SOP-C-126

Determination of Temperature

Revision 10

Approval:

_____ 8.14.20
Laboratory Manager Date

_____ 8/14/2020
Concurrence Date

Effective date: 8.14.20

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i. Identification of the method
a. EPA Method 170.1 (approved 1974), SM 2550A and 2550B (approved 2017)

ii. Applicable matrix or matrices
a. Water, soils, other materials

iii. Limits of detection and quantitation
a. Highly dependent on the range of the equipment used

iv. Scope and application, including parameters to be analyzed
a. This procedure applies to all samples received and temperature checks of freezers, refrigerators, ovens and incubators, and any other temperature readings necessary for sample analysis
b. This is not a TNI accredited method, but is used in conjunction with the overall accredited program and other SOPs.

v. Summary of the method
a. Thermometric measurement of heat

vi. Definitions
a. Bulb refers to the storage area for the liquid in liquid-in-glass thermometers. This end is the lowest on the temperature scale.
b. Stem refers to the main shaft of the thermometer.
c. Capillary refers to the channel that carries the liquid up the stem.
d. Main scale is where the temperature is read.
e. Total-immersion thermometers require that the liquid in the stem be completely immersed in the measured liquid. The placement of the thermometer must be adjusted during use so that the liquid in the bulb and stem are always immersed in the sample. These thermometers are the most accurate. This is indicated on the stem by "Total IMM."
f. Complete-immersion thermometers require that the entire thermometer be immersed in the measured liquid.
g. Partial-immersion thermometers require only the bulb and a specified portion of the stem be immersed in the measured liquid. There will be a mark or a line on the

thermometer stem designating how far into the material the thermometer must be placed. The standard partial-immersion thermometer has a line 76 mm from the end of the bulb. This is indicated on the stem by "76 MM IMM."

h. Correction Factor- The difference between the actual reading of the working thermometer and the NIST thermometer is Correction Factor (CF). Both the observed and the corrected temperatures are recorded along with the thermometer ID.

vii. Interferences

a. Improper placement, layering effects, reflective surfaces
b. Distance will affect the IR thermometer accuracy.

viii. Safety

a. Use care in handling glass thermometers, especially if mercury filled, glass can break easily and cut skin or release toxic mercury.
b. If mercury is released, advise the Laboratory Manager immediately. Ventilate area of spill. Put on protective clothing, including gloves, lab coat, and safety goggles or a full face shield if splashing is possible. Pick up mercury and place in a suitable container for disposal in a method that does not generate misting. Sprinkle the area with sulfur or calcium polysulfide to suppress mercury, clean up and dispose of in accordance with QAM-W-101, "Laboratory Waste".
c. Do not jar thermometers or heat them beyond their range. This can cause separation of the indicator. If indicator becomes separated it can possibly be joined by freezing and slowly warming. After it is joined it is calibration checked against an NIST traceable thermometer before use.

ix. Equipment and supplies

a. Various thermometers of varying ranges, mercury or spirit filled glass, digital, or non-contact IR models
b. Thermometer holding bottles for refrigerators and incubators

c. Thermocouple (Type J or K) with meter (NIST traceable)- in this SOP, thermocouple may be substituted for thermometer throughout the text.

x. Reagents and standards

a. Enviro-safe® liquid or equivalent for thermometer bottles
b. A precision thermometer traceable to certification by the National Institute of Standards and Technology (NIST).
c. Working laboratory thermometers are compared to the NIST thermometer and corrected to match the certified temperature.

xi. Sample collection, preservation, shipment and storage

a. If samples, analyze immediately upon removal from transport container.
b. Samples are not normally preserved or shipped for this SOP.

xii. Quality control

a. refer to QAM-Q-101, "Laboratory Quality Control"

xiii. Calibration and standardization

a. Thermometers are checked against an NIST traceable thermometer and CFs determined at least annually. The check is done at high and low points on the thermometer that bracket the range of use.
b. The NIST reference thermometer, if not damaged or separated, is good for five years with a calibration certificate of five points. The thermometer must be accompanied by a certificate that matches the 5 year acceptance time. The Laboratory Manager or designee will notify the Laboratory Quality Assurance Manager so they may obtain any necessary certificates from the manufacturer if not properly received.
c. Thermometers are checked before every use for separation of the indicating medium, and repaired or replaced when separation occurs.
d. Calibration verification is required upon repair in accordance with QAM-I-118, “Thermometer Calibration Verification”.

e. Thermometers and thermocouple meters may be NIST traceable with expiration listed and certificate on file. In this case, they are not checked against another.

xiv. Procedure

a. Thermometer Selection
   1. Select a thermometer that has a range of measurement including the expected temperature.
   2. When receiving samples or when there are cross contamination concerns, a non-contact IR thermometer is best chosen.
   3. Select a thermometer with a measure of precision that matches the task at hand. For example, if an incubator has an acceptable range of 44.3-44.7°C a thermometer with 1°C graduations may not be acceptable.

b. Thermometer Placement
   1. If using a conventional thermometer be sure that the bulb or probe is submerged or inserted into the oven or incubator as indicated by the marking on the thermometer.
   2. If using a non-contact IR thermometer, be sure that the infrared beam is intersecting with the sample container. It may be helpful to use a laser pointer, if available on the thermometer, to be sure of where the beam is pointed.

c. Reading the Thermometer
   1. Wait for the thermometer to adjust to the temperature of the medium being analyzed.
   2. For conventional thermometers locate the top of the column of indicating liquid in the capillary.
   3. Compare the top point of the indicator to the main scale. Mercury thermometers are read by reverse meniscus, red alcohol and other water-based media are read by meniscus. Often the capillary is so small that the meniscus is undetectable.
   4. Identify the precision of the main scale and read the thermometer to one decimal place of uncertainty. For example if the scale is marked in 1°C

graduations, the temperature may be read to the nearest 0.1°C.

5. If using a digital or IR thermometer read the temperature displayed.

xv. Data analysis and calculations;

a. Record the CF listed on the thermometer, thermometer ID, and the observed temperature on the appropriate log or form.
b. Subtract or add the CF and record the corrected temperature, if the E-log does not do it.
c. Use the corrected temperature for reporting.

xvi. Method performance

a. Method performance: refer to QAM-Q-101, "Laboratory Quality Control"

xvii. Pollution prevention

a. Pollution prevention: refer to QAM-W-101, "Disposal of Laboratory Waste"
b. Keep mercury thermometers away from sinks and drains whenever possible.

xviii. Data assessment and acceptance criteria for quality control measures

a. Data assessment and acceptance: refer to QAM-Q-101, "Laboratory Quality Control"

xix. Corrective actions for out-of-control data

a. Corrective action: refer to QAM-Q-105, "Corrective Actions"

xx. Contingencies for handling out-of-control or unacceptable data

a. refer to QAM-Q-101, "Laboratory Quality Control" and QAM-Q-105

xxi. Waste management

a. Waste management: refer to QAM-W-101, "Disposal of Laboratory Waste"
b. Mercury from broken thermometers is powdered with sulfur, collected, bagged, sealed and picked up by a hazardous waste collection contractor.

xxii. References

a. Standard Methods for the Examination of Water and Wastewater, latest online edition, ed. By Arnold E. Greenberg, et al., APHA, AWWA, Washington, D.C., Methods 1030D, 2550A and 2550B (approved 2017).
b. Methods for Chemical Analysis of Water and Wastes, U.S. Environmental Agency, 1974, Cincinnati, OH, Method 170.1
c. The Laboratory Companion; A Practical Guide to Materials, Equipment, and Technique. Gary S. Coyne. New York, NY, 1997. p 151-160.
d. Material Safety Data Sheet: Mercury. Mallinckrodt Baker, Inc. Phillipsburg, NJ.
e. The National Environmental Laboratory Accreditation Conference Institute (NELAC) standard, 2016.
f. Refer also to QAM-I-115, "Operation and Calibration of the IR Thermometer".

xxiii. Any tables, diagrams, flowcharts and validation data
none