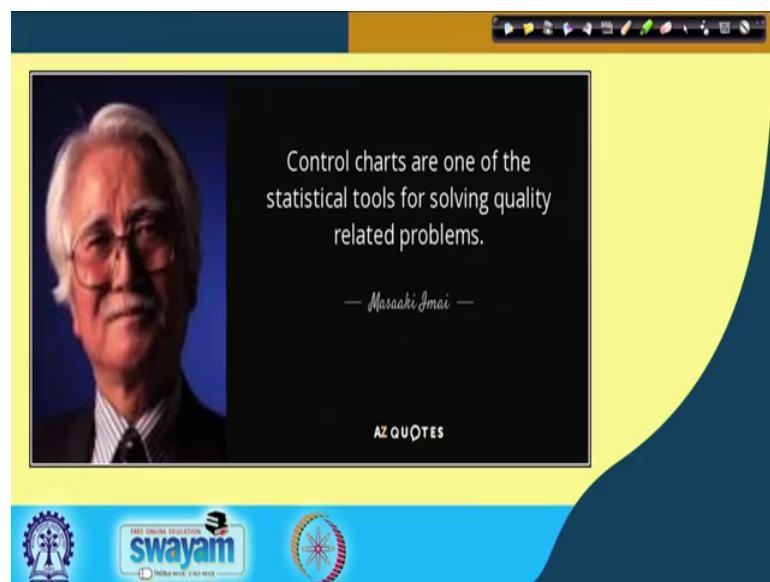


Six Sigma
Prof. Jitesh J Thakkar
Department of Industrial and Systems Engineering
Indian Institute of Technology, Kharagpur

Lecture - 56
Design of Acceptance Sampling Plans for Attribute (Part – 2)

Hello friends, once again I welcome you to our ongoing journey and Six Sigma and we are discussing the control phase of DMAIC cycle, as a part of that we are talking about acceptance sampling plans and now we will go deeper into the Design of Acceptance Sampling Plans for Attributes part 2 as a part of lecture 56. There is no substitute of control chart we always refer this and we strengthen our faith.

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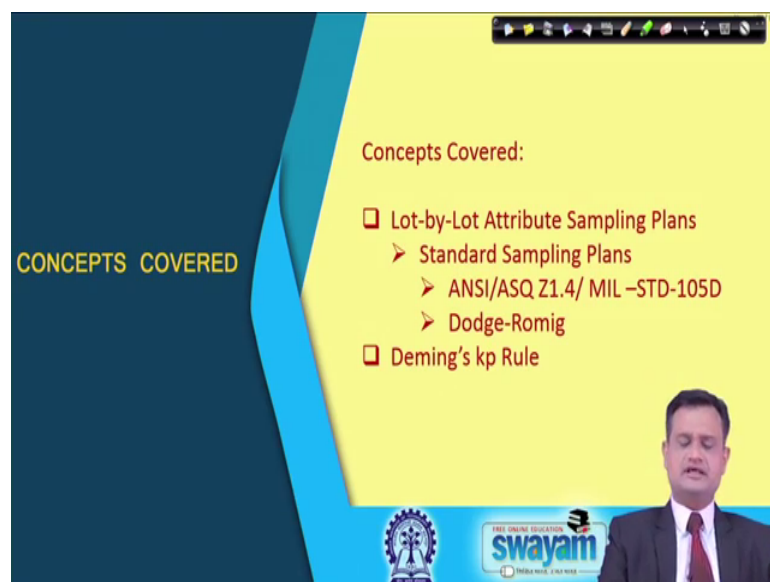


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If you recall we had a detailed discussion on lot by lot attribute sampling plans, single sampling plans, double sampling plans and multiple sampling plans and we have seen the Grubb's table and how to develop and design a particular sampling plan, whether it is single double or multiple what is the impact of n and c on the operating characteristic curve and how the discriminatory power of the sampling plan is affected.

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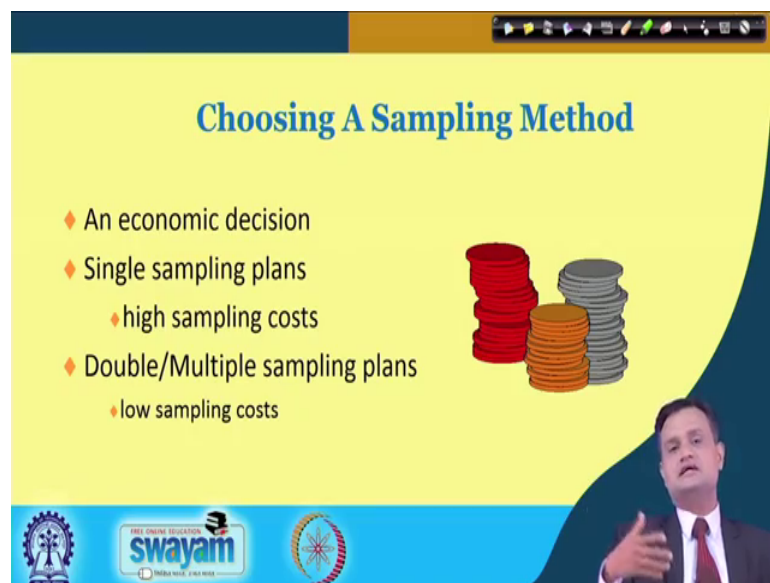


So, we had seen all this thing now as a part of this lecture we would like to go by lot by lot attribute sampling plan and already we have discussed single, double and multiple something which is still required or left is standard sampling plans and broadly they are

of 2 category; one is ANSI ASQ Z14 MIL STD 105D and second one is the Dodge Romig and another very good easy to follow sampling procedure is Deming's kp rule.

So, first we will try to complete with our lot by lot attribute sampling plan and in that we will discuss the standard sampling plan, typically two kind ANSI military standard and Dodge Romig and another one is Deming kp rule.

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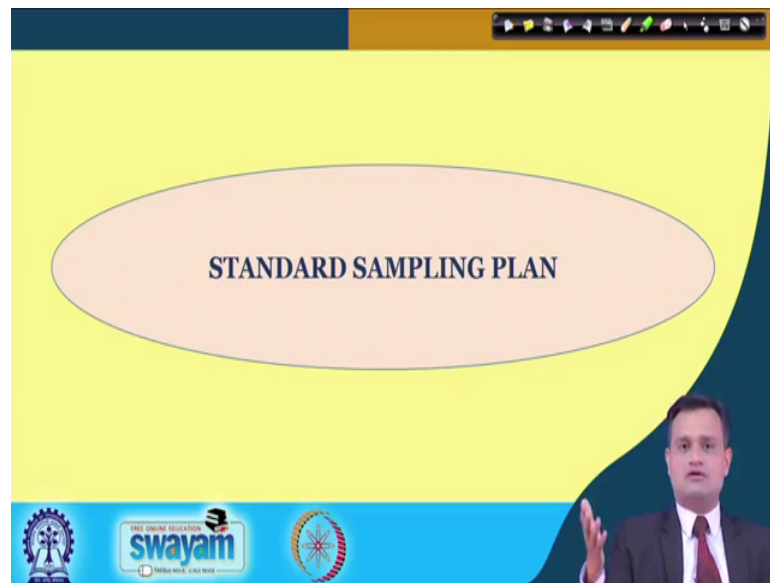


The slide is titled "Choosing A Sampling Method" in blue text on a yellow background. It contains a bulleted list of points, each preceded by a red diamond icon. To the right of the list is an illustration of three stacks of coins: a tall red stack, a medium orange stack, and a shorter grey stack. At the bottom of the slide, there is a blue banner with logos for "swayam" and "MHRD" (Ministry of Human Resource Development). A small inset image of a man in a suit is visible in the bottom right corner of the slide.

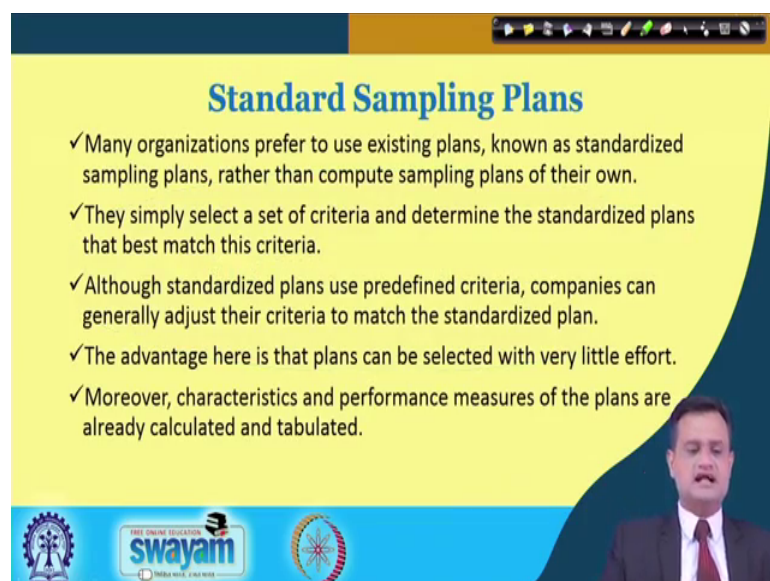
- ♦ An economic decision
- ♦ Single sampling plans
 - ♦ high sampling costs
- ♦ Double/Multiple sampling plans
 - ♦ low sampling costs

So, as I mentioned sampling helps us to reduce the cause, it's an economic decision and single sampling plan has high sampling cost, but the administration is easy, double sampling multiple sampling the sampling cost is less.

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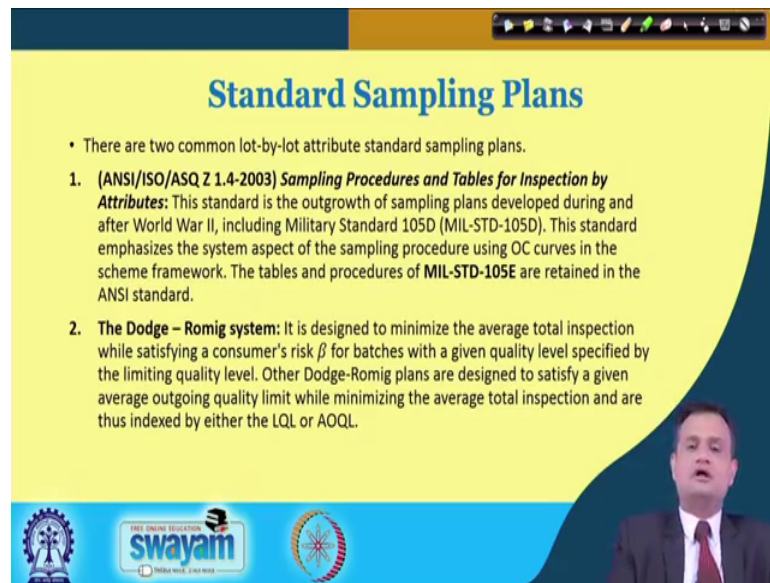


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So, now let us see the standard sampling plan. So, many organizations they are not interested in doing what we have done in the previous lecture, finding the values of c and all these based on producers risk and consumers risk and other things. In a traditional way they have to do, but in a traditional way they want to go for some standard procedure or some standards available as a part of military standards sampling plans and they are more comfortable in the use of this sampling plans.

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Standard Sampling Plans

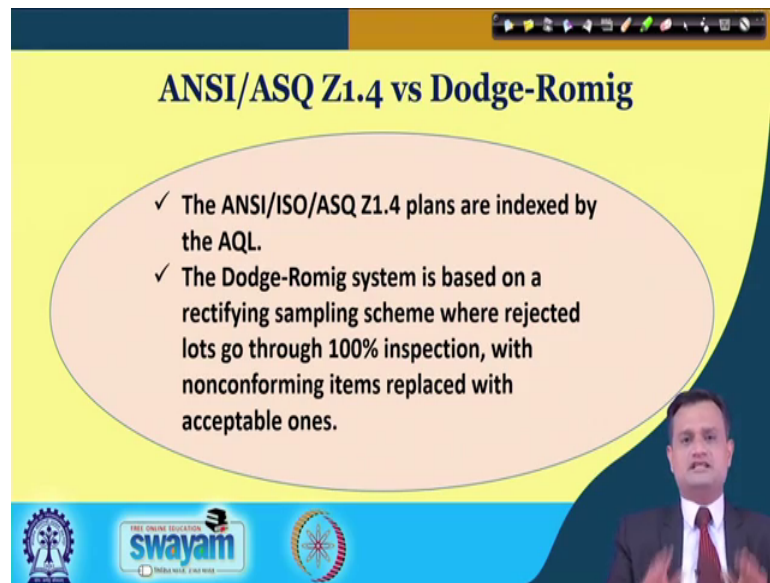
- There are two common lot-by-lot attribute standard sampling plans.

1. **(ANSI/ISO/ASQ Z 1.4-2003) Sampling Procedures and Tables for Inspection by Attributes:** This standard is the outgrowth of sampling plans developed during and after World War II, including Military Standard 105D (MIL-STD-105D). This standard emphasizes the system aspect of the sampling procedure using OC curves in the scheme framework. The tables and procedures of **MIL-STD-105E** are retained in the ANSI standard.
2. **The Dodge – Romig system:** It is designed to minimize the average total inspection while satisfying a consumer's risk β for batches with a given quality level specified by the limiting quality level. Other Dodge-Romig plans are designed to satisfy a given average outgoing quality limit while minimizing the average total inspection and are thus indexed by either the LQL or AOQL.

So, typically we have two categories of sampling plan ANSI ISO ASQ Z14 2003 and this plans basically are developed during world war 2, when they had lot of inspection to be carried out and it includes the military standard typically called as MIL STD 105D. And typically this kind of plans they emphasize the system aspect of the sampling procedure and they are written in the ANSI standard, so MIL STD is part of these ANSI.

The other category of standard sampling plan is Dodge Romig system and typically this is design with an objective to minimize the average inspection while satisfying the consumers risk that is beta. So, offering protection to the consumer with a given quality level specified by the limiting quality level that is LQL.

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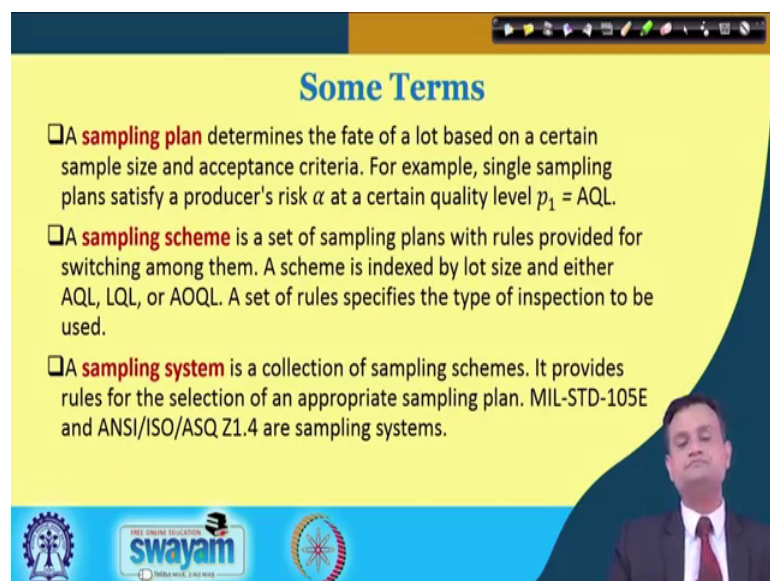
ANSI/ASQ Z1.4 vs Dodge-Romig

- ✓ The ANSI/ISO/ASQ Z1.4 plans are indexed by the AQL.
- ✓ The Dodge-Romig system is based on a rectifying sampling scheme where rejected lots go through 100% inspection, with nonconforming items replaced with acceptable ones.

The slide features a yellow background with a large orange oval containing the comparison points. At the bottom, there are logos for 'swayam' and 'INDIA WISE' along with a small video feed of a presenter in a suit.

So, we will try to refer broadly this two categories of the standard plan as a part of lot by lot attribute sampling and if I just put it in a very simple way then ANSI, ISO, ASQ Z1.4 plans are indexed AQL and if you see the Dodge Romig other standard plan, then it is based on the rectifying sampling scheme where the entire rejected lot go through the 100 percent inspection and with non coming and a confirming items are replaced with the acceptable once.

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Some Terms

- ❑ A **sampling plan** determines the fate of a lot based on a certain sample size and acceptance criteria. For example, single sampling plans satisfy a producer's risk α at a certain quality level $p_1 = \text{AQL}$.
- ❑ A **sampling scheme** is a set of sampling plans with rules provided for switching among them. A scheme is indexed by lot size and either AQL, LQL, or AOQL. A set of rules specifies the type of inspection to be used.
- ❑ A **sampling system** is a collection of sampling schemes. It provides rules for the selection of an appropriate sampling plan. MIL-STD-105E and ANSI/ISO/ASQ Z1.4 are sampling systems.

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So, this is the difference main difference between these two. Now before we go ahead let us try to say have some appreciation of the key terms, so first is a sampling plan. So, typically it determines the fate of a lot; fate of a lot and I have used another word if you recall sentence. So, it may punish the lot, so determines the fate of a lot based on a certain sample size and acceptance criteria and for example, we have seen in the single sampling plan that satisfies a producers risk α p_1 is equal to AQL. So, producer stipulated risk we have seen this examples in detail.

Now, a sampling scheme typically sets the rules provided for switching among them in a scheme is indexed by lot size your AQL, LQL, AOQL and set of rules specify the type of inspection to be used. So, now, here you will see little difference that it is not a same level of inspection you may even vary the level of inspection depending upon the quality of the lot.

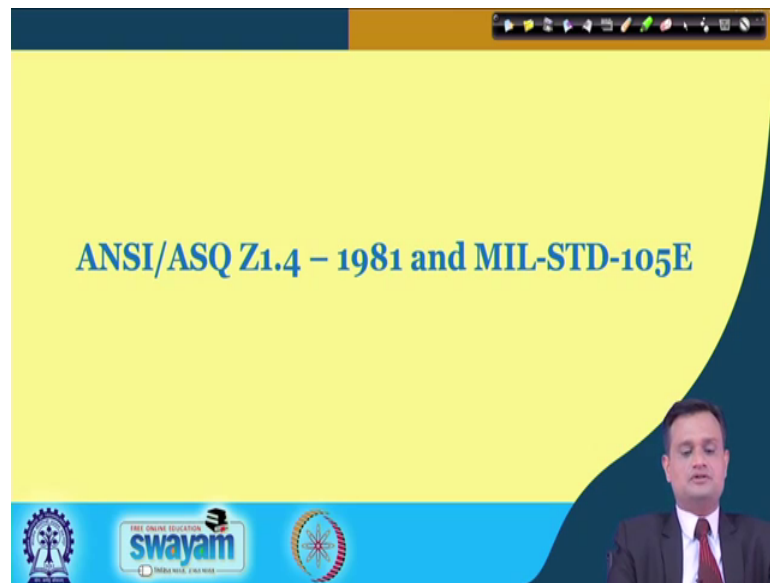
The third one is the sampling system. So, it's a collection of sampling schemes and basically provides the rule for selection of an appropriate sampling plan. So, MIL STD 105E ANSI I will call them as the sampling systems.

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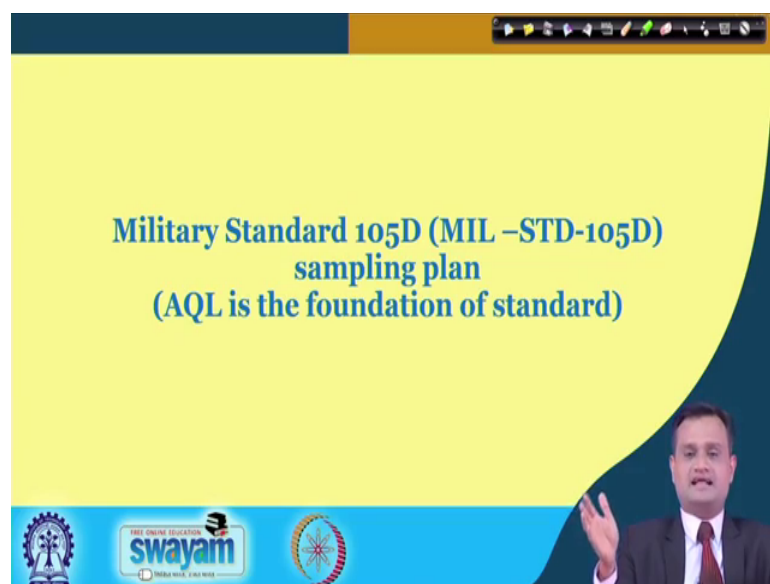


So, these are the key terms useful in understanding the standard sampling plan. Let us try to focus on 2, one is MIL STD 105D this is the Military Standard plan and part of your ANSI and second is Dodge Romig system.

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So, this is your ANSI ASQ military standard plan and typically this is based on AQL, so your average quality level acceptable quality level it is based on your AQL.

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What is MIL-STD-105D?

- ❑ Sampling plans are typically set up with reference to an acceptable quality level, or AQL.
- ❑ The AQL is the base line requirement for the quality of the producer's product.
- ❑ The producer would like to design a sampling plan such that the OC curve yields a high probability of acceptance at the AQL.
- ❑ On the other side of the OC curve, the consumer wishes to be protected from accepting poor quality from the producer. So the consumer establishes a criterion, the lot tolerance percent defective or LTPD.
- ❑ Here the idea is to only accept poor quality product with a very low probability.
- ❑ MIL-STD plans have been used for over 50 years to achieve these goals.

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So, now here what exactly I would like to do? So, producer would like to design a sampling plan such that, the OC curve yields a high probability of acceptance at AQL that is Acceptable Quality Level. Simultaneously my consumer would like to have a protection for limiting quality level or LTPD at the beta percent.

So; obviously, I have to look into this two aspects as usual and then I have to think about the sampling plan and MIL STD 105D, typically this plans are used over 50 years with many modifications, they try to address this issues.

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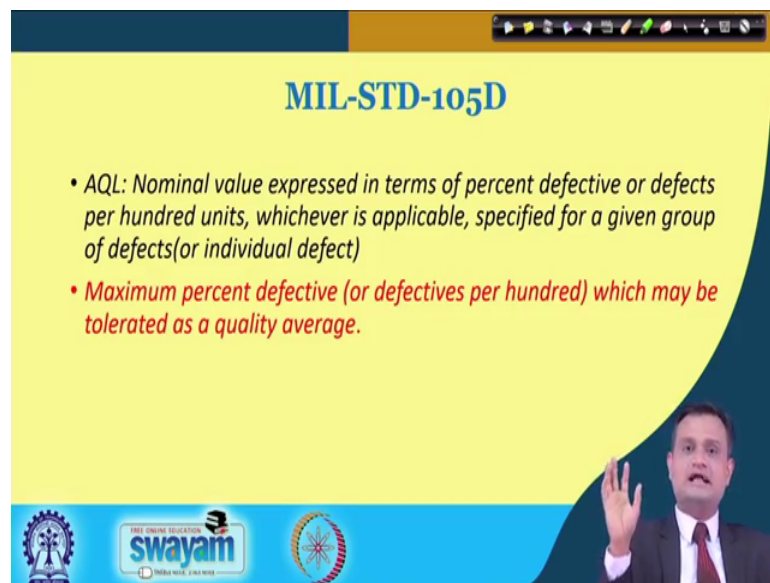
What is MIL-STD-105D?

A sampling scheme consists of a combination of a normal sampling plan, a tightened sampling plan, and a reduced sampling plan plus rules for switching from one to the other.

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So, in a simple way MIL STD 105D is a sampling scheme consist of a combination of normal sampling plan, a tightened sampling plan and a reduced sampling plan plus rules for switching from one to another. So, we have so far not talked about the level of inspection. Here you will see that we will also consider the level of inspection and the condition which will help us to switch from one particular say plan to another plan and this kind of thing is part of your ANSQ or military standard sampling plan.

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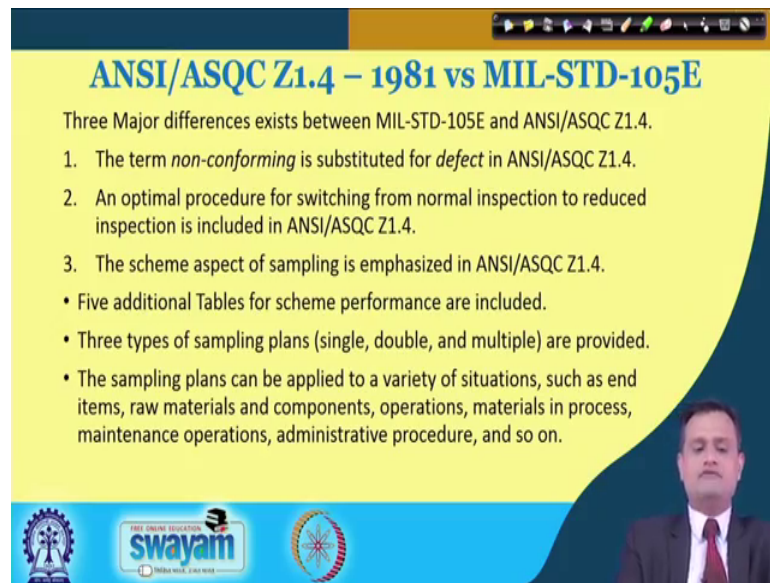
MIL-STD-105D

- AQL: Nominal value expressed in terms of percent defective or defects per hundred units, whichever is applicable, specified for a given group of defects (or individual defect)
- Maximum percent defective (or defectives per hundred) which may be tolerated as a quality average.

The slide is part of a video lecture. In the bottom right corner, there is a small inset image of a man in a suit and tie, gesturing with his right hand. In the bottom left corner, there is a logo for 'swayam' with the text 'FREE ONLINE EDUCATION' and 'SWAYAM' in a stylized font. To the right of the 'swayam' logo is a circular emblem with a gear-like design.

So, AQL is your nominal value expressed in terms of percent defective or defects per 100 units, whichever is applicable specified for a given group and this is the maximum percent defective which may be tolerated as quality average, so this we have seen.

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ANSI/ASQC Z1.4 – 1981 vs MIL-STD-105E

Three Major differences exists between MIL-STD-105E and ANSI/ASQC Z1.4.

1. The term *non-conforming* is substituted for *defect* in ANSI/ASQC Z1.4.
2. An optimal procedure for switching from normal inspection to reduced inspection is included in ANSI/ASQC Z1.4.
3. The scheme aspect of sampling is emphasized in ANSI/ASQC Z1.4.

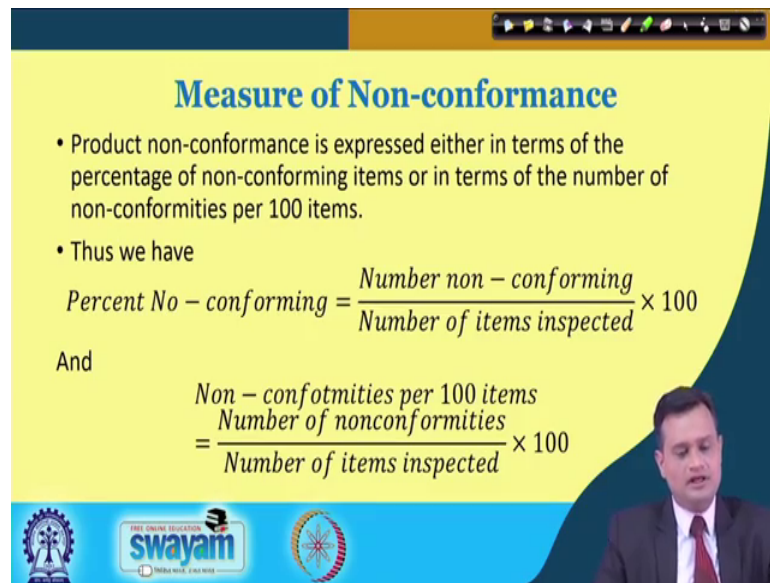
- Five additional Tables for scheme performance are included.
- Three types of sampling plans (single, double, and multiple) are provided.
- The sampling plans can be applied to a variety of situations, such as end items, raw materials and components, operations, materials in process, maintenance operations, administrative procedure, and so on.

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Now when you refer ANSI MIL STD fine MIL STD is part of ANSI, but there is just little difference. So, the difference is like this MIL STD and ANSI the term nonconforming is substituted for defect in ANSI ASQC Z14. An optimal procedure for switching from normal inspection to reduced inspection is included in your ANSI and the scheme aspect of sampling is emphasized in ANSI ASQC Z14.

So, 5 additional tables for scheme performance are included, three types of sampling plan single, double, multiple and the sampling plans can be applied to variety of situations say, it may be the end material or may be the raw material or components or operations and so on.

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Measure of Non-conformance

- Product non-conformance is expressed either in terms of the percentage of non-conforming items or in terms of the number of non-conformities per 100 items.
- Thus we have

$$\text{Percent No - conforming} = \frac{\text{Number non - conforming}}{\text{Number of items inspected}} \times 100$$

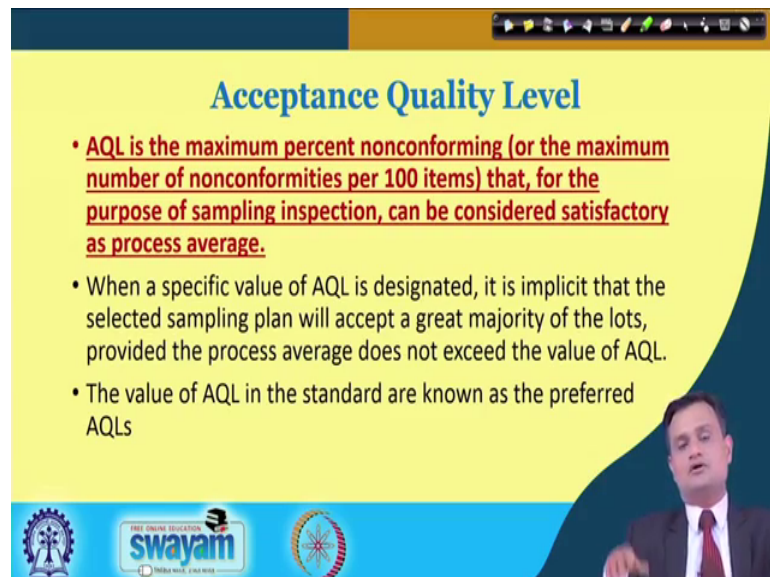
And

$$\frac{\text{Non - confotmities per 100 items}}{\text{Number of nonconformities}} = \frac{\text{Number of nonconformities}}{\text{Number of items inspected}} \times 100$$

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Now, if we just see the measure of non conformance then the percent nonconforming can be found as number nonconforming divided by number of items inspected into 100 or you can say nonconforming for 100 items number of non conformities and number of items inspected when you take the ratio multiply by 100.

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Acceptance Quality Level

- AQL is the maximum percent nonconforming (or the maximum number of nonconformities per 100 items) that, for the purpose of sampling inspection, can be considered satisfactory as process average.
- When a specific value of AQL is designated, it is implicit that the selected sampling plan will accept a great majority of the lots, provided the process average does not exceed the value of AQL.
- The value of AQL in the standard are known as the preferred AQLs

The slide includes logos for Swayam and other educational institutions at the bottom.

So, I would just like to remind you the important term Acceptance Quality Level this is AQL is the maximum percent nonconforming, maximum nonconformities per 100 items

that is for the purpose of sampling inspection, it can be considered satisfactory as process average. So, I am just trying to set the parallel between these two.

So, far we were only using AQL, but this AQL basically is an indication of your process average and you can use your AQL also as a process average. So, when a specific value of AQL is designated it is implicit that the selected sampling plan will accept a great majority of the lots provided the process average does not exceed the value of the AQL.

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General Inspection Levels

- ✓ Three general inspection levels are provided in the standards: I, II, and III.
- ✓ They provide about the same degree of protection to the producer by rejecting on average about 100α% of the lots that have a level of non-conformance given by the AQL.
- ✓ However these levels differ in their degree of consumer protection when acceptance of poor-quality batches is considered.
- ✓ Inspection level II is the norm; level I is less discriminating and requires about half the inspection as level II.
- ✓ Level III is the most discriminating of the three and requires about twice the inspection as level II.
- ✓ Level III has the steepest OC curve and provides the most protection for the consumer against the acceptance of poor lots.
- ✓ Selection of the general inspection level depends on what level of consumer protection is desired.

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So, this is the acceptable quality level, now we are talking about the inspection level that is the additional feature when we talk about the standard sampling plan. So, you have something called general inspection level. So, there are 3 general inspection levels I, II and III and as you go on the higher side from let us say 1 to 2 and 2 to 3, then your level of inspection is increasing.

So, typically they provide about the same degree of protection to the producer by rejecting on average about 100 alpha percent and inspection level II is the norm, 1 is less discriminatory and requires about half of the inspection compared to 3. Level III is more discriminatory. So, as I mentioned as you go from level I to level I to level III and it just goes my inspection level in the increasing order.

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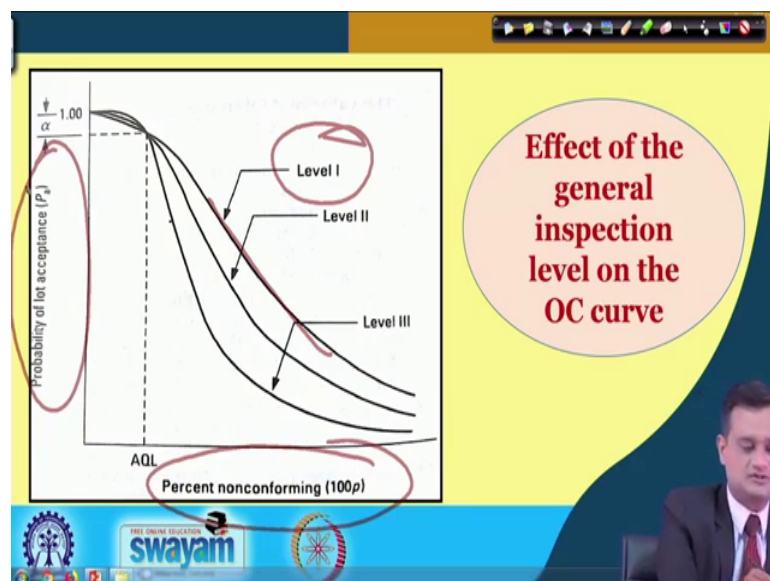
General Inspection Levels

- ❖ Of course, the sample size and hence the cost of inspection also increases as the inspection level changes from I to III.
- ❖ The method of inspection and the type of product also influence the choice of inspection level.
- ❖ If testing is destructive, inspection levels I and II may be appropriate.
- ❖ When items are costly, inspection level III may be the best choice.



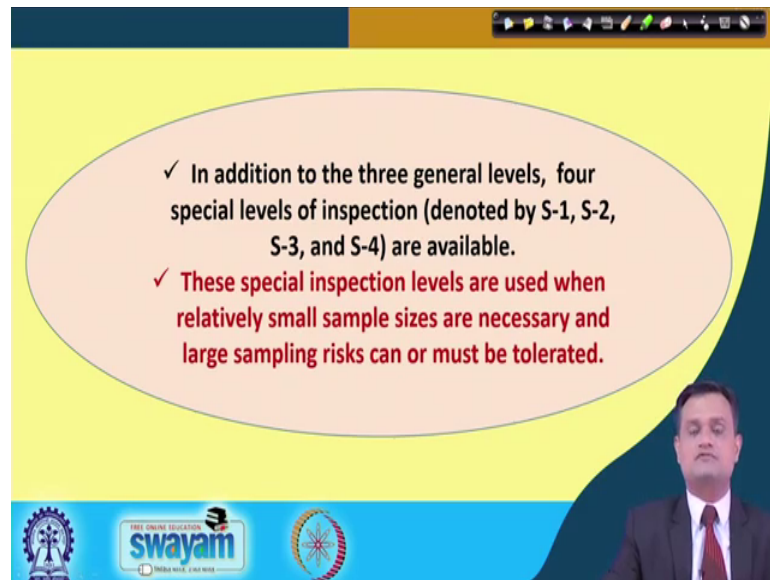
So, I have the general inspection level and cost of inspection also increases because I am trying to apply more and more tighter inspection. So, when I change from level I to level III and if testing is destructive there is a recommendation inspection level I in II may be appropriate, but if items are costly then inspection level III may be the best choice. So, I gave you the example that aircraft industry say, if they are purchasing highly precise item then; obviously, they need to apply a stringent high level inspection to see that they do not call for a problem later on when a faulty component is fitted in the aircraft.

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So, just see and appreciate that we have level I which is less discriminatory because the OC curve is stiffer you are comfortable with this percent nonconforming and probability of lot acceptance this is my alpha. And level II is more discriminatory level III is the highly discriminatory in terms of it's ability to separate out the good and bad quality lot.

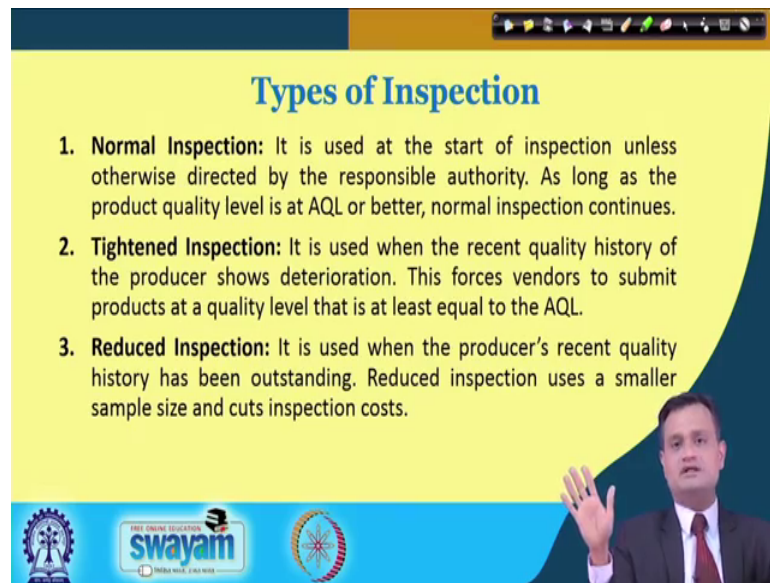
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- ✓ In addition to the three general levels, four special levels of inspection (denoted by S-1, S-2, S-3, and S-4) are available.
- ✓ These special inspection levels are used when relatively small sample sizes are necessary and large sampling risks can or must be tolerated.

Now, in standard plans you have some more variety and this says that in addition to the general level, four special levels of inspection denoted as S 1, S 2, S 3 and S 4 are available. So, this special inspection level typically you use when, relatively small sample sizes are necessary and large sampling risk can or must be tolerated So, when these condition prevails you go for this four special levels of inspection S 1, S 2, S 3 and S 4 in addition to your general level.

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Types of Inspection

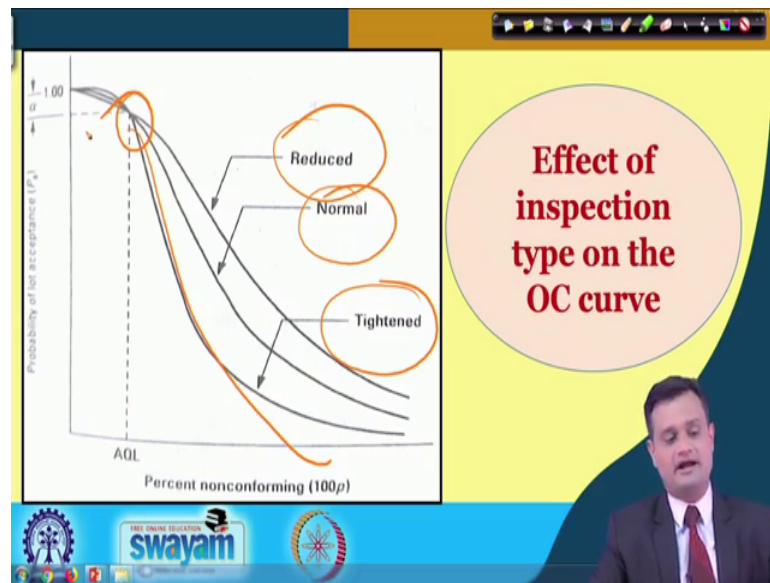
1. **Normal Inspection:** It is used at the start of inspection unless otherwise directed by the responsible authority. As long as the product quality level is at AQL or better, normal inspection continues.
2. **Tightened Inspection:** It is used when the recent quality history of the producer shows deterioration. This forces vendors to submit products at a quality level that is at least equal to the AQL.
3. **Reduced Inspection:** It is used when the producer's recent quality history has been outstanding. Reduced inspection uses a smaller sample size and cuts inspection costs.

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So, if we just see the type of inspection then you have normal inspection and usually it is used at the start of inspection unless otherwise directed by the accountable and responsible authority and as long as the product quality level is at AQL or better you are comfortable with the normal. So, if your process is producing let us say or AQL is 3 percent, it is more or less producing 3 percent defective you are happy with that and you will only apply the normal inspection level.

If let us say, you go for say recent history of the producer and you find that there is lot of deterioration. You are purchasing the material from some vendor and you find that there is lot of rejection or defects or if you see the process capability of your supplier and it is going down, then there is a risk and you would like to go for the increased inspection that is called tighter inspection. And third is the reduced inspection this is other way round that when producers recent quality history has been outstanding almost 0 or very less percent defective, then you can record or you can go for the reduced inspection and use the smaller sample size to cut upon the inspection cost.

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So, once again you can see the impact of these on the discriminatory power this is reduced; obviously, the discriminatory power is less this is normal little bit higher because it is cheaper and tighter. So, it is cheaper, but you can see that all these 3 OC curves they pass through one point that is AQL.

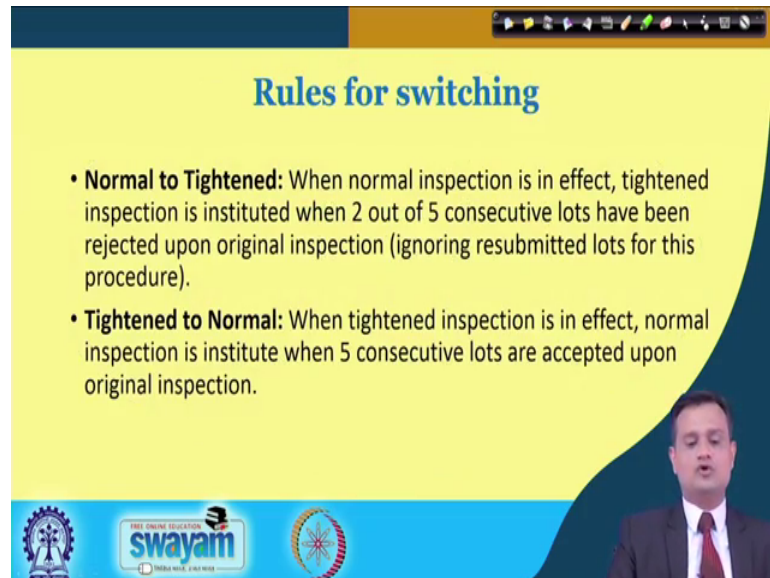
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- ❑ The general inspection level is selected prior to implementing the sampling plan, but the type of inspection – normal, tightened, or reduced – is dedicated by the outcomes of the inspection process.
- ❑ Of the three, tightened inspection has the most stringent requirements and the most discriminatory power.

So, with this understanding I would say the general inspection level is selected prior to implementing the sampling plan, but the type of inspection normal, tightened or reduced it decided by the outcomes of the inspection process. Too much rejection from the

vendor's material I have to go for tighter excellent history I will go for reduced otherwise I will be happy with the normal.

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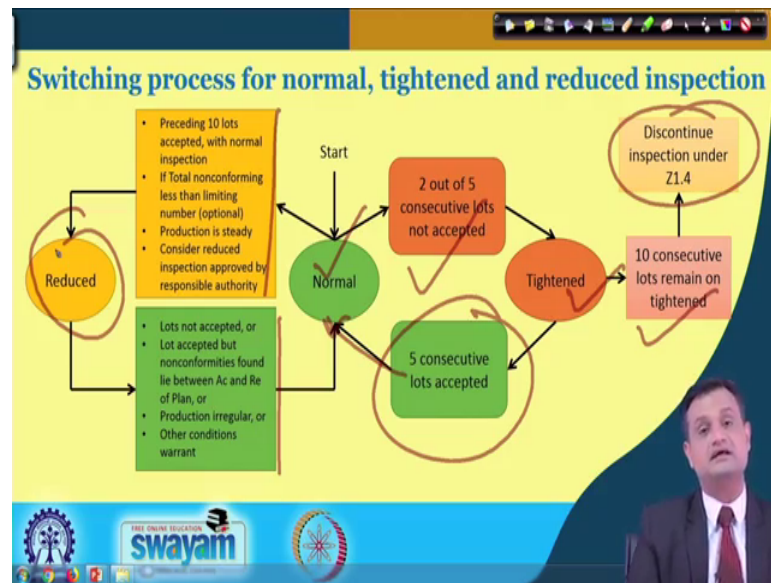
Rules for switching

- **Normal to Tightened:** When normal inspection is in effect, tightened inspection is instituted when 2 out of 5 consecutive lots have been rejected upon original inspection (ignoring resubmitted lots for this procedure).
- **Tightened to Normal:** When tightened inspection is in effect, normal inspection is institute when 5 consecutive lots are accepted upon original inspection.

So, rules for switching now this is something that is really an appealing factor of my standardized sampling plan, that I will not stick to only one inspection level and unnecessarily spent or bare inspection cost. So, there are some rules for switching let us say I want to switch from normal to tightened inspection. So, the condition is that when normal inspection is in effect means you are using, tightened inspection is instituted when 2 out of 5 consecutive lots have been rejected. So, you get an idea that there is some problem with the lot quality and you go for switch over to the tightened.

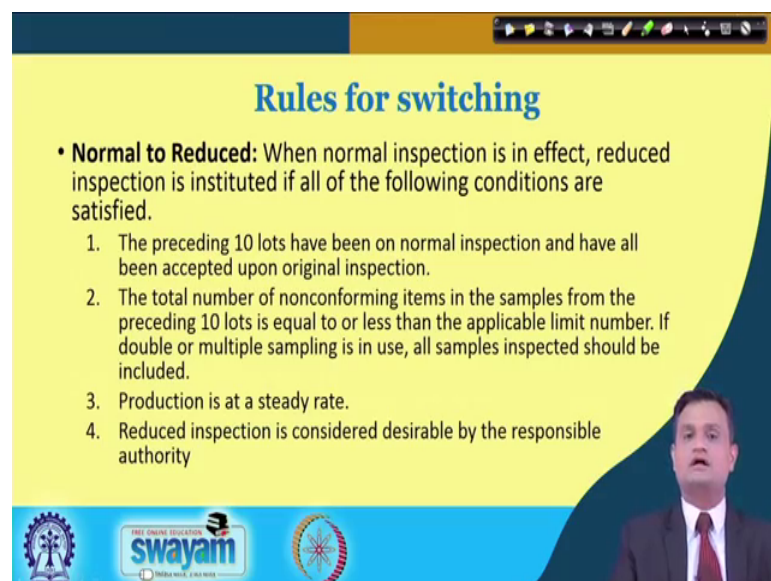
Now, other way round is also possible tightened to normal, so normal inspection is instituted when 5 consecutive lots are accepted upon the original inspection. So, you can move from normal to tightened and tightened to normal and obviously, when you go to a doctor you have a problem, he will prescribe some medication and once again you go when the problem has gone down he will also reduce the medication. Exactly same way we try to leverage the advantage by switching on the cost I have to bare on the inspection.

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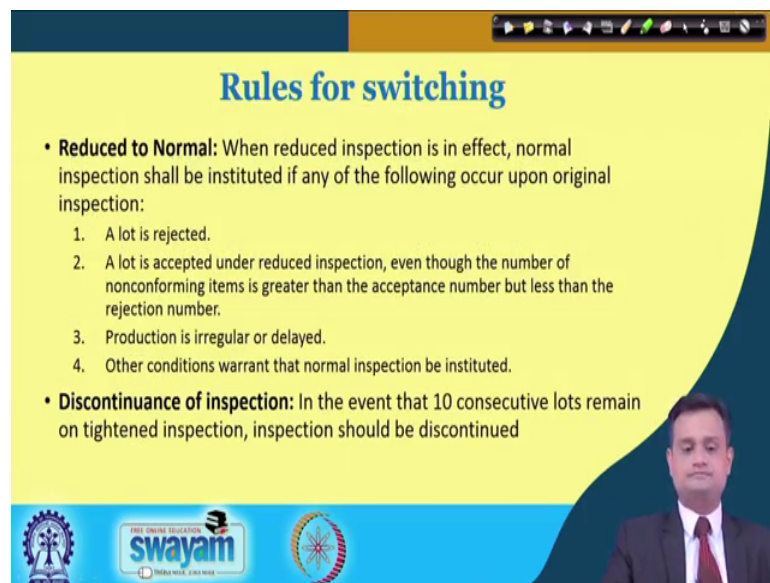
So, this is something which I explained in very simple way begin with the normal and then if 2 out of 5 consecutive lot go for the tightened, if let us say 10 consecutive lots remained tightened means still the quality is a problem discontinue and identify the real root cause get rid of it change the vendor whatever step is necessary management can decide. If let us say 5 consecutive lots are accepted go back to normal and these are some of the points I have indicated about the reduced inspection.

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So, you can follow this procedure in a very simple way and switch over is possible. So, I have just elaborated on rules of switching normal to reduced day the preceding 10 lots have been normal inspection have been accepted. Total number of nonconforming items in the samples from the proceeding 10 lot is equal or less than the applicable limit number, production is at steady rate reduced inspection is considerable and responsible authority can decide. So, this is normal to reduced.

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Rules for switching

- **Reduced to Normal:** When reduced inspection is in effect, normal inspection shall be instituted if any of the following occur upon original inspection:
 1. A lot is rejected.
 2. A lot is accepted under reduced inspection, even though the number of nonconforming items is greater than the acceptance number but less than the rejection number.
 3. Production is irregular or delayed.
 4. Other conditions warrant that normal inspection be instituted.
- **Discontinuance of inspection:** In the event that 10 consecutive lots remain on tightened inspection, inspection should be discontinued

Logos at the bottom: Indian Institute of Technology (IIT) Bombay, Swayam, and a circular logo with a gear and a person.

Reduced to normal a lot is rejected, lot is accepted under reduced inspection even though the number of nonconforming items is greater than the acceptable number production is regular or delayed and discontinuation of the inspection in the event 10 consecutive lot remain in the tightened inspection zone, it means the quality is really a problem.

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Selection of Sample Size

- ❑ The sample size is determined by first selecting a sample size code letter based on the lot size and the general inspection level (I, II, or III).
- ❑ Knowing the type of sampling plan (single, double, or multiple) and the type of inspection (normal, tightened, or reduced), the appropriate table is chosen. Using the sample size code, the sample size is then identified from the table.

The slide features a yellow background with a large light-orange oval containing the text. A red checkmark is next to the first bullet point. Red underlines are present under 'sample size code letter', 'lot size', 'general inspection level (I, II, or III)', 'type of sampling plan', 'type of inspection', 'appropriate table', 'sample size code', and 'sample size is then identified from the table'. At the bottom left are logos for 'swayam' and 'Free Online Education'. At the bottom right is a video inset of a man in a suit.

So, now, we talk about the sampling selection of the sampling plan under the standardized schemes of ANSI and then Dodge Romig. So, selection of the sample size we follow a very simple procedure say, the sample size is determined by first selecting a sample size code letter based on the lot size and the general inspection level. So, you know the health of your process you choose the inspection level or whatever you are using and then you have the lot size you will get a particular sample size you can select the sample size based on a code letter.

So, knowing the type of sampling plan this is the another thing, now you know that whether you want to go for single double or multiple and type of inspection normal tightened or reduced the appropriate table is chosen and using sample size code sample size is then identify from the table. So, just see how it operates and the idea will be clear.

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Implementation of ANSI/ASQC Z1.4

- Step 1: Determine the AQL.
- Step 2: Select the general inspection level (level II usually selected; change as needed)
- Step 3: Determine the lot size.
- Step 4: Find the sample size code letter from the appropriate table.
- Step 5: Determine the type of sampling plan (single, double, or multiple)
- Step 6: Identify the sampling plan on an appropriate table.
- Step 7: For initial inspection, start with normal inspection and change to tightened or reduced inspection based on the switching rules.



So, there is nothing much to say do say, determine the AQL, select the general inspection level II is usually selected, determine the lot size, find the sample size code later from the appropriate table, determine the type of sampling plan single double or multiple, identify the sampling plan on an appropriate table and for initial inspection start with the normal inspection and change to as I explained tightened or reduced inspection based on the switching rules.

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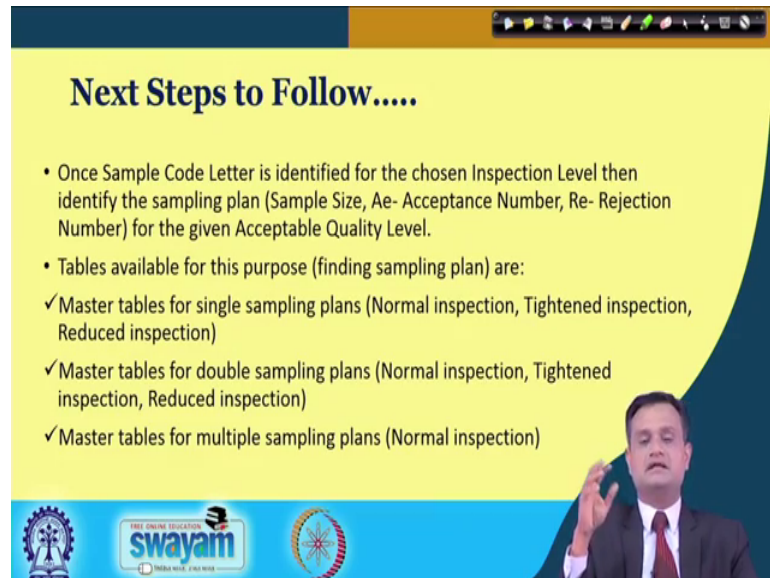
Sample Size Code Letters

Lot or Batch Size	Special Inspection Levels				General Inspection Levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1200	C	C	E	F	G	J	K
1201 to 3200	C	D	E	G	H	K	L
3201 to 10000	C	D	F	G	J	L	M
10001 to 35000	C	D	F	H	K	M	N
35001 to 150000	D	E	G	J	L	N	P



So, just see this suppose let us say my lot size falls somewhere here and I want to go for special inspection level then, I will let us say choose either S 1, S 2, S 3 and S 4 I will say let us S 3, so I will say my code letter code is C. Suppose I am going for general inspection level and I am choosing let us say 2 the I will let us say, for lot ranging in this I will say my letter code is F.

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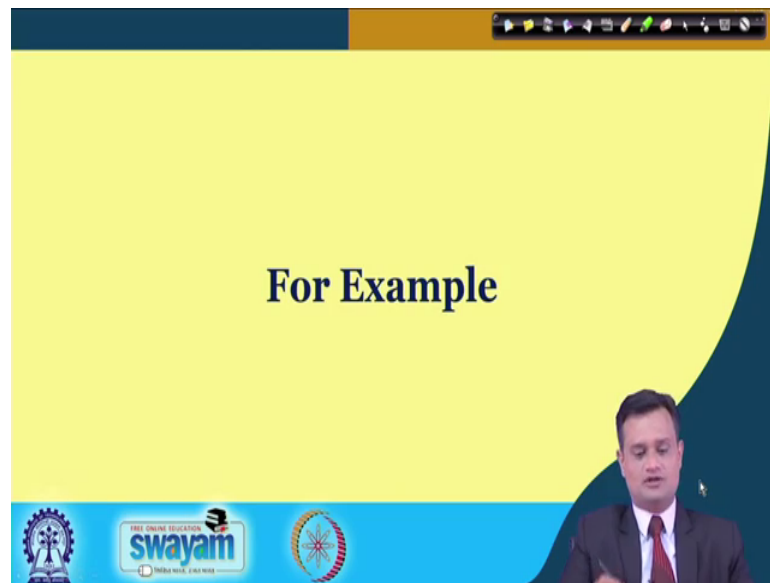
Next Steps to Follow.....

- Once Sample Code Letter is identified for the chosen Inspection Level then identify the sampling plan (Sample Size, Ae- Acceptance Number, Re- Rejection Number) for the given Acceptable Quality Level.
- Tables available for this purpose (finding sampling plan) are:
 - ✓ Master tables for single sampling plans (Normal inspection, Tightened inspection, Reduced inspection)
 - ✓ Master tables for double sampling plans (Normal inspection, Tightened inspection, Reduced inspection)
 - ✓ Master tables for multiple sampling plans (Normal inspection)

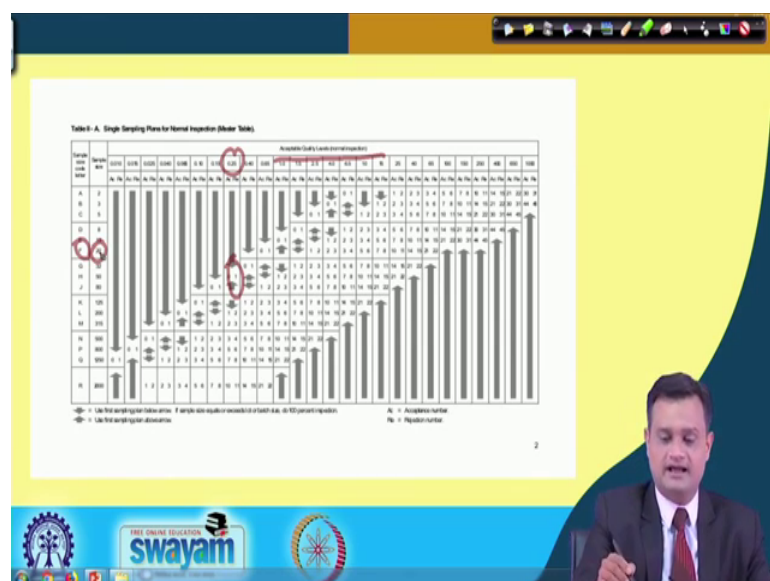
So, this is very simple to identify, now what is to be done? Once the letter code is identified for the chosen inspection level, then identify the sampling plan what you will do? Sample size, acceptance number, rejection number, for the given acceptable quality level.

So, tables are available for this purpose and you will find it in the book Mitra and other books suggested. So, there are master tables for single sampling plan and you will find here that master tables for single sampling plan again are available, for normal inspection tightened inspection reduced inspection. Similar way master tables for double sampling plan available for normal inspection, tightened inspection and reduced inspection and similar way master tables for multiple sampling plan you will have only for the normal inspection.

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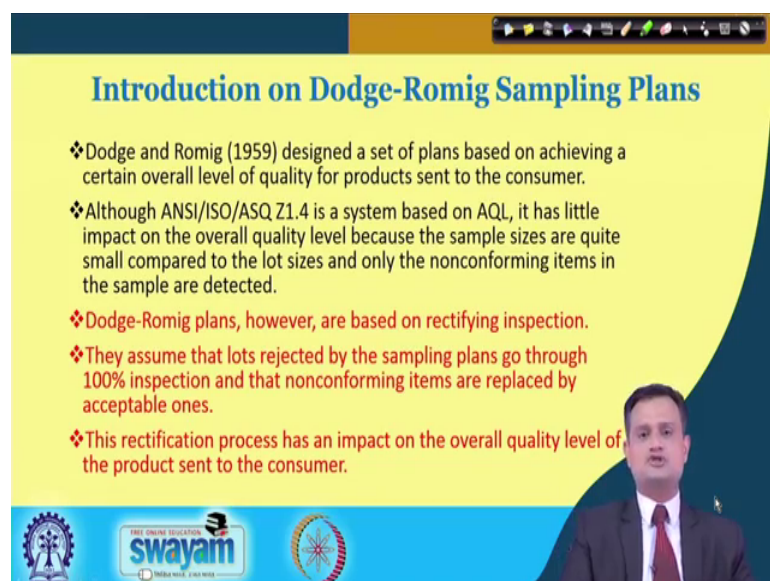
So, if we just see the example then once I have identified the code letter code let us say my letter code is F, then I will get the sample size and let us say I have this acceptable quality level AQL 0.25, then this particular thing becomes my acceptance number and rejection number already I got the sample size and I can have my sampling plan.

So, this is typically the master table for single sampling plan, for normal inspection likewise you will have many table, for single double multiple sampling plan as well as for tighter inspection, normal inspection and you can easily choose the sampling plan.

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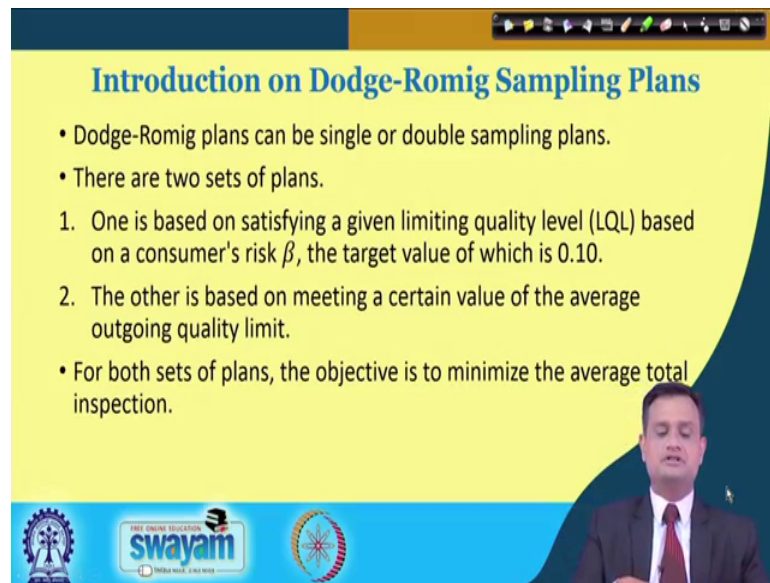


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Now, let us see the second scheme that is Dodge Romig sampling system sampling plan and typically they are based on the rectifying sampling and we have seen that ANSI your military standard is based on AQL and it has little impact on the overall quality level because your sample size are quite small. So, this we are trying to overcome in case of my Dodge Romig system and I will use the concept of rectification it means all the nonconforming items would be replaced, the rejected lot will be 100 percent checked and nonconforming items will be replaced.

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Introduction on Dodge-Romig Sampling Plans

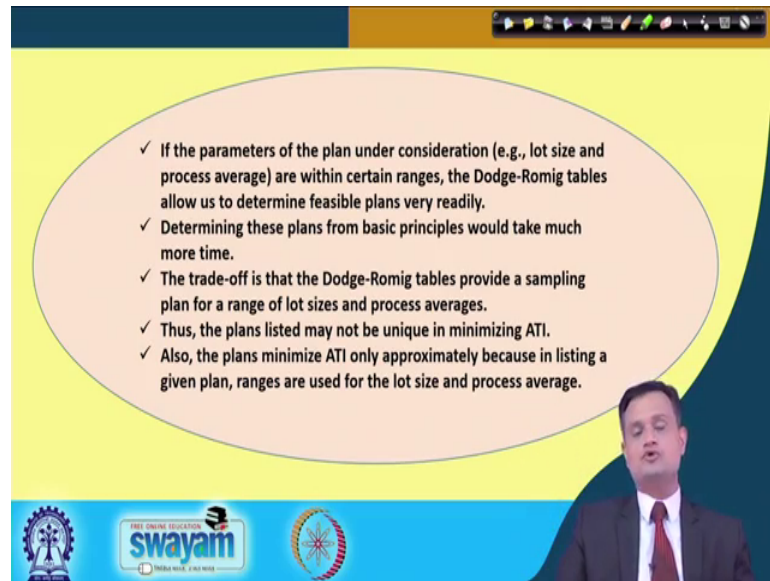
- Dodge-Romig plans can be single or double sampling plans.
- There are two sets of plans.
 1. One is based on satisfying a given limiting quality level (LQL) based on a consumer's risk β , the target value of which is 0.10.
 2. The other is based on meeting a certain value of the average outgoing quality limit.
- For both sets of plans, the objective is to minimize the average total inspection.

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So, I have the Dodge Romig scheme and one is based on there are two sets of plans; one is based on satisfying a given LQL that is Limiting Quality Level specific to my consumer risk β and the target value usually is 0.1 that we are following and the second set of plan is based on meeting the certain value of average outgoing quality limit.

So, I have two different types of plan, I can choose both depending upon the objective that either I want to minimize the average total cost of inspection or I want to be more critical in terms of my consumer protection or may be in terms of say other criteria like average outgoing quality limit.

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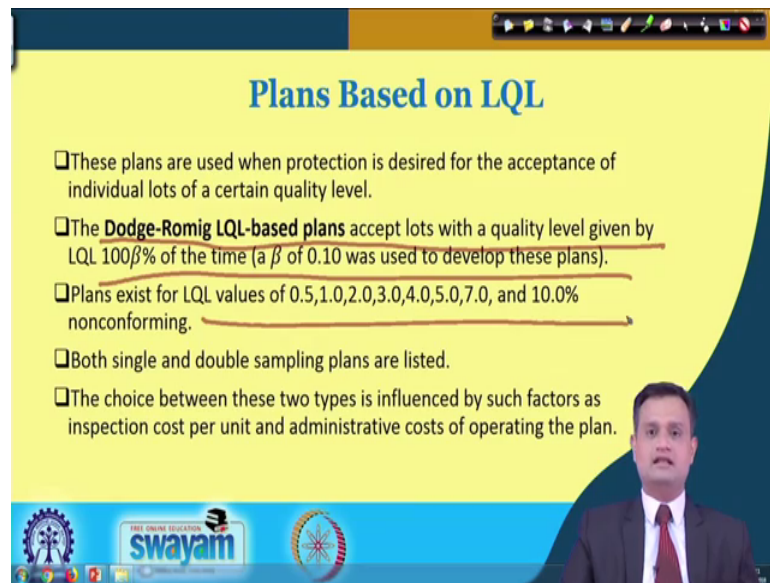


- ✓ If the parameters of the plan under consideration (e.g., lot size and process average) are within certain ranges, the Dodge-Romig tables allow us to determine feasible plans very readily.
- ✓ Determining these plans from basic principles would take much more time.
- ✓ The trade-off is that the Dodge-Romig tables provide a sampling plan for a range of lot sizes and process averages.
- ✓ Thus, the plans listed may not be unique in minimizing ATI.
- ✓ Also, the plans minimize ATI only approximately because in listing a given plan, ranges are used for the lot size and process average.

So, here if the parameters are of the plan are under consideration like lot size process average are within certain ranges, this Dodge Romig tables allow us to determine feasible plan very easily and readily. Determining this plans from principles would take much more time, so whatever principles we have used for designing the plans under single sampling, double sampling that will take much more time.

And the tradeoff is that particular this Dodge Romig table provide a sampling plan for a range of lot size and process averages. So, this is the tradeoff we get for range of sampling plan and the lot sizes you can easily readily figure out an appropriate plan. So, it also minimize the Average Total Inspection ATI and these are couple of advantages.

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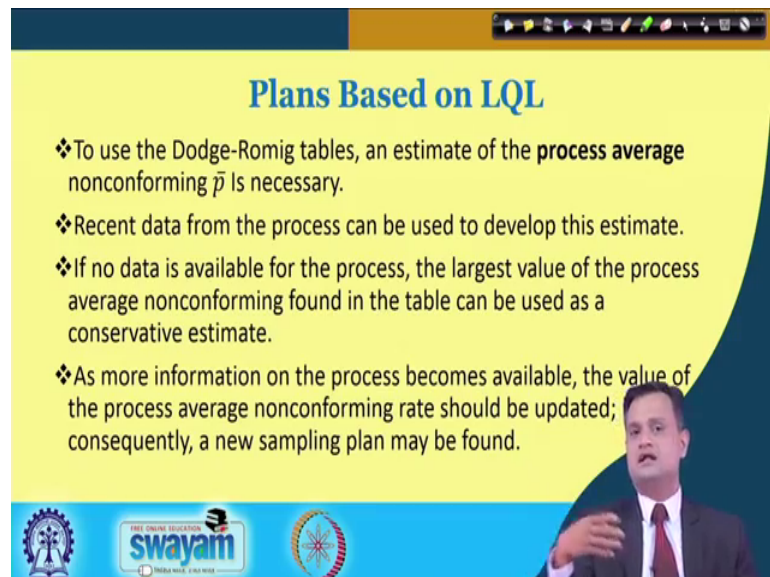
Plans Based on LQL

- ❑ These plans are used when protection is desired for the acceptance of individual lots of a certain quality level.
- ❑ The **Dodge-Romig LQL-based plans** accept lots with a quality level given by LQL $100\beta\%$ of the time (a β of 0.10 was used to develop these plans).
- ❑ Plans exist for LQL values of 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 7.0, and 10.0% nonconforming.
- ❑ Both single and double sampling plans are listed.
- ❑ The choice between these two types is influenced by such factors as inspection cost per unit and administrative costs of operating the plan.

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So, if you see the Dodge Romig LQL based plan 100 beta percent that beta of 0.1 was used to develop let us say this plan that is the standard value and let us say I can have different LQL level Limiting Quality Level that is my consumers specific to consumers risk 0.5, 1.0, 2.0 and both single and double sampling plans can be found.

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Plans Based on LQL

- ❖ To use the Dodge-Romig tables, an estimate of the **process average** nonconforming $\bar{p}$ is necessary.
- ❖ Recent data from the process can be used to develop this estimate.
- ❖ If no data is available for the process, the largest value of the process average nonconforming found in the table can be used as a conservative estimate.
- ❖ As more information on the process becomes available, the value of the process average nonconforming rate should be updated; consequently, a new sampling plan may be found.

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So, with this preliminary understanding if you see how to use the system Dodge Romig system, then I must have an estimate of the process average that is called $\bar{p}$ and you can use the s_n data from the process to develop this estimate for a sufficiently longer

period of time, you can collect the data number of nonconforming take the average and you will get the idea. And if no data is available the largest value of the process average nonconforming can be considered as a conservative estimate.

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Lot Size	Process Average											
	0-0.05%		0.06-0.50%		0.51-1.00%		1.01-1.50%		1.51-2.00%		2.01-2.50%	
	n	c	n	c	n	c	n	c	n	c	n	c
1-30	All	0	All	0	All	0	All	0	All	0	All	0
31-50	30	0	30	0	30	0	30	0	30	0	30	0
51-100	37	0	37	0	37	0	37	0	37	0	37	0
101-200	40	0	40	0	40	0	40	0	40	0	40	0
201-300	43	0	43	0	70	1	92	2	95	2	99	3
301-400	44	0	44	0	70	1	99	2	120	3	145	4
401-500	45	0	75	1	100	2	125	3	150	4	175	5
501-600	45	0	75	1	100	2	125	3	150	4	175	5
601-800	45	0	77	1	100	2	130	3	175	5	200	6
801-1,000	45	0	78	1	105	2	155	4	180	5	225	7
1,001-2,000	45	0	80	1	130	3	180	5	230	7	280	9
2,001-3,000	75	1	105	2	135	3	210	6	280	9	370	13
3,001-4,000	75	1	105	2	160	4	210	6	305	10	420	15
4,001-5,000	75	1	105	2	160	4	235	7	330	11	440	16
5,001-7,000	75	1	105	2	185	5	260	8	350	12	490	18
7,001-10,000	75	1	105	2	185	5	260	8	380	13	535	20
10,001-20,000	75	1	135	3	210	6	285	9	425	15	610	23
20,001-50,000	75	1	135	3	235	7	305	10	470	17	700	27
50,001-100,000	75	1	160	4	235	7	355	12	515	19	770	30

Dodge-Romig Single Sampling Table for Limiting Quality Level of 5.0%

So, now see interestingly how this works? You have the lot size is here, you have say particular process average. So, you can take the $\bar{p}$ or estimate of the process average it is given in the range; it is given in the range and you have n c and AOQL Average Outgoing Quality Limit.

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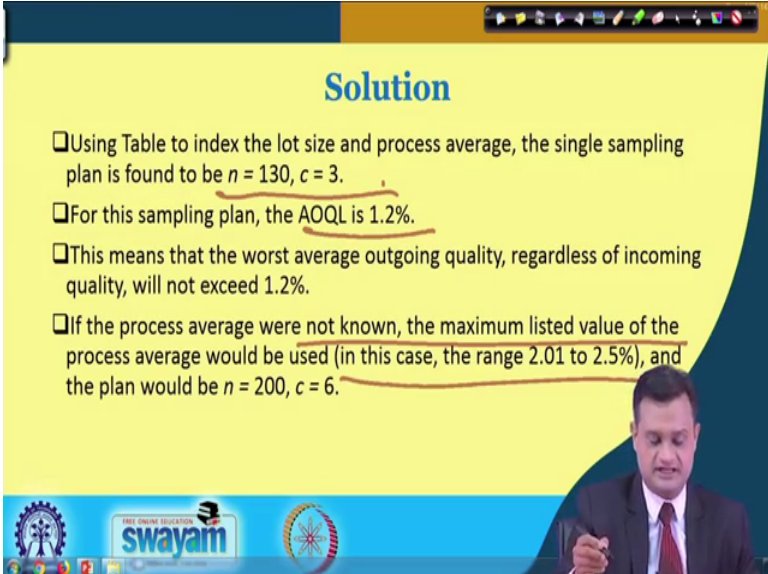
Example

Find a Dodge-Romig plan when the lot size is 700, the LQL is 5%, and the process average is 1.30% nonconforming. A single sampling plan is desired.

So, if you have to implement this system and also you can see that this particular table is for limiting quality 5 percent. So, for different limiting quality you can have different Dodge Romig tables and you can choose the one as per your LQL level.

So, now if you see the example that I have a lot size of 700 and LQL is 5 percent LQL is 5 percent and the process average is 1.3 percent nonconforming, how can I device a single sampling plan?

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Solution

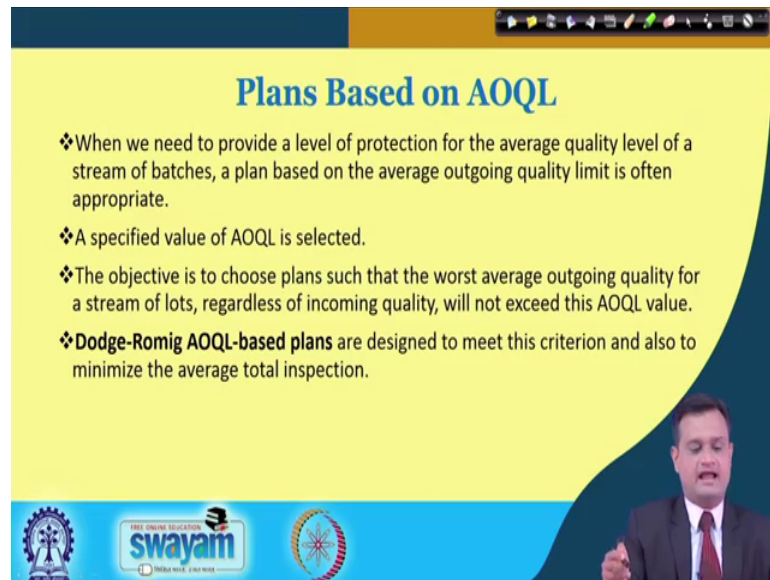
- ❑ Using Table to index the lot size and process average, the single sampling plan is found to be $n = 130$, $c = 3$.
- ❑ For this sampling plan, the AOQL is 1.2%.
- ❑ This means that the worst average outgoing quality, regardless of incoming quality, will not exceed 1.2%.
- ❑ If the process average were not known, the maximum listed value of the process average would be used (in this case, the range 2.01 to 2.5%), and the plan would be $n = 200$, $c = 6$.

So, I will use the table I have just now shown and I can find a single sampling plan n is equal to 130, c is equal to 3 because I have been given the capital and that is a lot size and AOQL is 1.2 percent. So, the process average were not known the maximum listed value of the process average can be used that is 2.01 to 2.05 percent. So, just see how this is determined. So, I have AOQL 1.2 percent I got n is equal to 100 and 30 and c is equal to 3 and range is 2.01 to 2.5 percent.

So, just see this particular table and this is my 2.01 to 2.5 percent and you can refer the lot size, so let us just see what was the lot size. So, you had the lot size 700 and if I just go back then where this falls. So, 700 will fall in this particular one and you can have n is equal to say 200, c is equal to 6 if you are given the process average then 1 to 1.5 percent it would be 130 and 3.

So, both I have explained that if I have the process average 1.3 percent in that case what I will get is this n is equal to 130 and c is equal to 3. If I do not know the average I will take the maximum value of the process average worst case n is equal to 200 and c is equal to 6.

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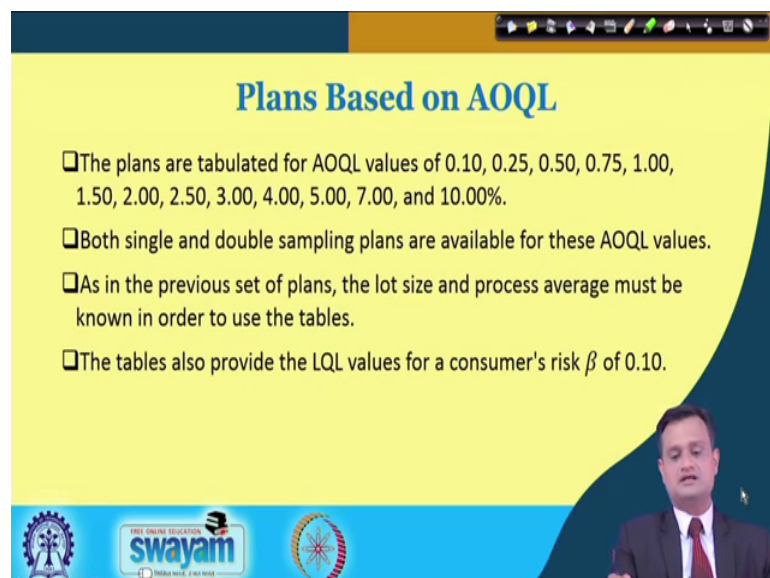
Plans Based on AOQL

- ❖ When we need to provide a level of protection for the average quality level of a stream of batches, a plan based on the average outgoing quality limit is often appropriate.
- ❖ A specified value of AOQL is selected.
- ❖ The objective is to choose plans such that the worst average outgoing quality for a stream of lots, regardless of incoming quality, will not exceed this AOQL value.
- ❖ **Dodge-Romig AOQL-based plans** are designed to meet this criterion and also to minimize the average total inspection.

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So, easily you can determine this and there are plans based on AOQL. So, Dodge Romig AOQL plans are designed to meet this particular criteria of AOQL and minimize the average total inspection.

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Plans Based on AOQL

- ❑ The plans are tabulated for AOQL values of 0.10, 0.25, 0.50, 0.75, 1.00, 1.50, 2.00, 2.50, 3.00, 4.00, 5.00, 7.00, and 10.00%.
- ❑ Both single and double sampling plans are available for these AOQL values.
- ❑ As in the previous set of plans, the lot size and process average must be known in order to use the tables.
- ❑ The tables also provide the LQL values for a consumer's risk β of 0.10.

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So, you have various plans based on AOQL 0.1, 0.25, 0.5 percent and you can have the tables with LQL also, so this can be seen even here.

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Lot Size	Process Average																	
	0-0.06%			0.07-0.60%			0.61-1.20%			1.21-1.80%			1.81-2.40%			2.41-3.00%		
	n	c	LQL %	n	c	LQL %	n	c	LQL %	n	c	LQL %	n	c	LQL %	n	c	LQL %
1-10	All	0	—	All	0	—	All	0	—	All	0	—	All	0	—	All	0	—
11-50	10	0	19.0	10	0	19.0	10	0	19.0	10	0	19.0	10	0	19.0	10	0	19.0
51-100	11	0	18.0	11	0	18.0	11	0	18.0	11	0	18.0	11	0	18.0	22	1	16.4
101-200	12	0	17.0	12	0	17.0	12	0	17.0	25	1	15.1	25	1	15.1	25	1	15.1
201-300	12	0	17.0	12	0	17.0	26	1	14.6	26	1	14.6	26	1	14.6	40	2	12.8
301-400	12	0	17.1	12	0	17.1	26	1	14.7	26	1	14.7	41	2	12.7	41	2	12.7
401-500	12	0	17.2	27	1	14.1	27	1	14.1	42	2	12.4	42	2	12.4	42	2	12.4
501-600	12	0	17.3	27	1	14.2	27	1	14.2	42	2	12.4	42	2	12.4	60	3	10.8
601-800	12	0	17.3	27	1	14.2	27	1	14.2	43	2	12.1	60	3	10.9	60	3	10.9
801-1000	12	0	17.4	27	1	14.2	44	2	11.8	44	2	11.8	60	3	11.0	80	4	9.8
1,001-2,000	12	0	17.5	28	1	13.8	45	2	11.7	65	3	10.2	80	4	9.8	100	5	9.1
2,001-3,000	12	0	17.5	28	1	13.8	45	2	11.7	65	3	10.2	100	5	9.1	140	7	8.2
3,001-4,000	12	0	17.5	28	1	13.8	65	3	10.3	85	4	9.5	125	6	8.4	165	8	7.8
4,001-5,000	28	1	13.8	28	1	13.8	65	3	10.3	85	4	9.5	125	6	8.4	210	10	7.4
5,001-7,000	28	1	13.8	45	2	11.8	65	3	10.3	105	5	8.8	145	7	8.1	235	11	7.1
7,001-10,000	28	1	13.9	46	2	11.6	65	3	10.3	105	5	8.8	170	8	7.6	280	13	6.8
10,001-20,000	28	1	13.9	46	2	11.7	85	4	9.5	125	6	8.4	215	10	7.2	380	17	6.2
20,001-50,000	28	1	13.9	65	3	10.3	105	5	8.8	170	8	7.6	310	14	6.5	560	24	5.7
50,001-100,000	28	1	13.9	65	3	10.3	125	6	8.4	215	10	7.2	385	17	6.2	690	29	5.4

Dodge-Romig Single Sampling Table for AOQL of 3.0%

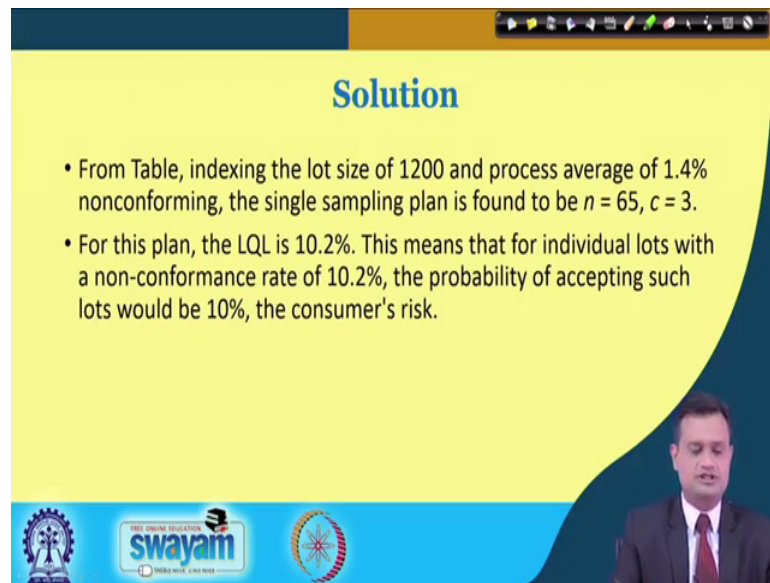
So, previously what you had seen here it was LQL, now this plans are for AOQL. So, you have Dodge Romig plan for say LQL that is limiting quality level as well as you have average outgoing quality level. So, same way you can see the procedure that find determine the range within which your lot size falls also look at the process average and then find the value of n c and LQL.

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Example

Find a Dodge-Romig single sampling plan when the lot size is 1200, the average outgoing quality limit is 3%, and the process average is 1.4% nonconforming.

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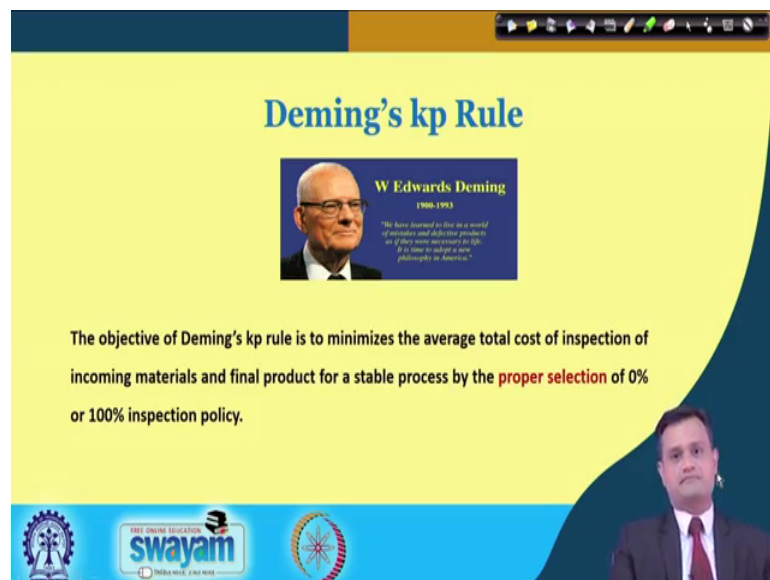
Solution

- From Table, indexing the lot size of 1200 and process average of 1.4% nonconforming, the single sampling plan is found to be $n = 65$, $c = 3$.
- For this plan, the LQL is 10.2%. This means that for individual lots with a non-conformance rate of 10.2%, the probability of accepting such lots would be 10%, the consumer's risk.

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So, your system of finding the plan remain same and I have just put the example you can refer the table and you will get the appropriate plan.

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Deming's kp Rule

W Edwards Deming
1900-1993

"We have learned to live in a world of mistakes and defective products. It is time to adopt a new philosophy in America."

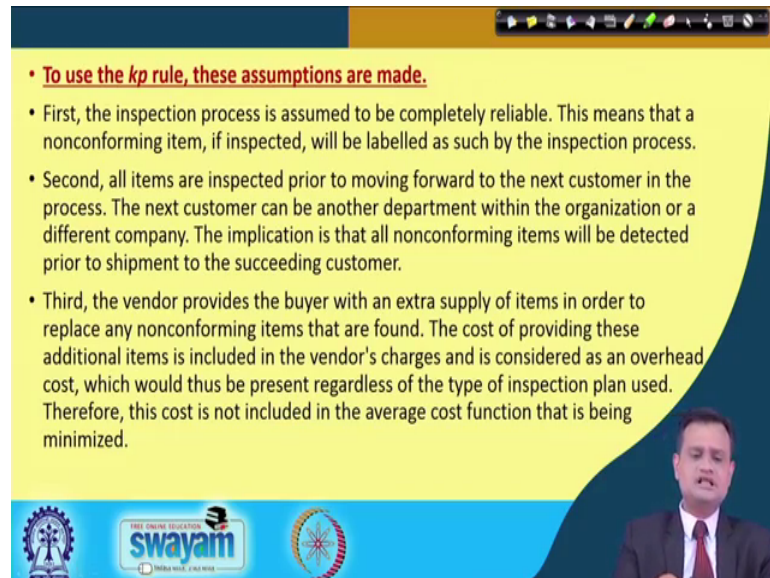
The objective of Deming's kp rule is to minimize the average total cost of inspection of incoming materials and final product for a stable process by the proper selection of 0% or 100% inspection policy.

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Now, the final say topic we want to discuss in the attribute sampling plan is the kp rule and here the Deming has proposed a kp rule which is little bit different and it tries to basically minimize the average total cost of inspection of incoming material and the final product for a stable process by the proper selection of 0 percent or 100 percent inspection policy.

So, here there are 2 issues; when you want to use the Deming's k_p rule to decide about acceptance or rejection of the lot based on sampling, I want to minimize the average total inspection and also I want to consider the final product related cost may be the cost of rework or cost of replacement and may be its effect on the final performance of the product and I will consider a stable process.

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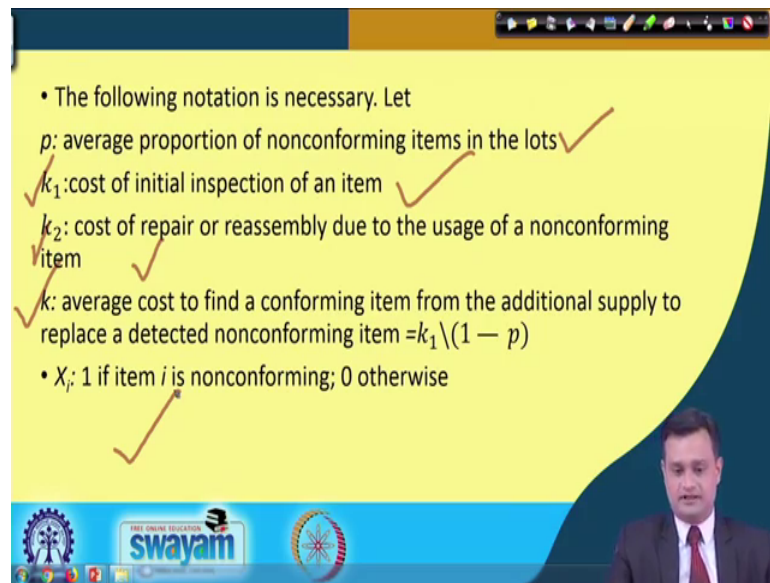
- **To use the k_p rule, these assumptions are made.**
- First, the inspection process is assumed to be completely reliable. This means that a nonconforming item, if inspected, will be labelled as such by the inspection process.
- Second, all items are inspected prior to moving forward to the next customer in the process. The next customer can be another department within the organization or a different company. The implication is that all nonconforming items will be detected prior to shipment to the succeeding customer.
- Third, the vendor provides the buyer with an extra supply of items in order to replace any nonconforming items that are found. The cost of providing these additional items is included in the vendor's charges and is considered as an overhead cost, which would thus be present regardless of the type of inspection plan used. Therefore, this cost is not included in the average cost function that is being minimized.

So, to use the k_p rules there are certain assumptions that needs to be satisfied that inspection process number 1, inspection process is assumed to be completely reliable. So, this means that if the component is nonconforming it will definitely detect that is nonconforming by the inspection process.

Number 2 all the items are inspected prior to moving forward to the next customer in the process and your next customer may be the next operation in the unit or it may be the final customer. The implication is that all conform a items will be detected prior to shipment to the succeeding customer whether internal or external.

And the third important point is that vendor provides the buyer with an extra supply of items in order to replace any nonconforming items that are found and the cost of providing this additional item in place of nonconforming item is included in the vendor charges and is considered as an over head. So, therefore, here the cost is included in the average cost function that is being minimized.

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- The following notation is necessary. Let
- p : average proportion of nonconforming items in the lots ✓
- k_1 : cost of initial inspection of an item ✓
- k_2 : cost of repair or reassembly due to the usage of a nonconforming item ✓
- k : average cost to find a conforming item from the additional supply to replace a detected nonconforming item $= k_1 / (1 - p)$ ✓
- X_i : 1 if item i is nonconforming; 0 otherwise ✓

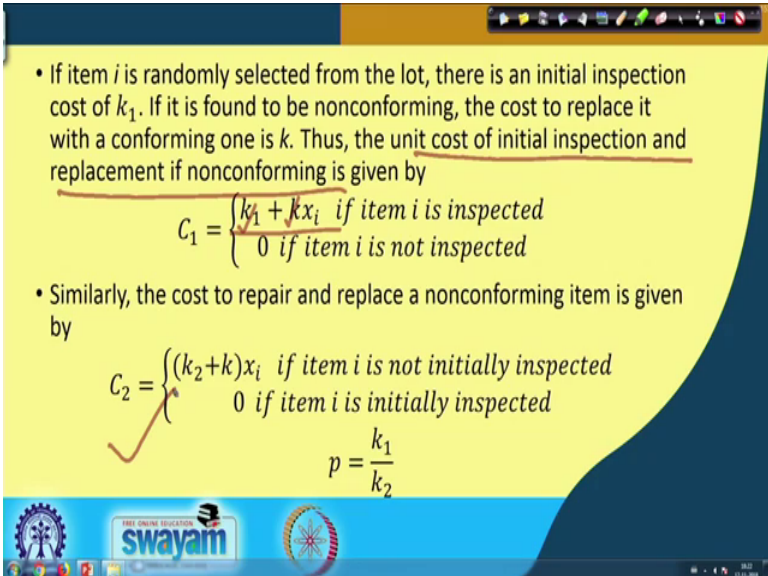
Now, just let us try to appreciate the notations we use in this it is a very simple rule, p is the average proportion of non conforming items in the lots k_1 is the cost of initial inspection of an item. So, consider that item has come you are inspecting a particular lot try taking a sample and you are inspecting the items, so it is the initial inspection cost. k_2 is the cost of repair or reassembly due to the usage of nonconforming item, do you get the idea here.

Now let us say you have fitted the item into the product and because of that either there is a problem in the performance of the product and you need to repair it or let us say you need to reassemble it. So, altogether there is a value addition which is required and this is the component which is something very interesting deming has considered. So, this is my k_2 , k_1 is the cost of initial inspection k_2 is the cost of repair or reassembly of the product due to the usage of the say nonconforming item, so this is something which is very special.

K is the average cost to find conforming items from the additional supply to replace a detected nonconforming item. Now see he is also considering the third component k is the average cost of finding a non a conforming item from the additional supply. Now you have found that a particular lot is rejected and number of nonconforming items needs to be replaced by the vendor and this is the additional cost on the side of vendor is a overhead.

Now, vendor will supply a new lot, but again you will not accept it just like that you will inspect it and there would be some cost incurred on the inspection for identifying the conforming item which can be substituted replaced for the nonconforming item in the lot. So, this is really interesting and X_i is the 1 if item i is nonconforming 0 if it is conforming. So, once you have understood this terms then the remaining part is just a matter of computation of cost.

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- If item i is randomly selected from the lot, there is an initial inspection cost of k_1 . If it is found to be nonconforming, the cost to replace it with a conforming one is k . Thus, the unit cost of initial inspection and replacement if nonconforming is given by

$$C_1 = \begin{cases} k_1 + kx_i & \text{if item } i \text{ is inspected} \\ 0 & \text{if item } i \text{ is not inspected} \end{cases}$$
- Similarly, the cost to repair and replace a nonconforming item is given by

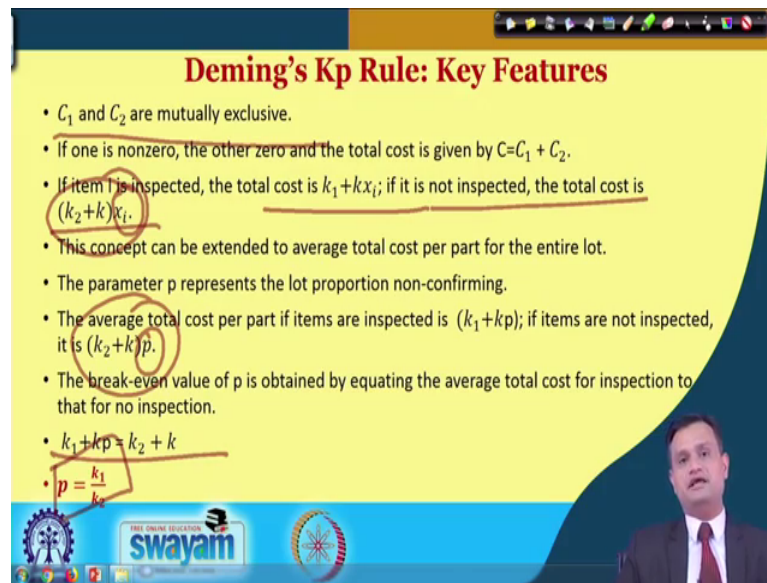
$$C_2 = \begin{cases} (k_2 + k)x_i & \text{if item } i \text{ is not initially inspected} \\ 0 & \text{if item } i \text{ is initially inspected} \end{cases}$$

$$p = \frac{k_1}{k_2}$$

So, I will say the unit cost of initial inspection in the replacement if nonconforming is given. So, C_1 is k_1 plus kx_i if item i is inspected and I will say k_1 is the initial cost of inspection, k is the average cost of inspection as I have to identify the conforming item from the lot supplied by this vendor and replace it for the nonconforming item.

And then I have the C_2 that is k_2 plus kx_i , so k_2 you know and k is my average cost of inspection multiplied by x_i , so I have cost C_2 . So, this will become 0 if item i is not inspected, this will become 0 if item i is initially inspected.

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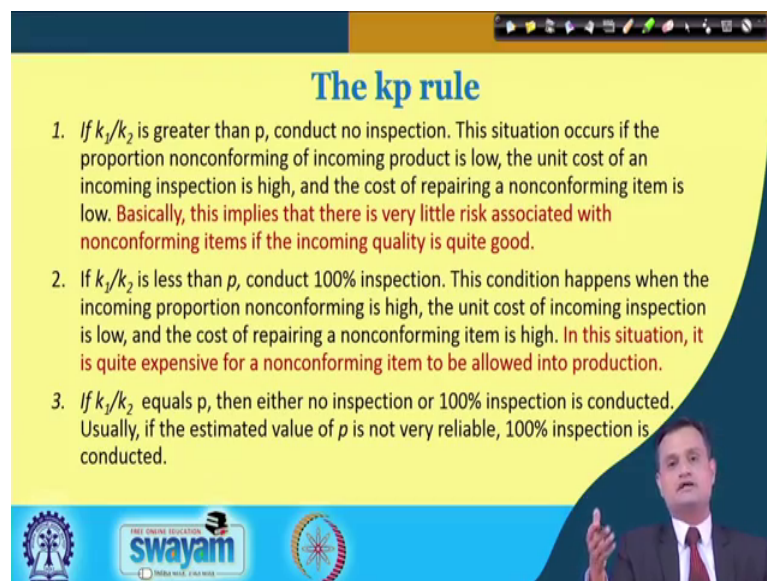
Deming's Kp Rule: Key Features

- C_1 and C_2 are mutually exclusive.
- If one is nonzero, the other zero and the total cost is given by $C = C_1 + C_2$.
- If item i is inspected, the total cost is $k_1 + kx_i$; if it is not inspected, the total cost is $(k_2 + k)x_i$.
- This concept can be extended to average total cost per part for the entire lot.
- The parameter p represents the lot proportion non-conforming.
- The average total cost per part if items are inspected is $(k_1 + kp)$; if items are not inspected, it is $(k_2 + k)p$.
- The break-even value of p is obtained by equating the average total cost for inspection to that for no inspection.
- $k_1 + kp = k_2 + k$
- $p = \frac{k_1}{k_2 - k_1}$

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So, now you have p k_1 by k_2 how it is found? Is a very simple system, that you just try to consider C_1 and C_2 they are mutually exclusive and if one is zero other nonzero other is zero the total cost is C is equal to C_1 plus C_2 . Now the total cost of inspection k_1 plus kx_i we have seen and the total cost if it is not inspected the total cost is k_2 plus kx_i , you just try to replace your say x_i by p , that is the proportion nonconforming, so you will get now the proper quantity that can be equated and when you equate this you will get the value of p k_1 by k_2 .

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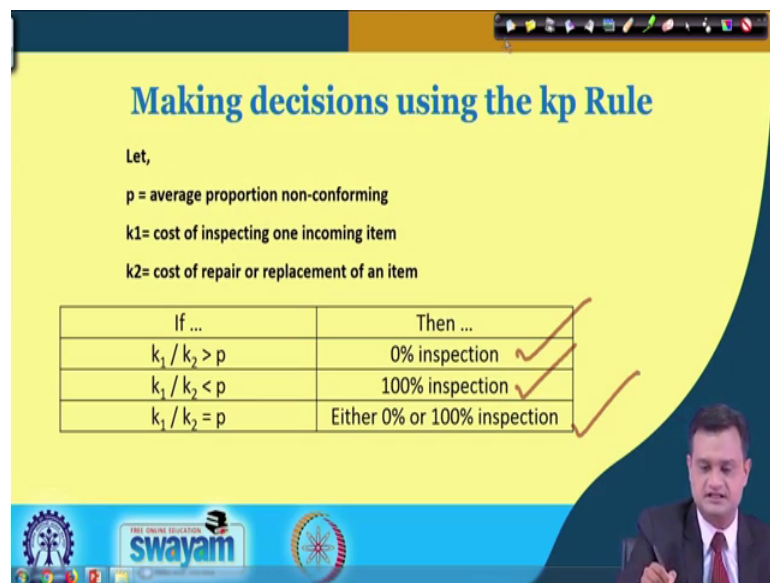
The kp rule

1. If k_1/k_2 is greater than p , conduct no inspection. This situation occurs if the proportion nonconforming of incoming product is low, the unit cost of an incoming inspection is high, and the cost of repairing a nonconforming item is low. Basically, this implies that there is very little risk associated with nonconforming items if the incoming quality is quite good.
2. If k_1/k_2 is less than p , conduct 100% inspection. This condition happens when the incoming proportion nonconforming is high, the unit cost of incoming inspection is low, and the cost of repairing a nonconforming item is high. In this situation, it is quite expensive for a nonconforming item to be allowed into production.
3. If k_1/k_2 equals p , then either no inspection or 100% inspection is conducted. Usually, if the estimated value of p is not very reliable, 100% inspection is conducted.

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So, once you got this expression you need to follow a very simple rule if k_1 / k_2 is greater than p , conduct no inspection because you have say proportion of nonconforming incoming product is very low and this implies that there is very little risk associated with the nonconforming. k_1 / k_2 is greater than p conduct 100 percent inspection and quite expensive non conforming item to be allowed into the production and k_1 / k_2 equals p then either no inspection or 100 percent inspection.

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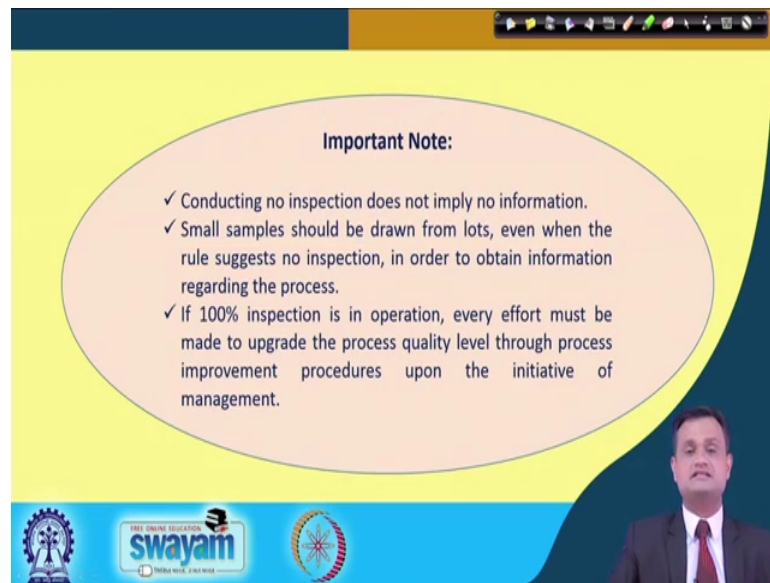
Making decisions using the kp Rule

Let,
 p = average proportion non-conforming
 k_1 = cost of inspecting one incoming item
 k_2 = cost of repair or replacement of an item

If ...	Then ...
$k_1 / k_2 > p$	0% inspection ✓
$k_1 / k_2 < p$	100% inspection ✓
$k_1 / k_2 = p$	Either 0% or 100% inspection ✓

So, this is what I have put in a very simple way greater than p 0 percent inspection, 100 percent inspection, 100 percent inspection, 0 or 100 percent inspection.

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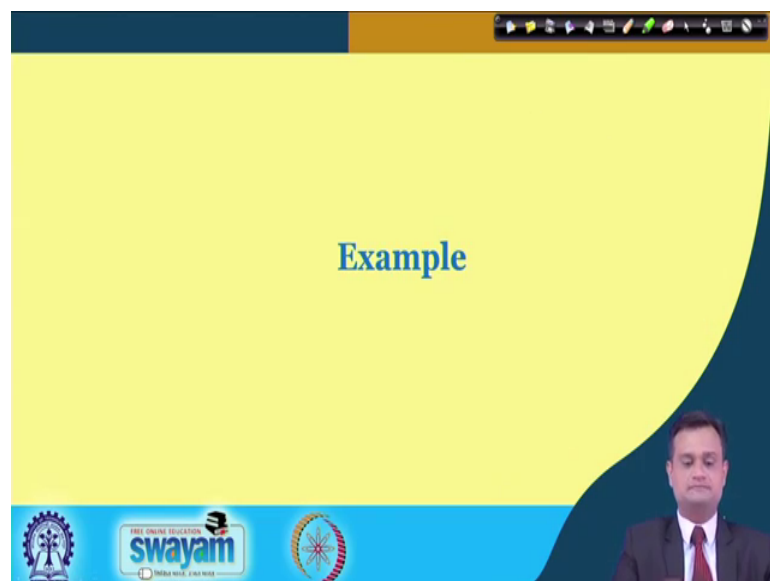
Important Note:

- ✓ Conducting no inspection does not imply no information.
- ✓ Small samples should be drawn from lots, even when the rule suggests no inspection, in order to obtain information regarding the process.
- ✓ If 100% inspection is in operation, every effort must be made to upgrade the process quality level through process improvement procedures upon the initiative of management.

The slide features a yellow background with a large light orange oval containing the text. At the bottom, there is a blue banner with the Swayam logo and the text 'FREE ONLINE EDUCATION swayam'.

So, I would like to question you before I finish that there is an important note about kp, rule conducting no inspection does not imply no information. You can take the small samples draw from the lots and even when the rules suggest no inspection, in order to obtain the information you can take the sample and develop an idea about the overall say health of the process non conforming items it is producing. If 100 percent inspection is in operation, every effort must be made to update the process quality level through the process improvement, so that you can get rid of so much of cost on the inspection.

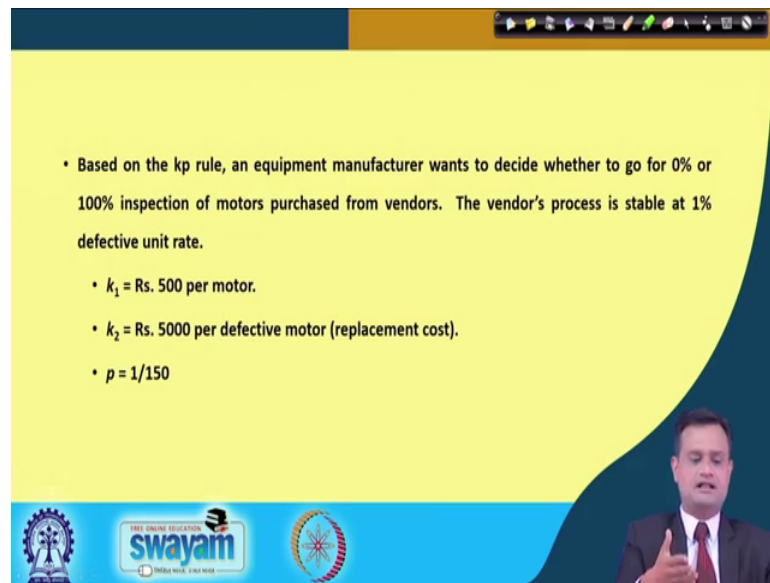
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Example

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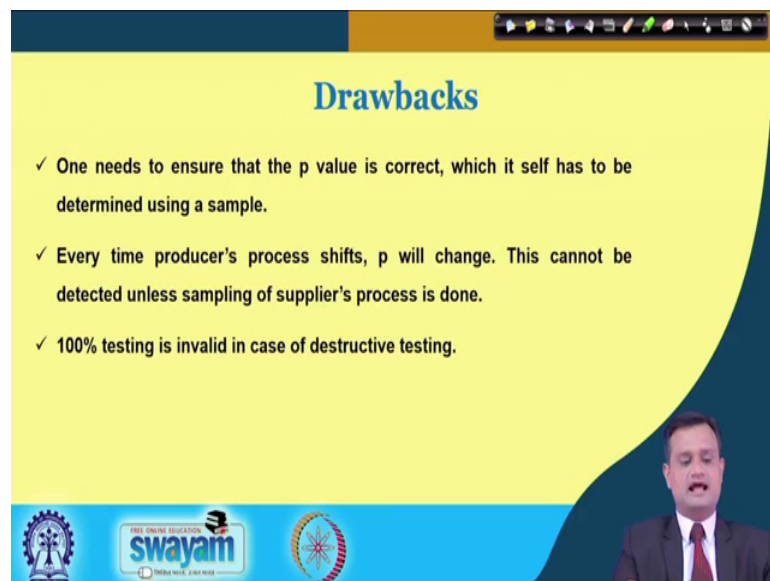
A presentation slide with a yellow background and a dark blue header and footer. The header contains a toolbar with various icons. The main content area lists the following points:

- Based on the k_p rule, an equipment manufacturer wants to decide whether to go for 0% or 100% inspection of motors purchased from vendors. The vendor's process is stable at 1% defective unit rate.
- $k_1 = \text{Rs. } 500$ per motor.
- $k_2 = \text{Rs. } 5000$ per defective motor (replacement cost).
- $p = 1/150$

The footer contains three logos: a gear icon, the 'swayam' logo with the text 'FREE ONLINE EDUCATION' and 'SWAYAM', and a circular logo with a star.

So, this is the example then you can just take the ratio and use the rule to decide about.

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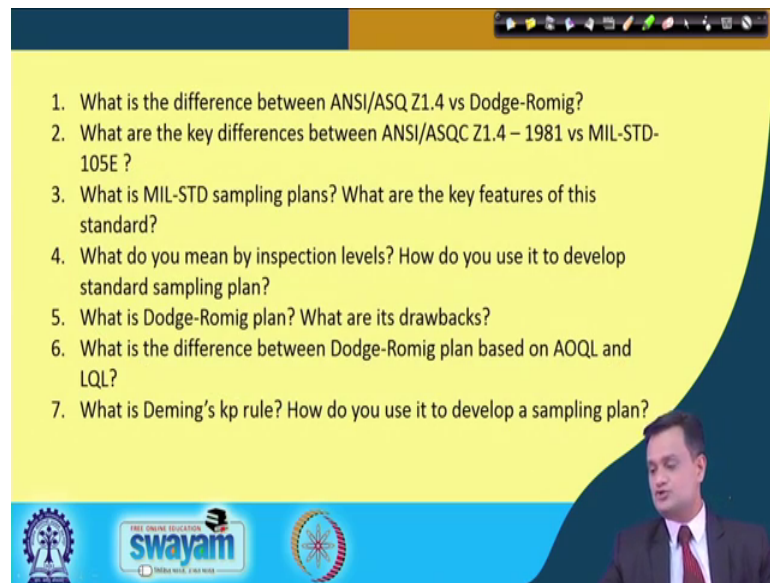
A presentation slide with a yellow background and a dark blue header and footer. The header contains a toolbar with various icons. The main content area is titled 'Drawbacks' in blue text and lists the following points:

- ✓ One needs to ensure that the p value is correct, which it self has to be determined using a sample.
- ✓ Every time producer's process shifts, p will change. This cannot be detected unless sampling of supplier's process is done.
- ✓ 100% testing is invalid in case of destructive testing.

The footer contains three logos: a gear icon, the 'swayam' logo with the text 'FREE ONLINE EDUCATION' and 'SWAYAM', and a circular logo with a star.

So, there are couple of drawbacks of k_p rule that one needs to ensure that p value is correct, which itself has to be determined using a sample and every time produces process shifts there is a shift in the process p will change and this cannot be detected unless sampling of suppliers process is done very important point. 100 percent testing is invalid in case of destructive testing.

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1. What is the difference between ANSI/ASQ Z1.4 vs Dodge-Romig?

2. What are the key differences between ANSI/ASQC Z1.4 – 1981 vs MIL-STD-105E ?

3. What is MIL-STD sampling plans? What are the key features of this standard?

4. What do you mean by inspection levels? How do you use it to develop standard sampling plan?

5. What is Dodge-Romig plan? What are its drawbacks?

6. What is the difference between Dodge-Romig plan based on AOQL and LQL?

7. What is Deming's kp rule? How do you use it to develop a sampling plan?

The slide features a yellow background with a blue wave on the right. At the bottom, there are logos for Swamyam and a small video inset of a man in a suit.

So, before we end as a usual practice just give a thought what is ANSI ASQ standard with respect to Military Standard also what is the difference between Military Standard and Dodge Roming standard? How do you use the kp rule? What are it's advantages drawbacks and what additional information you can draw if you really use the standard plans for acceptance sampling specifically when you have the liberty or when you have the opportunity to switch the inspection level and this kind of say opportunity is not available in any other scheme.

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References

- Montgomery, D C. Design and Analysis of Experiments, Wiley.
- Mitra, Amitava. Fundamentals of Quality Control and Improvement, Wiley India Pvt Ltd.

The slide has a yellow background with a blue wave on the left. At the bottom, there are logos for Swamyam and a small video inset of a man in a suit.

So, I have used mainly Mitra for this you can also refer the Montgomery.

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Conclusion

- ❖ The effectiveness of the sampling plan will be determined by its discriminatory power.
- ❖ The standard sampling plans are convenient and easy to develop based on predefined standards and hence industries prefer using this compared to developing their own sampling plans.
- ❖ Deming's kp rule is to minimize the total cost of incoming and intermediary material and final product for a stable process by the proper selection of 0% or 100% inspection policy. However, if there is a shift in producer's process, p will change. This cannot be detected unless sampling of supplier's process is done.

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And we have to design a plan which can take care of this stipulated producers and consumers risk and it can offer an appropriate discriminatory power for the given criticality of my quality characteristic. So, thank you very much for your interest in learning this attribute sampling plan or design of plan for attributes and we have gone in detail of the acceptance sampling plan for attributes, keep revising solve your problems in given in the textbook of with or using the real life data and try to get a control over the concept which is very important part of statistical quality control. So, keep revising, introspecting, applying.

Thank you very much, be with me, enjoy.