

SECTION IV

CALIBRATION SYSTEMS -- TEST QUESTIONS

- 4.1 A calibration customer has requested that a laboratory follow a customer written procedure to carry out the work it has contracted to be done. The laboratory should do this:
- Under all circumstances
 - Unless there's a law against it
 - Unless a National Standard method exists
 - Unless the lab has a better procedure

Solution: As with any quality business, customer requirements take precedence over other considerations except, of course, when there's a law against it. ISO/IEC 17025 requires that a lab carry out a customer procedure if one is supplied, but the lab is required to notify the customer if it believes the customer's procedure to be incorrect, out of date, or not applicable.

Answer b is correct.

Reference: *CCT Primer*, Section IV - 10.

- 4.2. Items showing on a calibration overdue list are an indication that:
- There are devices past their due date for calibration
 - Management is not aware of the calibration staff shortage
 - The quality management system is significantly broken
 - The laboratory's accreditation should be withdrawn

Solution: Without further investigation the only conclusion that can be drawn is that "There are devices past their due date for calibration." The overdue list may have been the exception, and it is being corrected at the time the list was viewed. However, it may also indicate a major problem such as those shown in the other answer choices, or other root causes.

Answer a is correct.

Reference: *CCT Primer*, Section IV - 35.

- 4.3. Written procedures for all tests and calibrations are:
- Required at all times for all work
 - Required only for accredited tests and calibrations
 - Not required but are commonly used
 - Required for U.S. Military applications only

Solution: Written procedures are not required, even by ISO/IEC 17025, the strictest of quality system standards for laboratories. In order to not use a procedure, though, the lab must demonstrate that the work can be done correctly without it. There are many good reasons to always use procedures, but they are not mandatory.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 2.

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- 4.4. A customer has requested that if an instrument passes specifications, no measurement data be included on the calibration certificate. Is this a permissible practice?
- Yes, unconditionally
 - Yes, but the laboratory must retain the data anyway
 - No, data must be provided on all certificates
 - Maybe, data must be provided if the title says "Calibration Certificate" but may be omitted if it says "Calibration Report"

Solution: The only data values that are required to be reported are those that are failures or out of tolerance. Any passing value may be recorded but is not required. The laboratory must retain all measurement data collected in any case, but is not required to report passing values on a certificate.

Answer b is correct.

Reference: *CCT Primer*, Section IV - 58.

- 4.5. Under which circumstances should calibration environmental conditions be recorded and reported?
- Only when working in the laboratory
 - Only when working in the field
 - Only when calibrating reference standards to use in future work
 - Under practically all calibration situations

Solution: Recording and reporting of the calibration environment is always a good idea. There are few, if any, calibrations in which the environment does not have an effect. In addition, when working under accreditation, there is a requirement to keep all information necessary to reproduce the conditions under which the work was done.

Answer d is correct.

Reference: *CCT Primer*, Section IV - 14.

- 4.6. A lab needs a quality system to ensure all of the following, EXCEPT:
- Obsolete documents are removed so they can't be accidentally used
 - Employees are aware of their duties, responsibilities, and salaries
 - Problems are recorded and corrective action is taken
 - Computer records of calibration data are backed up

Solution: Note that a negative response is requested. A quality system is a standard method for management of documents, data, and corrective action. Employee awareness is important, but salaries are not usually included in quality system procedures or data.

Answer b is the correct, incorrect, choice.

Reference: *CCT Primer*, Section IV - 45/49.

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- 4.7. Calibration of a high pressure sensor requires cross-floating a reference piston gage (max pressure 10 000 psig or 69 MPa) against a source of 1500 MPa. Is it possible to calibrate this TI, and if so, what is required?
- Yes, extra weights can be added to the piston to increase its range
 - The sensor should not be calibrated at full scale but only to the maximum pressure available
 - Yes, but a pressure divider unit (attenuator) is required
 - It is not possible to calibrate this TI

Solution: An input attenuator or pressure divider is required in order to scale the 1500 MPa source by a known amount. The scaled, lower pressure may then be compared to the reference piston gage at a pressure within its capabilities. The reference attenuator is calibrated as well, so the division of the unknown pressure under test is done by a precisely known ratio.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 8.

- 4.8 A calibration report should have as many as three addresses or locations listed on it. They are:
- The address of the laboratory, the client's facility, and the location where the TI is used
 - The address of the laboratory, the client's calibration facility, and the location where the TI was calibrated
 - The address of the laboratory, the client's billing office, and the location where the TI was calibrated
 - The address of the laboratory, the client's office, and the location where the TI is used

Solution: Several identifying items are required on calibration certificates. The name and address of the laboratory doing the work is required. The location where the TI was calibrated (address, building, room number... whatever is needed to completely identify the location) is required, and the name of the customer of the work is required. Often, the business or billing address of the customer is included along with the name.

If a laboratory is "in-house" to a factory or other facility, the name and address of the customer is not needed, but the location of the TI is still required.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 55/58.

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4.9. According to ISO/IEC 17025, laboratory managerial personnel must:

- a. Appoint deputies or alternates for all calibration and testing personnel positions
- b. Ensure personnel are free from undue pressures and influences that affect the quality of work
- c. Have a member of their staff with the title of quality manager or quality assurance manager
- d. Provide for electronic storage and transmission of client test results

Solution: ISO/IEC 17025 states "have arrangements to ensure that its management and personnel are free from any undue internal and external commercial, financial and other pressures and influences that may adversely affect the quality of their work." Deputies are required for key managerial personnel and not for all calibration and testing positions. A member of staff must be appointed as quality manager (however named), but this person's title does not need to be any specific title. If electronic storage and transmission of test results are used, there must be policies and procedures in place to protect the customer's confidential information. However, it is not required that these be provided in electronic format.

Answer b is correct.

References: *CCT Primer*, Section IV - 23 and ISO/IEC 17025:2005.

4.10. A calibration certificate must be identified in some fashion. A requirement for the identification is that:

- a. It must be in boldface type, at least 12 points high
- b. It must be unique
- c. It must appear on every page of the report
- d. It must somehow include the date of calibration

Solution: The certificate number or other identification must be unique. It must not be possible to have two certificates with the same number. The type style and size is not specified. It usually appears on every page but is not required. The date of calibration is required but it does not have to be part of the certificate number or other identification.

Answer b is correct.

Reference: *CCT Primer*, Section IV - 57.

4.11. Calibration intervals for each measuring instrument based upon ANSI/NCSL Z540.3 are established:

- a. By the appropriate GIDEP standards
- b. By corporate rules and procedures
- c. To control the probability of calibrations being out of tolerance
- d. At a predetermined time interval

Solution: The interval of calibration of measuring equipment should be established to control the probability of calibrations being out of tolerance at the end of the calibration interval.

Answer c is correct.

References: *CCT Primer*, Section IV - 32. ANSI/NCSL Z540.3

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4.12. A calibration procedure will usually exempt which of the following elements?

- a. A date of issue
- b. The signature of the person who wrote it
- c. A revision level
- d. A revision history

Solution: A date of issue, a revision level, and a revision history are all common requirements for any controlled quality system document. A signature of the author is common but not necessary. A signature of any approving authority is often required.

Answer b is correct.

Reference: *CCT Primer*, Section IV - 3.

4.13. A calibration lab owns a van and hires a driver to pick up new work and deliver completed work. The driver takes the van on a two-day run once a week to do pickups and deliveries in two adjacent states. The distances are too great for the driver to return to the lab during the intervening evening, so he/she stays in a motel. The equipment stays in the van overnight (the van has a double-lock and an alarm system). Is this arrangement likely to be acceptable?

- a. Yes, it's fine
- b. No, there is still too great a risk that the equipment will be stolen
- c. No, during weather extremes, the equipment might be subject to unacceptable temperature or humidity swings
- d. No, transport of equipment in an ordinary van will subject it to excessive vibration

Solution: ISO/IEC 17025 requires that the laboratory shall take all necessary steps to protect the integrity of the test or calibration item. This includes protection from environmental extremes.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 25.

4.14. The ISO 9001 quality system standard is:

- a. The same as ISO/IEC 17025
- b. In conflict with ISO/IEC 17025
- c. Compatible with ISO/IEC 17025
- d. Required for use in all calibration laboratories

Solution: One intent of the writers of ISO/IEC 17025 was to make it unnecessary for an organization to both be accredited to ISO/IEC 17025 and registered to ISO 9001. The quality system requirements in ISO/IEC 17025 are intended to be completely compatible with ISO 9001.

As ISO 9001 revisions occur, any changes will be rectified in the next revision of ISO/IEC 17025, and joint registration and accreditation will not be necessary.

Answer c is correct.

References: *CCT Primer*, Section IV - 45. ISO/IEC 17025:2005. ISO 9001:2000. ISO 9001:2008.

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- 4.15. What is the principal mechanism by which humidity affects calibration of high-precision scales and balances?
- a. High humidity will corrode masses used as reference standards
 - b. Low humidity will encourage accumulation of electrostatic charges which changes the apparent weight of the test masses
 - c. Humidity contributes to air density, which in turn changes the air buoyancy of the test masses
 - d. High humidity fogs the window covering the scale's display, making it hard to read

Solution: Humidity does not have a strong effect on weighing in any case, but its strongest influence is in the variation of air density which, in turn, changes the air buoyancy correction.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 16.

- 4.16. When testing, calibrating, or sampling involves a device that has firmware, the firmware:
- a. Must be under revision, date, and configuration control
 - b. Is exempt from validation because it is an original equipment manufacturer (OEM) item
 - c. Is required to have a Certificate of Authenticity (CoA) affixed to the testing device
 - d. Must meet the same validation requirements as necessary for software

Solution: When firmware is used for testing, calibration, and sampling, it must meet the same validation requirements as those necessary for software.

Answer d is correct.

Reference: *CCT Primer*, Section IV - 43.

- 4.17. When calibrating a photographic light meter with a standard source:
- a. Adjustments should be made both for total darkness and for the brightness of the source
 - b. The meter should be "nulled" against a known meter
 - c. Intermediate values on the scale are not important and need not be checked or calibrated
 - d. Both negative and positive values of light intensity must be checked

Solution: A photographic light meter measures light intensity on a scale. Typical scale calibrations are performed by making adjustments at or near zero and at or near full scale.

Answer a is correct.

Reference: *CCT Primer*, Section IV - 8/9.

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- 4.18. All policies, procedures, calibration and test methods, work instructions, checklists, and blank forms used in calibration and test must be approved by:
- The top management of the company
 - The accreditation body that has issued the laboratory's certificate
 - A person authorized by the organization for that purpose
 - The National Institute of Standards and Technology

Solution: The organization can designate anyone to approve policies and procedures. This is often the quality manager, but does not have to be anyone in particular. Approval authority should be designated by top management.

Answer c is correct.

Reference: *CCT Primer*, Section IV - 46/47.

- 4.19. The ACME Calibration Laboratory exclusively uses its own internal methods for the work it does for customers. The procedures, though, are all actually reprinted from published methods - usually U.S. military procedures but occasionally manufacturer's procedures where military procedures don't exist. The lab adds its own preparatory instructions concerning how to receive and prepare the TI and its own post-calibration instructions showing how to prepare the correct paperwork and fill out a certificate.

Based on the above explanation, would one say:

- The lab's procedures are acceptable for accredited work
- The lab's procedures may not be used because they are printed on the lab's own letterhead
- The lab's procedures may not be used because any change to a published procedure makes them invalid
- The lab's procedures may not be used because any procedure change must be approved by the originating organization

Solution: Any published procedure may be copied (subject to copyright if applicable) and modified to meet the laboratory's requirements as long as the technical content remains substantially unchanged.

Answer a is correct.

Reference: *CCT Primer*, Section IV - 13.

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4.20. Calibration certificates should indicate the environmental conditions during the calibration process:

- a. Under all circumstances
- b. Only when calibrating in the field away from the permanent laboratory
- c. When the technician believes the conditions were out of range
- d. When the environmental conditions can have an influence on the results

Solution: Even though answer **d** is correct, it is common practice to always list environmental conditions, at least temperature and humidity, on every calibration certificate. The requirements for test reports are not as strict.

Any environmental condition that can affect calibration results must be listed on a calibration certificate.

Answer d is correct.

Reference: *CCT Primer*, Section IV - 59.

4.21. A technician is assigned to calibrate a TI. He/she begins work and finds the unit inoperative. The correct procedure to follow next is:

- a. Attempt to repair the unit immediately
- b. Tag the unit and set it aside to be repaired
- c. Return the unit to the customer as-is
- d. Tag the unit, notify the customer, and ask if repair is desired

Solution: The exact steps to be taken should be dictated by corporate policy, however it is most common to wait for guidance from the customer. The customer may wish to use other services for repair, or to scrap the tool rather than attempt repair.

Answer d is correct.

Reference: *CCT Primer*, Section IV - 26/27 (and logic).

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- 4.22. A technician determines that a manufacturer's manual is the correct one to use by:
- Comparing the brand and model number of the TI and the manual
 - Checking the organization's Master List of controlled documents
 - Checking the print date or date of issue of the manual
 - Comparing the model and serial number of the TI with the applicable manual statements

Solution: Answer **a** is a tempting choice, but in fact many items of IM&TE undergo many revisions and modifications during the service life of the instrument. The calibration procedures may be different for each revision level. The technician must check to make sure that the procedure being used is the correct one for the actual TI on the bench.

Answer d is correct.

Reference: *CCT Primer*, Section IV - 3.

- 4.23. Which of the following aspects of IM&TE must be included in the asset history file?
- All associated software
 - Associated accessories such as test leads or plumbing adapters
 - Original sales literature from which the asset was purchased
 - Record of current and previous locations of the asset

Solution: An instrument is not considered complete without its associated software. There is always a configuration control issue to make sure that the revision level of the software is appropriate for the specific hardware. The asset file needs to have this information as an essential part of the record.

Answer a is correct.

Reference: *CCT Primer*, Section IV - 31 and 42/43.

- 4.24. A reference standard long gage block (a dimensional standard) made of gage steel has been traceably calibrated at the ISO standard reference temperature and is exactly 100 mm long. What error will be caused if this same block is used at 30 °C and thought to be of the same length?
- 11.5 mm
 - 11.5 μm
 - 100.011 5 mm
 - 11.5 °C

Solution: Solving the problem requires knowledge of the thermal expansion of gage steel, listed in the *CCT Primer*, as approximately 11.5 ppm/°C. This block is being used 10 degrees warmer than its calibration temperature, so it will expand a total of 115 ppm. 100 mm X 115 ppm = 11 500 nm or 11.5 μm.

Answer **c** is the correct length of the block at temperature, but the question asks what would be the error, not the total length.

Answer b is correct.

Reference: *CCT Primer*, Section IV - 14.

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- 4.25. A calibration certificate may state measurement uncertainty, or it may instead contain a statement of compliance to an identified metrological specification. Which of the following is NOT an identified metrological specification?
- a. ASTM D 2240
 - b. TUR of 4:1
 - c. Manufacturer's specifications for 90-day period
 - d. Ambient temperature of 20 degrees C during calibration

Solution: Note that a negative response is requested. An identified metrological specification is one that indicates some limits of expected variation or error. ASTM specs almost always list precision and bias, a statement of TUR can be calculated to yield info about variation. Manufacturer's specifications will have some indication of error, but temperature specs, as in answer **d**, do not address other expected sources of variation.

Answer d is the correct, incorrect, choice.

Reference: *CCT Primer*, Section IV - 59.

- 4.26. How must the end customer be involved in the use of laboratory developed methods?
- a. They must be consulted on the method
 - b. They must design the method
 - c. They must approve the method after it is designed
 - d. They must agree that a laboratory developed method will be used

Solution: The end customer is not considered to necessarily have the technical capability to design a method (they might, but they might not). ISO/IEC 17025 does require, however, that if the laboratory is going to develop a test or calibration method for use on an end customer's work, that the customer must agree.

Answer d is correct.

References: *CCT Primer*, Section IV - 36/37. ISO/IEC 17025.

- 4.27. A non-prescriptive standard:
- a. Describes what must be done but not how it is to be done
 - b. Describes what must be done and how it is to be done
 - c. Describes neither what must be done or how, but suggests what could be done
 - d. Describes where to find a reference to what must be done

Solution: A truly non-prescriptive standard will set expectations and goals and will not specify anything about how they are to be accomplished. This is left entirely up to the organization that decides to conform to the standard. Often, standards that intend to be non-prescriptive turn out to be hybrids, where goals are stated but in some cases the means for achieving those goals are at least outlined as requirements. ISO/IEC 17025, for example, requires management reviews of the effectiveness of the quality system but has a required minimum agenda for those reviews.

Answer a is correct.

Reference: *CCT Primer*, Sections IV - 10/13 and VI - 117 and other references.
