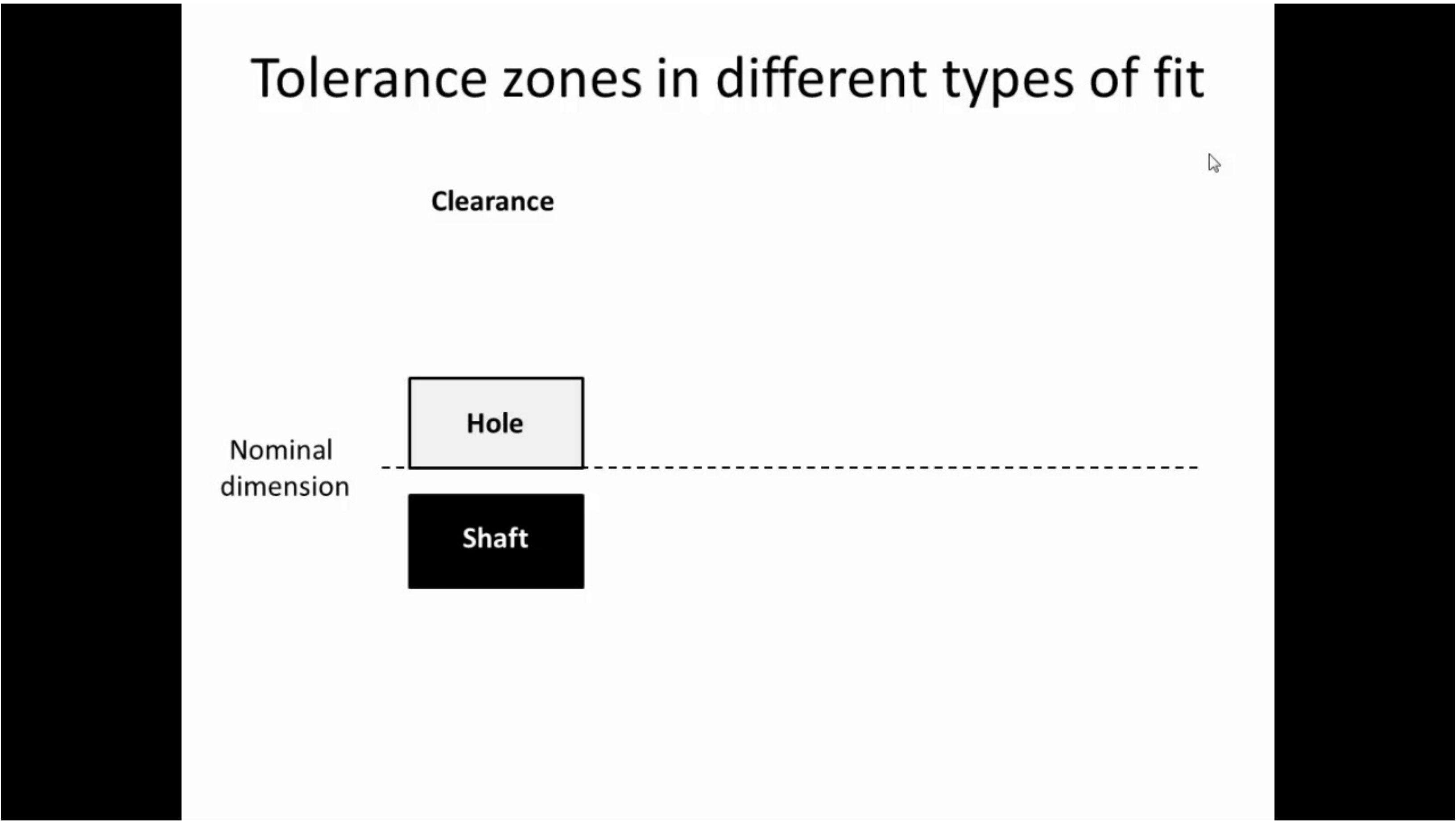
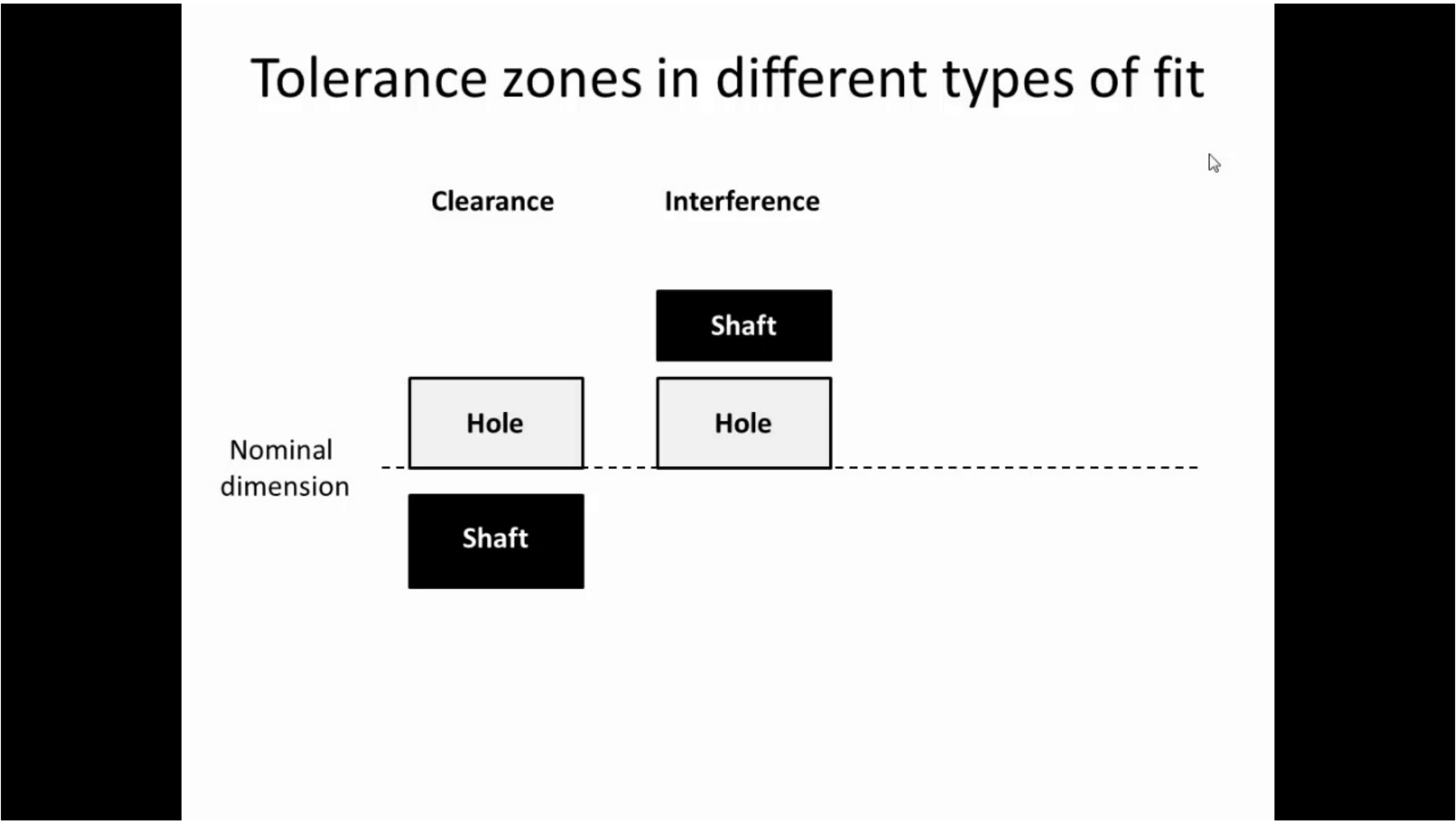
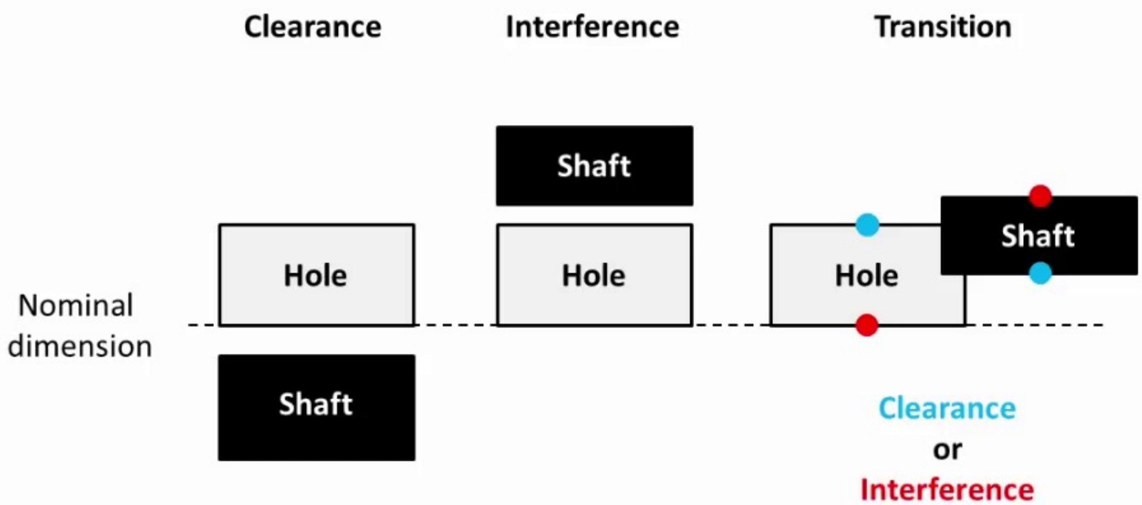


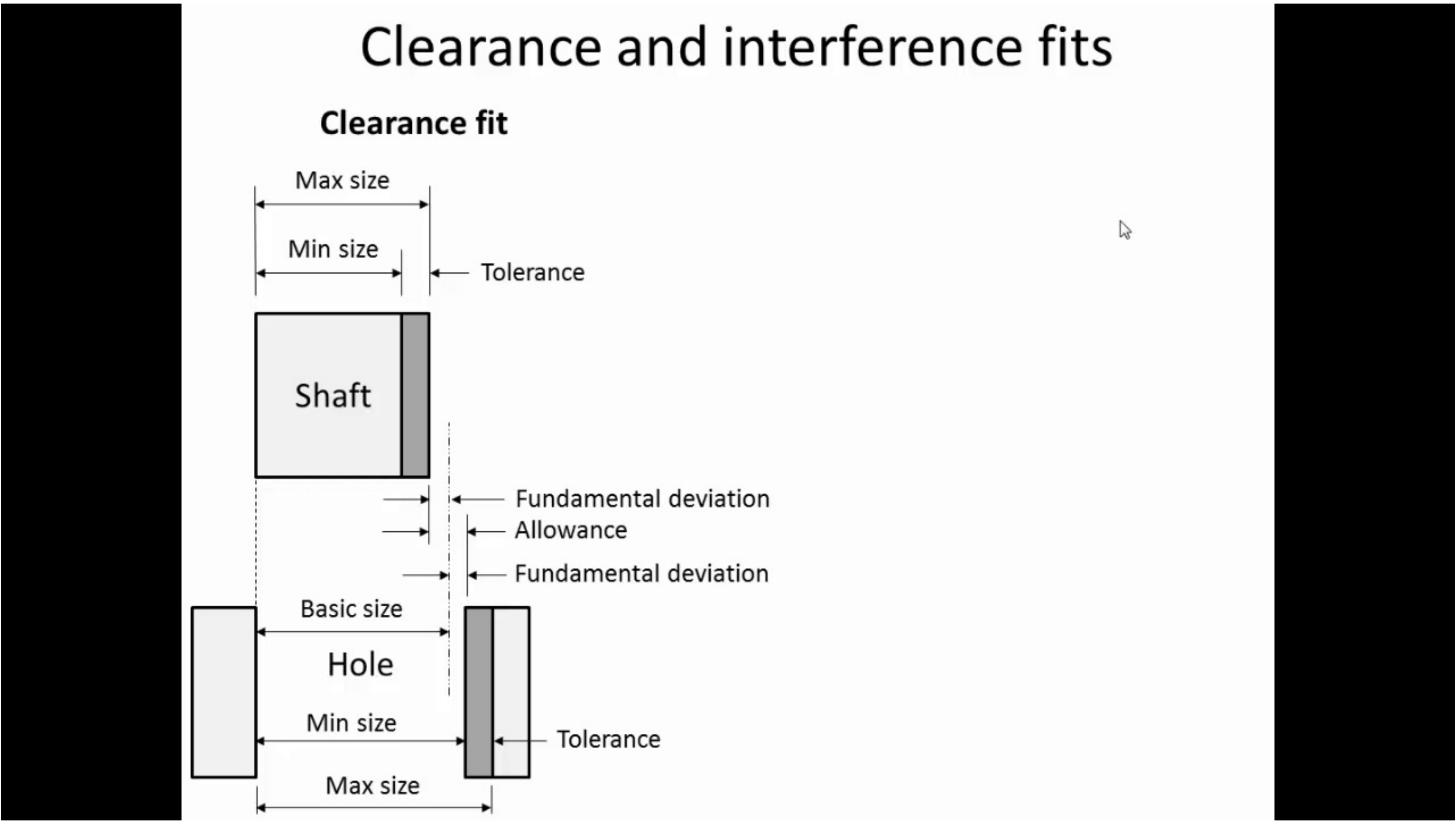
But here's a quick graphical summary of the three types of fit that we are going to look at specifying in the rest of this last job that we took in terms of shaft cylindrical shaft mating with a cylindrical hole in in these examples in a clearance fit at the shop is always smaller than the whole the heights of the boxes show the signs of the tolerance Evans and bull designs a reference back to single nominal Dimension, which is shown by the dashed horizontal line.



In an interference fit by contrast the shaft is always larger than the hole in its on the form stating. Otherwise before they are pushed together. I need a transition fit tolerance zones over Life as we talked about so thick and turn out to be either clearance where the shop is smaller than the whole or interference where the shaft is larger.

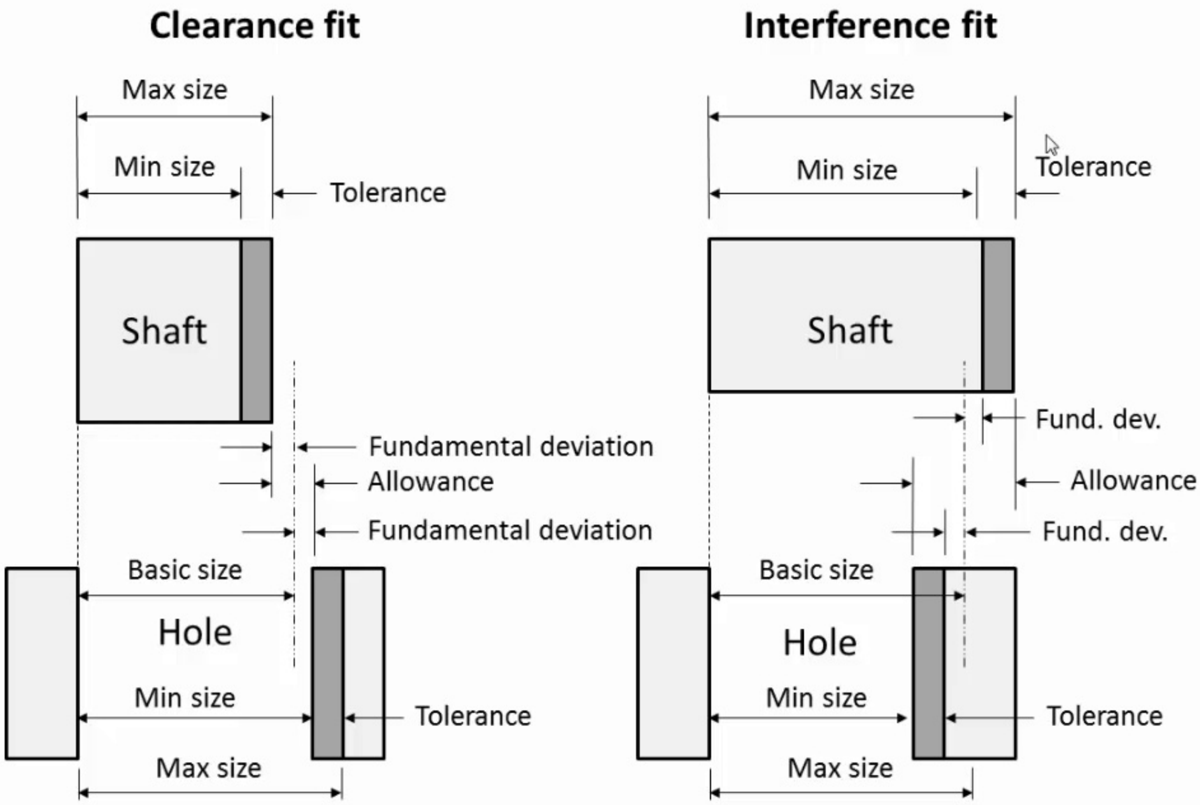
Tolerance zones in different types of fit

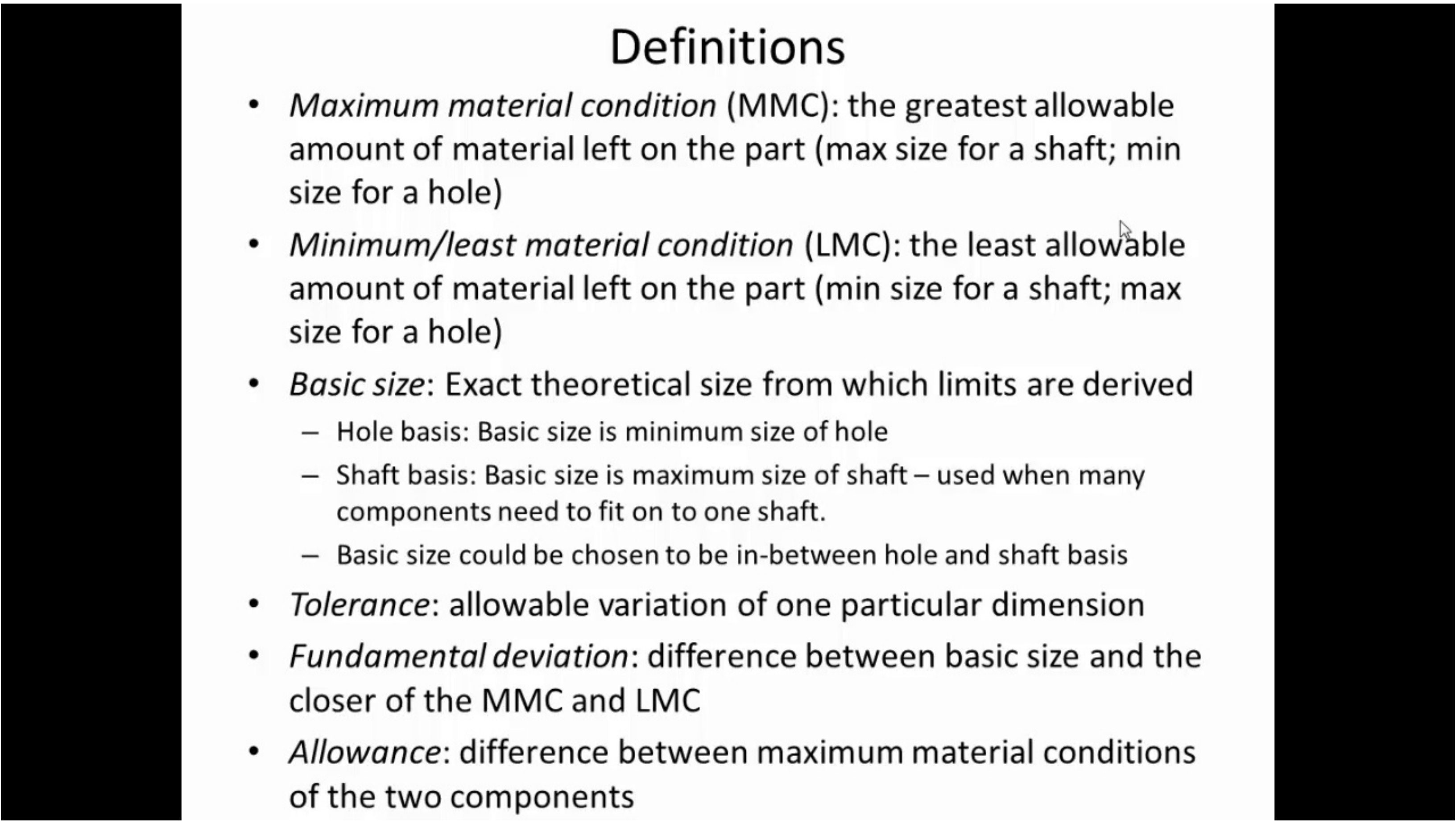




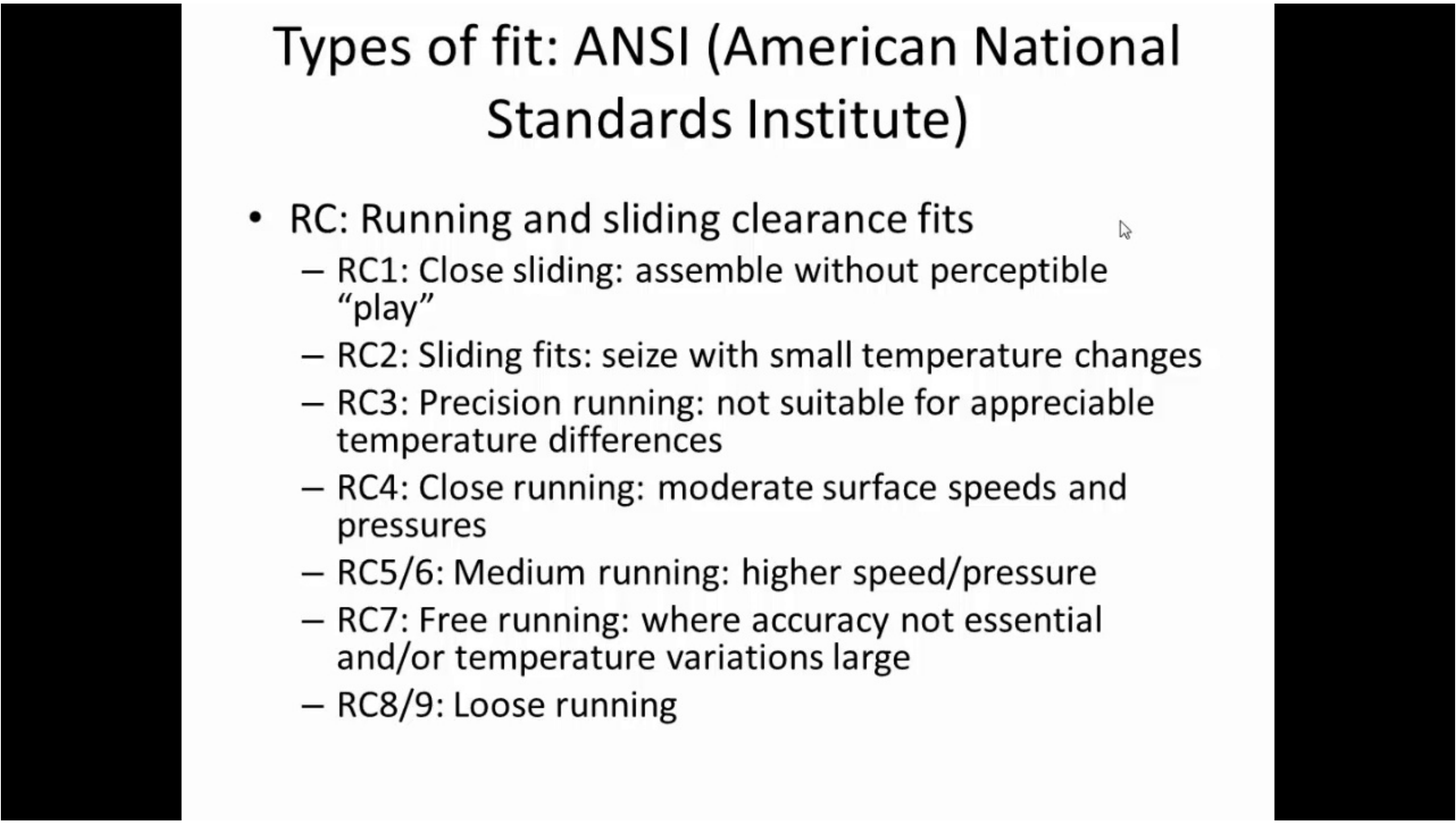
Let's go into a little more detail on the terminology that's involved in specifying tolerances here. We show a shaft on a hole in cross-section diesel supposed to come together to form clearance the dark of shaded region show the tolerance zone for each component. Each component has a maximum and minimum size that it is allowed to take You also need to be familiar with the time maximum material condition ommc which as it implies would correspond to the maximum size of a shaft or the minimum size of a whole another words when the most material is left on the component conversely the least material condition or LMC is that which occurs when the most material has been removed from the component assuming of course that we've been making this with a subtractive person? As discussed previously the difference between the maximum and minimum sizes of Any Given component is called the tolerance and old dimensions are referenced to some nominal or basic sisal dimension. I'd say when you're meeting a shops in the whole there is one single basic size that is used as the basis for defining those dimensions. The difference between at the maximum material condition for a given component on the basic size of a component is cool the fundamental deviation and the difference between the component sizes in maximum. Material condition is Tums the allowance Through what I've shown here is for a clearance fit but these terms have exactly the same meanings for interference fit or indeed for any other type of fit.

Clearance and interference fits

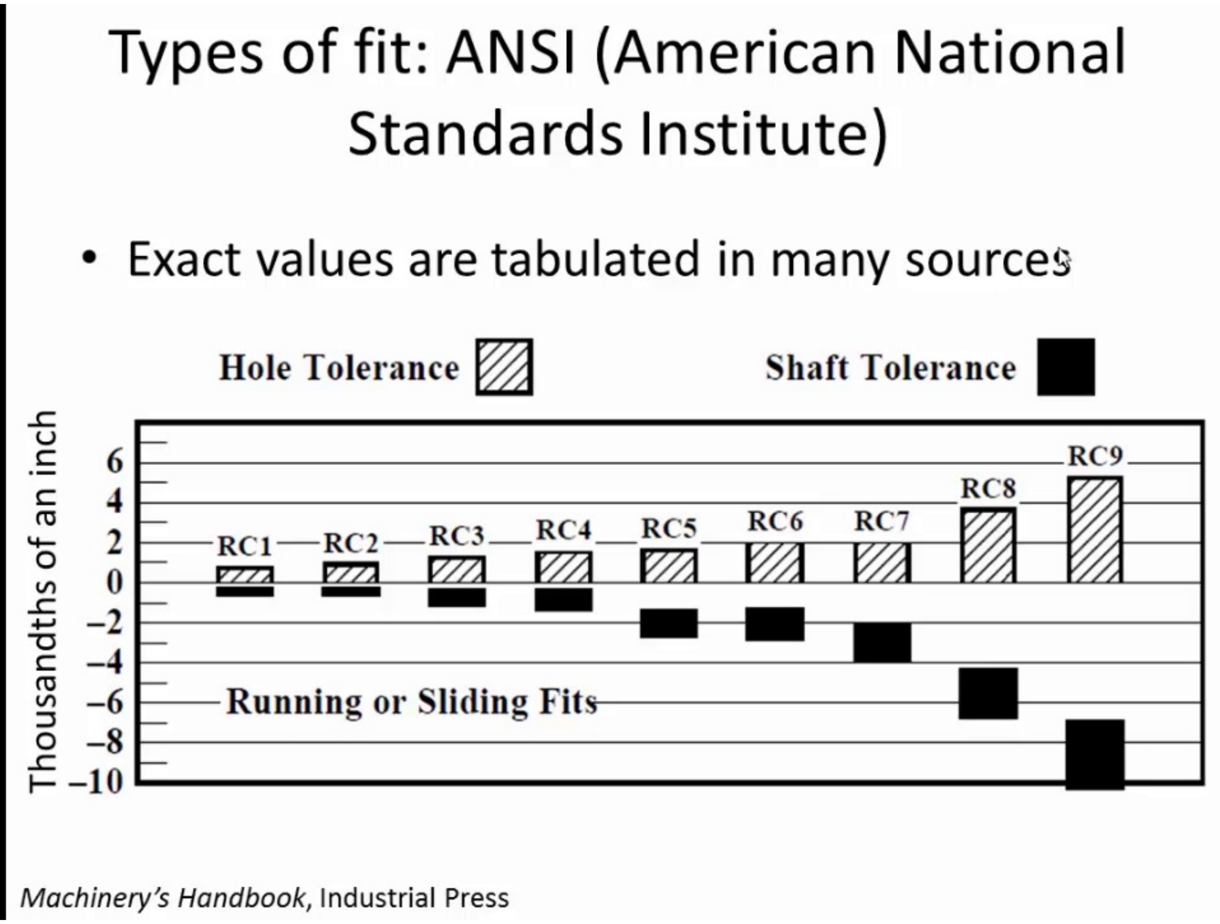




Here's a summary of all those times for you to refer back to later.



So let's look at some specific subclasses of fit. Within clearance fits, for example, the ideal amount of clearance depends on the desired function answer this ends organizations, like the American national standards Institute have come up with subclasses. If it's not here is Will ANSI has a defined as the nine subclasses of clearance fit that can be relevant in applications where the components are actually good to have to move relative to each other in use which one of these are going to want to use will depend on for example how much friction you are willing to accept between the components how well aligned you need to keep the two components as they slide relative to each other. So you more clearance would allow more slot Atmore misalignment to arise more vibration pass. Elusive we need to consider whether the gap between the components needs to serve as any kind of seal. In the stirling engine that you looked at for example, the piston and the cylinder tattoo aluminum components subtract it be manufactured and they need to slide past each other with minimal friction. But at the same time preventing too much air from escaping through that Gap they have to do that without any kind of lubricant in the Gap to the Gap needs to be kept small and machine precisely and very smoothly to keep friction low at the same time. So why this week's homework you're going to be asked to recommend which of these subclasses of fit do I should be used in that application?

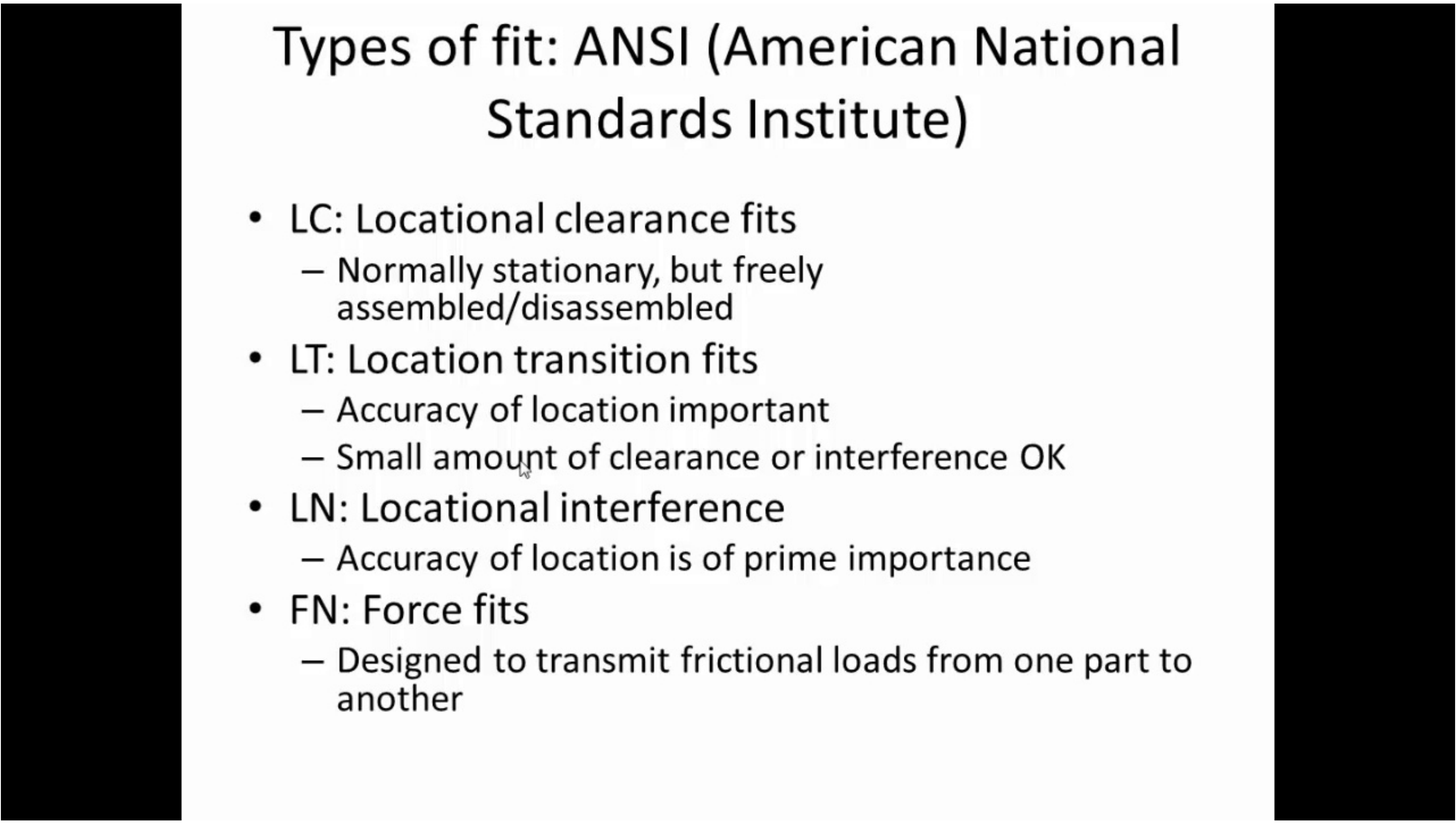


Now if you look in Industry Han books like machinery's handbook for example, and I posted a full copy of that as a PDF on bcourses on the files and then additional references you look at hand books like this. You will see diagrams that illustrates the sizes of Tolerance are in this but different subclasses of fit is important to note. When you look at these diagrams that the allowable tolerance zones are specific to a particular range of basic sizes. This diagram for example is drawn for basic diameters around Harford of an inch.

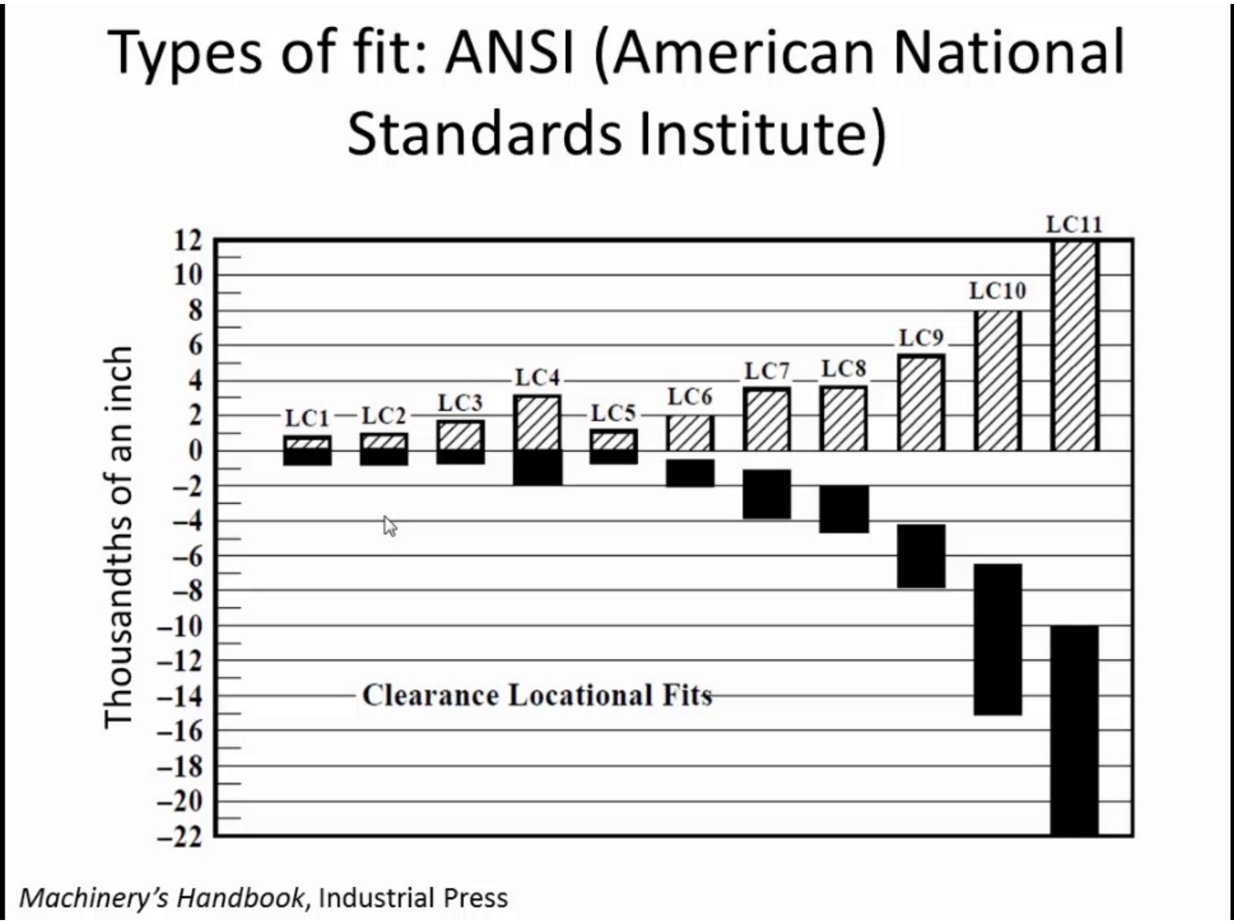
Table 3. American National Standard Running

Nominal Size Range, Inches (Over – To)	Class RC 1 Clear-ance[a]	Class RC 1 Standard Tolerance Limits Hole H5	Class RC 1 Standard Tolerance Limits Shaft g4	Class RC 2 Clearance[a]	Class RC 2 Standard Tolerance Limits Hole H6	Class RC 2 Standard Tolerance Limits Shaft g5
	Values shown below					
0 – 0.12	0.1 0.45	+0.2 0	−0.1 −0.25	0.1 0.55	+0.25 0	−0.1 −0.3
0.12 – 0.24	0.15 0.5	+0.2 0	−0.15 −0.3	0.15 0.65	+0.3 0	−0.15 −0.35
0.24 – 0.40	0.2 0.6	+0.25 0	−0.2 −0.35	0.2 0.85	+0.4 0	−0.2 −0.45
0.40 – 0.71	0.25 0.75	+0.3 0	−0.25 −0.45	0.25 0.95	+0.4 0	−0.25 −0.55
0.71 – 1.19	0.3 0.95	+0.4 0	−0.3 −0.55	0.3 1.2	+0.5 0	−0.3 −0.7
1.19 – 1.97	0.4 1.1	+0.4 0	−0.4 −0.7	0.4 1.4	+0.6 0	−0.4 −0.8
1.97 – 3.15	0.4 1.2	+0.5 0	−0.4 −0.7	0.4 1.6	+0.7 0	−0.4 −0.9
3.15 – 4.73	0.5 1.5	+0.6 0	−0.5 −0.9	0.5 2.0	+0.9 0	−0.5 −1.1
4.73 – 7.09	0.6 1.8	+0.7 0	−0.6 −1.1	0.6 2.3	+1.0 0	−0.6 −1.3
	0.6	+0.8	−0.6	0.6	+1.2	−0.6

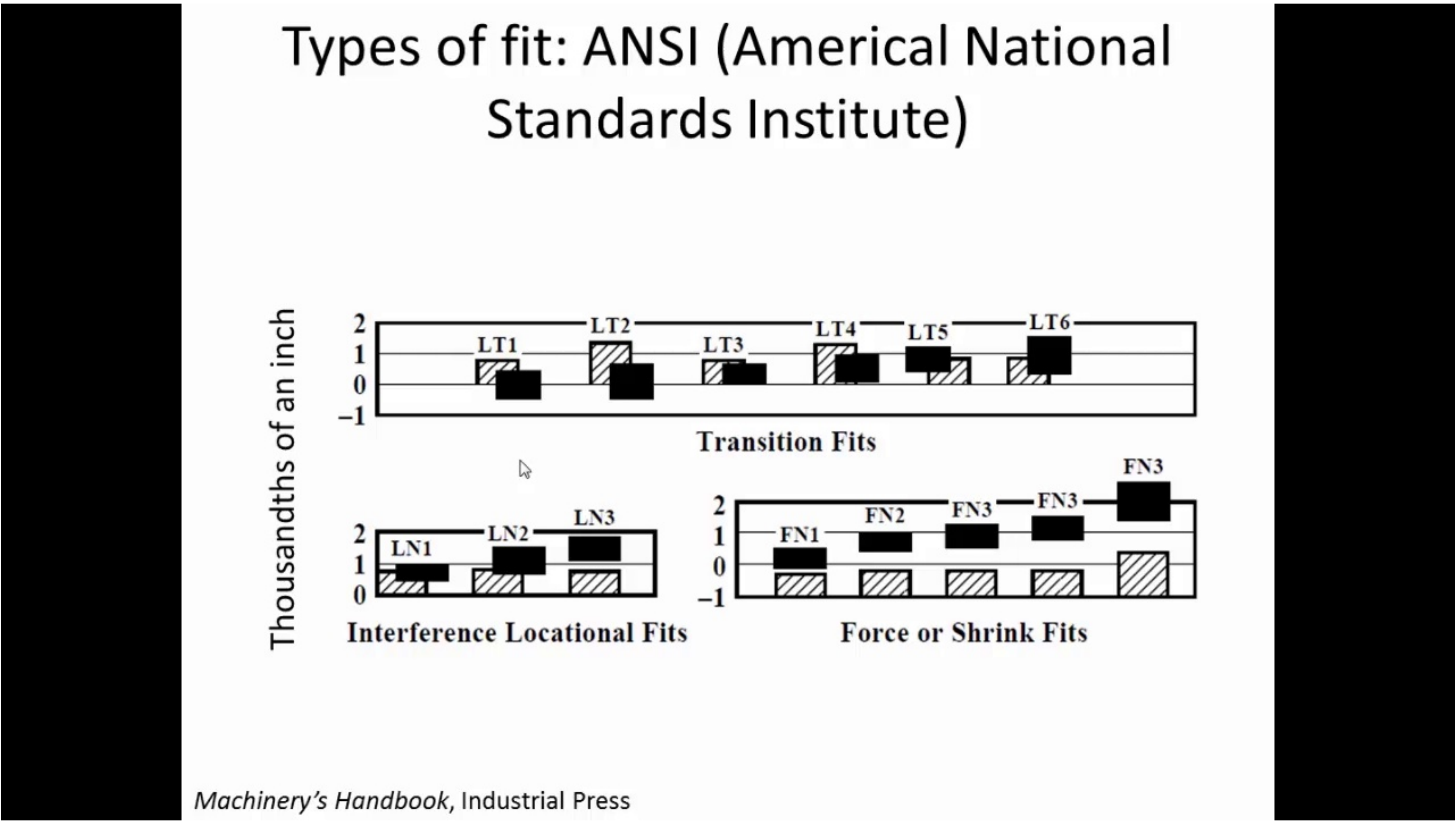
If in contrast reaction to look at a complete stable of running clearance tolerances and this table is reproduced in the homework. The tolerance is increase in size as the basic Dimension increases and that reflects the increased difficulty of holding a particular tolerance during manufacturing as a component becomes Lodge at much easier to hold a half of $1,000 in two and a half inch shaft and on 15in show after exam. If for example we look at class I'll see one which is the most stringent form of running clearance fit. When we look at a basic size the lies in the range of point for the .71 in we can read off the sizes of the tolerance zones for holding a shaft and the corresponding clearances. It's important to note that tolerance limits are given in thousands of an inch in this table and they're also given relative to the basic site to eat at these numbers to the basic size to get the absolute Dimensions that are allowable for a given classic fit. So I look at the number of cycles and blue hair for the largest hole. I'm for the smallest allowable shaft. We going to have the biggest clearance. I'm a point seven five thousands of an inch. So this is the the difference between these two values. In contrast to the smallest whole and the largest shaft the difference results in the smallest clearance the smallest gap between the two components to that clearance is simply the difference between the diameters of the shops in the whole house actually manufactured.



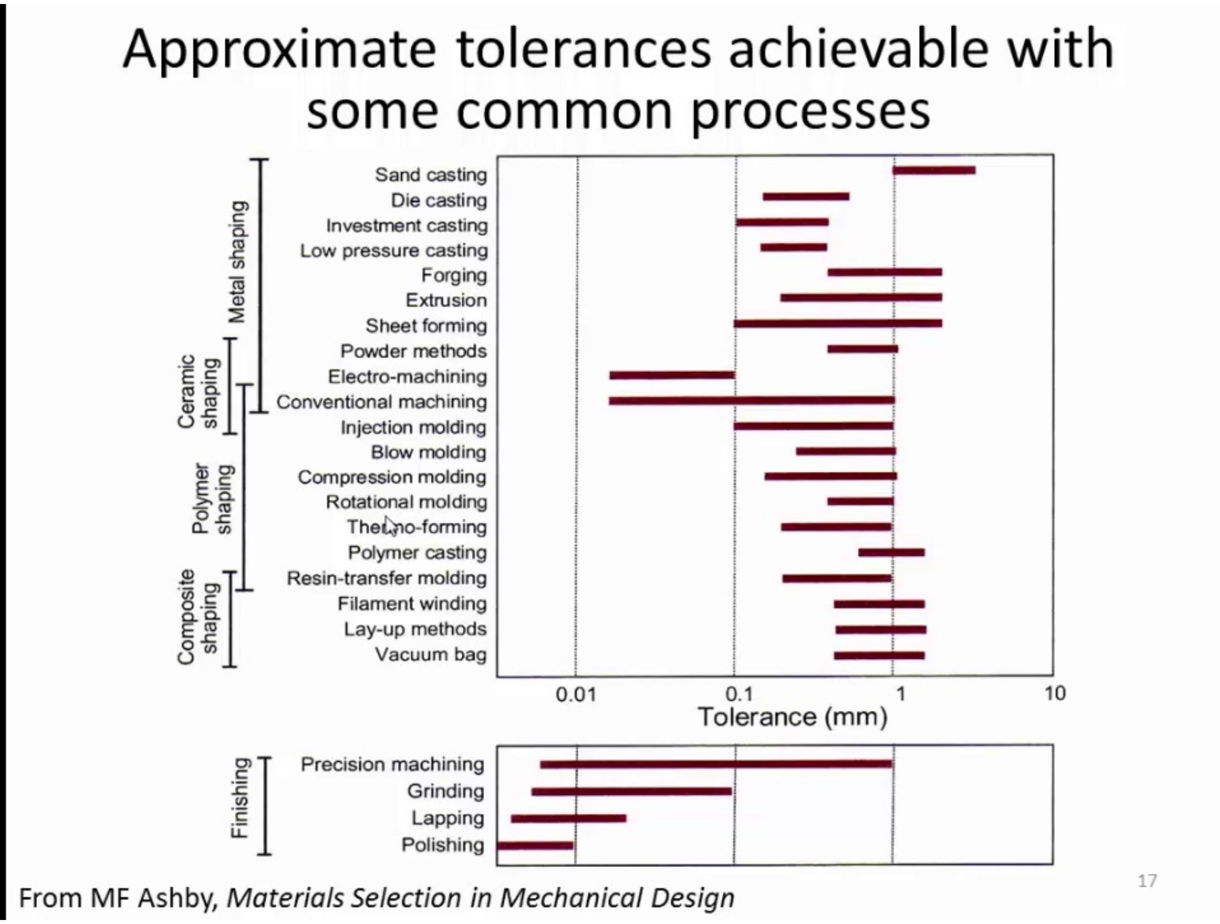
There are other classes of fit that I'm C has defined these include locational clearance pits where the clearance cambia smooth zero since the components World actually be moving relative to each other once they're in you we both have discussed location transition fits interference fits. It's full speed is another term for a shrink or expansion fit.



Here are the charts showing acceptable tolerance zones for location of clearance and for the transition interference and force fits full descriptions of all, these subclasses can be found. If you are interested in that machinery's handbook, but knowing the details of these particular subclasses won't be required for any of the assignments or exams.

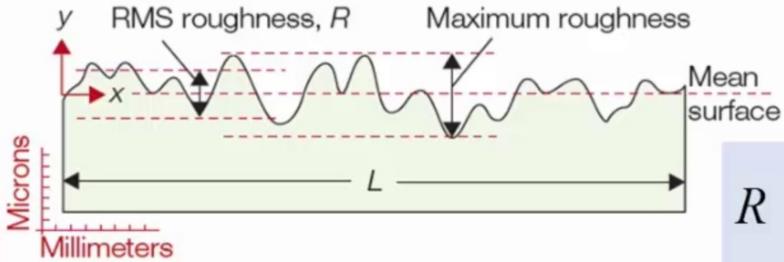


So once you've worked out what tolerances are required for your application, we have to pick a person who purchases to make them.



I hear knowing the capabilities of multiple purchases is important. So data sources, like this chart can be very valuable. Each process has a range of tolerance is that it can deliver and wearing a train to process will actually before will depend on the basic size of the component the age of the machine at the material being processed and so forth. The reason we went Cynthia was picked the purses with the smoothest achievable tolerance is usually going to be cost but it might also be related to energy consumption considerations material wastage or any number of other factors.

Roughness: definition and examples



$$R^2 = \frac{1}{L}\int_0^L y^2\,dx$$

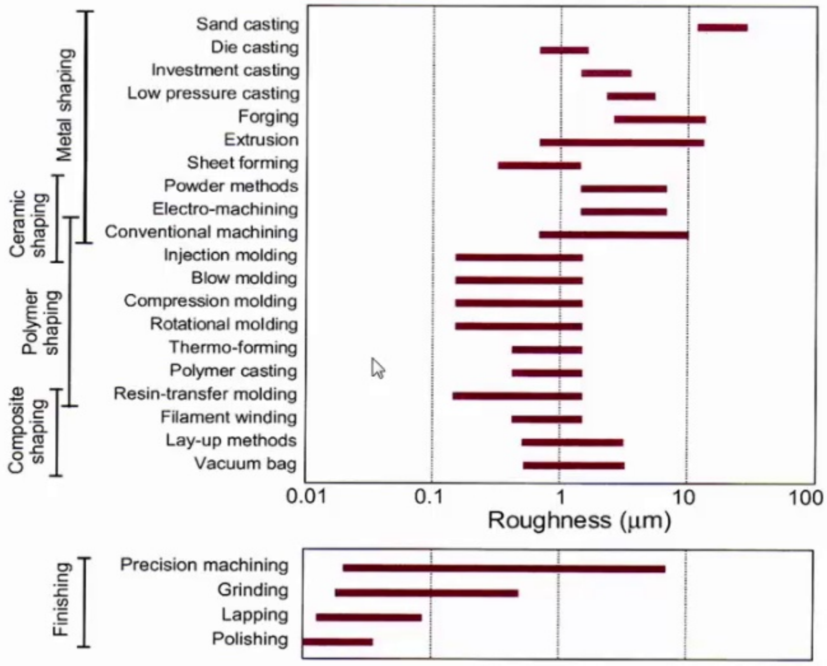
Table 13.3 Levels of Finish

Finish, μm	Process	Typical Application
$R = 0.01$	Lapping	Mirrors
$R = 0.1$	Precision grind or lap	High-quality bearings
$R = 0.2$–0.5	Precision grinding	Cylinders, pistons, cams, bearings
$R = 0.5$–2	Precision machining	Gears, ordinary machine parts
$R = 2$–10	Machining	Light-loaded bearings, noncritical components
$R = 3$–100	Unfinished castings	Nonbearing surfaces

From MF Ashby, *Materials Selection in Mechanical Design*

Tolerance as a concept though in the way that we've discussed it so far only characterizes how the average position of a surface is allowed to deviate from the ideal a real self will not only have deviation of the average but it also undulation the roughness and this itself is highly sensitive to the process being used. A very common definition of roughness is the so-called root mean square or RMS definition. This is a single number that averages surface deviations from the mean position of the surface. The RMS roughness is very helpful quantity for comparing different persons whose capabilities in regard to self is finished, but it's important to bear in mind. It doesn't contain any information about lateral length scales over which the self is might be undulating. Here you can see RMS roughness values tabulated for a range of purses from lapping which is fine polishing through grinding and machining to casting on alongside those applications that they might typically be used to manufacture.

Approximate roughnesses achievable with some common processes



RMS roughness: root mean square of deviations over the measured surface length, *i.e.*:

$$R^2 = \frac{1}{L}\int_0^L y^2\,dx$$

Usually, tolerance, *T*, lies between 5*R* and 1000*R*

20

From MF Ashby, *Materials Selection in Mechanical Design*

Does plenty of information available on typical process roughness is just as there is on typical persons tolerances on this chart shows some achievable roughness values. Allen deciding what brightness to Target in process selection as a general rule of thumb the Tolerance on a past. I mentioned should lie somewhere between 5 and 1000 times larger than the surface roughness. The process you're using is able to deliver. This is especially important for clearance pits because if the roughness is a significant portion of the tolerance surface disparities on the 270 is my 10. Colliding with each other and preventing simple running of the surface is relative to each other.