QAM-Q-103

Laboratory Equipment Maintenance

Revision 17

Approval:

Laboratory Manager — Date: 7-17-20

Concurrence — Date: 7.17.2020

Effective date: 7-31-20 (7-17-20 Errata)

Renewal date: 9-30-21 for 7-31-21, 8-3-22 for 7-31-22, 7-26-23 — Initials: JDM, DMH, JDM

Texas Institute for Applied Environmental Research

1. **Applicability and Purpose**
   This procedure applies to all equipment of the laboratory at the Texas Institute for Applied Environmental Research (TIAER), Tarleton State University, Stephenville, Texas. The purpose of this procedure is to ensure proper general maintenance and upkeep of laboratory equipment. Maintaining equipment in good working order is essential for production of high quality data within a laboratory. Specific instrument maintenance and troubleshooting are found in individual equipment manuals. A list of approved manuals and references are found in the Quality Assurance Manual (QAM-Q-100).

2. **Definitions**
   Maintenance: functions or actions required to ensure the proper working order of a piece of equipment. These actions include, but are not limited to, cleaning, minor repairs, changes of tubing, lubricants and other consumable parts, checks for damaged or worn components, and protective measures. Documentation of maintenance by approved vendors is also performed.

3. **Equipment, Reagents and Standards**
   Individually specific to procedures (see other QAMs/SOPs)

4. **Procedure**
   4.1. The Laboratory Manager (LM) or designee is responsible for periodic review and issuance of updated maintenance schedule assignments per the Maintenance Logbook format (Attachment 1, Q-103-1). This states what actions are to be taken at what time and by whom to maintain equipment. This log is currently an electronic log.
   4.2. Laboratory personnel are responsible for adhering to the routine maintenance schedule and carrying out other special maintenance tasks as required by the LM and QAMs/SOPs. Individual analysts are responsible for following instrument and chemistry analytical SOPs and/or the manufacturer's recommendations and manuals on proper maintenance of equipment to which they have been assigned. Analysts initial the Maintenance Log (Attachment 1, Q-103-1, Example

Maintenance Log) when the assigned task is complete and notify the LM of any failures or issues.

4.3. Temperatures of ovens, refrigerators, furnaces, incubators and other equipment are checked daily when in use and recorded in the Equipment Temperature Logbook (Attachment 2, Q-103-2), which is an electronic log (E-log). Analysts ensure thermometer and thermocouple correction factors are applied and listed, if applicable, in accordance with QAM-I-118. Some equipment have maximum/minimum temperature designations to be read and recorded from an electronic, NIST traceable thermometer or calibrated thermocouple device with data logger. In these cases, limits are reset periodically and recorded. An example is where samples are stored over the weekend in a refrigerator on days when no one is working. The max/min are reset on Friday and recorded the following working day to cover the time period not read daily.

4.4. Bacteria incubators with multiple shelves will have the temperature of at least the top and bottom shelf recorded twice daily, at least 4 hours apart, on days that the equipment is in use.

4.5. DI water conductivity is monitored daily when in use, and documented in the Specific Conductivity Logbook, C-113-1.

4.6. Maintenance activities, including changing of tubing, lines, light sources, filters, parts and any adjustments to instruments or equipment are recorded, initialed and dated in the Maintenance Logbook (Attachment 1, Q-103-1) in the comments section. Specific instrument QAMs also have assigned logbooks for maintenance documentation. If work is performed by an outside vendor, this is noted also. Any paperwork completed by the vendor is kept in the Laboratory Manager's files organized by folders for individual equipment.

4.7. If work performed affects calibrations or settings, this is also recorded in the Maintenance Logbook (Attachment 1, Q-103-1) comments section or appropriate instrument logbook. Followup calibration or checks are performed in accordance with the appropriate SOP for the specific equipment.

4.8. Backup parts and supplies are kept on hand for all instruments and equipment where possible and practical.

4.9. The laboratory maintains a good selection of tools appropriate for equipment maintenance.

4.10. Prior to placing a new method with new or existing associated equipment into service, a Demonstration of Performance (DOP) is performed in accordance with QAM-Q-101, “Laboratory Quality Control” and documented in the DOP logbook, Attachment 3, Q-103-3. Analyst performance of a method new to them are also documented in accordance with QAM-Q-107, “Laboratory Personnel Training.”

4.11. Volume checks are performed on each lot of glassware and disposable labware used in volumetric measurements, except for Class A glassware with an NIST tracebility certificate on file. See QAM-I-118 for this procedure.

4.12. All media used for microbiology will have the pH verified before first use.

4.13. See SOP-C-124 and C-114 for further sterility determination requirements of each lot of labware used in bacteria determination.

4.14. If any equipment is taken or used out of the main laboratory (i.e. in the mobile lab or another building) and cannot be calibrated or calibration checked under routine maintenance methods, the equipment is checked immediately upon return to the main laboratory. A CAR is written if maintenance schedules have been exceeded or the equipment fails the check. The LM is also notified in writing by email immediately.

5. **Quality Control and Safety Aspects**

5.1. Equipment maintenance is performed in accordance with this procedure and under the guidelines established in QAM-Q-101, "Laboratory Quality Control", QAM-S-101, "Laboratory Safety" and QAM-W-1 “Laboratory Waste” for quality, safety and pollution prevention. This QAM is to be used in conjunction with the equipment monitoring guidelines in other individual procedures. Equipment that fails calibration or maintenance checks is taken out of service until repaired or passing. Equipment failures are documented with a Corrective Action Report. Temperature controlled equipment, such as refrigerators and incubators, should be demonstrated to be passing as soon as possible after a failure.

5.2. Due to the more complex nature of maintenance requirements, certain instruments, including the autoanalyzer and alpha spectrometer, may each have their own maintenance logbooks. Maintenance and repairs for these instruments are not recorded in the general Maintenance Logbook of this procedure, but are noted in accordance with the QAMs for these instruments. Ensure that any maintenance performed is recorded in the appropriate logbook.
5.3. DOPs are further described or required by analytical SOPs.
5.4. Routine maintenance checks that do not alter equipment need not be recorded in the Maintenance Logbook, but may be logged in other logbooks. Any replaced parts, adjustments, tubing, etc. are be logged in the Maintenance Logbook.
5.5. No unauthorized maintenance or repair is performed on any instrument. Permission of the LM is obtained prior to performing any nonroutine equipment maintenance.
5.6. Safe use of tools, electricity and chemicals is observed at all times in maintenance of laboratory equipment.
5.7. Radioactive equipment and supplies are only handled or maintained by personnel authorized and trained to use them. The Radiation Safety Officer is responsible for oversight and training for radiochemistry operations.
5.8. Record all filter and bottle preservation preparations in the Equipment Preparation Log (Q-103-4, attachment 4) with appropriate lot numbers, dates, initials, etc. as listed.

6. References

6.1. Good Laboratory Practice Standards, ed. by Willa Y. Garner, et al., American Chemical Society, Washington, D.C., 1992
6.2. Standard Methods for the Examination of Water and Wastewater, most current approved edition, ed. by A. E. Greenberg, et al., APHA, AWWA, Washington, D.C.
6.3. Code of Federal Regulations, Title 40, Part 160: Good Laboratory Practice Standards, National Archives, most recent edition.
6.4. National Environmental Laboratory Accreditation Conference (NELAC) standard, 2016, The NELAC Institute (TNI).
6.5. TIAER Laboratory QAM and SOP manuals.

7. **Attachments**
   7.1. Example Maintenance Logbook, Q-103-1
   7.2. Example Equipment Temperature Logbook, Q-103-2
   7.3. Example Demonstration of Performance Logbook, Q-103-3
   7.4. Example Equipment Prep Log, Q-103-4
   7.5. Example Glassware and Equipment Transfer Log

Attachment 1
Example Maintenance Logbook

Maintenance Logbook																															
Month_____																															
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Daily																															
Deionized Water Check																															
Balance Calib. Checks																															
Temperature Checks																															
Weekly																															
Vac. Pumps: Clean & Oil																															
Pipettors: Clean & Oil																															
Dessicators																															
pH probe filled & soaking																															
Waste Barrel Check																															
Reset thermometer max/min																															
Monthly																															
Thermometer expiration check																															
Autoanalyzers maintenance																															
Backup Data																															
TP TKN Block Digestors																															
Clean Vent Hoods																															
Clean Computers																															
Generator maintenance-Mobile																															
UV-Vis check & clean																															
Balance Wt. Expiration Dates																															
Standard Report																															
SOPs/training up to date																															
Clean vacuum pumps w/ solvent																															
SOP revision secondary review																															
DO probe maintenance																															
Equipment Temperature Log/Elog Review																															
Pick Up Maintanance																															
Air Quality Check																															
Bacteria Duplicate Count																															
LQAO 10% ESDMS Data Review																															
LQAO Audit Reports																															
Quarterly																															
1 point Pipetter/Volumetric Equip. Calib check																															
Autoclave timer check																															
Annual																															
Thermometer calibration check																															
Calibrate Block Digestors																															
NIST thermometer certification																															
Balances & weight certifications																															
Autoclave pressure/Therm. calibration																															
Autoclave thermom. calib.																															
Pipetter/ Volumetric Equip. Calib. Check																															
Inhibitory residue testing																															
Determination of Uncertainty																															
LOD Study																															
Other																															

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Attachment 1
Example Maintenance Logbook Activities Descriptions

Daily:

Deionized Water Check—Calibrate C-1 with 0.01 M KCl and test DI water. See SOP-C-113.

Balance Calib. Checks—Test balances with an NIST traceable weight. See QAM-I-101.

Temperature Checks—Check and record the temperature of all in-use equipment (Refrigerators, ovens, incubators, etc.) See QAM-Q-103.

Weekly:

Vac. Pumps: Clean & Oil—Fill oil reservoirs on vacuum pumps. Clean with solvent bimonthly (or monthly during periods of heavy use).

Pipettors: Clean & Oil—clean vacuum chamber and plunger; oil plunger and seals of pipettors that are able to be disassembled. Note in comments which pipetters are done.

Dessicators—check and replace desiccant as necessary based on indicator color.

pH probe filled & soaking—pH probe is filled (with probe solution, if low), closed, and soaking in pH 4 buffer.

Waste Barrel Check—check waste barrel and other waste containers for leaks, tightly closed lids, and general cleanliness.

Reset thermometer max/min—On Fridays or days before lab closures, maximum/ minimum records reset on thermometers for checking next open day

Monthly:

Thermometer expiration check—check all thermometers for short expiration dates.

Autoanalyzers maintenance—Clean wash reservoir; wipe platens and rollers.

Backup Data—remove run data from autoanalyzer and UV-vis computers and store on TIAER server

TP/TKN Block Digestors—wipe surfaces, remove debris from block.

Clean Vent Hoods—wipe down counter top and walls. Remove unused equipment.

Clean Computers—dust keyboards and vents on all computers.

Generator maintenance—**Mobile**—Run generator for 30 minutes to an hour. Check general condition and tires for flats. Drain water from separator.

UV-Vis check & clean—clean flow cell with cleaning solution. Wipe down surfaces.

Balance Wt. Expiration Dates—check balance weights for short expiration dates.

Standard Report—take inventory of all reagents and standards and consumable supplies that have short expiration dates.

SOPs and Training Up to Date-Checked by the LM/LQAO and updated training matrix posted.

Clean vacuum pumps w/ solvent- cycle through a solvent (trichloroethylene) in a hood. Clean canisters and filters with the solvent. Run dry until solvent has been adequately evaporated.

SOP revision secondary review- Review effective dates of SOPs to check for those that are coming due and notify LM. Review SOPs for temporary changes that have not been included in the next revision.

D.O. Probe membrane- scuff gold surface of probe, change membrane and fill membrane solution.

Security Camera Check—On Monday, or first weekday, video data is removed and reviewed from the motion sensor cameras.

Equipment Temperature Log / Elog Review—A review of the Equipment Temperature Log for errors in data entry, correction factors, etc. All E-logs are checked to verify that all calculation cells are locked.

Pick Up Maintenance—Start and run pick up for at least 30 minutes. Check general condition and tires for flats.

LQAO 10% ESDMS Data Review—LQAO reviews 10% of data for errors.

LQAO Audit Reports—LQAO will complete all audit reports that are due for that month.

Tray Sealer Check—Check the IDEXX tray sealer for leaks and cracks

Air Quality Check—Test air quality with appropriate microbial test.

Bacteria Duplicate Count—Duplicate the count of one tray or filter for each bacteria analysis.

Quarterly

1 Pt. Pipetter/Volumetric equipment calibration check—check calibration of pipetters and non-class A graduated or volumetric containers. See QAM-I-117.

Autoclave Timer Check— Check the autoclave timer against a stop watch per QAM -I-110.

Radioactive Inventory—Take an inventory of Radioactive Materials

Annual:

Thermometer calibration check—check thermometers against NIST traceable thermometer. See QAM-I-118.

Calibrate Block Digestors—check calibration of block digestors. See QAM-I-107.

NIST thermometer certification—recertify or order new NIST traceable thermometer.

Balances & weight certifications—arrange for calibration of balances. Recertify or order new weights.

Pipetter/Volumetric Equipment Calibration check- single or multipoint, depending on the pipetter used. See I-117 for instructions.

Autoclave Pressure/Thermometer Calibration—Calibrate the autoclave pressure gauge. Will be performed by an outside party.

Inhibitory Residue Test- check of bacteria glassware washing method and sent to outside lab (C-124).

Determination of Uncertainty—Perform a determiniation of uncertainty for all microbiological analyses. See SOP-C-114 and SOP-C-124.

LOD Study—Perform 7 replicates of a standard that is 2-3 times the current LOD for the determination of an updated LOD.

Radioactive Inventory and Review of RADChem Program—RSO will inventory Radiochemicals and review the RADChem program.

pH DOP—Perform a DOP of the pH meter

Attachment 2
Equipment Temperature Logbook (Example)

Equipment Temperature Logbook

Correction Factor y=0.02x-0.5

Start Date	Start Time	End Date	End Time	Equipment ID	Thermometer or Thermocouple ID	Max °C observed	Max °C corrected	Min °C Observed	Min °C corrected	Initials	Pass/Fail & Comments
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		
				R6-R	T-119		-0.5		-0.5		

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Data review:

Review Date:

LM log edit: mm 3/5/2016

Log QA check:

Attachment 3
Example Demonstration of Performance Logbook

Demonstration of Performance (DOP) Logbook							
For analytical methods and equipment used							
Date	Time	Analyst	QAM/ SOP # Method Reference	Equipment ID/Model/ Serial #	Description of Performance Evaluation	Results	LM/LQAO approval and date

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Attachment 4 Examples of Equipment Prep Logs

TSS GLASS FIBER FILTER RINSE

DATE	INITIALS	Manufacturer/ LOT #	Approx. Vol DI water used in x3 rinses	Pan ID	Date/time in oven 103-105C	Date/time in furnace 500-550C	COMMENTS	QA REVIEW	QA REVIEW DATE
11/30/2015	tc	Whatman, Lot#: 9597961	60mL	X	12/1/2015 @ 13:22	n/a	filters 1-7		
12/9/2015	am/vsh	Whatman, Lot#: 9597961	60mL	T	12/9/2015@12:12	n/a	filters 1-25/ vsh training am		
12/9/2015	am/vsh	Whatman, Lot#: 9597961	60mL	M	12/9/2015@14:20	n/a	filters 1-25/ vsh training am		
1/4/2016	am/vsh	Whatman, Lot#: 9633953	60mL	Z	1/4/2016@10:15	n/a	filters 1-25/ vsh training am		
1/22/2016	am/vsh	Whatman, Lot#: 9633953	60mL	H	1/22/2016@9:55	n/a	filters 1-25/ vsh training am		
1/22/2016	vsh/jas	Whatman, Lot#: 9633953	60mL	E	1/22/16/1500	n/a	filters 1-25/ vsh training jas		
1/22/2016	vsh/jas	Whatman, Lot#: 9633953	60mL	J	1/22/2016/1330	n/a	filters 1-25/ vsh training jas		
1/22/2016	vsh/jas	Whatman, Lot#: 9633953	60mL	X	1/22/16/1400	n/a	filters 1-25/ vsh training jas		
						n/a			
						n/a			

NITROCELLULOSE 0.45Um FILTER PREP (RINSE/SOAK)

DATE	INITIALS	Manufacturer/ LOT #	# filters	1st START TIME	1st END TIME	vol. DI	2nd START TIME	2nd END TIME	vol. DI	FILTER BATCH ID	COMMENTS	QA REVIEW	QA REVIEW DATE
12/1/2015	vsh	Merck Millipore/R5BA71058	50	11:35	12:35	2000mL	12:37	15:40	2000mL	120115a			
12/1/2015	vsh	Merck Millipore/R5BA71058	50	11:45	12:45	2000mL	12:51	15:58	2000mL	120115b			
1/5/2016	vsh	Merck Millipore/R5BA71058	50	8:45	9:45	2000mL	12:46	15:50	2000mL	010516a			
1/5/2016	vsh	Merck Millipore/R5BA71058	50	8:45	9:45	2000mL	13:00	16:00	2000mL	010516b			
1/13/2016	vsh	Merck Millipore/R5BA71058	50	9:30	10:30	2000mL			2000mL	011316A			
1/13/2016	vsh	Merck Millipore/R5BA71058	50	9:45	10:45	2000mL			2000mL	011316B			

PREPARATION OF FIELD SAMPLE BOTTLES

DATE	INITIALS	BOTTLE ID	# Of Bottles	PRESERVATIVE	Preservative Control #	COMMENTS	QA REVIEW	REVIEW DATE
12/21/2015	am	D	71	H2SO4	2451			

Bacteria Sample Bottle Log

Approved: jrh 5/10/18

*Note: Will also be used for sterile pipettes, and IDEXX trays

ID	Lot	Manufacturer	Size	Expiration Date	Thiosulfate	Sterility Check			Volume Check			Autofluorescence			Efficacy of Thiosulfate		
			(mL)		Y/N	Pass/Fail	Logbook	Page	Pass/Fail	Logbook	Page	Pass/Fail	Logbook	Page	Pass/Fail	Logbook	Page
Sample Bottle	KL012	IDEXX	100	9/23/2020	N	pass	15-005	34-35	pass	15-005	26	Pass	18-001	95	NA	NA	NA
Pipette	62472	Kimble	1	n/a	N	pass	11-005	73	pass	I-117-2-4	30	NA	NA	NA	NA	NA	NA

Bacteria Media Log

Approved: jrh 5/10/18

*Note: Will also be used for sterile filters, sterile water, and diluent

ID	Lot	Source	Expiration Date	Sterility Check			Specificity			pH		
				Pass/Fail	Logbook	Page	Pass/Fail	Logbook	Page	Pass/Fail	Logbook	Page
mTEC	022018a	TIAER	8/19/2018	Pass	17-004	89	Pass	17-004	100	Pass	Q-102-3-13	Line 2183
TSBA	022118a	TIAER	8/20/2018	Pass	17-004	89	Pass	17-004	100	Pass	Q-102-3-13	Line 2184
Filters	1215 139H6 1501473	Fisher	12/31/2019	Pass	15-002	83	NA	NA	NA	NA	NA	NA

Glassware and Equipment Transfer Log

GLASSWARE AND EQUIPMENT TRANSFER LOG Approved jrh 11/13/19					Review	
Date	Initials	Description	Swipe or Survey Passed	Comments	Initials	Date

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