Control chart of a balance

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Introduction

Control charts are effective tools to check the stability of a method of analysis. The principle of their implementation is conceptually simple: a mass standard is weighed regularly on a balance scale, and obtained weights are graphed as measurement points, in respect to their chronological order of collection. If the control chart shows data variations, out of the permitted error limits, the balance is assumed to be inaccurate. To define the limit range, upper and lower control limits are drawn above and below the center line. The center line depicts the expected value. The results of tests are assumed to fall within these control limits. In order to determine whether the distribution of the measurement points are random or affected, and to ultimately take corrective actions for returning to normalcy, calibrations are set. For each analytical balance mass standard it is necessary to frame a minimum and maximum value.

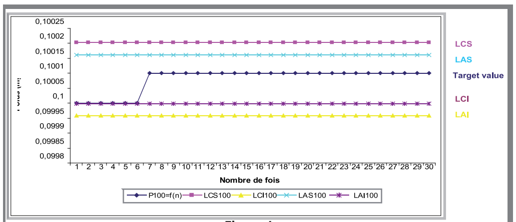

Figure 1

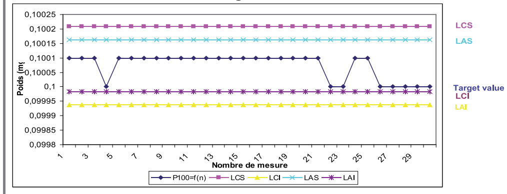

Figure 2

Figure 1: Control Chart and Alarm of the balance "MATLER AE260"
Figure 2: Control Chart and Alarm of the balance "DENVER APX200"

Method

1. Prepare mass standards (each mass standard should be provided with a certificate of calibration)
2. Execute 30 testing measurements and calculate the target value and standard deviation
3. Calculate the value target and the gap-type
4. Calculate upper and lower control limits (LCS, LCI)
5. Calculate upper and lower warning limits (LAS, LAI)
6. Draw the control chart

Interpretation of a control chart

The system is supposed to deviate in the following cases:
- A point falls outside of the limits established for a given control chart
- 7 successive points plot either all above or all below the target value
- 8 successive points show a systematic trend either to the upper control limit or to the lower control limit
- Any other distribution is suspected to be nonlinear

Results

Two control charts on two different balances for the same mass of 0.1 g were analyzed. We can see that the measurement system observed in Figure 1 is stable, since all 30 successive points coincide exactly with the value target. However, the system observed in Figure 2 was comparably more unstable: from point 4 onward, slight fluctuations were present. Nevertheless, both balances' values plotted within the upper and lower warning limits, and any trends of exceeding the limits were not revealed. We can therefore state that for the mass of 100 mg both of the balances were accurate.

Conclusion

The control charts of 2 balances were drawn for the following masses: 10, 20, 50, 100, 200, and 500mg. A comparison between the certified values for the mass standard and the average of the values from the two balances were made. To calculate absolute difference between the two values, the weight of a mass standard should be more than 20 mg (lower than 0.5% of absolute error).

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