



Integrated Forensic Laboratories™

# CONTROLLED SUBSTANCE TESTING CASEFILE REVIEW REPORT

A summary of the findings and recommendations  
from the technical and administrative review of  
St. Paul Police Department Crime Laboratory  
controlled substance case files.

January 31, 2013



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## Introduction and Executive Summary

Integrated Forensic Laboratories, Inc. (IFL) reviewed 100 cases produced by the St Paul Police Department Crime Laboratory (SPPD) for the purpose of identifying possible Type I (false identification) or II (failure to identify) errors on controlled substance identification. Errors were noted in the majority of case files examined, ranging from minor typographical errors to misidentification of a controlled substance. Analysis of controlled substances did not meet minimum standards as recommended by the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG). Substances were identified using methods that were inadequate or blatantly wrong. Chromatograms showed that the instruments were not maintained, were dirty and columns were used long after they should have been discarded. Presumptive color tests, an essential tool in the identification of unknown substances, were rarely used. Extraction methods were not documented and only one GC-MS analysis method was used, indicating a gross lack of understanding of the instruments. Reports greatly overstated the results and the reporting language was not standardized.

It is recommended that the St. Paul Police Department Crime Lab cease operations until a qualified Laboratory Director and Quality Director are hired.

## Background

On September 17, 2012, SPPD transferred scans of 100 controlled substance cases involving instrumentation analysis (GC-MS). Between September and November, IFL personnel reviewed these cases for possible technical and administrative errors.

## Personnel

IFL used four personnel to review the SPPD casework; Ron Fazio, Aliece Watts, Nathanael Stevens and Aubrey Norberg.

Ronald T. Fazio, B.S., M.B.A., F-ABC is the Laboratory Directory (LD) for IFL. He has over 20 years' experience in laboratory science; 15 in criminal forensic science alone. He is experienced and court-qualified in controlled substance identification, blood alcohol content (BAC) testing and quantification, firearm/tool mark examination, impression evidence, and crime scene analysis. Mr. Fazio has worked with, or overseen the work on the following instrumentation; SEM, FTIR, GC-MS, GC-FID, GC-FID-FID, GC-ECD, FAA, ICP, Cold Vapor Mercury, LC, HPLC, and others. Besides his experience in forensic testing, Mr. Fazio is an Adjunct Assistant Professor at the University of North Texas – Health Science Center.



Aliece B. Watts, B.S., M.S., MT (ASCP), PBT (ASCP), F-ABC is Quality Director (QD) for IFL. With over 30 years of laboratory experience and three board certifications (Forensic Biology, Medical Technology and Phlebotomy), Ms. Watts has an extensive background in Forensic DNA and Quality Assurance. She is an experienced ASCLD/LAB International (ISO 17025) assessor and a former member of the Texas Forensic Science Commission, a Governor appointed and Senate approved position. Besides extensive experience of working in crime labs, Ms. Watts is also an experienced college instructor, having taught numerous courses in forensic science.

Nathanael I. Stevens, Ph. D., is the Chemistry section supervisor for IFL. He graduated from the University of South Australia with a Bachelor of Applied Science, a Bachelor of Applied Science (Honors) and a Doctor of Philosophy in Applied Science from the Ian Wark Research Institute. Dr. Stevens has more than ten years of professional experience in many fields of chemistry including minerals, mining, manufacturing, nanotechnology and particle science and forensic science. He has collaborated on numerous interdisciplinary projects as well as military research with the US Army. Dr. Stevens holds several patent and provisional patents as well as several peer-reviewed tier-1 publications. Dr. Stevens has experience with GC-MS, FTIR, GC-FID, SEM, FTIR, ToF-SIMS, AFM, DLS, ICP and other instruments.

Aubrey L. Norberg, F-ABC, is also a founding member of IFL and a Senior Forensic Scientist currently specializing in controlled substance and blood alcohol cases. Additionally, Ms. Norberg is the Crime Scene Director and the Fingerprint section supervisor. She has published several papers in the field of forensic science.

## Findings

IFL reviewed all 100 cases for technical and administrative type errors. The reviews were based on generally accepted scientific principles and Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) working recommendations.

### SWGDRUG GUIDELINES

SWGDRUG outlines the minimum criteria for identifying and reporting controlled substances. SWGDRUG classifies analysis techniques into three Categories; A, B and C. Category A includes the most discriminating techniques such as mass spectrometry, Category B includes less discriminating techniques such as gas chromatography and Category C includes the least discriminating techniques such as color tests. Confirmatory analysis of a controlled substance requires a combination of Category A, B, or C techniques. For example; confirmatory analysis of a controlled substance would require a Category A (mass spectrometry) and a Category B (gas chromatography) or a Category A (mass spectrometry) and a Category C (color test). Failure to achieve positive, controlled results in at least two different Categories



would preclude identification. At most, a Lab would only be able to report a 'tentative' or 'inconclusive' result.

### **COLOR TESTS**

Presumptive tests (SWGDRUG Category C) can also be utilized to give an indication of what the unknown substance may be. The most frequently used presumptive chemistry tests are color change tests. SWGDRUG classifies color tests as a Category C technique, which combined with a Category A technique, qualify as a confirmation of the identity of the substance. Additionally, color tests will provide direction on the appropriate extraction method and instrument method for further analysis. Color tests were rarely used by the Lab.

### **EXTRACTION METHODS**

When unknown controlled substances are analyzed via a GC-MS, they must be first extracted into a suitable solvent. Since different controlled substances are soluble in different solvents, it is crucial the analyst selects an appropriate extraction method. If the incorrect extraction method is used, the controlled substance may not be identified. Extraction methods can range from the simply dissolving the material in a solvent, to complicated derivatization techniques. For example, cocaine base (crack cocaine) can be extracted for analysis by simply dissolving a small amount into chloroform, while cocaine salt should be first dissolved in a base solution, and then extracted into either chloroform, or hexane. GHB must be first derivatized with another chemical, and then extracted into a solvent before analysis on the GC-MS. Extraction methods were rarely identified by the Lab.

### **GAS CHROMATOGRAPHY – MASS SPECTROMETRY (GC-MS)**

Gas chromatography – mass spectroscopy, or GC-MS, is a widely used tool for the analysis and identification of controlled substances. In addition, GC-MS can separate mixtures of substances, common for controlled substances, and subsequently analyze the individual components. The GC-MS is comprised of two different instruments tethered together. The GC (a SWGDRUG Category B technique) separates mixtures of chemicals and records the amount of time they take to pass through the system. The amount of time a particular chemical takes to pass is called the 'retention time' or 'Rt'. By comparing the Rt of a chemical found in a submitted suspected drug, to the Rt of a known chemical, the Category B technique can be achieved. Retention times were rarely compared by the Lab.

The MS (a SWGDRUG Category A technique) takes the chemicals (introduced by the GC) and 'breaks' the molecules via a process called ion fragmentation. The MS then measures the weight and electronic charge of the fragments. From a pattern of the fragments, the analyst can identify the chemical. The chromatograph and mass spectrometry patterns produced by the GC-MS indicate the SPPD instruments were not properly maintained.



The GC-MS is controlled by software that allows many parameters to be changed and stored as different 'methods'. Using different methods allows a chemist to select the one that is most appropriate for the suspected controlled substance. For example, methamphetamine typically has a short retention time and many synthetic cannabinoids have very long retention times. Naturally, it is more efficient to have more than one method to analyze controlled substances. The SPPD Lab used a single method.

## REPORTING LANGUAGE

Standardization of reporting language is critical in the prosecution of individuals for controlled substance charges. Minnesota statutes contain specific language describing the substances, weights and dosage units for controlled substances and the corresponding penalties. Not mirroring the statute language could result in the wrong charges being filed. The Lab did not include language that mirrors statute language.

## Technical

### GC-MS ISSUES

1. GC-MS chromatograms and spectral data printouts were not paired. For example, the data for a sample also had information included on it from another case. This is misleading and could be used to demonstrate false identification, contaminated instrumentation or incompetency in a courtroom. However, it appears that the correct interpretation was transferred to the report. This indicates a lack of understanding of the instrument software.
2. The SWGDRUG minimal requirements for identification were not met on almost all of the cases. As discussed above, the minimum confirmatory identification requirements for a controlled substance requires a Category A result combined with a Category B or a Category C result. In the case of marijuana identification, macroscopic and microscopic identification is required in combination with a color test. GC-MS spectral data was obtained and the mass spectra was compared to library data (Category A), but no standards were run to compare the gas chromatography (no Category B).
3. Quality control on the GC-MS was unsatisfactory. Blanks, crucial to demonstrate that the solvents are not contaminated, were typically not run.
4. When blanks were run, chromatograms indicate that the GC capillary column and the injection port of the GC are most likely contaminated and hence in unsatisfactory condition for analysis. These areas of the instrument need to be clean and chemically inactive for successful analysis.
5. The spectral quality of identified substances frequently did not pass acceptable criteria. When a substance is analyzed on the mass spectrometer, a characteristic ion spectra is obtained. When the instrument is performing at manufacturer's specification, the ion spectra obtained for a substance will be comparable from instrument to instrument, thus allowing the comparison of substances to known references. Ion spectra often had unsatisfactory matches to reference



library data. It was also observed that the range of ions scanned was changed. For instance ions below 50 amu were sometimes excluded. This indicates a lack of understanding of the cause of the poor spectroscopy (likely caused by a poorly maintained MS). The Lab also failed to address any extraneous or missing ions that were visible in a library match but missing from the obtained data. Each ion should have been compared.

6. The chromatography and spectroscopy indicate that the instruments are in very poor operating condition. From examination of the reviewed data it is apparent that the GC-MS was operated with an expired column, dirty ion source and contaminated inlet assembly. Each of these is detrimental to the analysis of a controlled substance. As a result, it is possible that the Lab was unable to identify controlled substances, or even misidentify controlled substances and uncontrolled substances.
7. SPPD does not have sufficient mass spectral libraries to make suitable identifications (i.e. cannot identify acetyl codeine or monoacetylmorphine without using the IUPAC names). This is disconcerting as there are several excellent and free libraries specifically tailored for controlled substance testing.
8. Several reports were issued with unsatisfactory library matches for controlled substances including; methamphetamine, THC, pyrovalerone, thebaine, morphine, codeine and pharmaceuticals.
9. The analysis time on the GC for uncontrolled samples was different than for positive samples, yet the same method of analysis was used. This indicates that the Lab was possibly adjusting the analysis time in the method file, but was unaware of how to create different methods with longer analysis times. It would appear that the Lab did not know how to adjust the solvent delay; hence the detector was unnecessarily exposed, dramatically shortening its operational life.
10. The Lab did not make any indication that an actual comparison was made between the obtained results and the library match. This indicates that the Lab was relying on the software to make the identification, rather than making the interpretation for them.
11. When preparing samples to be analyzed on the GC-MS, most extractions were approximately 10,000 times too concentrated. This shows a very limited knowledge of good chromatography in addition to contributing to problems like *blowback*, where sample contaminates the exhaust system of the injection manifold and can later reenter the system, *shortened filament life*, where the filaments have to ionize many magnitude of molecules than normal causing shorten filament life and rapid contamination of the mass spectrometer components.
12. As discussed above, it is necessary to use different preparation or extraction techniques when preparing controlled substances for analysis on the GC-MS. The SPPD Lab appears to only have one extraction method; however there is no documentation in the case files of what that extraction method is. In addition to this, the Lab did not try and resolve or re-extract samples that were initially identified as containing non-controlled substances. Many illegal drugs require



specialized or multi-step extraction procedures. Hence it is likely that the Lab missed the identification of controlled substances.

13. Some samples of marihuana can be difficult to identify. Microscopic and macroscopic characteristics may be visible observable but a color test (Duquenois-Levine Test for THC) may be negative. If so, it is acceptable under SWGDRUG guidelines to extract THC from the plant material and analyze it on the GC-MS. This was observed in a few cases. However the results were incorrectly reported as 'THC'. With the presence of microscopic identifiers, and THC from the GC-MS, these items should have been reported as 'marihuana'. Another acceptable alternative would have been "containing an unknown amount of marihuana".
14. In some cases, instrumental data indicated the presence of several substances; however the Lab identified only some of the substances. This practice could easily allow a controlled substance to be missed during analysis.
15. In one case, the result was included in the case file but not on the report. Additionally one case file had the results from another case.
16. In one case, the sample number was not transcribed to the GC-MS properly, resulting in an incorrectly labeled result.

#### **WORKSHEET/PRESUMPTIVE ISSUES**

1. In a vast majority of cases, presumptive color tests (SWGDRUG Category C) were generally not performed and Retention Time (Rt) (SWGDRUG Category B) was generally not compared with a known standard. Regardless, the controlled substances were reported as confirmed ("PROVES") with only mass spectroscopy (SWGDRUG Category A). This does not meet SWGDRUG minimum acceptance criteria.
2. SWGDRUG allows for a portion of visually consistent substances or tablets to be tested as representative of the entire group. However, the Lab appears to have randomly selected the number of items to test and did not document how they arrived at the decision.
3. Extraction methods are optimized for specific substances to obtain optimal results. There was no indication of the extraction methods used for GC-MS.
4. Pharmaceuticals were visually identified only (Category B); typically no GC-MS analysis was conducted. Hence these samples were only visually identified, not confirmed.
5. In many cases, the evidence was described as received unsealed with no indication the seal was remediated.
6. Balances used to weigh exhibits were not identified on the worksheet.
7. The SPPD often identified and reported lower penalty group substances while only presumptively identifying controlled substances. This demonstrates little working knowledge of the controlled substance laws in the State of Minnesota.
8. Penalty group ranges allow forensic chemists to conserve resources by testing only those quantities and exhibits that will meet the minimum requirements for the penalty group and range. In many cases, testing was not done to penalty range.



9. In one case, a heroin color test was indicated with a check mark for marquis and a plus sign for sodium nitroprusside. This inconsistency makes it difficult to verify the results were accurately reported. Sodium nitroprusside is a color test for controlled substances such as methamphetamine and MDMA, not for Heroin. This result is a technical error.
10. In some cases, exhibits were reported as dimethyl sulfanone (DMSO – not a controlled substance). DMSO is a common cutting agent for methamphetamine. Therefore, these exhibits may have also contained methamphetamine. Since extraction methods were not included on the worksheets, it is impossible to determine whether methamphetamine was or was not actually in the exhibit.
11. One case had a reported description of “crack cocaine” is not consistent with the color test results. Furthermore, cocaine salt and base cannot be discriminated via GC-MS analysis.
12. One case indicated the Methamphetamine color test result was “?”. There is no explanation or definition for this term. The sample should have been re-tested.
13. In many cases, the evidence description on the report did not match the worksheet. Also, descriptions were subjective and inconsistent. Item descriptions are unclear and items are not adequately sub-numbered. Item descriptions were often incomplete.
14. In one case, an exhibit identified as weighing “trace” was tested while a second exhibit identified as weighing 0.33g was not tested. The exhibit with the greater weight should have been tested.
15. In many cases, writing on worksheets was illegible.
16. In many cases, the measured net weights do not equal the measured gross weights. Occasionally, only gross weights are recorded. The Lab recorded numerous gross and net weights with no explanation of meaning.

#### REPORT/OTHER ISSUES

1. The term “trace” was used repeatedly instead of determining a specific weight. This term should be reported as less than the measureable range that can determine with the equipment at hand. For example, <0.01 g.
2. The term “PROVES” was used repeatedly with only presumptive analysis. This is not a proper, scientific term and, in most cases, does not demonstrate minimum SWGDRUG acceptance standards for identification.
3. Non-controlled substances were not reported consistently. In cases where no controlled substances were identified, the report should clearly state “No controlled substance was detected”.
4. Reporting language was not scientifically sound; terminology did not meet accepted scientific standards and included information that should be left out, i.e. if the evidence was sealed.
5. In one case, a negative result was identified as methylene chloride, a solvent.
6. In one case, Capsaicin (a non-controlled substance) was reported with no supporting GC-MS data.



7. In one case, Wikipedia was used as a technical reference. Only reliable references should be used.
8. In one case, a Post-it note indicated a questionable practice of opening and weighing evidence by someone other than the employee.
9. In many cases, numbering of exhibits is confusing and inconsistent.
10. In at least one case, an exhibit was tested but was not included on the report.
11. The total weight of “numerous pieces” of substance was reported, yet instrumental data indicated that only one ‘piece’ was tested.
12. There was a typographical error in one report. Transcription errors were noted in many reports. This indicates that there is little to no case review prior to issuing reports.

## Administrative

Overall, the case files were found to be excessively complicated and difficult to review.

1. Cursive handwriting is nearly illegible.
  - Recommendation – Cursive handwriting should be avoided. Print is recommended.
2. Item/Exhibit description is confusing.
  - Recommendation – Item/Exhibit descriptions should be simplified and standardized. The use of acronyms (e.g. “pm” for “plant material”) is recommended. Acronyms, if used, should be standardized among all lab staff.
3. The case worksheet does not make clear what has been tested; presumptive or confirmative.
  - Recommendation – Change worksheet to clearly indicate what exhibit and/or sub-exhibit has been tested. ‘Clearly’ means that any competent forensic chemist should be able to interpret the work within a few minutes of review.
4. The reporting language is not scientifically sound and does not meet scientific standards, abbreviations are used in reports
  - Recommendation – Standardized reporting language that is universally adopted
  - Recommendation – Only include relevant information to the results of analysis
5. Reports lack the minimum industry standard documentation
  - Recommendation – Chain of Custody, Client Communication and Peer Review documents must be included in the case file
6. Case file documentation lacks page numbers, employee initials, and initials on corrections
  - Recommendation – Training on industry standard documentation and notation
7. Reports do not accurately represent what was recorded on the worksheet and are inconsistently formatted
  - Recommendation – Standardize formatting, evidence documentation and acronyms



## Conclusions

It is the consensus opinion of the reviewing IFL examiners that the analyses conducted at the St. Paul Police Department Crime Lab did not meet the minimal reporting requirements that are generally accepted by the forensic chemistry community.

The knowledge of the basic functions of the GC-MS and its accompanying software is questionable. There is no indication that there was any maintenance of the GC-MS, essential for instrument performance and reliability. The chromatography data on many cases suggests that the inlet system is contaminated and capillary columns are typically used after they have degraded past acceptable standards. The spectroscopy indicates that the ion source is very dirty and that the instruments are not regularly tuned.

Presumptive color tests were generally not performed on narcotic substances. When color tests were performed, the results were not accurately recorded and were often misused. Every extracted sample was run on the same GC method which also suggests a lack of understanding of how to create methods that are specialized for different families of controlled substances.

Reporting language does not reflect the industry standard for conclusive identification. In addition, reporting language needs to be simplified to clearly relate the information to the reader, especially considering that most readers will be non-scientific (i.e. District Attorneys and Detectives).

Our case review showed the Lab had a severe lack of knowledge and understanding of:

- chemical processes
- industry standards
- instrument maintenance
- standardization
- statutory regulations
- instrument software

Should SPPD decide to pursue training in the area of drug chemistry to a level of acceptable practices, that training must include the topic including:

- Presumptive color tests
- Sampling plans
- Extraction methods
- GC-MS operation and maintenance



- FTIR operation
- SWGDRUG requirements
- GC-MS interpretation
- Reporting requirements
- Competency and proficiency tests (written and practical)
- Testimony training and mock trials

## Recommendations

- IFL recommends that the St. Paul Police Crime Lab Chemistry section cease operations until this training is completed or another acceptable alternative is developed.
- IFL recommends that the GC-MS instruments be serviced before any further analysis is conducted. IFL recommends GMI be contracted to examine the condition of the instruments and make recommendations.
- The Lab did not capitalize on the resources in the forensic community that are readily available to them and demonstrated a lack of understanding of the basics of forensic chemistry and instrumentation.
- It is essential for the operation of the laboratory to hire a technically competent staff, including an experienced Quality Director and Lab Director. These positions are essential for forensic laboratory operation and are required for ASCLD/LAB International Accreditation (ISO).
- IFL does not recommend providing ISO compliant SOPs until SPPD has a technically competent chemistry staff.
- IFL strongly recommends comprehensive retesting of SPPD casework by an accredited forensic controlled substance laboratory. (It is, however, IFL's understanding that retesting is already underway with the State Laboratory)

## Disclaimer

The observations and recommendations included in this report do not constitute an audit of SPPD laboratory operations, but rather an independent review of case files and published laboratory reports. IFL reserves the right to change any of the opinions and recommendations included in this report.



**Signatures**

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