BUREAU OF MATERIALS

MATERIALS PROCEDURES

MP NUMBER: 22-25

EFFECTIVE DATE: 03/03/2025

APPROVAL: *Edward Inman*

REGIONAL CALIBRATION OF THERMOMETERS

PURPOSE:

To establish a standard method of calibrating thermometers issued to field personnel. The reference thermometer to be used for calibration purposes shall be an Omega DP 251, NIST traceable Precision RTD thermometer. The following methods and procedures listed will ensure reasonable accuracy for quality assurance testing purposes.

SUPERSEDES:

Materials Procedure Number 31 – Dated 07/01/2008

REFERENCES:

NJDOT Standard Specifications for Road and Bridge Construction, Addenda and Attachments
AASHTO T-309 Temperature of Freshly Mixed Concrete
AASHTO T-209 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
ASTM E-1 Standard Specifications for ASTM Liquid-in-Glass Thermometers
ASTM E-77 Standard Test Method for Inspection and Verification of Thermometers
ASTM C-1064 Temperature of Freshly Mixed Hydraulic-Cement Concrete
The Asphalt Institute, MS 2 – Mix Design Methods for Asphalt Concrete
The Asphalt Institute, MSP 2 SUPERPAVE Level 1 & 2 Mix Design

FORMS:

Bituminous Lab Thermometer Calibration Sheet

INSTRUCTIONS:

I. Frequency of Calibration shall be at least once per year, or whenever a question of thermometer accuracy occurs:

A. Each Regional Laboratory Manager:
   1. Will contact the Bureau of Materials to schedule for instruction in the use of and acquisition of a calibrated Reference Thermometer.
   2. Will coordinate with all field personnel to have all team or individually assigned NJDOT and/or contractor issued thermometers available for calibration.
   3. Develop a unique record or marking for each thermometer that is to be calibrated and establish a written record for all assigned thermometers, and the date of last calibration.
   4. Make random spot checks of cylinder water tank temperatures and compare them with the recording thermometers for each tub.

II. Thermometer Type:

A. Liquid–in–Glass (Gravimetric Purposes)
   1. All Liquid-in-Glass thermometers shall be calibrated in accordance with ASTM E 1 Standard Specification for ASTM Liquid-in-Glass Thermometers as outlined in Table 1.

B. Dial with Stem Thermometers (Portland Cement Concrete Testing)
   1. Only Thermometers with one degree Fahrenheit (1° F) divisions or less shall be calibrated.
   2. Thermometers shall be calibrated within their approximate working ranges. (32° F 120° F).

C. Digital with Stem Thermometers (Portland Cement Concrete Testing)
   1. Thermometers with 1° F divisions or less will be calibrated and checked for sensitivity conformance.
   2. Thermometers shall be calibrated in their working ranges. (32° F to 120°F).
   3. Thermometers found not to be in calibration but remaining in service shall have an offset labeled or adjusted according to the Reference Thermometer.

D. Dial or Digital-Stem Thermometers (Bituminous/HMA Testing, with 5 degree divisions)
   1. The Regional Lab Manager shall coordinate and schedule for the calibration of Bituminous (HMA) temperature testing devices, if necessary.
   2. Thermometers shall be calibrated in their normal working ranges (50° F to 350°F) and compared with the reference precision Reference Thermometer.
   3. The thermometers results compared with the Reference Thermometer are to be recorded and/or graphed if necessary.
   4. It will be the responsibility of each Region to calibrate their own thermometers.

III. Procedure Method for Calibration:

A. Liquid-in-Glass Thermometers, ASTM 17F or ASTM 17C used for temperature measurement of water in gravimetric testing. According to ASTM E 1, thermometers 17F and 17C will be calibrated at 70° F - 77° F and 21.1° C - 25° C, respectively.
   1. A water bath shall be used to produce calibration temperatures required for calibration temperatures of the above noted thermometers and will be compared with the Reference Thermometer results. The Bituminous Lab calibration sheet should be filled out noting any differences. If necessary, a graph should be produced to show the differences in temperature between the test thermometer and the Reference Thermometer temperature.

B. Dial with Stem Thermometers (Portland Cement Concrete Testing)
   1. Prior to calibration of the thermometers you should prepare two (2), five gallon buckets along with a hot water bath that will be set to the approximate temperatures.
   2. The first five-gallon bucket shall be filled with tap water and allowed to set at room temperature.
   3. The second five-gallon bucket should have approximately 5 pounds of ice placed in it and the remaining portion filled with tap water.
   4. Using a hot water bath, adjust the temperature of the water to produce a temperature between 90° F and 120°.
   5. The Bituminous Lab calibration sheet should be filled out noting any differences. If necessary, a three (3)-point graph should be produced to show the differences in temperature between the test thermometer and the RTD precision thermometer temperature.

C. Digital with Stem Thermometers (Portland Cement Concrete Testing)
   1. Follow procedure 2a through 2e as listed above.

D. Dial or Digital–Stem Thermometers (Bituminous/HMA Testing, with 5 degree divisions)
   1. Thermometers shall be calibrated in their working ranges (50° F to 300° F). All thermometers used for bituminous testing shall be calibrated at a minimum of two temperatures. The first at 140° F using a hot water bath.
   2. The second temperature will be at 275° F acquired by use of the kinematic viscosity oil bath.
   3. A third temperature above 275° F will be made. The use of a hot sand bath can be used for this purpose.
   4. The Bituminous Lab calibration sheet should be filled out noting any differences. If necessary, a three (3)-point graph should be produced to show the differences in temperature between the test thermometer and the Reference Thermometer temperature.