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Continuing Education Course #345
What Every Engineer Should Know about
Statistical Process/Quality Control II

1. The American National Standards Institute (ANSI) defines Quality Assurance (QA) as "All of those planned or systematic actions necessary to provide adequate confidence that an item will perform satisfactorily in service

- a. True.
- b. False

2. MIL-STD-1916 was released for use to the public by DoD in which month/year

- a. April 1, 1916
- b. April 1, 1926
- c. April 1,1996
- d. April 1, 1966

3. Which Military Standard (MIL-STD) did MIL-STD-1916 replace?

- a. MIL-STD 105D
- b. ISO 9000
- c. MIL-STD 414
- d. MIL-STD-105E

4. Quality loss refers to losses incurred by a system or organisation (society) from the time a product is released for shipment to the time of its ultimate use and disposal

- a. True.
- b. False.

5. In general, any quality system will make products that are robust (insensitive) to variations due to the noise factors

- a. True.
- b. False

6. External Noise factors include the following

- a. Operating Environment
- b. Temperature and Humidity
- c. Operators
- d. Suppliers
- e. All of the above

7. Internal Noise include all but

- a. Tool wear
- b. Production and process plans
- c. Machine setting
- d. Raw material variation

8. Designing for robustness requires three specific design steps. Which of the following is not one of those design steps?

- ○ a. System Design
- ○ b. Product Design
- ○ c. Tolerance Design
- ○ d. Parameter Design

9. Process capability is defined as the ability of the process to operate within the process spread or within the desired tolerance as specified either by the customer or the producer and it is sometimes referred to as the process sigma

- ○ a. True
- ○ b. False.

10. With respect to PPM/DPMO (parts per million/Defects per million opportunities);

- ○ a. A 3-sigma (3-σ) process yields lower PPM/DPMO than a five- sigma (5-σ) process
- ○ b. A 3-sigma (3-σ) process yields higher PPM/DPMO than a five- sigma (5-σ) process
- ○ c. The PPM/DPMO for a 3-sigma process is the same as that of a 5-sigma process
- ○ d. There is no basis for comparison between the PPM/DPMO of a 3-sigma process and that of a 5-sigma process

11. With respect to PPM/DPMO (Parts Per Million/Defects Per Million Opportunities), a 6-sigma (6σ) process has a PPM/DPMO and process capability (Cpk) values of;

- ○ a. PPM/DPMO=0.2, Cpk =5
- ○ b. PPM/DPMO=0.0002, Cpk =2
- ○ c. PPM/DPMO=0.002, Cpk =5
- ○ d. PPM/DPMO=0.002, Cpk =2

12. A quality loss due to manufacturing errors as a result of external and internal noise factors as well as lack of robustness in design is measured using:

- ○ a. loss function
- ○ b. squared loss function.
- ○ c. mean squared loss function, sometimes also called the mean squared deviation
- ○ d. Any of the above may be used.

13. . In Lot Acceptance Sampling Plans (*LASP*), it is important to realize that the decision to reject or not reject a lot is based on information from the sample only. Hence such decision has some risk associated with it because it is only based on a sample rather than the entire lot.

- ○ a. True
- ○ b. False

14. In Double Sampling Plan (DSP) it is <u>not</u> possible to reach a decision to reject or not reject the lot based on the information gathered after inspecting the first sample.

- ○ a. True
- ○ b. False

15. In Double Sampling Plan (DSP) if after the first sample is inspected or screened and no decision is reached as to reject or not reject, then the procedure is to go ahead and take a second sample and combine the sample size and decide based on the sampling result of the two samples.

- ○ a. True
- ○ b. False

16. *Type I Error* (Producer's Risk) for a sampling plan is the probability of rejecting a lot that has a nonconformance level equal to the *AQL*. The producer suffers when this occurs, because a lot with acceptable quality was rejected

○ a. True
○ b. False

17. *Type II Error* (Consumer's Risk) for a sampling plan is the probability of rejecting a lot that has a nonconformance level equal to the *LTPD*. The consumer suffers when this occurs, because a lot with unacceptable quality was rejected.
○ a. True
○ b. False

18. In Lot Acceptance Sampling Plans (*LASP*), 100% human inspection is not effective as a sampling strategy because of:
○ a. fatigue effects on the inspection personnel.
○ b. placing inspectors in series to enhance efficacy is not effective due to the human psychology of social loafing that occurs in a group.
○ c. Humans are not able to carry out inspection tasks
○ d. The reliability of system of components in series is less the reliability of each individual component
○ e. a, b d.

19. AOQ--The Average Outgoing Quality is a measure of the quality level resulting from an LASP where rejected lots are subjected to 100% screening and the nonconforming items found in the accepted samples are replaced. It is a function of N, *n, c, p*. Given the following parameters of a sampling plan, compute AOQ.
N=2000, n=25, p=2%, Pa =0.6065. Compute the AOQ for this single plan if N is assumed to be much larger than n, that is N>>>>n
○ a. AOQ=0.02
○ b. AOQ=0.012
○ c. AOQ=0.6065
○ d. None of the above

20. Which of the following is true about Type A OC curve and Type B OC curve
○ a. Type- A OC curves is for Finite Universe or lots and uses the Hypergeometric distribution to compute the probabilities
○ b. Type- B OC curves is for Infinite Universe and uses the Binomial or Poisson distributions to compute the probabilities
○ c. They are the same, there no difference
○ d. a and b

21. Assume that after the computation of the values of AOQ for different acceptable value of the lot proportion nonconforming p, the maximum value of AQL=0.0009, and the minimum value is 0.0003. What is the AOQL?
○ a. AOQL=0.00
○ b. AOQL=0.0003
○ c. AOQL=0.0006
○ d. AOQL=0.0009

22. For Average Total Inspection (*ATI*) when rejected lots are 100 % inspected, it is easy to calculate the *ATI* if lots come consistently with a nonconforming quality level of *p*. Assume that for or a single *LASP* (*N, n, c*) with a probability P_a of accepting a lot with nonconformance level *p* we have the following:
N=200, n=25, p=2%, Pa =0.6065. Compute the ATI for this single plan
○ a. ATI=200
○ b. ATI=20
○ c. ATI=94
○ d. None of the above

23. For MIL-STD- 1916, the Verification Level (VL) and code letter (CL) determine the sampling plan required to assess product compliance to contract and specification requirements

- a. True
- b. False

24. Which is not an allowed switching procedure for MIL- STD- 1916
- a. Normal to Tightened
- b. Normal to Reduced
- c. Reduced to Tightened
- d. Tightened to Normal

25. According to the requirements of MIL-STD-1916, when sampling inspection is restarted after discontinuation of acceptance, it shall be at the restarted at:
- a. Tightened inspection stage
- b. Normal Inspection stage
- c. Reduced Inspection stage
- d. None of the above

26. According to the requirements of MI-STD-1916, the sample size for Reduced Inspection is more than that for Normal Inspection.
- a. True
- b. False

27. According to the requirements of MI-STD-1916, the sample size for Tightened Inspection is more than that for Normal Inspection.
- a. True
- b. False

Questions 28-30. The following parameters were specified for a sampling plan based on MIL-STD-1916 and its accompanying document MIL-HDBK-1916. Use Tables I and II of MIL-STD-1916 as shown in Tables 8 and 9 of the class materials
1. Verification Level (VL)= IV
2. Lot acceptance is by attribute sampling
3. Assume Lot size of 1000
4. Lot history set the switching state or Inspection level as Normal

28. What is the code letter (CL) corresponding to this sampling plan under Normal Inspection
- a. A
- b. B
- c. C
- d. D

29. Assuming a switch to Tightened Inspection is required, what is the Verification Level (VL)?
- a. V
- b. IV
- c. VI
- d. VII

30. Assuming a switch to Reduced Inspection is required, what is the Verification Level (VL)?
- a. V
- b. IV
- c. III
- d. II