



US Environmental Protection Agency Office of Pesticide Programs

**Office of Pesticide Programs
Microbiology Laboratory
Environmental Science Center, Ft. Meade, MD**

**Standard Operating Procedure for
Calibration and Maintenance of Thermometers
and Thermometer/Hygrometers**

SOP Number: EQ-02-08

Date Revised: 10-12-17

SOP Number	EQ-02-08
Title	Calibration and Maintenance of Thermometers and Thermometer/Hygrometers
Scope	Describes thermometers and thermometer/hygrometers in use in the laboratory, calibration requirements, and the procedure to point-check thermometer accuracy.
Application	Thermometers, including digital thermometers, are used to measure the temperature of autoclaves, water baths, incubators, refrigerators, and freezers. Thermometer/hygrometers are used to measure the temperature and humidity of laboratory rooms, incubators, and sample storage areas.

	Approval	Date
SOP Developer:	_____	
	Print Name: _____	
SOP Reviewer	_____	
	Print Name: _____	
Quality Assurance Unit	_____	
	Print Name: _____	
Branch Chief	_____	
	Print Name: _____	

Date SOP issued:	
Controlled copy number:	
Date SOP withdrawn:	

TABLE OF CONTENTS

<u>Contents</u>	<u>Page Number</u>
1. DEFINITIONS	3
2. HEALTH AND SAFETY	3
3. PERSONNEL QUALIFICATIONS AND TRAINING	3
4. INSTRUMENT CALIBRATION	3
5. SAMPLE HANDLING AND STORAGE	3
6. QUALITY CONTROL	3
7. INTERFERENCES	3
8. NON-CONFORMING DATA	3
9. DATA MANAGEMENT	4
10. CAUTIONS	4
11. SPECIAL APPARATUS AND MATERIALS	4
12. PROCEDURE AND ANALYSIS	4
13. DATA ANALYSIS/CALCULATIONS	6
14. FORMS AND DATA SHEETS	7
15. REFERENCES	7

<p>1. Definitions</p>	<p>1. ISO = International Organization for Standardization</p> <p>2. Vendor calibration = calibration by an ISO 17025 accredited vendor.</p> <p>3. Point-Check = to check the accuracy of a thermometer at operating temperatures against a vendor calibrated, similar type thermometer (i.e., verification thermometer).</p> <p>4. Verification thermometer = thermometer calibrated by an ISO 17025 accredited vendor; used to verify the accuracy of other similar thermometers in the point-check process.</p> <p>5. Additional definitions are provided in the text and on Form 1.</p>
<p>2. Health and Safety</p>	<p>1. The only mercury thermometers permitted in the laboratory are those which are coated with teflon. The teflon coating reduces the likelihood that mercury will be spilled in the event that the thermometer is broken.</p> <p>2. If a teflon-coated mercury in glass thermometer breaks (teflon remains intact), place the thermometer in the chemical waste bin in the fume hood in B209 for disposal. If the integrity of the teflon coating is questionable, call the SHEM manager (or contact security at extension 52800 if SHEM manager cannot be reached) immediately for assistance.</p>
<p>3. Personnel Qualifications and Training</p>	<p>Refer to SOP ADM-04, OPP Microbiology Laboratory Training.</p>
<p>4. Instrument Calibration</p>	<p>1. See Attachment 1 for thermometers, digital thermometers, and thermometer/hygrometers requiring vendor calibration annually.</p> <p>2. Calibration certificates/reports must contain the stamp of the accrediting body (e.g., A2LA, NVLAP) and the vendor's certificate number.</p>
<p>5. Sample Handling and Storage</p>	<p>Not applicable</p>
<p>6. Quality Control</p>	<p>For quality control purposes, the required information is documented on the appropriate form(s) (see section 14).</p>
<p>7. Interferences</p>	<p>Allow the thermometer to equilibrate with the solutions before taking the temperature reading.</p>
<p>8. Non-conforming Data</p>	<p>1. On occasion, thermometers must be discarded (e.g., broken columns, unreasonably large correction factor). Contact the facility Safety, Health, and Environmental Management Program Manager for proper disposal procedures.</p>

	2. Procedures will be consistent with SOP ADM-07, Non-Conformance Reports.
9. Data Management	<ol style="list-style-type: none"> 1. File completed Point Check Calibration of Laboratory Thermometers Record forms in the Point-Check Calibration of Laboratory Thermometers Record Book. 2. Update the inventory of thermometers requiring vendor calibration electronically in g:\mlb\Standard Operating Procedures\Current Versions\Word Versions\EQ-SOPs\Forms and Equipment Calibration Records. See Attachment 1, Sample Inventory of Thermometers Requiring Vendor Calibration. After each addition to or deletion from the inventory, file a hard copy of the inventory in the Thermometer and Hygrometer Calibration Certificates notebook. 3. File the annual Thermometer Calibration Reports for vendor-calibrated thermometers in the Thermometer and Hygrometer Calibration Certificates notebook. 4. Archive records consistent with SOP ADM-03, Records and Archives.
10. Cautions	<ol style="list-style-type: none"> 1. Remove thermometers and thermometer/hygrometers requiring vendor calibration when the calibration expires. Return to service when recalibration is complete. 2. Use thermometers subjected to point-check for one year. Repeat the point-check annually. 3. Call the SHEM manager (or contact security at extension 52800 if SHEM manager cannot be reached) immediately for assistance when mercury thermometers break.
11. Special Apparatus and Materials	<ol style="list-style-type: none"> 1. See Attachment 1 for a current inventory of thermometers/hygrometers requiring vendor calibration. 2. Refer to the Point-Check Calibration of Laboratory Thermometers Record Book to determine which thermometers (excluding vendor calibrated equipment in Attachment 1) are currently in use in the laboratory.
12. Procedure and Analysis	
12.1 Vendor Calibration	<ol style="list-style-type: none"> a. Refer to Attachment 1 for inventory of thermometers requiring vendor calibration. b. Before the calibration expires, remove the thermometer from service.

	<ul style="list-style-type: none"> c. Consult ISO 17025 accredited vendor regarding quote for service, packing/shipping instructions, and completion of any required forms prior to shipping. d. Pack and ship thermometer to vendor. e. File the certificate/record in the Thermometer and Hygrometer Calibration Certificates notebook and return the thermometer to service. f. Replace thermometers that fail the calibration process.
<p>12.2 Annually Required Point-Checks</p>	<ul style="list-style-type: none"> a. Once a year, Kessler maximum registration thermometers (for autoclaves) and water bath thermometers (liquid in glass) are checked at operating temperatures against a similar type verification thermometer (see Attachment 1). <ul style="list-style-type: none"> i. All other liquid in glass thermometers (e.g., incubator, refrigerator, freezer thermometers, including FRIO-Temp Precision Thermometers) are point-checked annually on an as-needed basis, depending upon the functionality of the Environmental Monitoring and Alarm System (see section 12.3). b. To point-check the accuracy of the Kessler maximum registration thermometers, place the thermometer to be checked and the verification thermometer side-by-side in one of the laboratory's autoclaves and run a sterilization cycle (e.g., liquid 15 minute cycle). c. To point-check the accuracy of FRIO-Temp Precision Thermometers, place a flask of de-ionized water or ethanol next to the thermometer in the incubator, refrigerator, or freezer. Place the liquid in glass verification thermometer into the flask of de-ionized water or ethanol. Once the de-ionized water or ethanol has reached the temperature of interest, conduct the accuracy check. Neither the FRIO-Temp Precision nor the verification thermometer may rest on the bottom of their respective container/flask. d. To point-check the accuracy of liquid in glass thermometers other than FRIO-Temp (e.g., water bath thermometers), use a water bath to simultaneously immerse the liquid in glass verification thermometer and the thermometer to be calibrated into the water bath at the temperature of interest. Otherwise, point-checks are taken by simultaneous immersion of the thermometers in a flask of deionized water or ethanol and then placing the flask containing both thermometers in the instrument being monitored until the deionized water or ethanol reaches the temperature of interest. Thermometers

	<p>may not touch the bottom of the flask.</p> <ul style="list-style-type: none"> e. Any difference in temperature readings between the verification thermometer and the laboratory thermometer is recorded on the Point-Check Calibration of Laboratory Thermometers Record Form (see 14.0). f. Add a label displaying the date of calibration and correction factor (even if it is zero), around the top of the corresponding thermometer. g. Once a point-check is performed, thermometers may be used for one year before the point-check must be repeated. h. When routinely recording temperatures for the laboratory, laboratory equipment, media etc., the observed temperature reading of the thermometer read plus the correction factor for that specific thermometer must be recorded. i.
<p>12.3 Environmental Monitoring and Alarm System Failure</p>	<ul style="list-style-type: none"> a. The laboratory utilizes the Environmental Monitoring and Alarm System (EMAS) (see SOP QC-05, Monitoring Environmental Parameters) to collect environmental data electronically for incubators, refrigerators, freezers, laboratories, and sample storage rooms. b. In the event that EMAS is not working, appropriate liquid in glass thermometers (e.g., FRIO-Temp Precision Thermometers) will be point-checked annually, on an as needed basis, against a verification liquid in glass thermometer and employed to measure the temperature of incubators, refrigerators, and freezers. See section 12.2). <ul style="list-style-type: none"> i. As an alternative to conducting point-check of liquid in glass thermometers in the event of an EMAS failure, digital thermometers (Attachment 1) may be used to measure the temperature of incubators, refrigerators, and freezers. ii. Thermometer/hygrometers (Attachment 1) may be used to monitor the temperature/humidity of laboratories and sample storage areas in the event of an EMAS failure.
<p>13. Data Analysis/ Calculations</p>	<ul style="list-style-type: none"> 1. The correction factor for the vendor calibrated verification thermometers is determined by the accredited company that performs the calibration verification for this thermometer. Consult the certificate for this value. 2. Digital thermometers and thermometer/hygrometers are indicated to be within tolerance. No correction factor is indicated on the calibration

	certificates. 3. Point-Check Process: Consult Form 1 for relevant definitions.
14. Forms and Data Sheets	Forms are stored separately from the SOP under the following file names: Attachment 1: Sample Inventory of Thermometers Requiring Vendor Calibration Point-Check Calibration of Laboratory EQ-02-08_F1.docx Thermometers Record Form
15. References	Operation manuals for thermometer/hygrometers are located in file cabinet in D-wing.