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Best Practice Manual

for the Forensic Identification and Comparison of Glass

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ENFSI's position on Best Practice Manuals

ENFSI wishes to promote the improvement of mutual trust by encouraging forensic harmonization through the development and use of Best Practice Manuals. Furthermore, ENFSI encourages sharing Best Practice Manuals with the whole Forensic Science Community which also includes non ENFSI Members.

Visit www.enfsi.eu/documents/bylaws for more information. It includes the ENFSI policy document Policy on Creation of Best Practice Manuals within ENFSI (code: QCC-BPM-001).

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BEST PRACTICE MANUAL FOR THE FORENSIC IDENTIFICATION AND COMPARISON OF GLASS

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1. AIMS

This Best Practice Manual (BPM) provides a framework for procedures, quality principles, and approaches to the forensic examination of glass. Member laboratories of the European Network of Forensic Science Institutes (ENFSI) and other forensic science laboratories can use this manual to establish and maintain working practices in the field of forensic identification and comparison of glass. Following the recommendations in the manual, users should be able to deliver reliable results, maximize the quality of the information obtained and produce a robust interpretation of the findings. The use of consistent methodology and the production of more comparable results will facilitate interchange of data between laboratories.

This BPM is aimed at experts in the field of forensic glass investigation. That is any person working within the field of forensic glass examination at a professional level whereby it is assumed that an expert has prior knowledge of this discipline.

This BPM is a guideline and not a standard operating procedure, and addresses the requirements of the judicial systems in general terms only.

This BPM provides the means to choose between the methods that are currently accepted by the European Paint, Glass and Taggants Expert Working Group (PGT) forensic glass analysis community.

The scope of this manual includes the procedures, personnel, equipment and facilities involved in the forensic process, from reception of samples at the forensic laboratory to presentation of results in a report.

The term BPM is used to reflect the scientifically accepted practices at the time of creating. The term BPM does not imply that the practices laid out in this manual are the only good practices used in the forensic field.

This BPM is independent of any ISO standard or ASTM standards, but it is written to agree with ISO 17025 and ASTM-standards that are relevant for forensic comparison and analysis of glass [1].

2. SCOPE

This manual applies to identification, classification, and comparison of glass by analysis of physical and chemical characteristics of the samples.

The forensic examination of glass is complex. This BPM and its Guidelines will cover methods that are normative and suitable in the field so that practitioners and reporting scientists will be able to choose the most suitable route according to needs and available equipment.

This BPM does not cover detailed description of Scene of Crime (SOC) investigation and recovery of evidence from the crime scene.

This manual covers the following methods/analytical techniques.

Table 1: Topics covered in this Best Practice Manual (see Guidelines)

	Topic
Guideline 6	Recovery of Glass in Forensic Identification and Comparison of Glass
Guideline 7	Forensic Examination of Visual Characteristics of Control and Recovered Samples of Glass

	Topic
Guideline 8	Determination of Refractive Indices of Glass Fragments
Guideline 9	Scanning Electron Microscopy and Energy Dispersive Spectroscopy of Glass Samples in Forensic Science
Guideline 10	Micro X-ray Fluorescence Spectroscopy of Glass Samples in Forensic Science
Guideline 11	Quantitative Elemental Analysis of Glass Samples using LA-ICP-MS

This Best Practice Manual and the associated Guidelines are not specific to any of commercial instruments on the market. It is expected that an individual laboratory will be aware of any instrument specific functions and limitations.

This manual will present relevant and recommended methods accompanied by a short summary of their limitations and strengths (see chapter 5 and 6). For details, please refer to the specific guidelines attached to this BPM.

3. TERMS AND DEFINITIONS

For the purposes of this guideline, the relevant terms and definitions given in ENFSI documents, the ILAC G19 “Modules in Forensic Science Process”, as in standards like ISO 9000, ISO 17020 and 17025 apply.

For an extensive reference on glass terminology, please see ASTM C162-05(2015) Standard Terminology of Glass and Glass Products (ASTM, 2015) [2].

Table 2: Definitions and Terminology relevant in for the content in Best Practice Manual. The definitions/terms are not covered in ASTM C162-05(2015)

	Definition
Calibration	Operation that, under specified conditions, in a first step, establishes a relationship between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties (of the calibrated instrument or secondary standard) and, in a second step, uses this information to establish a relationship for obtaining a measurement result from an indication
Class	See “Group”
Coating	Functional and/or decorative layer applied to a glass surface
Collaborative exercise	A situation in which two or more groups of practitioners perform a test against pre-established criteria
Control sample	A sample of known origin, e.g. a sample from a broken sheet of glass at the scene of crime
Density	Mass per unit volume
Discriminate	To distinguish between two samples; to differentiate
Discriminating power	The ability of an analytical procedure to distinguish between two items of different origin
Glass	An inorganic product of fusion that has cooled to a rigid condition without crystallizing

	Definition
Group	A group or class of items that share properties or characteristics within a given uncertainty, often given as categorical data
Group characteristics	Properties that define a group of items collectively
Practitioner	A person trained to perform testing
Proficiency Test	Proficiency testing is the evaluation of the performance of a practitioner against pre-established criteria
Questioned sample	Material of an unknown source/origin collected from a known location either as, or from, items of evidence (e.g., fragments recovered from a suspect's clothing)
Raw data	The actual, unprocessed results from an analysis or measurement
Recovered sample	Material recovered from an object (such as glass collected from the surface of a piece of clothing)
Refractive index	The ratio of the speed of light in one media compared to another, usually expressed as n=v1/v2 (n=refractive index, v1 = speed of light in medium 1 and v2 = speed of light in medium 2)
Validation	A process that aims to demonstrate that the method of choice is appropriate for the application intended

4. RESOURCES

4.1 Personnel

Reporting Scientist: the forensic scientist responsible in a particular case, for directing the examination of the items submitted, interpreting the findings, writing the report and providing evidence of fact and opinion for the court.

Peer reviewer: a forensic scientist with a similar level of competence as the Reporting Scientist. The peer reviewer should be able to independently interpret the results and assist the reporting scientist in formulating a correct, consistent and understandable report (see chapter 5.1).

Analyst/Assistant: an individual carrying out general casework examinations or analytical tests under the supervision of a Reporting Scientist and who can provide information to assist with the interpretation of the tests.

All personnel must have undergone proper, documented training in accordance with the institution’s requirements and/or the implemented quality management system (QMS).

An individual may be responsible for more than one of the defined roles.

4.2 Equipment

In this BPM, it is assumed that the institute consists of laboratories that are adequate to collect, isolate, prepare and analyse evidence. In addition, the facilities should be designed in such a way to minimize the risk of contamination of evidence.

It is also assumed that basic equipment such as glassware, balances, proper light sources etc are available.

It is strongly recommended that stereomicroscopes are available as general-purpose apparatus.

In order to identify glass, the object should be observed in transmitted cross-polarized light, preferably under a microscope.

To compare glass, it is considered, as minimum to meet the requirement in this BPM, to have access to at least one of the following:

- equipment to measure refractive index by means of oil immersion method (Guideline 8)
- equipment to perform elemental analysis
  - SEM/EDS (Guideline 9)
  - (micro-) XRF (Guideline 10)
  - LA-ICP-MS (Guideline 11)

Equipment for performing compound microscopy and interference microscopy will also be relevant when comparing glass. These methods will not be covered in this manual.

4.3 Reference materials

See individual guidelines for specific reference materials. In general, it is recommended to use certified reference material or material that have been broadly tested by laboratories. Example: Schott/BKA-K5 glass for measurement of refractive index.

4.4 Facilities & Environmental Conditions

Facilities etc., should conform to ISO17025 standards.

4.5 Risk-Based Thinking

It is recommended that each institute have written protocols for risk management/risk analysis. Risk management is a method for controlling unwanted errors and failures in the process of forensic analysis and assessing any impact if such issues should occur.

Risk management should ideally consider each step of the forensic analysis and determine if these have a high, medium or low impact at that point and how these may affect the final evaluation of the findings; e.g. the risk of giving wrong conclusion in the written report. The assessment should ideally determine how errors and failures are detected, how often these could occur and what actions should be taken to prevent that type of risk occurring. Some risk management models use a scoring process to determine the severity of an error or failure.

It is recommended that a risk analysis is performed for any given method or process on a regular basis to identify recurring issues.

Each laboratory should define at which level the risk management/risk assessment should be executed; e.g. at institutional level and/or at detailed level such as for each specific method.

4.6 Materials and Reagents

Materials and reagents shall be of such quality (purity/grade) that they meet the expected requirements of the method. It is recommended that product data is available/documented.

5. METHODS

The PGT-expert working-group only recommends the use of methods that are published in peer-reviewed scientific journals and aimed at forensic science. The guidelines in this BPM present what is normative and generally accepted methods for visual characteristics of control and recovered samples and comparison of glass.

The following tables will provide general information of the methods listed in Table 3.

Table 3: General information of the methods

Method	Recovery of glass from items
Description	Description of recovery, collection, handling and seizure of glass
Input	Items submitted
Output	Debris, fragments or pieces of glass
Discriminating power	Not applicable
Consequences for subsequent analyses	When executed properly, debris inherently containing fragments of glass and/or fragments/pieces of glass are provided for subsequent analyses
Strengths	Fast and efficient when executed properly
Limitations	Other evidence material may suffer physical damage or loss
Equipment, facilities	Proper tools, reasonable large paper-sheets, environment free of possible sources of contamination
Other remarks	See also ASTM E1492 [3]
Guideline	EPG-guideline 6: *Recovery of Glass in Forensic Identification and Comparison of Glass*

Method	Visual Characteristics of Control and Recovered samples of glass
Description	Description of visual inspection of glass (fragments, pieces).
Input	Samples of recovered and glasses
Output	Metric and visual characteristics of glass (thickness, surface, bulk colour, coatings, description of surface by interferometry)
Discriminating power	Elimination of glass from different sources can be achieved by e.g., colour, thickness, low to intermediate discrimination power for determination of thickness whereas for interferometry the discrimination power is not known
Consequences for subsequent analyses	If deemed different, further analysis is not needed
Strengths	Fast and efficient when, non-destructive
Limitations	Size of recovered fragments or insufficient control representative of broken glass object
Equipment, facilities	Proper source of light, stereo microscope, metric measurement tools with adequate resolution and sensitivity, interferometer system
Other remarks	None
Guideline	EPG-guideline 7: *Forensic Examination of Visual Characteristics of Control and Recovered Samples of Glass*

Method	Determination of refractive index of glass fragments
Description	Measurement of refractive index of glass fragments by oil-immersion method
Input	Glass samples (control and questioned glass)
Output	Refractive index
Discriminating power	Fairly good discrimination of glass samples from different sources depending on quality of sample (i.e. size, presence of dirt at samples etc)

Method	Determination of refractive index of glass fragments
Consequences for subsequent analyses	If deemed different, further analysis is not needed. If deemed indistinguishable further analysis such as elemental analysis and reannealing can be performed to establish similarities or discrimination
Strengths	Suitable for sub-millimetre samples, samples can be subjected to further analysis, good discrimination, well documented and mature method
Limitations	Sensitive to contamination
Equipment, facilities	A system suitable for measurement of RI consisting of a phase-contrast microscope, hot-stage, camera, control-unit for collection of images/video and control temperature and suitable software. For calibration a set glass samples with known refractive indices are required together with (Silicon) Oils with specified refractive index range. One or more samples of glass with known refractive index to be used on a daily basis to control the system
Other remarks	*See also ASTM E1967* [4]
Guideline	EPG-guideline 8: *Determination of Refractive Indices of Glass Fragments*

Method	Determination of elemental composition by Scanning Electron Microscopy and Energy Dispersive Spectroscopy
Description	Determination of elemental composition of glass fragments on main- and minor level (>1 g/kg)
Input	Samples of recovered glass (control and questioned glass)
Output	Elemental composition
Discriminating power	Very high discrimination of glass samples from different sources, depending on quality of sample (i.e., size, presence of dirt at samples etc)
Consequences for subsequent analyses	It is recommended that SEM/EDS is used in combination with other methods, preferably determination of refractive index or determination of trace element concentration by LA-ICP-MS. If deemed different, further analysis is not needed. If deemed indistinguishable or associated within the uncertainty of the method, the association should be confirmed by at least one supplementary method
Strengths	Fast and reliable method, well documented, for qualitative and semi-quantitative analysis little sample preparation needed, hence non-destructive
Limitations	Somewhat low discrimination for main elements. If quantitative analysis is performed, sample preparation is required, and samples then may be inaccessible for other methods
Equipment, facilities	Scanning electron microscope with low vacuum system if no carbon coater is available, energy dispersive spectrometer, carbon coater, suitable sample holders, embedding material
Other remarks	None
Guideline	EPG-guideline 9: *Scanning Electron Microscopy and Energy Dispersive Spectroscopy of Glass Samples in Forensic Science*.

Method	Determination of elemental composition by X-ray fluorescence (XRF)
Description	Elemental composition of glass fragments on trace/minor and major element level
Input	Samples of recovered glass (control and questioned glass).
Output	Elemental composition
Discriminating power	Elimination of glass from different sources can be achieved, high to intermediate discrimination depending on quality of sample (i.e. size, presence of dirt at samples etc)
Consequences for subsequent analyses	It is recommended that XRF is used in combination with other methods, preferably determination of refractive index or determination of trace element concentration by LA-ICP-MS. If deemed different by use of XRF, further analysis is not needed. If deemed indistinguishable or associated within the uncertainty of the method, the association should be confirmed by at least one supplementary method
Strengths	Fast, well documented and reliable method with little to none sample preparation, non-destructive, more sensitive for elements with Z>20 (Ca) than SEM-EDS
Limitations	Determination of trace elements only down to approx. 0.5 g/kg (depending on the element); when a collimator optic is used spot size of minimum 1 mm, with polycapillary spot size of ≥ 20 µm possible
Equipment, facilities	Micro-XRF unit (x-ray tube, detector, polycapillary or collimator optics, data acquisition and evaluation software), vacuum system (optionally helium supply)
Other remarks	None.
Guideline	EPG-guideline 10: *Micro X-ray Fluorescence Spectroscopy of Glass Samples in Forensic Science*

Method	*Quantitative elemental analysis of glass samples using LA-ICP-MS*
Description	Determination of the concentrations of main, minor and trace elements in glass (approximately 100 µg/kg to 500 g/kg
Input	Glass samples (control and questioned glass)
Output	Quantitative data for typically 15-20 chemical elements
Discriminating power	Very high discrimination of glass samples from different sources
Consequences for subsequent analyses	If deemed different, further analysis is not needed. If deemed indistinguishable or associated within the uncertainty of the method, the association may be confirmed by Refractive Index measurement
Strengths	Fast and reliable, well documented method for the qualitative and quantitative analysis of glass samples. Little sample preparation needed; Surface contamination is not critical. Irregularly formed glass particles can be examined
Limitations	Fragments of approximately 0.4 mm x 0.2 mm x 0.1 mm are typically needed for full analysis with six replicates and 600 laser pulses. Smaller fragments can be examined with reduced numbers of replicates or reduced ablation time. Some level of education and training is necessary to operate the instruments appropriately. Somewhat expensive in purchase and maintenance.
Equipment,	Laser Ablation and ICP-MS units, data reduction software, high purity

Method	*Quantitative elemental analysis of glass samples using LA-ICP-MS*
facilities	He and Ar gas supply, sufficient air exhaust, stable temperature and humidity
Other remarks	*See also ASTM E2927* [5]
Guideline	Guideline 11: Quantitative *Elemental Analysis of Glass Samples Using LA-ICP-MS*

5.1 Case review

It is recommended that a case review is independently carried out by a competent peer reviewer, see 4.1. The aim of a peer-review is to control and confirm that appropriate methods and steps have been taken to achieve robust and reliable results with suitable interpretation of the findings. Critical findings should be documented in the case file and approved by the peer-reviewer (see chapter 7.3).

6. VALIDATION AND ESTIMATION OF UNCERTAINTY OF MEASUREMENT

6.1 Validation

In this Best Practice Manual, validation is defined as specific steps taken to demonstrate that a given method is suitable for its intended use.

In order to refer to use of this Best Practice Manual and the guidelines herein, the methods used must be validated.

Each analytical method should be validated according to the institute's internal quality assurance policy.

Prior to validation of a new method, a validation plan for the actual method should be written. It is recommended that the plan describes the minimum requirement for considering the method validated. For an elucidation of factors that should be taken into consideration, see *Guidelines for the single laboratory Validation of Instrumental and Human Based Methods in Forensic Science* [6].

6.2 Estimation of uncertainty of measurement

In this Best Practice Manual, estimation of uncertainty is limited to the representation of measured values of the same parameters for quantitative analysis for that sample by use of calibration curves, limits of detection and instrumental sensitivity. These topics are covered in the *GUM: Guide to expression of Uncertainty in measurement* and in *IUPAC Gold Book* [7,8].

An institute should keep a record of documents that cover the following topics, if relevant:

1. How to determine and present measurement uncertainties?
2. How to establish calibration curves for the method and how to determine the uncertainty of the calibration curves?
3. Determination of limits of detection for a method or the working range (e.g. upper and lower limits of detection/quantification etc.) of the method.

It is recommended that laboratories hold documents that describe the use of graphical as well as tabular representation of uncertainties.

7. QUALITY ASSURANCE

7.1 Proficiency Testing / Collaborative Exercises

Proficiency tests should be used to test and confirm the quality of the forensic comparison and identification of glass. Laboratories performing forensic glass analysis should on a regular basis, participate in collaborative exercises and/or proficiency tests. The test should, if possible, cover the various analytical techniques used at the laboratory.

7.2 Performance Controls

It is imperative to monitor performance of analytical equipment periodically. The purpose is to assure stability and follow trends. The laboratory should consider making a suitable system for documentation and safe keeping of recorded measurements. It is recommended to establish control cards/charts to follow trends in analytical performance. Limits or defining points where action must be taken, should be established for each analytical method/equipment where possible. Suitable reference material for testing analytical performance stability must be used.

7.3 Verification / Peer Review

It is recommended that a case review is independently carried out by a competent peer-reviewer, as described in 5.1.

The peer-review should be in agreement with the conclusion of the report, which is supported by the analytical results etc.

A peer-reviewer should also read the final report in order to check formal details such as dates, names, internal and external case-file numbers, identification of seizures, finalizing of seizures etc. Further, a peer-reviewer should confirm that the report answers the question raised in the request, that internal procedures/the policy of the institute are met (such as scale of conclusion) and ensure that the language used is clear, concise and unambiguous.

8. HANDLING ITEMS

To ensure that relevant samples are properly collected at the scene of crime, a limited set of the most important recommendations are given in 8.1.

8.1 At the scene

Glass from broken windows or broken glass of known origin should be collected and marked as *Control Glass*. If possible, glass from the actual broken window, still in its frame/attached to the car body or at any original place holder, is preferred. Be aware of double or triple glazing. Collect each layer of glass in a separate container and mark unambiguously. If needed, mark what is the outside and inside of the window, car glass etc.

Do not mix glass collected from place holder and glass collected from the ground.

Glass from the ground should be placed in separate containers.

Glass associated with a suspect or glass of unknown origin should be marked as recovered glass. Awareness should be taken to avoid cross contamination, especially of glass from the scene of crime and the suspect.

Small, but visible fragments may be collected separately and attached to gelatine foil or similar material. Try not to attach small fragments to adhesive tape, as glue may attach to/contaminate the fragment.

Parts of tools containing glass should be covered, preferably by a non-static material such as paper/cardboard or similar. Try to avoid plastic bags as the glass fragments can penetrate the plastic and also tend to stick to the inner surface of the bag.

Garments from individuals should be packaged separately in paper-bags or similar. Avoid using plastic bags. If the garments are wet, it may be expedient to let them dry before shipment to the laboratory. Dry horizontally on paper. Send the paper together with the garments to the laboratory, as it may contain glass fragments.

Treat the garments gently to avoid losing glass fragments.

8.2 At the laboratory

See Guideline 6: Recovery of glass in forensic identification and comparison of glass.

9. INITIAL ASSESSMENT

Based on the request from the client and preliminary examination (often visual inspection) of the received items, an assessment as to whether the laboratory can conduct the examination/analysis should be undertaken. An assessment should be made to establish if such examination/analysis will assist in the investigation. Such an assessment should be done in co-operation with the client.

If issues arise (whether the preliminary examination revealed that the packaging was damaged, deadlines cannot be met etc.) the client should be contacted, and an agreement on further actions should be made.

For a more elaborate introduction, see Guideline 7: *Forensic examination of visual characteristics of control and recovered samples of glass.*

10. PRIORITISATION AND SEQUENCE OF EXAMINATIONS

After preliminary examination of the items, a plan/strategy for the recovery of glass and sequence of analytical procedures should be outlined. The different steps will depend on the case, the items received, the request/questions asked by the client and the equipment available at the laboratory.

It is recommended that an outline of the procedure is documented in the case file. Deviations from the procedure should be documented. Deviations from the preliminary plan/strategy may occur as a natural cause of the examination.

It is the responsibility of the Reporting Scientist to set the plan for the analytical procedures to be used, to determine the analytical sequence and to make sure that the necessary corrective steps are taken if deviations from the original plan occur.

11. RECONSTRUCTION

Not applicable.

12. ASSESSMENT OF RESULTS AND INTERPRETATION

12.1 Introduction

Data obtained from analytical processes as described in this Best Practice Manual will only on rare occasions exhibit equal results. Differences in the results occur due to real physical and chemical differences between samples (between-sample variability) and within-sample variability (due to e.g., in homogeneity, surface effects, tension), random measurement errors and systematic measurement errors. Potential sources of random and systematic measurement errors are discussed in each guideline, where applicable.

12.2 Data treatment

Preliminarily treatment of data can be done by graphical representation of data, summarizing statistics in tables or testing hypothesis by use of statistical models. These methods will provide information such as median or mean values, spread of data, or whether a statistical test supports or rejects the hypothesis that two (or more) compared values share the same properties.

One or several of the following methods of data evaluation may be applied at this stage:

1. Test for outliers (Grubbs test).
2. Grouping of measurements such as Evett Lambert Modification 1&2, Scott-Knott Modification 2 [9].
3. Comparison of (mean) values (univariate and multivariate data)[1] by
   a. visual representation of data [10,11]
   b. n-sigma tests [12,13]
   c. Range overlap criteria (ASTM E1967)
   d. hypothesis tests (such as t-test, Tukey´s test, Hotelling´s T2-test) [9,11,12,14]
4. Classification (e.g., by pre-defined numerical criteria, Principal Component Analysis, Linear Discriminant Analysis).

The statistical methods and tests listed above are the most predominant in the field glass comparison. Other methods exist and may also be applied.

It is recommended that whenever a statistical method or test is applied, an in-house validation/verification should be performed in advance.

If no further evaluation, such as to the evidential strength of the findings is to be performed, the results of such calculations may be communicated in a *technical report*.

Another branch of data treatment is the evaluative interpretation of the findings. An evaluative interpretation will provide information about *evidential strength*. In forensic science, this is often defined as the probability of obtaining a set of observations if one hypothesis is true held against the probability of obtaining the same sets of observations given that the alternative hypothesis is true [15].

Evaluative/interpretative assessment of the data aims to provide information for the strength of the evidence (i.e., the observations) under two competing hypotheses [15,16]. Note: hypotheses may be referred to as “propositions” in some texts.

[1] This can typically be done by presenting a hypothesis saying that the two compared quantities are indistinguishable (H_0). Next, the validity of this hypothesis(H_0) will be tested against the hypothesis that the two quantitates are different (H_1).

The question from the client should be used to form the hypothesis of the prosecutor ($\mathbf{H_p}$). In order to be balanced, an alternative hypothesis should be introduced, ($\mathbf{H_d}$)[2]. For example, information provided by the suspect should be used to form the alternative. H_p and H_d must be mutually exclusive.

The observations (the data from the analysis) are denoted **E.**

When the hypothesis and the evidence have been established, the probability of the observations if (given) the hypothesis of the prosecutor is true can be assigned. In addition, the probability of the observations if (given) the hypothesis of the defence is true should be assigned. Often, to assign this probability, some sort of background information should be available.

The ratio between those two probabilities is referred to as the likelihood ratio (LR).

The likelihood ratio is defined as «...the ratio of the probability of the evidence if the prosecution's proposition is true, to the probability of the evidence if the defence proposition is true (i.e. ***the likelihood ratio***)» [17].

In order to evaluate the likelihood ratio (LR) for any given proposition (H_p, H_d), the following should be taken into consideration:

- level of proposition or hypothesis (source, activity)
- available, relevant case related information
- available background data (databases)
- excepted variability (within and between source variation)

12.3 Databases

To perform an evaluation of evidential strength, background information should be available (such as population studies). Such databases can, for example, provide information about the probability of random matches. Relevant databases are (but not limited to):

- databases on frequencies of occurrence of features
  - refractive index
  - elemental composition
  - thickness
- sales numbers (market share)
- transfer and persistence of glass on garments, tools
- information on background levels of glass

Laboratories should be aware that regional differences concerning frequencies, background levels etc may occur.

13. PRESENTATION OF RESULTS

It is recommended that results are presented in a written report. The report should be concise when answering the requests/questions asked by the client. The language should be simple and easy to understand for the members of the court, the prosecutor, defence and public opinion.

It is recommended that the report is independently reviewed by a peer-reviewer before its release.

[2] **d** refers to defence.

Presentation of the results might also be given orally, normally in court. It is recommended that oral presentations are given in a clear and concise form using simple language. Technical terms should be avoided or defined in plain words.

14. HEALTH AND SAFETY

This document does not address safety concerns, if any, associated with its use. The institute referring to this manual must decide which measures must be taken to conduct the examinations safely and in accordance current regulations.

15. REFERENCES

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16. AMENDMENTS TO PREVIOUS VERSION

This Best Practice Manual is a complete rewrite of the first edition of the European Paint, Glass Group and Taggants Best Practice Manual of Forensic Glass Examination. No references to amendments to previous versions are given in this paragraph of the current BPM.