

THE ASQ CERTIFIED QUALITY ENGINEER



Quality excellence to enhance your career
and boost your organization's bottom line

asq.org/cert



ASQ

Excellence Through Quality®

Certification from ASQ is considered a mark of quality excellence in many industries. It helps you advance your career and boosts your organization's bottom line through your mastery of quality skills. Becoming certified as a Quality Engineer confirms your commitment to quality and the positive impact it will have on your organization.



Examination

Each certification candidate is required to pass an examination that consists of multiple-choice questions that measure comprehension of the body of knowledge.

The ASQ Certified Quality Engineer

The Certified Quality Engineer (CQE) is a professional who understands the principles of product and service quality evaluation and control. This body of knowledge and applied technologies include, but are not limited to, development and operation of quality control systems, application and analysis of testing and inspection procedures, the ability to use metrology and statistical methods to diagnose and correct improper quality control practices, an understanding of human factors and motivation, familiarity with quality cost concepts and techniques, and the knowledge and ability to develop and administer management information systems and to audit quality systems for deficiency identification and correction.



CQE

Computer Delivered - The CQE examination is a one-part, multiple choice 175-question exam and is offered in English only. 160 multiple choice questions are scored and 15 are unscored. Total appointment time is five-and-a-half hours, exam time is 5 hours and 18 minutes.

Paper and Pencil – The CQE examination is a one-part, 160-question, five-hour exam and is offered in Mandarin and Korean in certain locations.

For comprehensive exam information on the Quality Engineer certification, visit asq.org/cert.



Education and/or Experience

You must have eight years of on-the-job experience in one or more of the areas of the Certified Quality Engineer Body of Knowledge.

A minimum of three years of this experience must be in a decision-making position. "Decision making" is defined as the authority to define, execute, or control projects/processes and to be responsible for the outcome. This may or may not include management or supervisory positions.

If you were ever certified by ASQ as:

- Quality Auditor (CQA)
- Reliability Engineer (CRE)
- Software Quality Engineer (CSQE)
- Manager of Quality/Organizational Excellence (CMQ/OE)
- Supplier Quality Professional (CSQP)

Experience used to qualify for certification in these fields applies to certification as a Quality Engineer (CQE).



If you have completed a degree* from a college, university, or technical school with accreditation accepted by ASQ, part of the eight-year experience requirement will be waived, as follows (only one of these waivers may be claimed):

- Diploma from a technical or trade school—one year will be waived.
- Associate's degree—two years waived.
- Bachelor's degree—four years waived.
- Master's or doctorate—five years waived

*Degrees or diplomas from educational institutions outside the United States must be equivalent to degrees from U.S. educational institutions.

BODY OF KNOWLEDGE

The ASQ Certified Quality Engineer (CQE)

Topics in this body of knowledge (BoK) include 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 that material that will be covered in the exam. It is meant to clarify the type of content that will be included on 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. Management and Leadership (17 Questions)

A. Quality Philosophies and Foundations

Describe continuous improvement tools, including lean, Six Sigma, statistical process control (SPC), and total quality management. Understand how modern quality has evolved from quality control through statistical process control (SPC) to total quality management and leadership principles (including Deming's 14 points). (Understand)

B. The Quality Management System (QMS)

1. Strategic planning

Identify and define top management's responsibility for the QMS, including establishing policies, and objectives, setting organization-wide goals, and supporting quality initiatives. (Apply)

2. Deployment techniques

Define, describe, and use various deployment tools in support of the QMS such as:

a. Benchmarking

Define the concept of benchmarking and why it may be used. (Remember)

b. Stakeholder

Define, describe, and use stakeholder identification and analysis. (Apply)

c. Performance

Define, describe, and use performance measurement tools such as cost-benefit analysis. (Apply)

d. Project management

Define, describe, and use project management tools, including Gantt charts and the responsible, accountable, consulted and informed matrix (RACI). (Apply)

3. Quality information system (QIS)

Identify and describe the basic elements of a QIS, including who will contribute data, the kind of data to be managed, who will have access to the data, the level of flexibility for future information needs, and data analysis. (Understand)

C. ASQ Code of Ethics for Professional Conduct

Determine appropriate behavior in situations requiring ethical decisions. (Evaluate)

D. Leadership Principles and Techniques

Analyze various principles and techniques for developing and organizing teams and leading quality initiatives. (Analyze)

E. Facilitation Principles and Techniques

1. Roles and responsibilities

Describe the facilitator's roles and responsibilities on a team. (Understand)

2. Facilitation tools

Apply various tools used with teams, including brainstorming, nominal group technique, conflict resolution, and force-field analysis. (Apply)

F. Communication Skills

Identify and distinguish between specific communication methods that are used for delivering information and messages in a variety of situations across all levels of the organization. (Analyze)

G. Customer Relations

Define, apply, and analyze the results of customer relation tools such as customer satisfaction surveys. (Analyze)

H. Supplier Management

1. Techniques

Apply various supplier management techniques, including supplier qualification, certification, and evaluation. (Apply)

2. Improvement

Analyze supplier ratings and performance improvement results. (Analyze)

3. Risk

Understand business continuity, resiliency, and contingency planning. (Understand)

I. Barriers to Quality Improvement

Identify barriers to quality improvement, analyze their causes and impact, and implement methods for improvement. (Analyze)

II. The Quality System (18 Questions)

A. Elements of the Quality System

1. Basic elements

Interpret the basic elements of a quality system, including planning, control, and improvement, from product and process design through quality cost systems and audit programs. (Evaluate)

2. Design

Analyze the design and alignment of interrelated processes to the strategic plan and core processes. (Analyze)

B. Documentation of the Quality System

1. Document components

Identify and describe quality system documentation components, including quality policies and procedures to support the system. (Understand)

2. Document control

Evaluate configuration management, maintenance, and document control to manage work instructions and quality records. (Evaluate)

C. Quality Standards and Other Guidelines

Apply national and international standards and other requirements and guidelines, including the Malcolm Baldrige National Quality Award (MBNQA), and describe key points of the ISO 9000 series of standards. (Note: Industry-specific standards will not be tested.) (Apply)

D. Quality Audits

1. Types of audits

Describe and classify the various types of quality audits such as product, process, management (system), registration (certification), compliance (regulatory), first, second, and third party. (Apply)

2. Roles and responsibilities in audits

Identify and define roles and responsibilities for audit participants such as audit team (leader and members), client, and auditee. (Understand)

3. Audit planning and implementation

Describe and apply the stages of a quality audit, from audit planning, including assessing risks through conducting an audit. (Apply)

4. Audit reporting and follow-up

Apply the steps of audit reporting and follow-up, including the need to verify corrective action. (Apply)

E. Cost of Quality (COQ)

Identify and apply COQ concepts, including cost categorization, data collection, reporting, and interpreting results. (Analyze)

F. Quality Training

Identify and apply key elements of a training program, including conducting a needs analysis, preparing curricula and materials, and determining the program's effectiveness. (Apply)

III. Product, Process, and Service Design (21 Questions)

A. Classification of Quality Characteristics

Define, interpret, assess, and classify quality characteristics for new and existing products, processes, and services. (Note: The classification of defects is covered in IV.B.3.) (Evaluate)

B. Design Inputs, Techniques, and Review

1. Inputs

Classify design inputs such as customer needs, regulatory requirements, critical to quality, and risk assessment into robust design using techniques such as failure mode and effects analysis (FMEA). (Analyze)

2. Techniques

Apply Design for X (DFX), Design for Six Sigma (DFSS), and requirements traceability. (Apply)

3. Review

Identify and apply common elements of the design review process, including roles and responsibilities of participants. (Apply)

C. Technical Drawings and Specifications

Interpret specification requirements in relation to product and process characteristics and technical drawings, including characteristics such as views, title blocks, dimensioning and tolerancing, and geometric dimensioning and tolerance symbols (GD&T). (Evaluate)

D. Verification and Validation

Interpret the results of evaluations and tests used to verify and validate the design of products, processes and services, such as installation qualification (IQ), operational qualification (OQ), and process qualification (PQ). (Evaluate)

E. Reliability and Maintainability

1. Predictive and preventive maintenance tools

Describe and apply the tools and techniques used to maintain and improve process and product reliability. (Apply)

2. Reliability and maintainability indices

Apply indices such as mean time to failure (MTTF), mean time between failure (MTBF), mean time to repair (MTTR), availability, and failure rate. (Apply)

3. Reliability models

Classify and apply the basic elements of reliability models such as exponential, Weibull, and bathtub curve. (Apply)

4. Reliability/Safety/Hazard Assessment Tools

Define, construct, and interpret the results of failure mode and effects analysis (FMEA), design FMEA (dFMEA), process FMEA (pFMEA), use FMEA (uFMEA), failure mode, effects, and criticality analysis (FMECA), and hazard analysis. (Analyze)

IV. Product and Process Control (23 Questions)

A. Methods

Implement product and process control methods such as control plan development, critical control point identification, and work instruction development and validation. (Analyze)

B. Material Control

1. Material identification, status, and traceability

Define and distinguish between these concepts, and describe methods for applying them in various situations. (Analyze)

2. Material segregation

Describe material segregation and its importance, and evaluate appropriate methods for applying it in various situations. (Evaluate)

3. Material classification

Assess and classify product and process defects and nonconformities. (Evaluate)

4. Material review board (MRB)

Describe the purpose and function of an MRB, and evaluate nonconforming product or material to make a disposition decision in various situations. (Evaluate)

C. Acceptance Sampling

1. Sampling concepts

Apply the concepts of producer and consumer risk, and related terms, including operating characteristic (OC) curves, acceptable quality limit (AQL), and lot tolerance percent defective (LTPD). (Apply)

2. Sampling standards and plans

Identify, interpret, and apply ANSI/ASQ Z1.4 and Z1.9 standards for attributes and variables sampling. (Analyze)

3. Sample integrity

Identify and apply techniques for establishing and maintaining sample integrity. (Apply)

D. Measurement and Test

1. Measurement tools

Select and describe appropriate uses of inspection tools such as gage blocks, calipers, micrometers, optical comparators, and coordinate measuring machines (CMM). (Analyze)

2. Destructive and nondestructive tests

Identify when destructive and nondestructive measurement test methods should be used and apply the methods appropriately. (Apply)

E. Metrology

Apply metrology techniques such as calibration, traceability to calibration standards, measurement error and its sources, and control and maintenance of measurement standards and devices. (Apply)

F. Measurement System Analysis (MSA)

Calculate, analyze, and interpret repeatability and reproducibility (gage R&R) studies, measurement correlation, capability, bias, linearity, precision, stability and accuracy, using MSA quantitative and graphical methods. (Evaluate)

V. Continuous Improvement (26 Questions)

A. Quality Control Tools

Select, construct, apply, and interpret the following quality control tools:

1. Flowcharts
2. Pareto charts
3. Cause and effect diagrams
4. Control charts
5. Check sheets
6. Scatter diagrams
7. Histograms (Analyze)

B. Quality Management and Planning Tools

Select, construct, apply, and interpret the following quality management and planning tools:

1. Affinity diagrams and force field analysis
2. Tree diagrams
3. Process decision program charts (PDPC)
4. Matrix diagrams
5. Interrelationship digraphs
6. Prioritization matrices
7. Activity network diagrams (Analyze)

C. Continuous Improvement Methodologies

Define, describe, and apply the following continuous improvement methodologies:

1. Total quality management (TQM)
2. Kaizen
3. Plan-do-check-act (PDCA)
4. Six Sigma (Analyze)

D. Lean tools

Define, describe, and apply the following lean tools:

1. 5S
2. Value stream mapping
3. Kanban
4. Visual control
5. 8 Wastes
6. Standardized work
7. Takt time
8. Single minute exchange of die (SMED)
9. Overall equipment effectiveness (OEE) (Evaluate)

E. Corrective Action

Identify, describe, and apply elements of the corrective action process, including problem identification, failure analysis, root cause analysis, 5 Whys, problem correction, recurrence control, and verification of effectiveness. (Evaluate)

F. Preventive Action

Identify, describe, and apply various preventive action tools such as error proofing/poka-yoke, and robust design, and analyze their effectiveness. (Evaluate)

VI. Quantitative Methods and Tools (34 Questions)

A. Collecting and Summarizing Data

1. Types of data

Define, classify, and compare discrete (attributes) and continuous (variables) data. (Apply)

2. Measurement scales

Define and describe nominal, ordinal, interval, and ratio scales. (Understand)

3. Data collection methods

Describe various methods for collecting data, including tally or check sheets, data coding, automatic gaging, data automation, database integration, and identify the strengths and weaknesses of the methods. (Apply)



4. Data accuracy and integrity

Identify factors that can influence data accuracy such as source/resource issues, flexibility, versatility, inconsistency, inappropriate interpretation of data values, and redundancy to ensure data accuracy and integrity. (Apply)

5. Data visualization techniques

Apply and interpret data visualization techniques using dashboards, and select the appropriate metrics for dashboards. (Apply)

6. Descriptive statistics

Describe, calculate, and interpret measures of central tendency and dispersion, apply the central limit theorem, and construct and interpret frequency distributions, including simple, categorical, grouped, ungrouped, and cumulative. (Evaluate)

7. Graphical methods for depicting distributions

Apply and interpret diagrams such as probability plots for normal and other distributions. (Note: Histograms are covered in V.A.) (Analyze)

B. Quantitative Concepts

1. Terminology

Define and apply quantitative terms, including population, parameter, sample, statistic, random sampling, and expected value. (Analyze)

2. Drawing statistical conclusions

Distinguish between numeric and analytical studies. Assess the validity of statistical conclusions by analyzing the assumptions used and the robustness of the technique used. (Evaluate)

3. Probability terms and concepts

Describe concepts such as independence, mutual exclusivity, multiplication rules, complementary probability, and joint occurrence of events. (Apply)

C. Probability Distributions

1. Continuous distributions

Define and distinguish between these distributions such as normal, uniform, exponential, lognormal, Weibull, Student's *t*, and *F*. (Analyze)



2. Discrete distributions

Define and distinguish between these distributions such as binomial, Poisson, hypergeometric, and multinomial. (Analyze)

D. Statistical Decision-Making

1. Point estimates and confidence intervals

Define, describe, and assess the bias of estimators. Calculate and interpret standard error, tolerance intervals, and confidence intervals. (Evaluate)

2. Hypothesis testing

Define, interpret, and apply hypothesis tests for means, variances, and proportions. Apply and interpret the concepts of significance level, power, type I, and type II errors. Define and distinguish between statistical and practical significance. (Evaluate)

3. Paired-comparison tests

Define and use paired-comparison (parametric) hypothesis tests and interpret the results. (Apply)

4. Goodness-of-fit tests

Define and use chi square and other goodness-of-fit tests and understand the results. (Apply)

5. Analysis of variance (ANOVA)

Define, use, and interpret ANOVA and interpret the results. (Analyze)

6. Contingency tables

Define and use contingency tables to evaluate statistical significance. (Apply)

E. Relationships Between Variables

1. Linear regression

Calculate simple linear regression models. Illustrate hypothesis tests for regression statistics. Use linear regression models for estimation and prediction. (Apply)

2. Simple linear correlation

Calculate the correlation coefficient and its confidence interval and illustrate a hypothesis for correlation statistics. (Apply)

3. Time-series analysis

Define, describe, and use time-series analysis, including moving average to identify trends and seasonal or cyclical variation. (Apply)

F. Statistical Process Control (SPC)

1. Objectives and benefits

Identify and explain the objectives and benefits of SPC. (Understand)

2. Common and special causes

Describe, identify, and distinguish between these types of causes. (Analyze)

3. Selection of variable

Identify and select variable characteristics for monitoring by control charts. (Analyze)

4. Rational subgrouping

Define and apply the principles of rational subgrouping. (Apply)

5. Control charts

Identify, select, construct, and use various control charts, including $\bar{X}$ -R, $\bar{X}$ -s, individuals and moving range (ImR or XmR), moving average and moving range (MamR), p, np, c, and u. (Analyze)

6. Control chart analysis

Read and interpret control charts and use rules for determining statistical control. (Evaluate)

7. Short-run SPC

Identify and define short-run SPC rules. (Understand)

G. Process and Performance Capability

1. Process capability studies

Define, describe, calculate, and use process capability studies, including identifying characteristics, specifications and tolerances, developing sampling plans for such studies, and establishing statistical control. (Analyze)

2. Process performance vs. specifications

Distinguish between natural process limits and specification limits, and calculate percent defective, defects per million opportunities (DPMO), and parts per million (PPM). (Analyze)

3. Process capability indices

Define, select, and calculate C_p , C_{pk} , C_{pm} , and C_r , and evaluate process capability. (Evaluate)

4. Process performance indices

Define, select, and calculate P_p and P_{pk} , and evaluate process performance. (Evaluate)

H. Design and Analysis of Experiments

1. Terminology

Define terms such as dependent and independent variables, factors, levels, response, treatment, error, and replication. (Understand)

2. Planning and organizing experiments

Identify the basic elements of designed experiments, including determining the experiment objective, selecting factors, responses, and measurement methods, and choosing the appropriate design. (Analyze)

3. Design principles

Define and apply the principles of power and sample size, balance, replication, order, efficiency, randomization, blocking, interaction, and confounding. (Apply)

4. Full-factorial experiments

Construct full-factorial designs and use computational and graphical methods to analyze the significance of results. (Analyze)

5. Two-level fractional factorial experiments

Construct two-level fractional factorial designs and apply computational and graphical methods to analyze the significance of results. (Analyze)

VII. Risk Management (21 Questions)

A. Risk Fundamentals

1. Risk terminology

Define, describe, and apply risk terminology such as risk, risk management, severity, occurrence, detection, and risk-based thinking. (Analyze)

2. Types of risk management

Understand and apply various types of enterprise (strategic, software, business, regulatory, medical, audit), operational (supplier, supply chain, safety, project, manufacturing, operations, service, quality system), and product (design, process, use, safety) risk management. (Apply)

B. Risk Planning and Assessment

1. Risk management plan

Analyze and interpret a risk management plan and its components (objectives, risk criteria, stakeholder identification, and team member roles/responsibilities) to identify and prioritize risks. (Analyze)

2. Risk assessment

Apply categorization methods and evaluation tools to assess risk such as failure mode and effects analysis. Identify and apply evaluation metrics including the use of risk matrices, risk priority numbers, and acceptability criteria. (Analyze)

C. Risk Treatment, Control, and Monitoring

1. Identification and documentation

Identify risks, gaps, and controls and document with tools such as a risk register. (Analyze)

2. Risk management system evaluation

Apply auditing techniques and testing of controls to evaluate a risk management system. (Apply)

3. Risk treatment strategies

Understand and apply risk treatment strategies, such as avoid, mitigate, transfer, and accept. (Analyze)

4. Risk monitoring

Apply risk monitoring techniques such as, complaint tracking, trending, and post-market surveillance. (Analyze)

5. Mitigation planning

Apply and interpret risk mitigation plan. (Analyze)



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.

Visit asq.org/cert for comprehensive exam information.



Enhance your career with ASQ certification today!

Visit asq.org/cert for additional
certification information including:

- Exam Dates - asq.org/cert/dates
- Additional CQE Details - asq.org/cert/quality-engineer
- Reference materials - asq.org/cert/quality-engineer/references
- Exam Preparation Resources - asq.org/cert/prepare
- Apply for the Exam - asq.org/cert/apply-certification
- Computer-Based Testing Information - asq.org/cert/computer-based-testing

2022 CQE BoK

