BODY OF KNOWLEDGE
CERTIFIED QUALITY TECHNICIAN 2012

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.

I. Quality Concepts and Tools (22 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
   Identify basic quality principles related to products (such as features, fitness-for-use, freedom from defects, etc.) and processes (such as monitoring, measuring, continuous improvement, etc.) (Understand)
3. Quality standards, requirements, and specifications
   Define and distinguish between national or international standards, customer requirements, and product or process specifications. (Understand)
4. Cost of quality (COQ)
   Describe and distinguish between the four classic cost of quality categories (prevention, appraisal, internal failure, external failure) and classify activities appropriately. (Apply)
5. Six sigma
   Identify key six sigma concepts and tools, including green belt and black belt roles and responsibilities, project types and processes used, and define terms such as quality function deployment (QFD), design, measure, analyze, improve, control (DMAIC), etc. (Remember)
6. Lean
   Identify key lean concepts and tools such as, 5S, value-stream mapping, flow, pull, etc. (Remember)
7. Continuous improvement techniques
   Define and use various continuous improvement techniques including the Plan Do Check Act (PDCA) cycle, brainstorming, benchmarking, etc. (Understand)

B. Quality Tools

Select, construct, apply, and interpret the seven basic quality tools: 1) cause and effect diagrams, 2) flowcharts (process maps), 3) check sheets, 4) Pareto charts, 5) scatter diagrams, 6) control charts, and 7) histograms. (Evaluate)

C. Team Functions

1. Meeting management
   Define, describe, and apply various meeting management techniques, including selecting team members, creating and following an agenda, facilitation techniques, recording and distributing minutes, establishing ground rules and protocols, etc. (Apply)

2. Team building methods
   Apply basic team building methods and concepts such as, group dynamics, decision-making tools (e.g., majority voting, multi-voting, consensus), and creative-thinking tools (e.g., nominal group technique). (Apply)

3. Team stages
   Describe the team development stages of forming, storming, norming, and performing, (Understand)

4. Global communication
   Define and describe the impact that globalization has on team-related issues, including developing virtual teams and participating on them, using electronic communications to support long-distance collaboration, etc. (Understand)

II. Statistical Techniques (18 Questions)

A. General Concepts

1. Terminology
   Identify and differentiate between statistical terms such as population, sample, parameter, statistic, statistical process control (SPC), etc. (Understand)

2. Frequency distributions
   Define and compute normal, Poisson, and binomial frequency distributions. (Apply)

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. Statistical inference
   Determine, calculate, and apply confidence levels in various situations. (Apply)

4. Confidence limits
   Determine, calculate, and apply confidence limits in various situations. (Apply)

5. Probability
   Calculate probability using the basic concepts of combinations, permutations, and area under the normal curve. (Apply)

C. Control Charts

1. Control limits vs. specification limits
   Identify and describe the different uses of control limits and specification limits. (Understand)

2. Variables charts
   Identify, select, construct, and interpret variables charts such as $\overline{X} - R$, $\overline{X} - s$, etc. (Analyze)

3. Attributes charts
   Identify, select, construct, and interpret attributes charts such as p, np, c, u, etc. (Analyze)

4. Process capability measures
   Define the prerequisites for capability, and calculate and interpret C_p, C_{pk}, and capability ratio (C_R) in various situations. (Analyze)

5. Common and special cause variation
   Interpret various control chart patterns (runs, hugging, trends, etc.) and use rules for determining statistical control to distinguish between common cause and special cause variation. (Analyze)
6. Data plotting
   Identify the advantages and limitations of using this method to analyze data visually instead of numerically. (Understand)

III. Metrology and Calibration (17 Questions)

A. Types of measurement and test equipment (M&TE)

Describe, select, and use the following types of M&TE, and evaluate their measurement results to determine conformance to specifications. (Evaluate)

1. Hand tools (e.g., calipers, micrometers, linear scales, analog, digital, vernier scales)
2. Gauges (e.g., pins, thread, custom gauges)
3. Optical tools (e.g., comparators, profiles, microscopes)
4. Coordinate measuring machines (CMM)
5. Electronic measuring equipment (e.g., digital displays, output)
6. Weights, balances, and scales
7. Hardness testing equipment (e.g., Brinell, Rockwell)
8. Surface plate methods and equipment
9. Surface analyzers (e.g., optical flats, roughness testers)
10. Force measurement tools (e.g., torque wrenches, tensiometers)
11. Angle measurement tools (e.g., protractors, sine bars, angle blocks, gage blocks)
12. Color measurement tools (e.g., spectrophotometer, color guides, light boxes)

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
   Establish calibration schedules on the basis of M&TE usage history and gauge repeatability and reproducibility (R&R) data. Describe the potential impact of using out-of-calibration tools or failing to calibrate equipment on a regular basis. (Analyze)
2. Calibration error
   Identify the causes of calibration error and its effect on processes and products. (Understand)

IV. Inspection and Test (23 Questions)

A. Blueprint Reading and Interpretation

1. Blueprint symbols and components
   Interpret drawings and apply requirements in various test and inspection activities. (Analyze)
2. Geometric dimensioning and tolerancing (GD&T) terminology
   Define and use GD&T terms covered in the ASME Y14.5 standard. (Analyze)
3. Classification of product defect characteristics
   Define, distinguish between, and classify defect characteristics in terms of critical, major, minor, etc. (Apply)

B. Inspection Concepts

1. Types of measurements
   Define and distinguish between direct, differential, and transfer measurements. (Understand)
2. Gauge selection
   Determine which measurement instrument to use in various situations, based on considerations such as the characteristic to be measured, test uncertainty ratio (TUR), test accuracy ratio (TAR), etc. (Analyze)
3. Measurement systems analysis (MSA)
   Define and distinguish between measurement terms such as correlation, bias, linearity, precision-to-tolerance, percent agreement, etc. 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 and rounding rules 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 (receiving, in-process, final, source, first-article, etc.), and determine what type of inspection is appropriate at different stages of production, from raw materials through finished product. (Apply)
7. Inspection error
   Define various types of inspection error, including parallax, fatigue, flinching, distraction, etc. (Understand)
8. Product traceability
   Describe the requirements for documenting and preserving the identity of a product and its origins. (Understand)
9. Certificates of compliance (COC) and analysis (COA)
   Define and distinguish between these two types of certificates. (Understand)

C. Inspection Techniques and Processes

1. Nondestructive testing (NDT) techniques
   Identify various NDT techniques (X-ray, eddy current, ultrasonic, liquid penetrant, electromagnetic, magnetic particle, etc.) for specific applications. (Understand)
2. Destructive testing techniques
   Identify various destructive tests (tensile, fatigue, flammability, etc.) for specific applications. (Understand)

3. Other testing techniques
   Identify characteristics of testing techniques such as those used for electrical measurement (DC, AC, resistance, capacitance, etc.), chemical analysis (pH, conductivity, chromatography, etc.), and physical/mechanical measurement (pressure tests, vacuum, flow, etc.) (Remember)

D. Sampling

1. Sampling characteristics
   Identify and define sampling characteristics such as operating characteristic (OC) curve, lot size, sample size, acceptance number, switching rules, etc. (Apply)
2. Sampling types
   Define and distinguish between fixed sampling, 100% inspection, attributes and variables sampling, etc. (Apply)
3. Selecting samples from lots
   Determine sample size (e.g., AQL), selection method and accept/reject criteria (e.g., zero-defect sampling) used in various situations. (Apply)

E. Nonconforming material

1. Identifying and segregating
   Determine whether products or material meet conformance requirements, and use various methods to label and segregate nonconforming materials. (Apply)
2. Material review process
   Describe various elements of this process, including the function of the material review board (MRB), the steps in determining fitness-for-use and product disposition, etc. (Understand)

V. Quality Audits (11 Questions)

A. Audit types and terminology

Define basic audit types: 1) internal, 2) external, 3) systems, 4) product, 5) process; and 6) 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 standard, 3) audit plan (preparation), 4) audit performance, 5) opening and closing meetings, 6) 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, 4) audit sampling plans and procedural guidelines. (Apply)

D. Audit communication tools

Identify and use appropriate interviewing techniques and listening skills in various audit situations, and develop and use graphs, charts, diagrams, and other aids in support of written and oral presentations. (Apply)

VI. Corrective and Preventive Action (CAPA) (9 Questions)

A. Corrective action

Identify and apply elements of the corrective action process: 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)

B. Preventive action

Identify and apply elements of a preventive action process: use various data analysis techniques (e.g., trend analysis, failure mode and effects analysis (FMEA) product and process monitoring reports) to identify potential failures, defects, or process deficiencies; assign responsibility for improving the process (develop error- or mistake-proofing devices or methods, initiate procedural changes, etc.), and verify the effectiveness of the preventive action. (Apply)

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

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.