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| **OWM On-the-Job Training and Mentoring**  **Worksheet Form** | | | | | |
| **Employee/Trainee Name:** | | | | | |
| **Trainer/Mentor Name:** | | | | | |
| **Topic/Procedure: NC SOP 25 Calibration of Liquid-In-Glass and Digital Thermometers (plus: SOP 9 and 29, GMP 11, GMP 12, and GMP 13)** | | | | | |
| **GENERAL Measurable Training/Learning Objectives Applicable for all SOPs** | | | | **Trainee Initials and Date** | **Mentor Initials and Date** |
| DESCRIBE (and FOLLOW/USE) applicable safety and protective equipment requirements for this SOP | | | |  |  |
| DESCRIBE (and PERFORM) laboratory process for receipt, handling, storage, and return of related customer standards (noting issues unique to this SOP) | | | |  |  |
| DESCRIBE (and FOLLOW) laboratory process for preparing calibration certificates (and amendments) | | | |  |  |
| DESCRIBE (and FOLLOW) laboratory process for documenting non-conformities to laboratory procedures and/or ISO/IEC 17025 | | | |  |  |
| PERFORM this SOP while DESCRIBING steps as if for an assessor | | | |  |  |
| **NC SOP 25 Measurable Training/Learning Objectives** | | | | **Trainee Initials and Date** | **Mentor Initials and Date** |
| Section 1.1, Metrologist can:  IDENTIFY and FIND the documentary standards (HB 105-6, AASHTO Accreditation Policy and Guidance on Thermometer Selection and Records, ASTM E 1, E 77, E 644, E 1137/1137M, E 2488, NIST Calibration Uncertainties of Liquid-in-Glass Thermometers, NIST SP 250-23, NIST SP 1088);  LOOK UP tolerance limits; and  DESCRIBE the most likely procedure for each type of thermometer based upon material design (See GMP 12). | | | |  |  |
| Section 1.2, After observing, reading, and performing this calibration procedure, the Metrologist can:  DESCRIBE and PERFORM the procedure in such a way that it would satisfy an internal auditor or accreditation auditor. | | | |  |  |
| Section 1.2, the Metrologist can:  IDENTIFY location of laboratory calibration certificates for working standards, laboratory traceability hierarchy, and status of calibration due dates; (ASSESSMENT of the laboratory traceability records as performed during LAP Problems).  DESCRIBE good measurement comparison techniques based on reading and observing demonstrated NC SOP 25 calibration;  IDENTIFY and VERIFY that laboratory facility is operating within limits and  DESCRIBE what happens if environmental limits are not met (non-conformity; IDENTIFY the Administrative Procedure and Action Item Form. | | | |  |  |
| Section 2.2, DISCUSS how Metrologists use check standards and control charts to monitor measurement operation, IDENTIFY all the control charts associated with thermometry operations and DESCRIBE the differences between these charts.  DESCRIBE the maintenance service and/or calibration procedure for laboratory equipment (paying particular attention to what equipment requires calibration and which items do not);  VERIFY that standards to be calibrated have equilibrated the requisite amount of time (DESCRIBE Administrative Procedure for Care and Handling of Submitted/Laboratory Standards).  IDENTIFY environmental equipment that is used in each area of the laboratory.  FIND and review calibration certificates, traceability hierarchy, and calibration intervals for equipment used to measure environmental conditions.  REVIEW status of environmental equipment to ensure it has appropriate resolution and has suitable calibrations and uncertainties. (Related to Traceability Assessment used during LAP problems.) | | | |  |  |
| Section 2.4.1., the Metrologist can:  IDENTIFY and CREATE a calibration plan using a combination of stem correction (liquid-in-glass only), control chart readings, and requested calibration points by the customer. This involves the ability to IDENTIFY available equipment.  DESCRIBE the following steps:  1. how the thermometers are handled and placed in the bath  2. how the bath temperatures are changed (refer to the equipment manuals depending on bath type and approach)  3. what observations might indicate problems with the bath during the procedure  4. how and when data is recorded  5. what values to expect for the check standard (awareness of appropriate limits)  6. how to measure the linear distance from the top of the bulb to the meniscus and determine number of degrees for stem correction (liquid-in-glass only)  7. how to enter data into the stem correction cells in the spreadsheet to produce the correct stem correction calculation (liquid-in-glass only) | | | |  |  |
| Section 2.4.2, NOTE: This section of the Procedure only applies to liquid-in-glass thermometers that will be expected for routine customer normal use. The Metrologist can:  DEMONSTRATE NC SOP 25 with a liquid-in-glass thermometer using these Procedure steps. DESCRIBE the tools used for these Procedure steps and what issues are of concern if noted during examination. | | | |  |  |
| Read NIST SP 1088. Mentor to share practices in the laboratory for repair of liquid-in-glass thermometers that exhibit damage. After completing this and referring to Sections 5 and 6, the Metrologist can:  DESCRIBE laboratory practices for determining when a liquid-in-glass thermometer requires repair and  IDENTIFY and SELECT appropriate steps available to remedy the damage to the thermometer following laboratory practices. | | | |  |  |
| Section 2.4.4, the Metrologist can:  DESCRIBE the steps of the NC SOP 25 procedure, including evaluation of constructed liquid of thermometer, type of thermometer (total or partial), and determination of steps for stem correction.  PERFORM the steps of the NC SOP 25 procedure, following each step, using proper care and handling of thermometry standards, unknown standards, monitor, camera, grid template, and recording observations.  DESCRIBE:  1. the scale range and division size for liquid-in-glass thermometers  2. how to use the monitor, camera, and grid paper for purposes of taking readings | | | |  |  |
| Section 4, the Metrologist can:  IDENTIFY laboratory check standards that will be used and be able to FIND the applicable control chart for the check standards that will be used;  PERFORM the calibration of the check standard and enter the value in the appropriate control chart and determine if the results are in/out of applicable statistical limits;  DESCRIBE the laboratory control chart components based on the SOP 9 checklist (similar to LAP Problems that EVALUATE the control charts compared to the SOP 9 checklist);  DESCRIBE what values are inside the warning and action limits and what the likely variation of values is for the check standards being used.  Mentor should provide insight of common problems that have been or might be observed for the standards in question, what trends might be reviewed over time, and how data from the control chart is used to calculate and update the standard deviation of the measurement process, degrees of freedom, and uncertainties.  PERFORM calculations to determine the Correction of the unknown standard.  VERIFY that calculations are correct in laboratory software (values match) | | | |  |  |
| Section 5, the Metrologist can:  REVIEW "official laboratory uncertainties" and  DETERMINE:   1. Whether uncertainties are sufficiently small for applicable tolerances (< 1/3) per the documentary standards (if this applies) 2. Which entry lines are required for generation of an uncertainty budget (NC\_UNCAnalysis), as well as where these values come from | | | |  |  |
| Section 5 and SOP 29, the Metrologist can:  Read SOP 29 and be able to LIST and DESCRIBE the 8 steps in the uncertainty process in the context of NC SOP 25.  Step 1. SPECIFY - refers to NC SOP 25 and the measurement equations listed in the SOP  Step 2. Metrologist should be able to IDENTIFY, DESCRIBE, SELECT, QUANTIFY, CONVERT all sources/components from Table 1 to CALCULATE the COMBINED uncertainty using a root sum square method.  COMPARE and EVALUATE - this section and TABLE 1 with the official laboratory uncertainties. (Similar to what is done during LAP Problems).  VERIFY calculations in the laboratory spreadsheets for uncertainty using this SOP. | | | |  |  |
| Section 5.12, the Metrologist can:  EVALUTE the Uncertainty Statement on the calibration certificate. | | | |  |  |
| Section 6.1, the Metrologist can:  CREATE a calibration certificate that COMPLIES with SOP 1 and items that must be included per NC SOP 25.  LAP Problems include evaluation of laboratory templates against section 7.8 in ISO/IEC 17025 and SOP 1. Laboratory administrative procedures for calibration certificates to be reviewed and assessed for compliance as well. | | | |  |  |
| Section 6.2, the Metrologist can:  DESCRIBE the conformity assessment that is listed in this section, assess the measurement results, and uncertainties per section 5 for compliance with the applicable documentary standards. | | | |  |  |
| **Trainee Final Observations/Assessments Summary:** | | | | | |
| Describe how confident you are with finding all the files and resources in your laboratory that are needed to perform this calibration, prepare a certificate, and return items to customers? What additional training do you think you need to improve? How much additional time performing this calibration do you think you need to feel confident? What additional questions do you have or follow up would you like to see? | | | | | |
| **Trainer Observations/Assessments Summary:** | | | | | |
| Describe in your own words: How closely did the trainee follow the SOP? How many times and what nominal values/standards/equipment were used when you demonstrated the procedure AND when you observed the trainee performing the procedure? How did your measurement results agree? How did their values look on the laboratory control chart(s)? Were they able to describe the procedure to your satisfaction? Were gaps observed? Is additional follow up needed? What additional assessments did you observe that help to ensure that learning objectives were met? | | | | | |
| **Objective Evidence Assessed by Trainer/Mentor (***maintenance of electronic records is encouraged***):** | | | | | |
| * Reading Outline (completed by trainee, reviewed by trainer/mentor, discussed) * Video of Demonstration/Performance (optional, recommended) * Data Sheet(s) of completed measurements * Traceability Assessment of Laboratory Standards Used completed by trainee (Using GMP 13 forms, with list of laboratory files/locations) * Calculations for the SOP with work shown by hand or in Excel with Validation Notes * Spreadsheet File(s) PDF print-out of data entry of completed measurements * Control Chart record showing trainer/mentor data and trainee data and evaluation of control charts with SOP 9 checklist evaluation * Independent Uncertainty analysis following applicable SOP and SOP 29, comparison with official laboratory uncertainties * Calibration Certificate for calibrations performed by trainee * Calibration Certificate marked up as reviewed for compliance with SOP 1 and applicable SOP * List of laboratory files reviewed by trainee:   + Template Spreadsheet File:   + Completed Spreadsheet File(s): | | | | | |
| **Applicable Proficiency Test(s):** | **Date of Calibration:** | | **PT Evaluation Report**  (*Name, Date*) | | |
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| **Employee/Trainee Signature:** | | **Trainer/Mentor Signature:** | | | |
| **Recommended for Approved Signatory Status (Name, Title, Signature):** | | | | | |
| **Approved for signatory status by NIST Office of Weights and Measures (name & date):** | | | | | |