Manufacturing System Technology - II
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Lecture – 19

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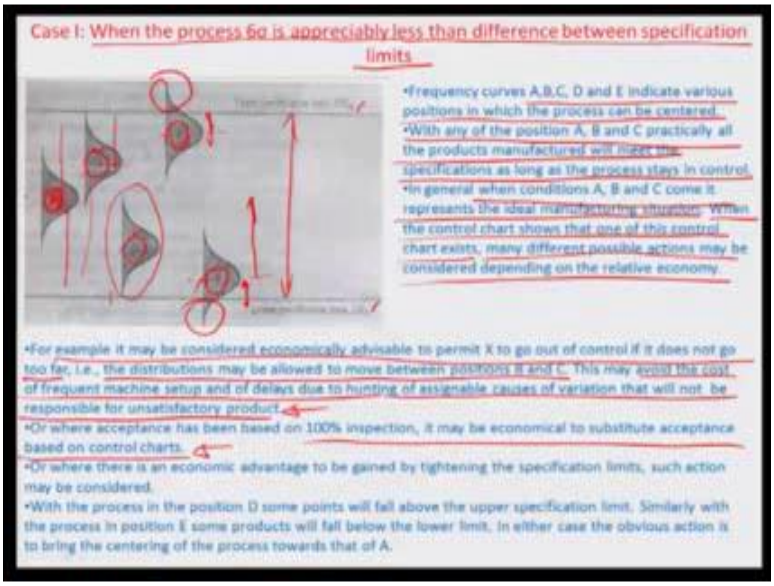

Hello and welcome to this manufacturing systems technology part 2 module 19. We were talking about the various situations, where there were the frequency distributions as normal curves for a process, and we are trying to meet these specification lines, but particularly upper specification limit and the lower specification limit with respect to the process mean in the spread. So, there were 3 cases which evolved case one was when the process 6 sigma, which is the process spread is appreciably less than the difference between these specification limits. You can see here that you know the amount of 6 sigma, which is this spread is much, much lower and comparison to the difference between the UCLX and the LSLX as recorded here.

So, the frequency curves A B C D and E indicate various positions in which the process can be centered. For example, this process D would have a mean very, very close to the upper specification while process, E would have a mean very, very close to the lower specification etcetera. So, with any of the positions A B and C practically all the products manufactured will meet this specification as long as the process stays in control, because you can see there all these 3 within the specification lines. In fact, anything outside this distributions C would just about cross the LSLX. So, we would not really consider them in our process. So, in general when conditions A B and C come it represents the ideal manufacturing situation when the control chart shows that one; one of this control chart exists many different possible actions may be considered depending on the relative economy.

For example, it may be considered economically advisable to permit x to go out of control if it does not go too far, because obviously, you know if you if you look at the way that lets say these are centered the means are quite far away from the upper specification limit or as matter fact the lower specification limits, and even a little bit of run out should be allow. So, the distributions may be allowed to more between positions. In fact, B and C, if you are talking about the process mean in the spread out of the process A. So, this just 2 probably avoid the cost of the frequent machine set up and of delays due to hunting of assignable causes of variation that will not be responsible for un unsatisfactory product or where acceptance has been based on 100 percent inspection it may be economical to substitute acceptance based on control charts. So, that is really how the processes spread and mean centered about the upper and lower specification limits would actually indicate different levels and degrees of control which may be needed on the processes.

So, now if you considered the lets say the position D or the position E, these are really serious situations where the mean is quite close to the upper specification limit in this particular cases, you can see and towards the lowest specification limits in this particular cases you can see, and this spread also is in such a manner that there is a possibility that the process may just run out of control, because of the mean in the spread. So, these are really unacceptable processes. So, you have to do something. So, that you can either sent to the mean more towards the center of the upper, and the lowest specification limits. So, that the spread in the mean all together comes within this domain. So, there would be definitely a tightening on the process or the process control needed in cases D and E. So, that is what you can say when you compare specifications to the actual distributions

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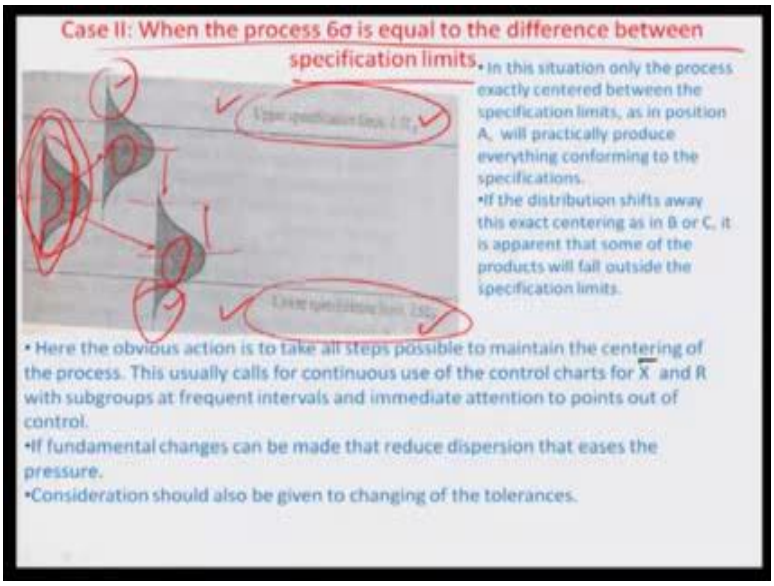

There is another case which is the little more serious when the process 6 sigma equals to the difference between the specification limits. So, now you can see exactly like let us say the A is the process, which is the mean centered about the central specification. And obviously, there is going to be USL LX and LSL LX LSL X as the upper in the lower bounds of the specification. So, mean in the specification mean are almost centric to each other. So, even a little bit of deviation for example, you can see here B and C are deviated slightly from the position A, they are not lowed because the movement that happens process goes out of control. So, you will have to do everything possible to bring the B the mean at B or the mean at C close to the mean at A. So, have to somehow move these means together. So, process still this control. So, this is how you read you know it is one the upper and lowest specification limits the various control aspects of the chart.

So, another possibility could be in this case to sort of probability revise the tolerance of C, if it works out for this particular process, because obviously, it is a very, very tight situation where the process mean and spread of just about good enough to be a commodity to be a upper, and the lower little bit of D control also leads to out runs and many rejects as you can see here. So obviously, either you probably change, you know the process control by making this little bit tighter. So, that you know you can have the spread lesser or alternatively you can change or think of changing this specifications, if need if there is a lot of factor of safety, which is been put in the original design. So, that still the process can be within controls.

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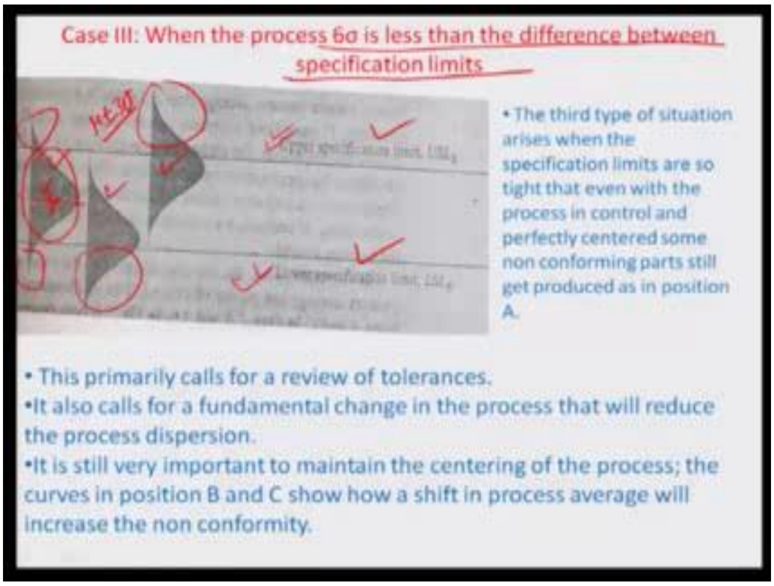

So, with the various ways to do or executes this, there is another case which I would like to discuss which talks about when the process 6 sigma is actually less than the difference between these specification. So, the respective of whether its center or not there is gone to be a loss in terms of rejects of the products that the process produces. So, even if you can center around the mean does not work out. So, now, this needs a really process change. For example, you can go from lets even a talking about diameter of a shaft, we can go from a manual system do not automatic system or may be A, C and C control system to a sort of reduce this variability sigma.

So, that the new plus minus you know 3 sigma would always fall between the USL and the LSL. So, that is what exactly has to be done, if is not possible. So, its al already the processes at the limit of its capability and obviously will have to think of changing this specification in this case. If you want the process to producing parts which are acceptable otherwise the process just is not feasible in this particular manner. So, these are how you interpret the various cases, you have the different means as standard deviations put together are sort of riming with respect of upper and lower specification limits.

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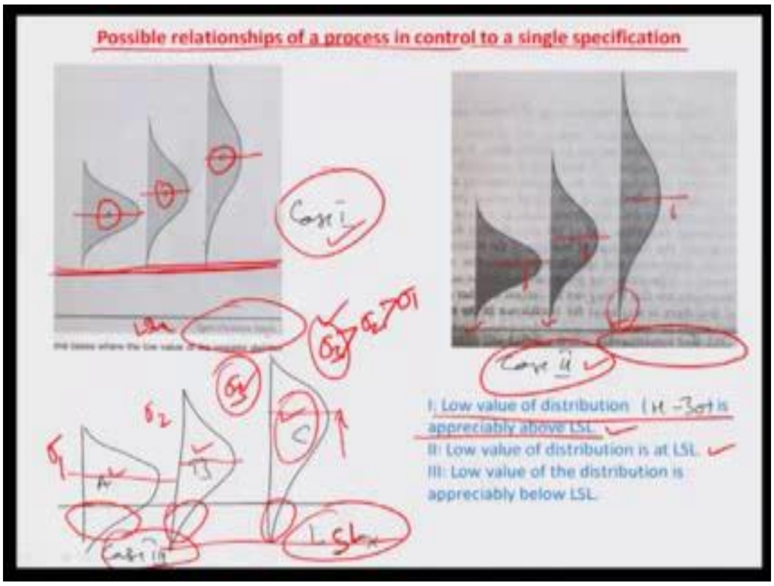

So, I would just like to show a little different situation here, where the possible relationship of a process in control to a single specification is identified, where 3 different cases; case one, case two, and cases three, you know in this particular case for example, case one as you may see there are different processes A B and C with certain spread in a mean, and you know all though the means are all differently shifted in the spreads are all different the lower specifications or the lower you know acceptable limits are more or less same for all the 3 processes.

So, in case one the low value of distribution u minus 3 sigma is appreciably above of LSL, the lower specification limits for x which is actually a good thing, because everything is that is produced the acceptable in this case. And case 2 is a case where all of them are lying on the LSLX; that means, little bit of deviation in terms of may be the change of the mean would in the down word direction would make a part the unacceptable, and the case 3 is even a little bit different, you know like quite serious that if you look at all these 3 - A B and C are distributions the processes indicate a greater amount of reject when the spread is smaller or may be a little bit lesser amount of reject, if it is larger and you know the least amount of reject, if it is even the largest.

So, in a way if the sigma alters and the cases, where all the processes are sort of riming with the lower specification limits, it is always y is to have A greater sigma. Let us say this is sigma 1, this is sigma 2, and this is sigma 3. So obviously, sigma 3 is greater than sigma 2 is greater than sigma 1. So, you can always think of having a greater sigma. So, that you know the mean can be accordingly shifted particularly in cases, where the lower specification limits are sort of all similar to each other or the lower percentage of rejects are same to each other.

So, in this particular case as you can see greater is the sigma or the greater is the process spread the better it is. So, this such cases to exists, where there is always a alignment of the lower side of the limit of rejects, and of the of the particular process and the movement that goes or starts going outside the lowest specification limit, it is always wise to have a wider spread than smaller spread as can be seen this particular example. So, such practical decisions have to be arrived at sometimes by a process control engineer or a quality control engineer.

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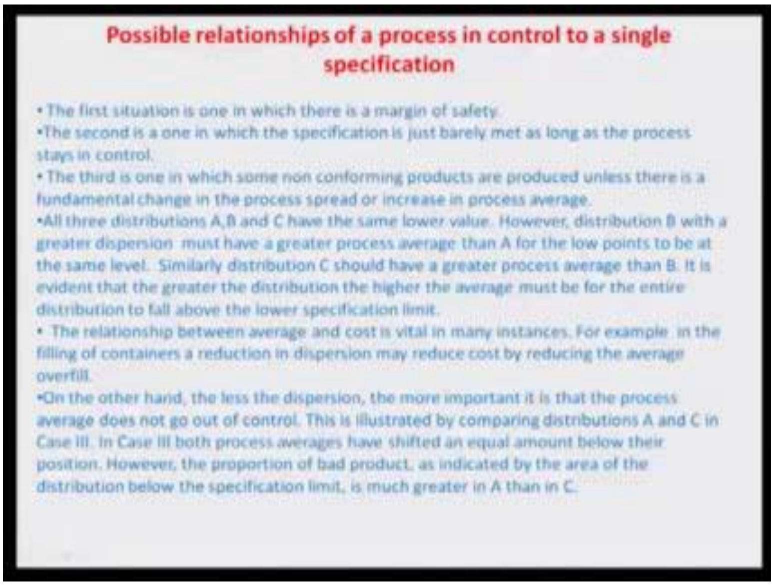

And let us just detail all these possible relationships of a process in control to a single specification particularly the LSL as you are seeing there. So, the first situation is one in which there is a margin of safety. Obviously, second is a one in which the specification is just barely met as long as the process stays in control, and the third is one in which some non conforming products are produced unless there is a fundamental change in the process spread or increase in the process average. So, all 3 distributions A B and C have the same lower value; however, distribution B with A greater dispersion must have a greater process average than A for the low points to be at the same level, similarly distribution C should have a greater process average than B as I talked about before.

So, it is evident that the greater the distribution the higher the average must be for the entire distribution to fall above the lower specification limits, and the relationship between average and cost is vital in many instances. For example, in the filling of containers a reduction in dispersion may reduce cost by reducing the average overfill, on the other hand the less the dispersion the more important, it is that the process average goes out of control, and this is illustrated by comparing distributions A and C. In case A B and C, in case 3 both process averages have shifted an equal amount below their position. However, the proportion of bad product are indicated by the area of the distribution below the specification limit is greater than greater in A than in C.

So, as I told you that its advantages in that particular case to have a greater spread of the processes at a higher average or a mean rather than a lower average mean in a lesser spreads have of the process. So, that is have we sort of indicate the various relationships in this kind of a single specification meeting situation.

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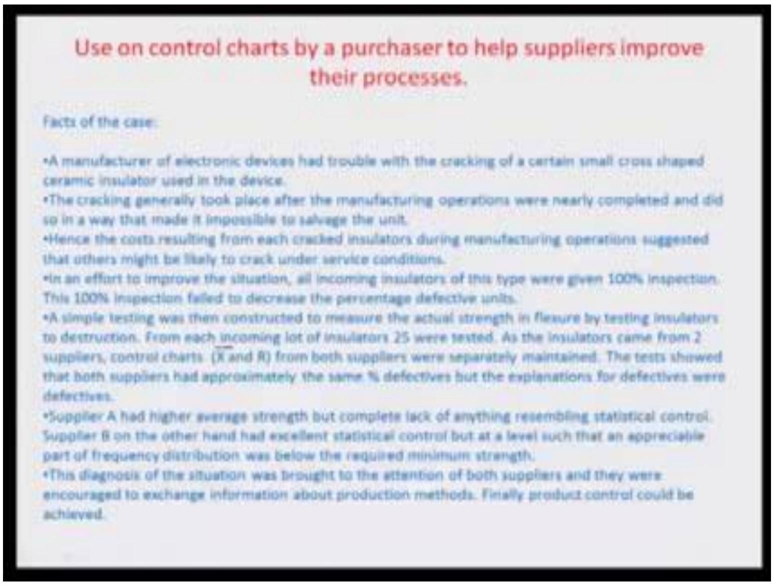

So, we now demonstrate some of the uses on the control charts by a purchaser to help suppliers improve their processes, there is a case which is given her a manufacturing manufacturer of electronic had trouble with the cracking of a certain small cross section ceramic insulator used in the device. So, the cracking generally took place after manufacturing operations were nearly completed. So, in a way that made it impossible to salvage the unit. So, will have to just throw the units have the crackers developed hence the costs resulting from each cracked insulators during manufacturing operations suggested the others might be likely to crack under service conditions. So, in an effort to improve the situation all incoming insulators of this type were given 100 percent inspection or this 100 percent inspection failed to decrease the percentage defective units.

So, simple testing was constructed to measure the actual strength inflection by testing insulators to destruction from each incoming lot of insulators 25 where tested as the insulators came from 2 suppliers control charts of X bar and R were floated from both suppliers, and they were separately maintained for a long mode of time the tests showed that both suppliers had approximately the same percentage defectives, but the explanations for defectives were the followings.

So, supplier had higher average strength, but complete lack of anything resembling statistical control B. On other hand had excellent statistical control, but at a level such that an appreciable part of frequency distribution was below the required minimum strength. So, this diagnosis of the situation was brought to the attention of both suppliers, and they could encourage to sort of exchange information about production methods. And finally, product control could be achieved. So, it shows how control charts were used for checking the defects, which were actually alternating for different kind of defects between the 2 manufactures and they was simply exchanged on each other. So, that they could have a better control you know of both the processes and learn from each other strung points.

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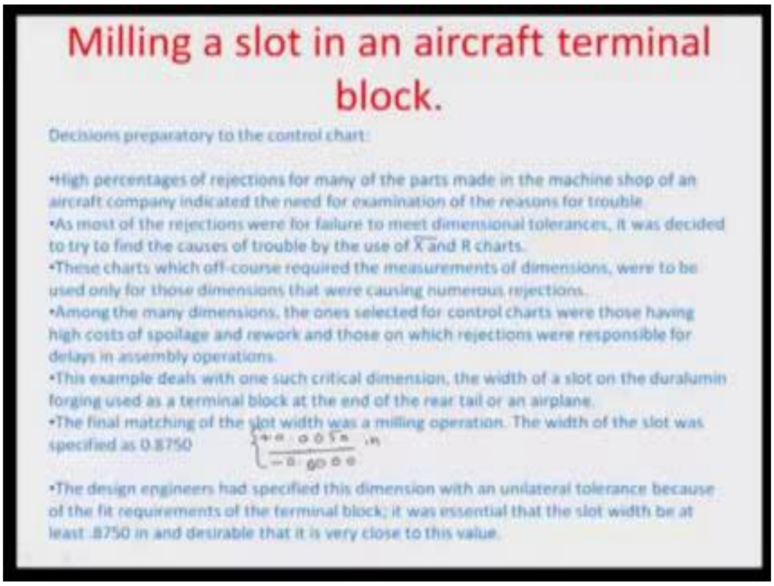

So, I think I had only earlier described the milling a slot in an aircraft terminal block, I am going to just may be go through a few more issues in this particular terminal block.

So, what are the decisions which are preparatory to the control chart why the terminal block, example was chosen in the particular industry. So, there are high percentage rejections for many of the parts made in the machine shop of an aircraft company, and this indicate the need for examination of the reasons for trouble, and as most of the rejections were for failure to meet dimensional tolerances, it was decided to try to find the causes of trouble by the use of x bar and r charts. And these charts which of course, required the measurements of dimensions were to be used only for those dimensions where it was causing numerous amounts of rejections.

So, particularly the milling slot width in this particular case was they can as a dimension. So, among the many dimensions the one selected for control charts were those having high costs of spoilage and rework. So, we very judiciously the company chose, you know that particular dimension which creates a lot of low value added to the system in terms of rework or spoilage or rejections or you know even like not being able to fit on the electrical panel properly so on so far. And those one which rejections were responsible for delays in assembly operations were also considered. So, one critical dimension was found or isolated to be a very important nature, and that was the width of a slot on the duralumin forging used as a terminal block at the end of the rear tail of an airplane. So, the final matching of the slot width was a milling operation, and the width of the slot was specified to be 0.87509, you know this is inches. So, it is basically inches mean.

And then this specification limits said there it has to be within plus 0.0050 inches in minus of 0.000 inches. So, that is about you know the way that this example was invasion, the design engineers had specified this dimension with an unilateral tolerance, because of the fit requirements of the terminal block, and it was essential that the slot width be at least 0.8750 inches and desirable that it is very close to this value. So, now the question you know arises that once this dimension has been sort of isolated and this specifications being laid out the next step which is the control chart floating comes out to be a picture. So, I am going to close this module in a interest of time, but in the next module will starts as to how this charts was floated, and how you can a various information from this charts which leads to some learning experiences.

Thank you.