

## **BODY OF KNOWLEDGE CERTIFIED QUALITY TECHNICIAN 2024**

The topics in this Body of Knowledge include additional detail in the form of subtext explanations and the cognitive level at which the questions will be written. This information will provide useful guidance for both the Exam Development Committee and the candidate preparing to take the exam. The subtext is not intended to limit the subject matter or be all-inclusive of what might be covered in an exam. It is meant to clarify the type of content to be included in the exam. The descriptor in parentheses at the end of each entry refers to the maximum cognitive level at which the topic will be tested. A complete description of cognitive levels is provided at the end of this document.

**Math note: Approximately 20% of the questions in each CQT exam will require calculation.**

### **I. Quality Concepts and Tools (19 Questions)**

#### **A. Quality Concepts**

- 1. Customers and suppliers**  
Define internal and external customers, identify their expectations, and determine their satisfaction levels. Define internal and external suppliers and key elements of relations with them. (Understand)
- 2. Quality principles for products and processes**  
Explain basic quality principles related to products (e.g., features, fitness-for-use, and freedom from defects) and processes (e.g., monitoring, measuring, and continuous improvement). Confirm conformance to product or process specifications. Understand the production part approval process (PPAP). (Apply)
- 3. Quality standards, requirements, and specifications**  
Define and distinguish between national and international standards, quality management systems, customer requirements, and product and process specifications. (Understand)
- 4. Cost of quality (COQ)**  
Describe and distinguish between the four classic cost of quality categories (i.e., prevention, appraisal, internal failure, and external failure) and classify activities appropriately. Understand and apply total cost of quality and cost of poor quality (COPQ). (Apply)

#### **B. Quality Tools**

The seven basic quality tools

- Select, construct, and interpret the seven basic quality tools: **1.** cause and effect diagrams, **2.** flowcharts (i.e., process maps), **3.** check sheets, **4.** Pareto charts, **5.** scatter diagrams, **6.** control charts, and **7.** histograms. (Evaluate)
- 8. Problem-solving techniques**  
Define, describe, and apply problem-solving techniques, such as 5 Whys and 8D. (Apply)
  - 9. Lean**  
Identify key concepts and tools, such as 5S, value-stream mapping, and flow. (Remember)
  - 10. Continuous improvement techniques**  
Define and use various continuous improvement techniques, including the plan-do-check-act (PDCA) cycle, six sigma DMAIC (design, measure, analyze, improve, control), brainstorming, and benchmarking. (Apply)

#### **C. ASQ Code of Ethics for Professional Conduct**

Determine and apply appropriate behaviors and actions that comply with the ASQ Code of Ethics. (Evaluate)

## II. Statistical Techniques (17 Questions)

### A. General Concepts

1. Terminology  
Identify and explain statistical terms, such as population, sample, parameter, statistic, and statistical process control (SPC). (Understand)
2. Normal distribution  
Define normal distribution and explain the area under the normal curve. (Understand)

### B. Calculations

1. Measures of central tendency  
Define, compute, and interpret mean, median, and mode. (Analyze)
2. Measures of dispersion  
Define, compute, and interpret standard deviation, range, and variance. (Analyze)
3. Confidence levels and limits  
Explain confidence levels and confidence limits in various situations. (Understand)

### C. Control Charts

1. Control limits vs. specification limits  
Identify and distinguish between the different uses of control limits and specification limits. (Analyze)
2. Variables charts  
Identify, construct, and interpret variables charts, such as individual moving range (I-MR) chart,  $\bar{X} - R$ , and  $\bar{X} - s$ . (Analyze)
3. Attributes charts  
Explain and interpret attributes charts, such as p, np, c, and u. (Understand)
4. Process capability measures  
Define the prerequisites for capability, calculate capability indices (e.g.,  $C_p$ ,  $C_{pk}$ ,  $P_p$ , and  $P_{pk}$ ), and draw conclusions from the results. (Analyze)
5. Common and special cause variation  
Interpret various control chart patterns and trends. Use rules for determining statistical control to distinguish between common cause and special cause variation. (Analyze)

## III. Metrology and Calibration (16 Questions)

### A. Types of Measurement and Test Equipment (M&TE)

Describe the following types of M&TE. (Understand)

1. Hand tools (e.g., calipers, micrometers, linear scales, analog, digital, vernier scales, and dial indicators)
2. Gauges (e.g., pins, threads, custom gauges, and gauge blocks)
3. Optical tools (e.g., comparators, profiles, and microscopes)
4. Coordinate measuring machines (CMMs) (e.g., touch probes, vision, and laser)
5. Electronic measuring equipment (e.g., digital displays and output)
6. Weights, balances, and scales
7. Surface plate methods and equipment

8. Surface analyzers (e.g., profilometers)
9. Force measurement tools (e.g., torque wrenches and tensometers)

## **B. Control and Maintenance of M&TE**

1. M&TE identification, control, and maintenance  
Describe various methodologies for identifying and controlling M&TE to meet traceability requirements and apply appropriate techniques for maintaining such equipment to obtain optimum performance. (Apply)
2. Customer-supplied M&TE  
Describe and apply requirements for validation and control of customer-supplied equipment. (Apply)

## **C. Calibration of M&TE**

1. Calibration intervals  
Apply calibration schedules based on M&TE usage history and risk. (Apply)
2. Calibration results  
Interpret calibration results and the potential impact of using out-of-calibration tools or failing to calibrate equipment on a regular basis. Recognize the need to adjust calibration schedules based on calibration data, records, history, and reliability, and document results. (Analyze)
3. Calibration error  
Identify the causes of calibration error and its effect on processes and products. (Understand)
4. Hierarchy of standards  
Explain the levels of standards (e.g., reference, primary, and transfer) and their relationship to one another. (Apply)

# **IV. Inspection and Test (21 Questions)**

## **A. Reading and Interpreting Drawings**

1. Drawing symbols and components  
Interpret drawings and apply requirements in various test and inspection activities. (Analyze)
2. Geometric dimensioning and tolerancing (GD&T)  
Define and apply GD&T covered in the ASME Y14.5 standard. (Analyze)
3. Classification of product defect characteristics and symbols  
Define and distinguish between product defect characteristics (e.g., critical, major, and minor) and characteristic symbols (e.g., significant and critical). (Analyze)

## **B. Inspection Concepts**

1. Types of measurements  
Define and select between direct, differential, derived, and transfer measurements. (Understand)
2. Gauge selection  
Determine which measurement instrument to use considering factors such as resolution, accuracy, tolerance, environment, and product features. (Evaluate)
3. Measurement system analysis (MSA)  
Define and distinguish between measurement terms, such as correlation, bias, linearity, precision-to-tolerance, attribute, variable, and percent agreement. Describe how gauge repeatability and reproducibility (R&R) studies are performed and how they are applied in support of MSA. (Analyze)

4. Rounding rules  
Use truncation, rounding rules, significant digits, and significant figures on both positive and negative numbers. (Apply)
5. Conversion of measurements  
Convert between metric and English units. (Apply)
6. Inspection points  
Define and distinguish between inspection point functions (e.g., receiving, in-process, final, source, and first-article). Determine what type of inspection is appropriate at different stages of production, from raw materials through finished product. (Analyze)
7. Inspection error  
Explain various types of inspection error, including operator error (e.g., parallax and fatigue), environment (e.g., vibration, humidity, and temperature), and equipment (e.g., limitations, capability, and setup). (Understand)
8. Product traceability  
Explain the requirements for documenting and preserving the identity of a product and its origins. (Apply)
9. Certificates of compliance (CoC) and analysis (CoA)  
Define and compare these two types of certificates. (Understand)

### **C. Sampling**

1. Sampling characteristics  
Identify and define sampling characteristics, such as lot size, sample size, acceptance number, and switching rules. (Apply)
2. Sampling types  
Define and distinguish between sampling types, such as fixed, single, double, skip lot, 100% inspection, attributes, variables, acceptance, parts per million (PPM), and average outgoing quality (AOQ). (Apply)
3. Selecting samples from lots  
Determine sample size (e.g., AQL), selection method, and accept/reject criteria used in various situations. (Apply)

### **D. Nonconforming Material**

1. Identifying and segregating  
Determine whether products and material meet conformance requirements. Use various methods to label, segregate, and document nonconforming material. (Evaluate)
2. Material review process  
Explain various elements of this process, such as the function of the material review board (MRB), the steps in determining fitness-for-use, and product disposition. (Understand)

## **V. Quality Audits (13 Questions)**

### **A. Audit Types and Terminology**

Define basic audit types: **1.** internal, **2.** external, **3.** systems, **4.** product, **5.** process, **6.** virtual, and **7.** distinguish between first-, second-, and third-party audits. (Understand)

### **B. Audit Components**

Describe and apply various elements of the audit process: **1.** audit purpose and scope, **2.** audit reference standards, **3.** audit plan (preparation), **4.** audit performance, **5.** opening and closing

meetings, **6.** grading / classifying audit findings (e.g., major, minor, and observational), and **7.** final report and verification of corrective action. (Apply)

### **C. Audit Tools and Techniques**

Define and apply various auditing tools: **1.** checklists and working papers, **2.** data gathering and objective evidence, **3.** forward- and backward-tracing, and **4.** audit sampling plans and procedural guidelines. (Apply)

## **VI. Risk Management (14 Questions)**

### **A. Risk Assessment and Mitigation**

Describe methods of risk assessment and mitigation, such as trend analysis (SPC), failure mode and effects analyses (e.g., PFMEA and DFMEA), root cause analysis (RCA), product and process monitoring reports, inputs for risk assessment (e.g., customer complaints and field / warranty returns), and control plans. (Understand)

### **B. Corrective Action**

Explain and apply elements of the corrective action process, including identify the problem, contain the problem (interim action), assign responsibility (personnel) to determine the causes of the problem, and propose solutions to eliminate it or prevent its recurrence (permanent action), verify that the solutions are implemented, and confirm their effectiveness (validation). (Apply)

### **C. Preventive Action**

Explain and apply elements of the preventive action process, select data analysis techniques to identify potential failures, defects, and process deficiencies, assign responsibility for improving the process (e.g., develop error- and mistake-proofing devices and methods, initiate procedural changes, evaluate lessons learned, and conduct read across), and verify the effectiveness of the preventive action. (Apply)

## **Levels of Cognition** **Based on Bloom's Taxonomy – Revised (2001)**

In addition to **content** specifics, the subtext for each topic in this BOK also indicates the intended **complexity level** of the test questions for that topic. These levels are based on “Levels of Cognition” (from Bloom's Taxonomy – Revised, 2001) and are presented below in rank order, from least complex to most complex.

### **Remember**

Recall or recognize terms, definitions, facts, ideas, materials, patterns, sequences, methods, principles, etc.

### **Understand**

Read and understand descriptions, communications, reports, tables, diagrams, directions, regulations, etc.

### **Apply**

Know when and how to use ideas, procedures, methods, formulas, principles, theories, etc.

### **Analyze**

Break down information into its constituent parts and recognize their relationship to one another and how they are organized; identify sublevel factors or salient data from a complex scenario.

### **Evaluate**

Make judgments about the value of proposed ideas, solutions, etc., by comparing the proposal to specific criteria or standards.

### **Create**

Put parts or elements together in such a way as to reveal a pattern or structure not clearly there before; identify which data or information from a complex set is appropriate to examine further or from which supported conclusions can be drawn.