General Instrument Maintenance Protocol

1 Scope

The purpose of this document is to provide definitions and general guidelines for the interpretation of the specific performance monitoring protocol available for each type of instrument. This document applies to personnel using the associated instrument(s)/equipment in Quantico, VA in the following disciplines/categories of testing: Drug chemistry, toxicology, paint, explosives (chemistry), fire debris, and Chemistry Unit general physical and chemical analysis.

2 Principle

Instruments available for the analysis of evidence are purchased from a variety of different manufacturers. All instruments eventually require maintenance, troubleshooting, and repair. Although the user interface and hardware fittings may differ, the overall instrument principles and maintenance are consistent.

This protocol divides instrument maintenance into two categories: Preventative and corrective. Preventative maintenance involves routine monitoring of performance, adjustment of common parameters (e.g., head pressure, solvent degas), and replacement of consumable items (e.g., septa, columns) in order to ensure reproducible and uninterrupted operation. Corrective maintenance may be required when poor performance is observed or the instrument fails to operate properly.

All performance monitoring protocols are based upon manufacturer’s recommendations. Users are encouraged to refer to the manufacturer's instrument manuals for more information on maintenance and troubleshooting. Users will be familiar with the operation of the instrument as described in the manual(s), specific instrument performance monitoring protocols, appropriate discipline SOPs and receive training from instrument support personnel, a trained operator, and/or the instrument manufacturer before operating such equipment.

The maintenance and operating procedures are categorized by how often they will be performed (daily, monthly, and/or as needed) to insure the integrity of the system. These terms are approximate time intervals, based on instrument use, and allow for weekends and other periods of instrument inactivity. The term ‘daily’ refers to each day the instrument is used for analysis. The term ‘monthly’ refers to each calendar month, not to exceed 45 calendar days from the previous month’s date of maintenance. The term 'as needed' refers to maintenance that is to be performed based on system performance or major interruptions in service. If other intervals will be followed, they will be specified in the applicable SOP.

3 Equipment/Materials/Reagents

Any materials (such as pump oil and solvents) and all replacement parts will meet manufacturer's specifications and recommendations. Manufacturer's instrument manuals and specific performance monitoring protocols are generally the best source for this information. Note that performance monitoring protocols refer to the manufacturer's name at the time of installation. Refer to the appropriate instrument support personnel for updated contact information for instrument parts, documentation, and service.

4 Standards and Controls

All standards, solutions, and mobile phases required are specified in the appropriate SOP.

5 Calibration

Any procedures used to calibrate and/or verify the integrity of the instrument will be specified in the appropriate SOP. Instruments that are calibrated by an outside vendor, such as pipettes and micrometers, are tracked in the Forensic Advantage (FA) Resource Manager (RM).

6 Sampling or Sample Selection

Not applicable.

7 Abbreviations and Definitions

a. SOP - Standard Operating Procedure. Interchangeably used in place of Performance Monitoring Protocol.
b. QA/QC - Quality Assurance/Quality Control
c. IOSS - Instrument Operation and Systems Support
d. CU - Chemistry Unit
e. Daily, Monthly, Yearly, As Needed - refer to Principle section
f. Manufacturer's Instrument Manual(s) - paper or electronic instrument documentation provided by the manufacturer.
g. Tuning - adjusting parameters (e.g., lens voltages) to maximize instrument performance
h. Calibration - correcting instrument responses to a known value (e.g., mass correction performed on a Time-of-Flight mass spectrometer).
i. GC - Gas Chromatograph(y). Refer to the "Gas Chromatograph General Maintenance Protocol" for GC-specific maintenance, and troubleshooting.
j. LC - Liquid Chromatograph(y). Refer to the "Liquid Chromatograph General Maintenance Protocol" for LC-specific maintenance, and troubleshooting.
k. HPLC - High Performance Liquid Chromatography (used synonymously with LC above).
l. MS - Mass Spectrometer (Spectrometry). Refer to the "Mass Spectrometer General

Maintenance Protocol" for MS-specific abbreviations, theory, maintenance, and troubleshooting.

m. TOF - Time-of-Flight (Mass Spectrometer, Spectrometry)
n. FTIR - Fourier Transform Infrared (Spectrophotometer, Spectrophotometry)
o. ATR - Attenuated Total Reflectance (FTIR Accessory, Objective)
p. UV-Vis - Ultraviolet-Visible (Light Source, Spectrophotometer)
q. SNR - Signal to Noise Ratio (SNR). A comparison of the electronic response of an analyte to the baseline noise.
r. Peak - A detector response that rises above the observed baseline. A response is considered a peak if it has a minimum SNR of 3:1.
s. Chromatogram – the detector response chart generated by a chromatographic instrument, generally plotted as response versus time.
t. Performance Standard/Testmix – a standard, known chemical or mixture of chemicals used to test the performance of an instrument.
u. Operator - a chemist trained to use the instrumentation.
v. NIST - National Institute of Standards and Technology
w. TIC - Total Ion Chromatogram
x. RIC - Reconstructed Ion Chromatogram
y. EI - Electron Impact (Ionization)
z. Profile/Continuum - Mass spectrometer data collected continuously without centroiding
aa. Centroid - Centered, non-continuous mass spectrometer data.
bb. m/z - Mass-to-Charge Ratio
cc. Unit-Mass - refers to the mass resolution of a standard quadrupole or ion trap mass spectrometer
dd. Accurate Mass - refers to the mass accuracy of a high-resolution mass spectrometer such as a Time-of-Flight (TOF)
ee. MCP - Micro Channel Plate
ff. RMS - Root Mean Square
gg. RSD - Relative Standard Deviation

8 Procedures

8.1 Performance Monitoring

The purpose of the performance monitoring protocols is to verify and track reproducibility, quality, accuracy, and reliability of instrument operation and generated data from analysis to analysis, day to day, and year to year. This includes recording specific instrument parameters and performing and recording specific tasks. This information is then available to track instrument performance patterns or to be used in court. These tasks are outlined under the 'Procedures' section of the performance monitoring protocols.

8.2 Preventative Maintenance

In order to prevent instrument downtime and casework delays, certain maintenance tasks will be required to be performed on a routine, predetermined schedule - daily, monthly, or yearly. These tasks will usually involve replacing parts before they cause problems. They are outlined under the 'Procedures' section of the performance monitoring protocols.

Each type and model of an instrument may have different, specialized components requiring specific preventative maintenance. Suggested step-by-step directions for specific maintenance procedures may be found in the manufacturer's instrument manuals. When performed, all preventative maintenance will be entered into the appropriate QA/QC log.

8.3 Corrective Maintenance

Evidence of poor performance or instrument malfunction should indicate to the operator to take corrective measures. There are some things the operator may try before contacting appropriate instrument support personnel to resolve the issue, depending on their level of training and comfort. Tips on general troubleshooting are provided by appropriate instrument support personnel, and can be found in the main instrument room. In addition, the operator may consult the manufacturer's instrument manual. If the operator is still unable to correct the problem, they can contact appropriate instrument support personnel by submitting a request for repair. All corrective maintenance will be entered into the appropriate QA/QC log.

8.3.1 Poor Performance

The necessity for maintenance will occur when the instrument fails to meet protocol decision criteria specifications or if other poor performance, such as a loss of sensitivity, is observed. Follow the above requirement in 8.3.

8.3.2 Instrument Malfunction

In the event of an instrument malfunction such as hardware or software failure that cannot be resolved by the above requirement in 8.3, appropriate instrument support personnel will contact the instrument manufacturer’s service representative.

8.4 Records

Any instrument logsheets and logbooks referred to in the 'Procedures' section of each SOP can be either paper or electronic format. Any example QA/QC logs and printouts are for reference only and may differ in appearance and form from the actual records generated.

a. All instruments that have a series of performance checks (such as daily or monthly) will have a QA/QC log. The operator will enter the appropriate information required by the SOP 'Procedures' section.

b. Upon completion and passing of all checks, the operator will print the necessary

reports and initial each page. If multiple pages are stapled together, only the first page needs to be initialed. The printout(s) will be placed in the three-ring QA/QC binder in the appropriate section(s).

c. The operator will record sample types, problems, pass/fail, maintenance, and comments in the QA/QC log, as appropriate.

9 Instrumental Conditions

Any parameters required to monitor the performance of an instrument will be specified in the appropriate SOP.

9.1 Minor Modifications

Some of the instrumental conditions referenced in the 'Instrument Conditions' section of an SOP may be slightly modified to obtain optimum instrument performance on a specific instrument. Any minor modifications to a performance monitoring protocol will require the approval of the IOSS Manager or appropriate instrument support personnel. The modification and its approval will be recorded in the instrument QA/QC log.

10 Decision Criteria

Every performance monitoring protocol will have specific decision criteria to determine if the instrument is operating properly. If these should fail, refer to the 'Corrective Maintenance' section of this protocol in conjunction with the instrument-specific SOP.

11 Calculations

Not applicable.

12 Measurement Uncertainty

Not applicable.

13 Limitations

Only properly trained personnel will perform duties involved in the operation, maintenance, or troubleshooting of this instrument. Instrument-specific limitations will be specified in the appropriate SOP.

14 Safety

Take standard precautions for the handling of all chemicals, reagents, and standards. Refer to the *FBI Laboratory Safety Manual* for the proper handling and disposal of all chemicals. Personal protective equipment should be used when handling any chemical and when performing any type of analysis. Many instrument components are held at temperatures of 250°C and higher. Precautions should be taken to prevent the contact of skin with heated surfaces and areas.

15 References

Instrument Operation and Systems Support SOP Manual.

Manufacturer's Instrument Manuals for the specific models and accessories used.

"Gas Chromatograph General Maintenance Protocol" (Inst 002) *Instrument Operation and System Support SOP Manual.*

"Liquid Chromatograph General Maintenance Protocol" (Inst 003) *Instrument Operation and Systems Support SOP Manual.*

"Mass Spectrometer General Maintenance Protocol" (Inst 004) *Instrument Operation and Systems Support SOP Manual.*

FBI Laboratory Safety Manual.

FBI Laboratory Quality Assurance Manual.

FBI Laboratory Operations Manual.

Rev. #	Issue Date	History
0	06/21/06	New document that replaces original which was titled "General Instrument Maintenance Protocol."
1	05/01/08	Updated ‘daily’ and ‘monthly’ descriptions in Section 2, and removed reference to green logbooks in Section 8.4c. Added information regarding calibration by outside vendors to Section 5. Corrected numbering error in Sections 14 and 15.
2	10/04/18	Changed title from ‘Policy’ to ‘Protocol’. Updated Section 1 Scope to include applicable disciplines/categories of testing. Added FA RM to Section 5. Updated heading in Section 6. Updated abbreviation for IOSS in Sections 7, 15, and header. Changed IOSS to ‘appropriate instrument support personnel’ in Sections 3, 8.3, 8.3.2 and 9.1. Clarified stapling of pages in Section 8.4 b. Changed Section 9.1 to ‘minor modifications’ to a performance monitoring protocols’ for clarity.

Approval

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General Chemistry
Technical Leader: Date: 09/28/2018

Toxicology
Technical Leader: Date: 09/28/2018

Metallurgy
Technical Leader: Date: 09/28/2018

Paints and Polymers
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