Training Outline for the Examination of Glass Evidence

1.0 Purpose – This document provides an outline for training in the collection, preservation and examination of glass evidence, including the requisite competency testing.

2.0 Scope – This training outline shall be followed by all trainees in the collection, preservation and examination of glass evidence, regardless of experience level.

3.0 Module 1 – Introduction to Glass and Glass Examination

3.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

3.1.1 Describe the history of glass and glass-making.

3.1.2 Describe the manufacturing processes and applications of glass.

3.1.3 Describe the chemical composition, physical properties and optical properties of the different types of glass.

3.1.4 Understand the general aspects of forensic glass examination.

3.2 Reading Assignments

3.2.1 State Crime Laboratory Evidence Guide.

3.2.2 Current North Carolina State Crime Laboratory procedures related to the examination of glass evidence, GRIM 3 and XRF.

3.2.3 Amstock, J. S. *Handbook of Glass in Construction*. New York: McGraw-Hill, 1997. 21-150, 491-525.

3.2.4 Angus-Butterworth, L. M. *The Manufacture of Glass*. New York: Pitman Publishing Corp., 1948. 25-104, 139-199.

3.2.5 Caddy, Brian. ed. *Forensic Examination of Glass and Paint: Analysis and Interpretation*. New York, NY: Taylor and Francis, 2001. 1-21. Print.

3.2.6 Corning Glass Works. *This is Glass*. Corning, New York, 1964.

3.2.7 Curran, James, Tacha Hicks and John Buckleton. *Forensic Interpretation of Glass Evidence*. Boca Raton, FL: CRC Press, 2000. Print.

3.2.8 Dodsworth, R. *Glass and Glassmaking*. Great Britain: Shire Publications Ltd., 1983.

3.2.9 Koons, R. D., et al. Forensic glass comparisons. In: *Forensic Science Handbook.* vol. I, 2nd ed. Richard Saferstein, Ed., Prentice Hall, Upper Saddle River, New Jersey, 2002, pp. 161–213.

3.2.10 Macfarlane, A. and G. Martin. *Glass: A World History*. Chicago: The University of Chicago Press, 2002. 204-207.

3.2.11 Pfaender, H. G. *Schott Guide to Glass*. London: Chapman & Hall, 1996. 16-120.

3.2.12 Varshneya, Arun. *Fundamentals of Inorganic Glasses*. San Diego, CA: Academic Press, 1994. Print.

3.2.13 ASTM Guidelines

3.2.13.1 ASTM Standard C162-05, 2010, "Standard Terminology of Glass and Glass Products." ASTM International, West Conshohocken, PA, 2010, DOI: 10.1520/C0162-05R10, <http://www.astm.org>.

3.2.14 SWGMAT Articles

3.2.14.1 SWGMAT. "Collection, Handling, and Identification of Glass." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

3.2.14.2 SWGMAT. "Forensic Examination of Glass Guideline." 2004.

3.2.14.3 SWGMAT. "Initial Examinations of Glass." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

3.2.14.4 SWGMAT. "Introduction to Forensic Glass Examination." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

3.2.15 Published Journal Articles

3.2.15.1 Bird, Milo. "Glass for the Bottle Buff." 1971.

3.2.15.2 Brown, Hoppen and Wortman. "Light and Electron Microscopy of Glass Fibers." McCrone Environmental Services Inc. 1989.

3.2.15.3 Doyle, P. J. "Recent Developments in the Production of Stronger Glass Containers." *Packaging Technology and Science* 1.1 (1988). 47-53.

3.2.15.4 Miller, Elmer T. "A Practical Method for the Comparison of Mineral Wool Insulations in the Forensic Laboratory." Presented at the 88th meeting of AOAC. Washington, DC. October 14-17, 1974.

3.2.15.5 Miller, Elmer T. "Optical Comparisons of Mineral Wool Insulations in the Forensic Laboratory." FBI.

3.2.15.6 Ojena S.M. and P.R. DeForest. "A Study of the Refractive Index Variations within and Between Sealed Beam Headlights Using a Precise Method." *Journal of Forensic Sciences* 14.3 (1969): 409-425.

3.2.15.7 Smith, F. and J. McGinnis. "Comparison of Headlight Lenses Using Refractive Index and Density." 1976.

3.2.15.8 Stadler, Leo E. and David Cronin. "Container Glass Composition." *The Glass Industry* December 1977.

3.2.15.9 Stadler, Leo E. and David Cronin. "Container Glass Composition: Part II." *The Glass Industry* January 1978.

3.2.15.10 Steinberg, Harold L. "Auto Headlight Glass: Visible Features of Forensic Utility." NBS Special Publication. 480-17, February 1978.

3.2.15.11 Swift, Howard. "How Surface Chemistry Affects Float Glass Properties." *The Glass Industry* 65 (1984): 27-30.

3.2.15.12 Tooley, F. *Handbook of Glass Manufacture*. 3rd ed., Vol. 2, New York: Ashlee Publishing Co. 1984. 685-727.

3.2.15.13 Underhill, M. "Multiple Refractive Index in Float Glass." *Journal of the Forensic Science Society* 20 (1980): 169-176.

3.2.15.14 Von Bremen, U. "Shadowgraphs of Bulbs, Bottles, and Panes." *Journal of Forensic Sciences* 20.1 (1975): 109-118.

3.3 Exercises

3.3.1 Read literature pertaining to this module.

3.3.2 The training officer shall provide an overview of the analytical processes including sample selection, the physical and optical properties of glass, microscopic examination of glass and elemental analysis of glass.

3.3.3 Complete the definition list of common glass terminology provided by the training officer.

3.4 Evaluation

3.4.1 The trainer and trainee will review and discuss the pertinent points of the required readings.

3.4.2 The trainee shall prepare a written paper describing the history of glass and glass manufacturing techniques.

4.0 Module 2 – Tools and Instrumentation Utilized in Glass Examinations

4.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

4.1.1 Demonstrate the handling techniques used in the examination of glass evidence.

4.1.2 Demonstrate the proper use of a polarized light microscope, micrometer and ultraviolet light source as they relate to glass examination.

4.1.3 Describe the proper use of Inductively Coupled Plasma Mass Spectrometry (ICP-MS) techniques.

4.1.4 Demonstrate the proper use of the Glass Refractive Index Measurement (GRIM3) system and interpret the data generated.

4.1.5 Demonstrate the proper use of X-ray Fluorescence (XRF) system and compare/interpret the spectra generated.

4.2 Reading Assignments

4.2.1 ASTM Guidelines

4.2.1.1 ASTM Standard E1967-98, 2003, "Standard Test Method for the Automated Determination of Refractive Index of Glass Samples Using the Oil Immersion Method and a Phase Contrast Microscope." ASTM International, West Conshohocken, PA, 2003, DOI: 10.1520/E1967-98R03, <http://www.astm.org>.

4.2.2 SWGMAT Articles

4.2.2.1 SWGMAT. "Elemental Analysis of Glass." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

4.2.2.2 SWGMAT. "Glass Refractive Index Determinations." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

4.2.3 Published Journal Articles

4.2.3.1 Almirall, Cole, Furton and Gettinby. "Classification and Discrimination of Forensic Glass Samples Using the Statistical Analysis of their Elemental Composition and Refractive Index Data." 1996.

4.2.3.2 Almirall, J. R., et al. "Discrimination of glass sources using elemental composition and refractive index: development of predictive models." *Science & Justice* 38.2 (1998): 93-100.

4.2.3.3 Brown, G. A. "Factors Affecting the Refractive Index Distribution of Window Glass." *Journal of Forensic Sciences* 30.2 (1985).

4.2.3.4 Collins, Jiranek and Kobus. "Automated Glass Refractive Index Measurement Using GRIM II. Survey of Glass in South Australia." 1987.

4.2.3.5 Crockett, J.S. and M.E. Taylor. "Physical Properties of Safety Glass." *Journal of Forensic Science Society* 9.3 (1969): 119-122.

4.2.3.6 Dabbs, M.D.G. and E.F. Pearson. "Some Physical Properties of a Large Number of Window Glass Specimens." *Journal of Forensic Sciences* (1971): 70-78.

4.2.3.7 Dabbs, M.D.G. and E.F. Pearson. "The Variation in Refractive Index and Density Across Two Sheets of Window Glass." *Journal of Forensic Science Society* 10.3 (1970).

4.2.3.8 Espinoza, E.O. and Thornton, J.I. "Three-Dimensional Presentation of Glass Density Versus Refractive Index Data." *Journal of Forensic Sciences* 32.2 (1986).

4.2.3.9 Evett, I.W. and Lambert, J.A. "The Interpretation of Refractive Index Measurements III." *Forensic Science International* 20 (1982): 237-245.

4.2.3.10 Evett, I.W. and Lambert, J.A. "The Interpretation of Refractive Index Measurements IV." *Forensic Science International* 24 (1984): 149-163.

4.2.3.11 Gray, P. *The Encyclopedia of Microscopy and Microtechnique*. New York: Van Nostrand Reinhold, 1973. 500-503.

4.2.3.12 Heideman, D.H. *Glass Comparisons Using a Computerized Refractive Index Database.* 26th Annual American Academy of Forensic Sciences. Dallas, TX. 13 February 1974. Conference Presentation.

4.2.3.13 Hickman, D.A. "A Classification Scheme for Glass." *Forensic Science International* 17 (1981): 265-281.

4.2.3.14 Hicks, T., et al. "The Classification and Discrimination of Glass Fragments Using Non-Destructive Energy Dispersive X-ray μFluorescence." Vol. 137, No. 2, (2003). 107-118.

4.2.3.15 Howden, C.R., R.J. Dudley and K.W. Smalldon. "The Analysis of Small Glass Fragments Using Energy Dispersive X-ray Fluorescence Spectrometry." *Journal of the Forensic Science Society* 18.1-2 (1978): 99-112.

4.2.3.16 Koons, R.D. and J. Buscaglia. "Distribution of Refractive Index Values in Sheet Glasses." *Forensic Science Communications* 3.1 (2001). <http://www.fbi.gov>.

4.2.3.17 Kunz. "Energy-Dispersive X-ray Fluorescence Analysis of Research Materials." *Spectroscopy* 3.8 (1988).

4.2.3.18 Locke and Perryman. "The Evidential Value of Dispersion in the Examination of Glass." Central Research Establishment Home Office Forensic Science Service. 1985.

4.2.3.19 McCrone, W.C. "Microscopical Characterization of Glass Fragments." *J. Association of Official Analytical Chemists* 55.4 (1972).

4.2.3.20 Miller, Elmer T. "A Rapid Method for the Comparison of Glass Fragments." *Journal of Forensic Sciences* 10.3 (1965): 272-281.

4.2.3.21 Newton, A.W.N. and J.S. Buckleton. "An Investigation into the Relationship Between Edge Counts and the Variability of the Refractive Index of Glass: Part I: Edge Morphology." *Forensic Science International*. 177.1 (2008): 24-31.

4.2.3.22 Ojena, S.M. and P.R. DeForest. "Precise Refractive Index Determination by the Immersion Method, Using Phase Contrast Microscopy and the Mettler Hot Stage." *Journal of Forensic Science Society* 12.1 (1972): 315-329.

4.2.3.23 Pella, Peter. "X-ray Spectrometry." *Instrumental Analysis*. Ed. G. D. Christian and James O'Reilly. 2nd ed. New Jersey: Allyn & Bacon. 1986. 412-450. Print.

4.2.3.24 Reeve, V., J. Mathiesen and W. Fong. "Elemental Analysis by Energy Dispersive X-ray: A Significant Factor in the Forensic Analysis of Glass." *Journal of Forensic Sciences* 21.2 (1976): 291-306.

4.2.3.25 Ryland. *Flat Glass Source Discrimination by Micro X-ray Fluorescence Spectroscopy*. Southern Association of Forensic Scientists. Sanibel, FL. 2001. Conference Presentation.

4.2.3.26 Ryland. "Re-evaluation of Density Discrimination in the Forensic Examination of Glass Fragments." 2004. Conference Presentation.

4.2.3.27 Satterthwaite, M.J., P.H. Harrison and J.H. Lambert. "Glass Refractive Index – Recent Developments in Measurement and Data Handling in UK Forensic Science Service Laboratories." Forensic Science Service, Wetherby Laboratory, West Yorkshire, England.

4.2.3.28 Slater, D.P. and Wilkaan Fong. "Density, Refractive Index, and Dispersion in the Examination of Glass: Their Relative Worth as Proof." *Journal of Forensic Science* 27.3 (1982): 474-483.

4.2.3.29 Smalldon, K.W. and C. Brown. "The Discriminating Power of Density and Refractive Index for Window Glass." *Journal of Forensic Sciences* 13.4 (1973): 307-309.

4.2.3.30 Stehr and Bogert. "Applications of Source-Tuned XRF Spectrometry with Light Element Analysis." 1988.

4.2.3.31 Suzuki, Y., et al. "Forensic Discrimination of Sheet Glass by a Refractive-Index Measurement and Elemental Analysis with Synchrotron Radiation X-ray Fluorescence Spectrometry." *Analytical Sciences* 21.7 (2005): 855-859.

4.2.3.32 Thornton, John I., et al. "Correlation of Glass Density and Refractive Index-Implications to Density Gradient Construction." *Journal of Forensic Sciences* 29.3 (1984): 711-713.

4.2.3.33 Wherry, C.D., B.J. Cross and T.H. Briggs. "An Automated X-ray Microfluorescence Materials Analysis System." *Advanced X-ray Analysis* 31 (1988): 93-98.

4.2.3.34 Zadora, G. "Classification of Glass Fragments Based on Elemental Composition and Refractive Index." *Journal of Forensic Sciences* 54.1 (2008): 49-59.

4.2.3.35 Zoro, et al. "A Preliminary Investigation of Refractive Index Anomalies at the Surfaces of Glass Objects and Windows." Central Research Establishment Home Office Forensic Science Service. 1986.

4.2.4 Appropriate instrument manuals.

4.3 Exercises

4.3.1 Read literature pertaining to this module.

4.3.2 Practice proper glass examination techniques by using the PLM, micrometer, UV Light Source, GRIM3 and XRF to analyze a minimum of 10 various glass samples.

4.3.3 Prepare an explanation of the XRF and GRIM3 in both layman and scientific terms.

4.4 Evaluation

4.4.1 The trainer and trainee will review and discuss the pertinent points of the required readings.

4.4.2 The trainee will provide oral explanations of the XRF and GRIM3 in both layman and scientific terms to the trainer.

4.4.3 A practical exam involving the analysis of 5 glass samples (known and unknown) using the techniques and instrumentation of glass examination. Determine which unknown samples could have originated from the known samples.

5.0 Module 3 – Glass Fractures and the Transfer and Persistence of Glass Particles

5.1 Objectives Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

5.1.1 Differentiate between low-velocity impact, high-velocity impact and thermal fractures.

5.1.2 Examine fractured windows to determine the point of impact, order of impact and direction of impact.

5.1.3 Describe proper packaging and reconstruction techniques of glass fracture evidence.

5.1.4 Describe transfer and persistence of glass particles on clothing and objects.

5.2 Reading Assignments

5.2.1 ASTM Guidelines

5.2.1.1 ASTM Standard C1256-93, 2008, "Standard Practice for Interpreting Glass Fracture Surface Features." ASTM International, West Conshohocken, PA, 2008, DOI 10.1520/C1256-93R08, <http://www.astm.org>.

5.2.2 SWGMAT Articles

5.2.2.1 SWGMAT. "Glass Fractures." *Forensic Science Communications* 7.1 (2005). <http://www.fbi.gov>.

5.2.3 Published Journal Articles

5.2.3.1 Allen, T.J. and J.K. Scranage. "The Transfer of Glass – Part 1: Transfer of Glass to Individuals at Different Distances." *Forensic Science International* 93.2 (1998): 167-174.

5.2.3.2 Allen, T.J., K. Hoefler and S.J. Rose. "The Transfer of Glass – Part 2: A Study of the Transfer of Glass to a Person by Various Methods." *Forensic Science International* 93.2 (1998): 175-193.

5.2.3.3 Allen, T.J., K. Hoefler and S.J. Rose. "The Transfer of Glass – Part 3: The Transfer of Glass from a Contaminated Person to Another Uncontaminated Person During a Car Ride." *Forensic Science International* 93.2 (1998): 195-200.

5.2.3.4 Allen, T.J., J. Locke and J.K. Scranage. "Breaking of Flat Glass – Part 4: Size and Distribution of Fragments from Vehicle Windscreens." *Forensic Science International* 93.2 (1998): 209-218.

5.2.3.5 Brewster, Fay, et al. "The Retention of Glass Particles on Woven Fabrics." *Journal of Forensic Sciences* 30.3 (1985): 798-805.

5.2.3.6 Burnett, B.R. "A Shot through the Window." *Journal of Forensic Sciences* 42.2 (2001): 379-385.

5.2.3.7 Chang, P.Y., P.C. Yeh and J.M. Yang. "Fatigue Crack Growth in Hybrid Boron/Glass/Aluminum Fibre Metal Laminates." *Fatigue & Fracture of Engineering Materials & Structures* 31.11 (2008): 989-1003.

5.2.3.8 Daeid, N.N., D. McColl and J. Ballany. "The Level of Random Background Glass Recovered from Fleece Jackets of Individuals Who Worked in Law

Enforcement or Related Professions." *Forensic Science International* 191.1-3 (2009): 19-23.

5.2.3.9 De Kinder, J., et al. "The Deviation of Bullets Passing Through Window Panes." *Forensic Science International* 125.1 (2002): 8-11.

5.2.3.10 Hicks, T., A. Vanina and P. Margot. "Transfer and Persistence of Glass Fragments on Garments." *Science & Justice* 36 (1995): 101-107.

5.2.3.11 Lambert, J.A. and M.J. Satterthwaite. "How Likely is it that Matching Glass will be Found in these Circumstances? – The Results of a Casework Study." Wetherby Laboratory. The Forensic Science Service. West Yorkshire, 1994.

5.2.3.12 Lambert, J.A., M.J. Satterthwaite and P.H. Harrison. "Survey of Glass Fragments Recovered from Clothing of Persons Suspected of Involvement in Crime." *Science & Justice* 35.4 (1995): 273-281.

5.2.3.13 Locke, John and John A. Unikowski. "Breaking of Flat Glass-Part 2: Effect of Pane Parameters on Particle Distribution." *Forensic Science International* 56 (1992): 95-106.

5.2.3.14 Luce, R.J.W. and J. Buckle. "A Study on the Backward Fragmentation on Window Glass and the Transfer of Glass Fragments to Individual's Clothing." *Journal of the Canadian Society of Forensic Sciences* 24.2 (1991): 79-89.

5.2.3.15 McCrone, W.C. "Microscopical Characterization of Glass Fragments." *J. Association of Official Analytical Chemists* 55.4 (1972): 834-839.

5.2.3.16 Michalske, T.A. and B.C. Bunker. "The Fracturing of Glass." *Scientific American* (December 1987): 122-129.

5.2.3.17 O'Brien, K.P. and R.C. Sullivan. "Glass Fractures." *Criminalistics: Theory and Practice.* Massachusetts: Allyn and Bacon, Inc. 1980. 69-78.

5.2.3.18 Pearson, E.F., R.W. May and M.D. Dabbs. "Glass and Paint Fragments Found in Men's Outer Clothing – Report of a Survey." *Journal of Forensic Sciences* 16.3 (1971): 283-299.

5.2.3.19 Pounds, C.A. and K.W. Smalldon. "The Distribution of Glass Fragments in Front of a Broken Window and the Transfer of Fragments to Individuals Standing Nearby." *Journal of Forensic Science Society* 18.3-4 (1978): 197-203.

5.2.3.20 Sosin, Kazimierz. "Some Regularities in the Shape of Broken Glass." *Forensic Science International* 18 (1981): 17-19.

5.2.3.21 Thornton, J.I. and P.J. Cashman. "The Effect of Tempered Glass on Bullet Trajectory." *Journal of Forensic Sciences* 31.2 (1986): 743-746.

5.2.3.22 Thornton, J.I. and P.J. Cashman. "Glass Fracture Mechanism – A Rethinking." *Journal of Forensic Sciences* 31.3 (1986): 818-824.

5.2.3.23 Walsh, K.A.J. and J.S. Buckleton. "On the Problem of Assessing the Evidential Value of Glass Fragments Embedded in Footwear." *Science & Justice* 26.1 (1986): 55-60.

5.2.3.24 Welch, A., R. Rickard and M. Underhill. "The Observation of Banding in Glass Fragments and its Forensic Significance." *Journal of the Forensic Science Society* 29.1 (1989): 5-13.

5.2.3.25 Xie, Q., et al. "Full-Scale Experimental Study on Crack and Fallout of Toughened Glass with Different Thickness." *Fire and Materials* 32.5 (2008): 293-306.

5.2.3.26 Zeichner, A. and E. Springer. "The Breaking of Tempered Glass Vehicle Windows Using Broken Spark Plug Insulators." *Journal of Forensic Sciences* 31.2 (1986): 691-694.

5.3 Exercises

5.3.1 Read literature pertaining to this module.

5.3.2 Examine windows that have been fractured with different objects such as a bat, rock and/or high velocity projectile.

5.3.2.1 Determine the type of impact.

5.3.2.2 Determine the point of impact, order of impact and direction of impact where applicable.

5.3.2.3 Explain the proper packaging techniques for this type of evidence.

5.3.3 Understand how glass transfers after breakage and persists on clothing and objects.

5.4 Evaluation

5.4.1 The trainer and trainee will review and discuss the pertinent points of the required readings.

5.4.2 The trainer and trainee will review and discuss how to determine point of impact, order of impact and direction of impact.

6.0 Module 4 – Glass Project

6.1 Objectives

6.1.1 Demonstrate knowledge gained from Modules 1 through 3 by completing a glass project.

6.2 Exercises

6.2.1 The trainee shall collect the appropriate number and/or types of glass samples necessary to complete the project. All measurements and observations shall be made on each sample including type of glass, thickness, morphology, color, refractive index and/or elemental composition.

6.3 Evaluation

6.3.1 Present the project and results to the Forensic Scientists in the glass discipline at the conclusion of the glass project.

7.0 Module 5 – Casework

7.1 Objectives Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

7.1.1 Complete a glass examination from receiving the evidence to writing the Laboratory Report.

7.1.2 Demonstrate how to handle, collect and package glass-related evidence.

7.1.3 Recognize and preserve other trace items of potential evidentiary value (ie. paint, hair, fiber).

7.1.4 Document evidence condition, analytical techniques, and render a conclusion in the case file properly.

7.1.5 Write a clear, concise Laboratory Report consistent with Laboratory and Section guidelines.

7.2 Exercises

7.2.1 The trainee shall perform casework with a qualified Forensic Scientist during the course of this training program. The following shall be discussed and practiced with the trainee:

7.2.1.1 Proper procedures for taking notes and marking evidence.

7.2.1.2 Proper procedures for handling and analyzing known glass standards and unknown glass samples.

7.2.1.3 Proper procedures for sample selection, collecting glass particles from clothing, shoes and other objects.

7.2.1.4 Proper packaging for recovered debris and glass evidence.

7.2.1.5 Determining which examination(s) apply to each individual case.

7.2.1.6 Interpretation of glass evidence and relevance and weight in conclusions.

7.3 Evaluation

7.3.1 A mock case consisting of a minimum of one known standard and two unknown samples. This exercise will include generating an entire Case Record and Report.

8.0 Module 6 - Final Evaluation and Preparation for Court

8.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

8.1.1 Demonstrate courtroom procedures.

8.1.2 Present the results of a glass examination in court effectively.

8.1.3 Describe the legal and ethical obligations of an expert witness.

8.1.4 Describe the admissibility standards set by *Daubert* and *Frye*.

8.2 Reading Assignments

8.2.1 CVs or Statements of Qualifications of other Forensic Scientists.

8.2.2 *Daubert v. Merrill Dow Pharmaceuticals,* 509 U.S. 579 (1993).

8.2.3 *Frye v. United States,* 293 F. 1013 (DC Cir. 1923).

8.2.4 Feder, H.A. and M.M. Houck. *Succeeding as an Expert Witness.* 4th ed. Boca Raton: CRC Press, 2008.

8.2.5 Kogan, J.D. "On Being a Good Expert Witness in a Criminal Case." *Journal of Forensic Sciences* 23.1 (1978): 190-200.

8.2.6 Philipps, K.A. "The Nuts and Bolts of Testifying as a Forensic Scientist." *Journal of Forensic Sciences* 22.2 (1977): 457-463.

8.2.7 Ron Smith and Associates, Inc. "Courtroom Testimony Techniques: Success Instead of Survival." Collinsville, Mississippi.

8.2.8 Tanton, R.L. "Jury Preconceptions and Their Effect on Expert Scientific Testimony." *Journal of Forensic Sciences* 24.3 (1979): 681-691.

8.3 Exercises

8.3.1 Read literature pertaining to this module.

8.3.2 Prepare or update a CV or Statement of Qualifications reflective of experience in glass examination.

8.3.3 Prepare a series of qualifying questions and answers to those questions for use in a voir dire.

8.3.4 Observe pretrial conferences and courtroom testimony of qualified Forensic Scientist, if possible.

8.4 Final Evaluation

8.4.1 Using the mock case from Module 5, successfully complete a moot court or roundtable discussion.

8.4.2 Successfully complete a final competency test covering all of the training materials.

9.0 Records

- Training file
- Training checklist

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original ISO Document
10/18/2013	2	Added issuing authority to header
08/29/2014	3	Updated header to Physical Evidence Section – Trace Unit, issuing authority to Physical Evidence Section Forensic Scientist Manager.
12/11/2015	4	Added NCSCL procedures to reading list as 3.2.2 Changed Trace Evidence Section to Forensic Scientists in the glass discipline in 6.3.1 Changed procedure title to match other procedures in the Unit