauge should enter fully through the hole and it should come out through the other side. So, then only you can try to check the shape and size of the hole this is a hole and this is your go gauge.

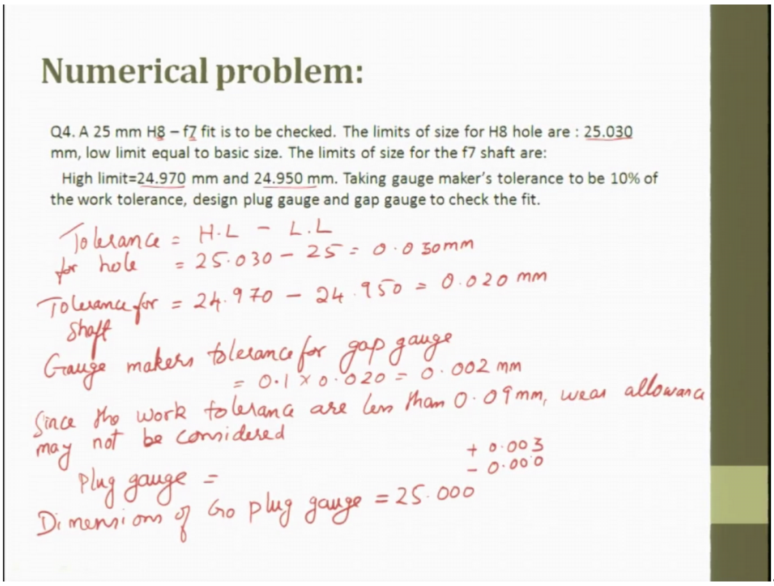
Now, what is the hint the go gauge must go to the fullest length so; that means to say if you have a go gauge and if you have a no go gauge, naturally what will happen by visual identity itself you can see go side will be green in color no go will be in red in color. So, suppose if the paint peels off or you are not able to clearly see the writing, then the next thing which should strike your mind is go gauge will always be longer no go gauge will be shorter.

During inspection it can be ensure that if there is any lack of straightness or roundness; what is roundness? Cylindri this is a cylinder section of these are sections of the cylinder and when you try to see this portion we what we see here is going to be the roundness of a hole a fully full entry of go gauge will not be allowed.

Thus its not only controls the diameter in any given cross section, but also ensures the bore alignment. I already drew a component you can have a component something like this ok. At every section when you try to measure it will be exactly 20 plus or minus 0.1 millimeter it will fall in that range, but overall if you see the alignment of this component the shaft is completely bend.

So, when it is pushed inside the bore or when they or the bore is drilled bit slight misalignment, then that can be found out by this gauge. So, that is why it is asked it is expected to go to the fullest length right that is why we said simultaneously it will check for multiple parameters.

(Refer Slide Time: 08:15)



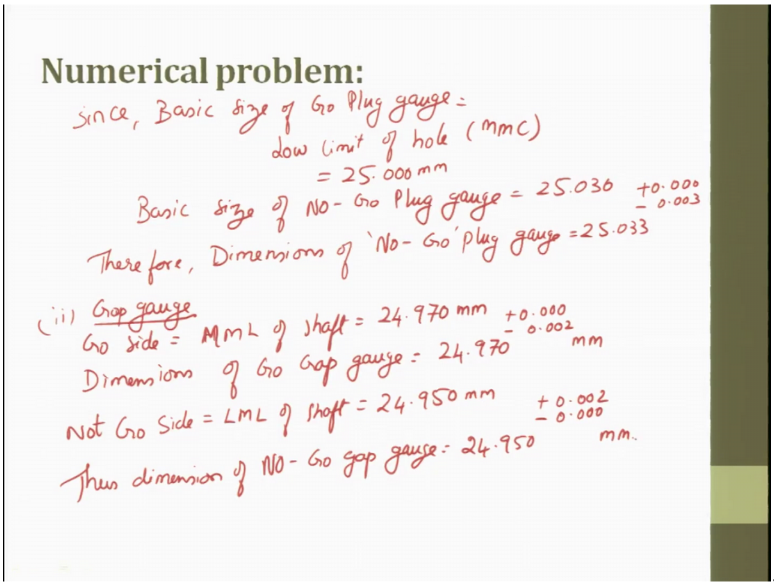
Let us take a numerical to solve ok. 25 millimeter H 8; 8 7 these are numbers which we have already done calculations and we have figured it out to be checked. The limits of size for H 8 hole are 25.030 millimeter.

Low limit equal to the basic size, the limit of the size for the f 7 shaft are high limit is this and this high limits are this and this. Take taking gauge makers tolerance to be 10 percent of the working tolerance design plus gauge and gap gauge to check the fit. So, what we do is first, we try to figure out the tolerance the tolerance for hole is nothing, but H L minus LL. So, which is 25.030 minus 25, which is nothing but 0.03 millimeter ok. Next is tolerance for shaft which is nothing, but 24.970 minus 24.950 which is nothing, but 0.020 millimeter ok.

Now, gauge makers tolerance for gap gauge is 0.10 percent (Refer Time: 10:34) 0.1 into 0.020. So, this is nothing, but 0.002 millimeter ok. Since the work tolerance are less than 0.09 millimeter wear allowance may not be considered ok.

So, if we want to talk about plug allowance plug gauge, which is nothing but for consider plug gauge. So, the dimensions of go plug gauge will be equal to 25.000 plus 0.003 and which is minus 0.000.

(Refer Slide Time: 12:05)



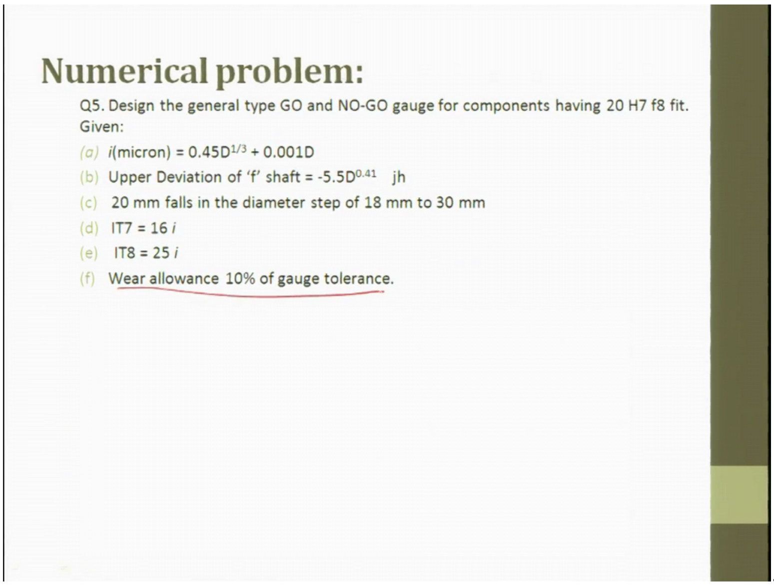
Since basic size of go plug gauge plug gauge is equal to low limits of hole, which is maximum material condition which is nothing, but 25.000 millimeter. The basic size of no go plug gauge plug gauge is equal to 25.030 therefore, dimensions of no go plug gauge is equal to 25.033 plus 0.00 minus 0.003.

For a go gauge or for a sorry for a gap gauge right go side will be equal to which is which is maximum material limit of shaft which is nothing, but 24.970 millimeter and the dimensions of go gap gauge will be equal to 24.970 plus 0.000 and it will be minus 0.002 millimeter.

So, then it is not go side or no go side for a gap gauge, it is going to be the lower limits lower material limits of shaft which is nothing but 24.950 millimeter thus dimensions of no go gap gauge will be equal to 24.950 plus 0.002 minus 0.000 millimeter. So, now, if you see in this problem, we have just solved for a plug gauge you have solve for plug gauge and we have also solved for gap gauge. So, this is for plug gauge and we have just played with the data which is available in the sum 25.030 and the lower limits are equal to in the basic size, then we have given H 7 for a shaft or the limiting size for f if f 7 shaft are this and this.

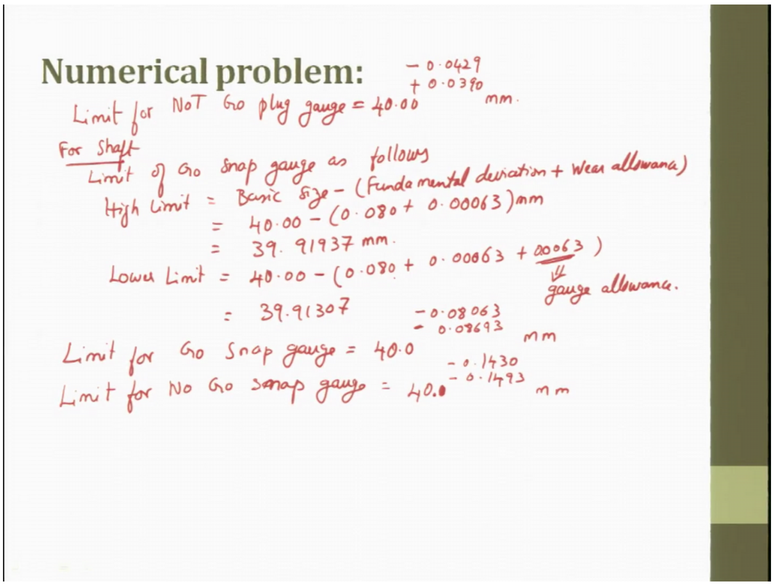
So, with this we have tried to do and this is how we try to figure out the dimensions for a go gauge and a no go gauge go no go gauge and a go gauge ok. So, go gauge and no go gauge so, we have got the answers. So, you can expect problems like this in the examination to be solved.

(Refer Slide Time: 16:15)



So, we are just looking at only this path of the problem. So, this you will try to solve limit.

(Refer Slide Time: 16:27)



.

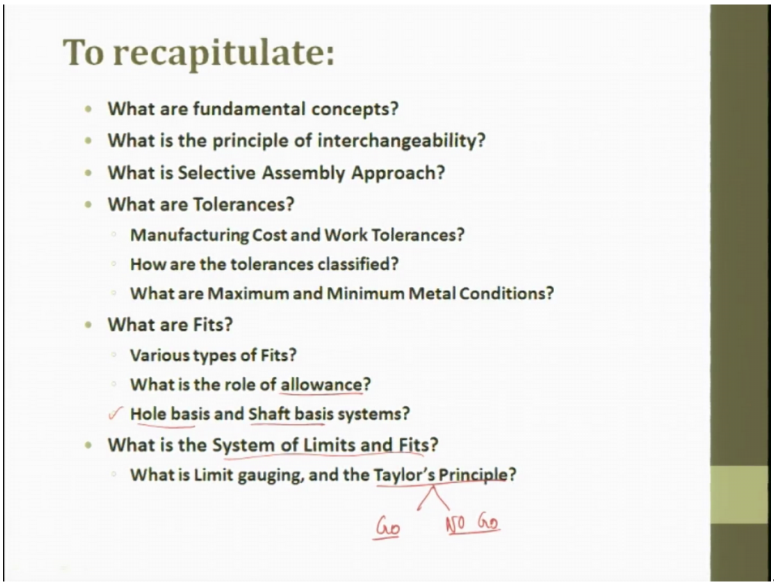
Limit for not go plug gauge which is nothing, but 40.00. So, it will be minus 0.0429 and this will be plus 0.0390 millimeter ok. For a shaft for a shaft the limits of go snap gauge is as follows right. So, here it will be high limit for what? So, this is nothing, but basic size minus fundamental deviation plus wear allowance wear allowance is what it is 10 percent right. So, this is nothing, but 40.00 minus 0.080 plus 0.00063 millimeter.

So, this is 39.91937 millimeter. If we talk about lower limits lower limit which is nothing but 40.00 minus 0.080 plus 0.00063 plus it is wear allowance plus gauge allowance know. So, gauge allowance is also one plus wear allowance plus gauge allowance 0.063. So, this is nothing, but gauge allowance. So, what we get the answer is 39.91307 ok. So, now, let us take for limit for go gauge go snap gauge snap gauge is equal to 40.0, it will be here minus 0.08063 plus 0 sorry it will be minus 0.08666 it will be 669693 millimeter.

This will be for limit for snap go snap gauge will be this is what it is for the. So, this will be minus this will be minus ok. So, the limit for no go gauge, you can solve it for no go snap gauge I will just write the answer you can try it and we will give the working solution it is very same. So, the exercise will be repeat. So, I thought I will write directly the answer 4.0. So, it becomes minus 0.1430 and it will be minus 0.1493 millimeter ok.

And we have already given the figure for this explanation in the in the previous slides. So, this part we will try to take care of this wear loss of 10 percent in the problem, which I did not solve wear now I have solved it. So, that this is for wear loss. So, you can have wear you can solve it and then you try to get the answer for it.

(Refer Slide Time: 20:54)



So, to recapitulate in this chapter what all did we see first we saw some fundamental concepts, then we saw interchangeable fundamental concepts are nothing, but precision, accuracy, interchangeability we saw, the binominal distribution then we saw the concept of interchangeability, then we saw selective assembly selective assembly means you select ah the or first you take a complete bin of us parts and then you sort it out to varying dimensions.

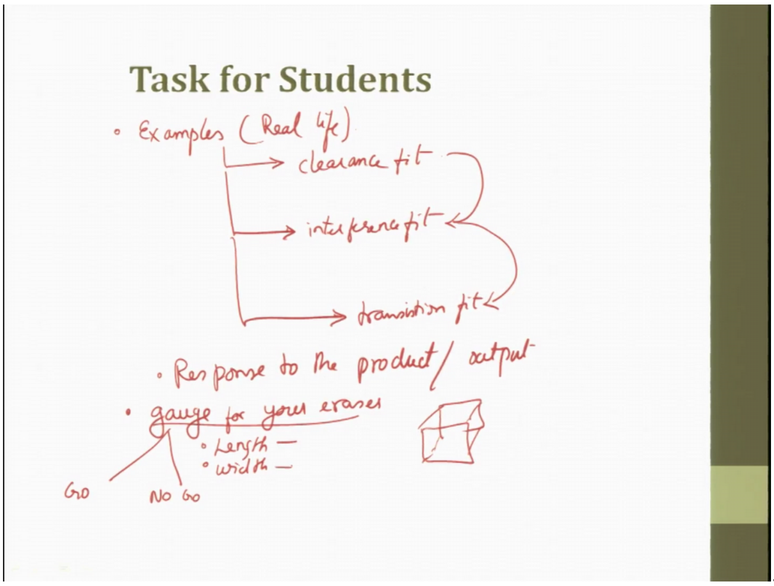
So, then correspondingly you also sort out the mating dimensions in several bins, and then pick from each one and then start doing it. Then we started looking into tolerance, then what are the influence of manufacturing cost and working tolerance then we saw the classification of tolerance, then maximum material limit condition and minimum material condition.

So, you subtract it you try to get a tolerance then we moved on to fits; why do we need fits? Because assembly plays an important role so, in fits you will have a male and a female. So, depending upon the tolerance which is given there maximum material and minimum material condition you can have three different types, of fits clearance fit, transition fit and interference fit.

So, depending upon the situation you can choose which fit you want, and then we discussed about allowance from fits we moved to allowance. So, then we also saw the different types of hole base system and shaft base system, currently the most popular one is hole base system so, that the shaft can be ground to or be to the requirements of hole base system.

Then finally, we saw the systems of limits and fits, all the definitions of all those things and Taylors principle wherein which we saw two things one is go gauge and another one is called as no go gauge. So, you can use a plug gauge you can use a snap gauge. So, go gauge will try to check multiple features in one shot, no go gauge will check only one feature in one shot this will be long and this will be short.

(Refer Slide Time: 22:54)



So, with this we come to an end to this chapter. So, now I would like to give a small assignment for the students ok. So, what I want is I want you to identify examples these examples are real life examples, real life example wherein which you will try to talk about clearance, fit, the interference fit and then transition fit ok. So, then what you will do is you will try to figure out some example for clearance interference and transition.

And after you do that. So, what you will do you will try to take the same example and shift the fit from clearance to interference, interference to transition and figure out what will be the response to the product in terms of output why is this given this exercise will give you a feel how important is fits ok.

The next one is I would request or I would like you guys to make a gauge for your eraser. You get a cuboidal eraser try to make a gauge for it, to check for length and width. When

I say gauge it should have two divisions it should have a go gauge it should have a no go gauge. So that means, to say you have to make a gauge you decide whatever it is this gauge should make sure that the eraser whatever is getting manufactured is perfect in terms of length and width.

So, these two are examples which you should try understand and appreciate how important is this indicator gauges, how difficult is to make a gauge for finding out the dimension. It is not a easy joke it you have to do a several calculations to figure it out and the other thing is fits and tolerance. With this we come to the end of this limits, fits and tolerance chapter and please try to do these two exercise these two exercise are not assignments you submit it back to me, but when you start looking from this perspective, you will learn and you will appreciate the metrology subject and this particular topic in particular.

Thank you.