



Swedish National Laboratory of Forensic Science

Control Chart for Refractive Index Measurements in Forensic Glass Analyses

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Introduction

In burglaries it is common that the perpetrator smashes a window to gain access. It is then likely to find glass fragments on the clothes and shoes of the perpetrator. These fragments can be compared to glass from the window at the crime scene. The Swedish Laboratory of Forensic Science, SKL, performs about 200 of such glass cases annually.

One of the methods used in forensic glass analyses is to measure and to compare refractive indices. The instrument used for these measurements is GRIM 3 (Foster & Freeman Ltd), see figure 1. A control chart is used as an internal quality control for these measurements, see figure 2.

The control sample

A glass sample with a similar refractive index as casework samples was chosen as the control sample. The control sample was manufactured by Schott Glaswerke (Mainz, Germany) and is optically homogenous¹. The control sample will last for at least 20 years and the refractive index of the glass is stable. One, additional advantage with this control sample is that it is used by several forensic laboratories around Europe which means that inter laboratory comparisons are possible.

One drawback with this control glass is that its repeatability is better compared to routine casework samples, due to its better homogeneity.

The control chart

An X-chart is plotted manually on a sheet of paper, see figure 2. A control sample is measured each day a casework sample is run. The control value is based on the mean value from three measurements. This is the same procedure as for the routine samples. The obtained value of the refractive index is then plotted with the date and the signature of the operator.

The central line (CL) is the calculated mean value of all control values obtained over a period of two years.

The limits are set based on the performance of the method – statistical control limits². This means that the warning limits are set at a distance of \pm two times the standard deviation from the central line ($CL \pm 2s$) and the action limits are set at a distance of \pm three times the standard deviation from the central line ($CL \pm 3s$).

A long-term evaluation of the quality control data is done once a year.

Daily interpretation of quality control²

The method is in control if:

- The control value is within the warning limits
- The control value is between warning and action limit and the two previous control values were within warning limits

The method is out of control if:

- The control value is outside the action limits
- The control value is between the warning and the action limit and at least one of the two previous control values is also between warning and action limit

Trends should always be discussed and analysed. Trends are the following:

- If seven control values in consecutive order are either gradually increasing or decreasing
- If ten out of eleven control values are lying on the same side of the central line

If the method is out of control no results are reported and the following actions are taken:

- The control sample is reanalysed
- The instrument is checked
- The instrument is recalibrated
- The limits of the control chart are checked
- The method is checked

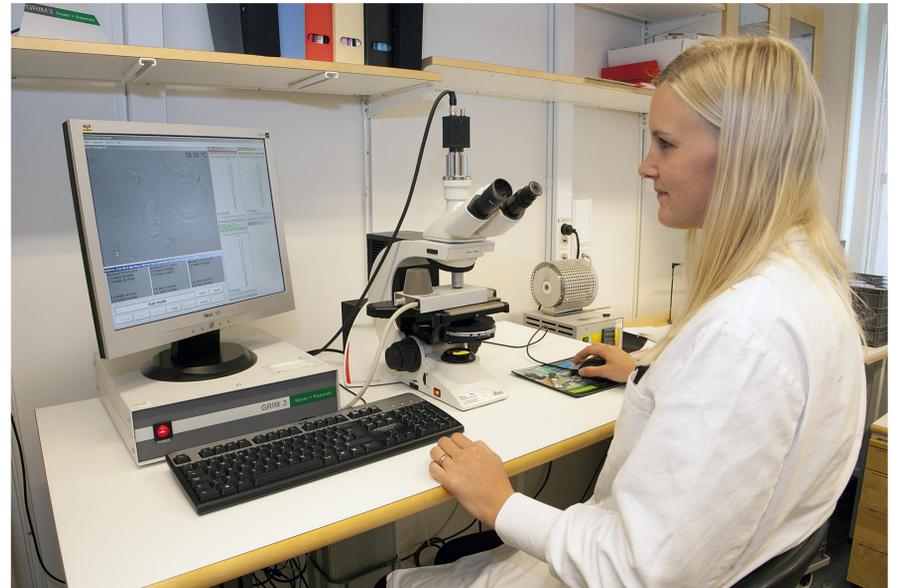


Figure 1. Instrument GRIM 3, Glass Refractive Index Measurement

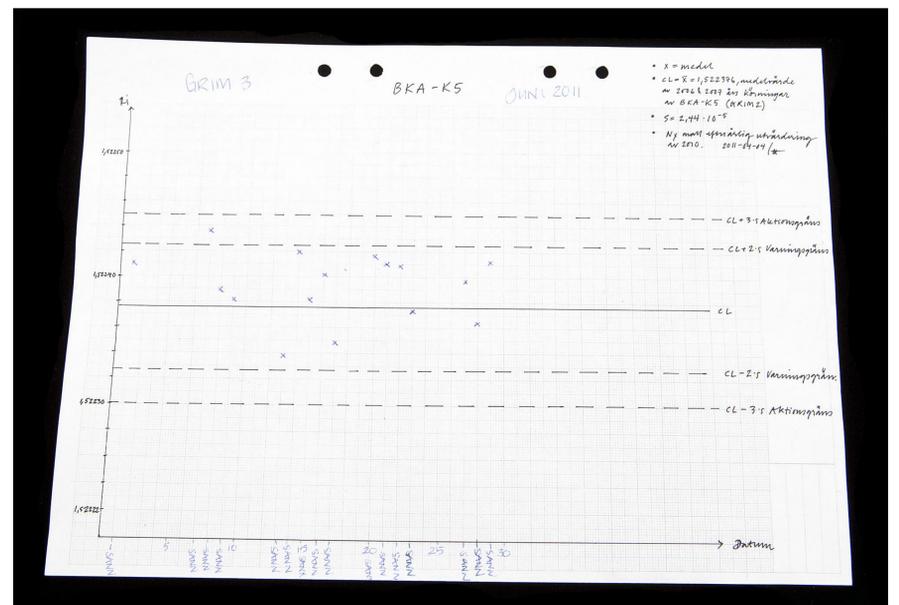


Figure 2. The control chart

The use of the control chart

All reference glasses from casework in Sweden are collected in a database. The internal quality control plays an essential role since it allows for refractive indices of the different glasses in the database to be comparable over time. From the database it is also possible to estimate the frequency of occurrence of glass with a certain refractive index, which is used to draw conclusions on the evidential value of the finding.

References

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2. H. Hovind, B. Magnusson, M. Krysell, U. Lund and I. Mäkinen. Internal Quality Control - Handbook for Chemical Laboratories, Nordtest technical report 569. www.nordtest.info.