**TEST 1**

**Theory**

1. What is the difference between the stability and the capability?

2. What is the difference between the control- and the specification limit? Based on what are they calculated and what are they used for?

3. Is it necessary for the control limits to be between the specification limits? Why?

4. How large is the ratio of noncomforming parts if CP=1. Sure?

5. Could CP be less than CPk? Why?

**Calculation**

1. The weight of a coffee pack should be 250.0+/-5g. The filling machine has a variance of 4 g2. The filling process is shifted, the expected filling weight is 249 g. How many percent of the produced coffee pack will conform the specifications?

3. The following samples were taken from a process, the results are given in the table.

a) What kind of chart (or charts) would you suggest to this process?

b) What will be the control limits of the chart (or charts)? Draw them on the charts and put there (at least) the first 5 points.

c) What do you think, is this process stable?

|  |  |  |  |
| --- | --- | --- | --- |
| **sample** | **measured sample items** | **mean** | **range** |
| 1 | 249,7 | 250,2 | 250,2 | 250,03 | 0,5 |
| 2 | 249,8 | 251 | 249,5 |  |  |
| 3 | 250,2 | 250,1 | 250,1 |  |  |
| 4 | 249,8 | 249,3 | 250,9 | 250,00 | 1,6 |
| 5 | 251,1 | 248,1 | 248,5 | 249,23 | 3 |
| 6 | 248,1 | 250,1 | 248,9 | 249,03 | 2 |
| 7 | 249,6 | 249,2 | 249,6 | 249,47 | 0,4 |
| 8 | 247,7 | 249,4 | 248,9 | 248,67 | 1,7 |
| 9 | 249,4 | 249,6 | 251,6 | 250,20 | 2,2 |
| 10 | 250,7 | 249,6 | 249,1 | 249,80 | 1,6 |
| 11 | 250,1 | 251,2 | 250,1 | 250,47 | 1,1 |
| 12 | 249,5 | 248,8 | 251,6 | 249,97 | 2,8 |
| 13 | 250,1 | 251,7 | 250,4 | 250,73 | 1,6 |
| 14 | 250,3 | 250,2 | 249,5 | 250,00 | 0,8 |
| 15 | 252,4 | 251,5 | 249,9 | 251,27 | 2,5 |
| 16 | 250,9 | 249,3 | 249,9 | 250,03 | 1,6 |
| 17 | 249,7 | 248,1 | 250,6 | 249,47 | 2,5 |
| 18 | 249,8 | 250,6 | 250,4 | 250,27 | 0,8 |
| 19 | 249,8 | 249,9 | 250,1 | 249,93 | 0,3 |
| 20 | 248,6 | 250,6 | 249,4 | 249,53 | 2 |
|  | **mean** |  |  | **249.92** | **1.53** |

**TEST 2**

**Theory**

1. What is the difference between the control- and the specification limit? Based on what are they calculated and what are they used for?

2. What tells you more about the process, Cp or Cpk? Why?

3. What is the difference between the short term and the long term capability indices?

4. How should we perform a measurement system analysis?

**Calculation**

1. Design a single sampling plan for tightened inspection of a lot of size 5 000. The general inspection level is III and the allowed ratio of nonconforming parts in the lot is 0.01.

2. In a Phase I analysis samples of 150 elements were taken from a process. It was found that the process is stable and the average ratio of noncomforming parts is 4%. After that, samples of 60 elements were used for monitoring the stability of the process. The measured data are given in the table below.
Prepare the control chart! Is the process stable?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sample** | **N** | **Defects** | **Sample** | **N** | **Defects** |
| 1 | 60 | 3 | 6 | 60 | 5 |
| 2 | 60 | 4 | 7 | 60 | 0 |
| 3 | 60 | 0 | 8 | 60 | 0 |
| 4 | 60 | 6 | 9 | 60 | 2 |
| 5 | 60 | 1 | 10 | 60 | 4 |

3. 15 parts were randomly selected from a process and each part was measured by the same 3 operators with 4 repetitions. The results of a measurement system analysis:



How large is the overall variance of the measurement system compared to the variance of the parts?

How could we improve the measurement system?