

General Instrument Performance Monitoring and Maintenance

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1 INTRODUCTION

The purpose of this document is to provide additional definitions and general guidelines for the interpretation of the specific Instrument Operation and Systems Support (IOSS) technical procedures available for each type of instrument.

Instrument systems used for the analysis of evidence are purchased from a variety of different manufacturers. In addition to performance monitoring, 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 document 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.

Individual performance monitoring and maintenance procedures are based upon instrument support personnel experience, service engineer suggestions, and manufacturer's recommendations, in addition to discipline/subdiscipline needs and requirements. Users will be familiar with the operation of the instrument, specific instrument performance monitoring and maintenance procedures, appropriate discipline/subdiscipline technical procedures, and receive training from instrument support personnel, a trained operator, and/or the instrument manufacturer before operating such equipment. Manufacturer's instrument manuals may be used as reference materials for diagrams and descriptions helpful in performing maintenance and troubleshooting when needed, but they are not used for specific procedures and are therefore not controlled documents.

Procedures are categorized by how often they will be performed (e.g., daily, monthly, annually and/or as needed) to ensure 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. See the 'Definitions and Abbreviations' Section for more information. If other intervals will be followed, they will be specified in the applicable procedure.

2 SCOPE

This document applies to personnel operating, maintaining and/or servicing the associated instrument(s)/equipment used in the following disciplines/subdisciplines: General Chemistry, Explosives Chemistry, Fire Debris, Metallurgy, Paints and Polymers, Seized Drugs, and Toxicology.

3 EQUIPMENT

- Equipment
 - Instrument systems are listed in individual IOSS instrument performance monitoring and maintenance procedures.

- Materials
 - Specific materials required are listed in individual IOSS instrument performance monitoring and maintenance procedures.

4 STANDARDS AND CONTROLS

All standards, solutions, and mobile phases required are specified in the appropriate IOSS and/or discipline/subdiscipline technical procedures.

5 ABBREVIATIONS AND DEFINITIONS

- Maintenance Intervals
 - Daily - refers to each day the instrument is used for analyses.
 - Monthly - refers to each calendar month the instrument is used, not to exceed 45 calendar days from the previous month the instrument was used or maintained.
 - Yearly/Annual - refers to each calendar year the instrument is used, not to exceed 380 calendar days from the previous year the instrument was used or maintained.
 - As-Needed - refers to maintenance that is to be performed based on system performance or major interruptions in service.
- Commonly Used Terms
 - IOSS - Instrument Operation and Systems Support
 - RSU – Research and Support Unit
 - CU - Chemistry Unit
 - EU – Explosives Unit
 - TEU – Trace Evidence Unit
 - FTU – Firearms and Toolmarks Unit
 - LD – Laboratory Division
 - Tuning - adjusting parameters (e.g., lens voltages) to maximize instrument performance
 - Calibration - the adjusting or standardizing of equipment to ensure agreement of a measurement with a reference standard (e.g., mass correction performed on a Time-of-Flight mass spectrometer)
 - GC – Gas Chromatography
 - LC - Liquid Chromatograph(y)
 - HPLC - High Performance (or High Pressure) Liquid Chromatography (also used synonymously with LC above)
 - UPLC – Ultra-High Performance (or Ultra-High Pressure) Liquid Chromatography (also used synonymously with LC above)
 - MS - Mass Spectrometer (Spectrometry)
 - MSD – Term commonly used by Agilent to describe their “Mass Selective Detector” single-quadrupole MS.
 - TOF - Time-of-Flight (Mass Spectrometer, Spectrometry)
 - FTIR - Fourier Transform Infrared (Spectrophotometer, Spectrophotometry)
 - ATR - Attenuated Total Reflectance (FTIR Accessory, Objective)
 - UV-Vis - Ultraviolet-Visible (Light Source, Spectrophotometer)

- SNR - Signal to Noise Ratio (SNR). A comparison of the electronic response of an analyte to the baseline noise
- Peak - A detector response that rises above the observed baseline. Multiple criteria are required to consider a response a peak, including a minimum SNR of 3:1
- Chromatogram - the detector response chart generated by a chromatographic instrument, generally plotted as response versus time
- Testmix/Performance Verification Standard - a standard, known chemical or mixture of chemicals used to test the performance of an instrument
- Operator - a discipline/subdiscipline chemist trained to use the specific system(s)
- NIST - National Institute of Standards and Technology
- TIC - Total Ion Chromatogram
- EIC – Extracted Ion Chromatogram
- RIC - Reconstructed Ion Chromatogram
- EI - Electron Impact (Ionization)
- CI – Chemical Ionization
- Profile/Continuum - Mass spectrometer data collected continuously without centroiding
- Centroid - Centered, non-continuous mass spectrometer data
- m/z - Mass-to-Charge Ratio
- Unit-Mass - refers to the mass resolution of a standard quadrupole or ion trap mass spectrometer
- MCP - Micro Channel Plate
- RMS - Root Mean Square
- RSD - Relative Standard Deviation

6 PROCEDURE

6.1 Performance Monitoring

The purpose of the performance monitoring portion of a procedure 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 'Procedure' section of the IOSS instrument performance monitoring and maintenance technical procedures.

6.2 Preventative Maintenance

In order to prevent instrument downtime and casework delays, certain maintenance are required to be performed on a routine schedule (daily, monthly, or yearly) or as-needed based on instrument performance monitoring. If other intervals will be followed, they will be specified in the applicable procedure. These tasks will usually involve replacing parts before they fail. Tasks are outlined under the 'Procedure' section of the IOSS instrument performance monitoring and maintenance technical procedures.

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Each type and model of an instrument may have different, specialized components requiring specific preventative maintenance. When performed, all preventative maintenance will be entered in the appropriate maintenance log.

6.3 Corrective Maintenance

Evidence of poor performance or instrument malfunction indicates to the operator to notify the appropriate instrument support personnel so they can perform corrective maintenance. 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. All corrective maintenance will be entered into the appropriate maintenance log.

6.3.1 Poor Performance

The necessity for maintenance will occur when the instrument fails to meet procedure 'Acceptance Criteria' specifications or if other poor performance, such as a loss of sensitivity, is observed. Follow the above requirement the 'Corrective Maintenance' section.

6.3.2 Instrument Malfunction

In the event of an instrument malfunction such as hardware or software failure that cannot be resolved in-house, appropriate instrument support personnel will contact the instrument manufacturer's service representative.

6.4 Records

Any instrument logs referred to in each procedure can be either paper or electronic format.

- A. All instruments that have a series of performance checks (such as daily, monthly and/or yearly) will have a log maintained by the specific Unit. The operator will enter the appropriate information required in the procedure.
- 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 binder maintained by the specific Unit. Optionally, the Unit may elect to generate and store printouts saved to PDF or other universal format. These electronic files should be saved to a common folder and named with necessarily identifying information, including the date collected and operator.
- C. The operator will record sample types, problems, pass/fail, maintenance, and comments in the appropriate log.

7 INSTRUMENTAL CONDITIONS

Any parameters required to monitor the performance of an instrument will be specified in the appropriate IOSS performance monitoring and maintenance procedure, which may refer to a discipline/subdiscipline technical procedure if appropriate.

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8 ACCEPTANCE CRITERIA

IOSS performance monitoring and maintenance procedures will have specific acceptance criteria to determine if the instrument is operating properly. If these should fail, refer to the 'Corrective Maintenance' section of this procedure in conjunction with the instrument-specific document.

9 LIMITATIONS

Only properly trained personnel will perform duties involved in instrument operation, maintenance, or troubleshooting. The end user is responsible for fulfilling the requirements of individual instrument technical procedures. Maintenance may also be performed by an instrument manufacturer's qualified service engineer and will be supervised by appropriate instrument support personnel or designee. Any instrument-specific limitations will be specified in the individual procedure.

10 SAFETY

Take standard precautions for the handling of all chemicals, reagents, and standards. Refer to the appropriate Laboratory Division safety documents for 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.

11 REVISION HISTORY

Revision	Issued	Changes
02	10/04/2018	Section 1- Updated scope to include applicable disciplines/categories of testing. Section 5- Added FA RM. Section 6- Updated heading. Section 8- Clarified stapling of pages. Section 9- Changed 9.1 to 'minor modifications' for clarity. Updated to 'Instrument Operation and Systems Support' throughout. Updated from IOSS to 'appropriate instrument support personnel' throughout.
03	09/30/2022	Revised to match new format requirements. Section 5- Added maintenance intervals and updated definitions.