Listed below is a summary of stated validation. Additional information can be provided upon request.

Validation Study/Research Project number: **15-001-V**
Validation Study Research Project
Testing Laboratory Section: Trace
Title: Revised GRIM3 Validation

Part 1: Validation Study / Research Project Proposal:
Scope of Project:
The GRIM 3(Glass Refractive Index Measure) is a system that can accurately measure the refractive index of small pieces of glass. The system measures the refractive index, at a particular wavelength, by finding the temperature where the glass and the mounting medium have the same refractive index. This is called the match temperature. This is done by changing the temperature of the oil, which changes the refractive index of the oil, until it matches the refractive index of the glass. There are three silicon oils (A, B, and C) that are used for this purpose that each covers a range of refractive indices (Appendix K). The instrument is to be calibrated using these oils and the Locke glass standards. The Locke standards are a set of glass standards that have known refractive index values. Most glasses fall into the range of Oil B; so this oil is the calibration curve that will be established yearly. A calibration curve for Oil A and/or Oil C will only be established if the glass being tested falls outside the calibrated range of Oil B.
The refractive index values of the glass standards measured at 20°C for the Locke glass standards (B2, B3, B4, B6, B7, B8, and B9) were being used. This method was recommended by the FBI (Buscaglia, J., et.al., 2002). However, the current method used by the FBI and recommended by Foster Freeman uses the values of the Locke glass standards at the match temperature. This is because when the calibration curve is performed the refractive index is obtained at the match temperature not 20°C. This will slightly affect the value of the refractive index and the calibration curve. These differences are outline for all of the glasses (Table 1). The calibration curve using Oil B will be redone using the refractive index of the standards at the match temperature (Foster & Freeman User Manual, pp. 53-60). When the initial validation of the GRIM 3 was completed 2006, Oils A and C were not validated (Engebretson, A, & Koch, J., 2006). The GRIM 3 Oils A, B and C will be calibrated and validated using the Locke standards so that it may be used to test glass that falls in these ranges.
The precision, accuracy, and ruggedness of the method used to determine the refractive index of glass using the GRIM 3 will be validated.
The glass standard used, SRM 1822a, will be validated to establish an acceptable range of refractive index values at 589 nm using the new calibration curve done for Oil B (Fraser, G.T. & Walters, R.L., 2008). This was previously established by NIST but the certification has since expired. The current acceptable range of the RI of this glass was established by examining the refractive index values obtained while the standard was not expired. This was while the GRIM 3 was calibrated

using the refractive index values at 20°C not the match temperature. The acceptable range for this glass standard will be determined using the new calibration curve.

Conclusion

According to the Scientific Working Group for Materials Analysis, the overall precision of the automated method after repeat measurements over the course of five days of the same type of glass at 589nm is +/- 0.00001 (SWGMAT, 2005). Furthermore, the precision observed by the GRIM 3 method with replicated measurements of an optical glass sample is +/- 0.00002, which is classically superior to the measurable variation of a glass object (Bottrell, 2009). Our experimental findings show that the standard operating procedure for the measure of refractive index at match temperature with the GRIM 3 for glasses that fall in the range of Oils A and B is accurate, precise and displays adequate ruggedness and robustness. Therefore, the GRIM 3 is fit for use in the BCA trace evidence section for Oils A and B. In contrast, Oil C cannot be validated. There were no suitable glass samples that fell into the Oil C range in order to test the calibration curves.