



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-02-10

Date Revised: 10-18-23

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Title	Calibration and Maintenance of Thermometers and Thermometer/Hygrometers
Revisions Made	<ul style="list-style-type: none">• Minor editorial changes.• Added instructions to save thermometer calibration reports electronically.• For the point-check calibration of laboratory thermometers process, added instructions to consult with the Branch Chief regarding laboratory thermometer replacement if the difference in temperature readings between the verification thermometer and laboratory thermometer is greater than 1°C.

SOP Number	EQ-02-10
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.

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<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 (see section 14).</p>
<p>2. Health and Safety</p>	<p>1. Only mercury thermometers coated with teflon are permitted in the laboratory. The teflon coating reduces the likelihood that mercury will be spilled if 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 Safety, Health, and Environmental Management Program (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 section 11 for additional information.</p> <p>2. Calibration certificates/reports, which accompany vendor calibrated thermometers, 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>When conducting the annual point-check process (see section 12.2), allow the thermometer to equilibrate with the solutions before taking the temperature reading.</p>
<p>8. Non-conforming</p>	<p>1. On occasion, thermometers must be discarded (e.g., due to broken</p>

<p>Data</p>	<p>columns, unreasonably large correction factors). Contact the facility SHEM manager for proper disposal procedures.</p> <p>2. Management of non-conforming data will be consistent with SOP ADM-07, Non-Conformance Reports.</p>
<p>9. Data Management</p>	<p>1. Electronically maintain an inventory of thermometers requiring vendor calibration in g:\MLB\Standard Operating Procedures\Current Versions\Word Versions\EQ-SOPs\Forms and Equipment Calibration Records. See Attachment 1, Inventory of Thermometers Requiring Vendor Calibration.</p> <p style="padding-left: 40px;">a. After each addition to or deletion from the inventory, file a hard copy of the inventory in a record book.</p> <p>2. File the Thermometer Calibration Reports for vendor-calibrated thermometers in a record book and electronically in g:\MLB\Standard Operating Procedures\Current Versions\Word Versions\EQ-SOPs\Forms and Equipment Calibration Records.</p> <p>3. File completed Point Check Calibration of Laboratory Thermometers Record Forms in a record book.</p> <p>4. Archive records consistent with SOP ADM-03, Records and Archives.</p>
<p>10. Cautions</p>	<p>1. Remove thermometers and thermometer/hygrometers requiring vendor calibration when the calibration expires. Return to service when recalibration is complete.</p> <p>2. Use thermometers subjected to point-check for one year. Repeat the point-check annually.</p> <p>3. Call the SHEM manager (or contact security at extension 52800 if SHEM manager cannot be reached) immediately for assistance when mercury thermometers break.</p>
<p>11. Special Apparatus and Materials</p>	<p>1. See Attachment 1 for a current inventory of thermometers requiring vendor calibration (see section 12.1).</p> <p>2. Refer to the current Point-Check Calibration of Laboratory Thermometers Record Forms to determine which thermometers (excluding vendor calibrated equipment in Attachment 1) are currently in use in the laboratory and due for an annual point-check (see section 12.2).</p>
<p>12. Procedure and Analysis</p>	

<p>12.1 Vendor Calibration</p>	<ul style="list-style-type: none"> a. Refer to Attachment 1 for inventory of thermometers requiring vendor calibration. Thermometers include: <ul style="list-style-type: none"> i. Liquid-in-glass; verification thermometer ii. Kessler maximum registration thermometer (for autoclaves); verification thermometer iii. Digital thermometers iv. Thermometer/hygrometers b. Before the calibration expires, remove the thermometer from service for shipment to the vendor. 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 appropriate record book and electronically 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. Refer to the current Point-Check Calibration of Laboratory Thermometers Record Forms to determine which thermometers (excluding vendor calibrated equipment in Attachment 1) are currently in use in the laboratory and are due for an annual point-check. Examples include: <ul style="list-style-type: none"> i. Kessler maximum registration thermometers ii. Liquid-in-glass thermometers, including FRIO-Temp Precision Thermometers b. 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; vendor calibrated). <ul style="list-style-type: none"> i. All other liquid-in-glass thermometers (e.g., incubator, refrigerator, and 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).

	<ul style="list-style-type: none">c. 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).d. To point-check the accuracy of FRIO-Temp Precision Thermometers, place a flask of de-ionized water or ethanol (for freezers) 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. Neither the FRIO-Temp Precision nor the verification thermometer may rest on the bottom of their respective container/flask. Once the deionized water or ethanol has reached the temperature of interest, conduct the accuracy check.e. 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 (for freezers) 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 may not touch the bottom of the flask.f. Complete the Point-Check Calibration of Laboratory Thermometers Record Form (Form 1, see section 14).<ul style="list-style-type: none">i. Follow instructions on Form 1 to calculate the thermometer's correction factor, the difference in temperature readings between the verification thermometer and the laboratory thermometer.ii. Consult with the Branch Chief regarding laboratory thermometer replacement if the difference in temperature readings between the verification thermometer and the laboratory thermometer is greater than 1°C.g. Add a label displaying the date of calibration and correction factor (even if it is zero) around the top of the corresponding thermometer.h. Once a point-check is performed, thermometers may be used for
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	<p>one year before the point-check must be repeated.</p> <ul style="list-style-type: none"> i. When routinely recording temperatures for the laboratory, laboratory equipment, media etc., record the temperature value that equals the observed thermometer temperature plus/minus the correction factor for the thermometer.
<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. If EMAS is not working, point-check appropriate liquid-in-glass thermometers (e.g., FRIO-Temp Precision Thermometers) annually or on an as needed basis, against a verification liquid-in-glass thermometer and used 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, vendor-calibrated digital thermometers (Attachment 1) may be used to measure the temperature of incubators, refrigerators, and freezers. ii. Vendor-calibrated 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 (section 14) for relevant definitions.
<p>14. Forms and Data Sheets</p>	<p>Forms and attachments are stored separately from the SOP under the following file names:</p> <p style="text-align: center;">Attachment 1: Sample Inventory of Thermometers Requiring Vendor Calibration EQ-02-10_A1.docx</p>

	Point-Check Calibration of Laboratory Thermometers Record Form	EQ-02-10_F1.docx
15. References	Operation manuals for thermometer/hygrometers are located in a file cabinet in the D-wing.	