

# Certified Reliability Engineer (CRE)

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# Course Description:

- Assuring Reliability of new products is a major challenge for senior management of most organizations. This Reliability Engineering workshop is designed to provide in-depth understanding of Reliability Engineering Basics, Life Data Analysis, Reliability in Design, Reliability Testing, Maintainability and Availability and various Statistical Techniques. For more details, see agenda of the workshop on page 2. According to American Society for Quality (ASQ) : "The Certified Reliability Engineer (CRE) is a professional who understands the principles of performance evaluation and prediction to improve product/systems safety, reliability, and maintainability." The CRE Body of Knowledge (BOK) and applied technologies include, but are not limited to, design review and control; prediction, estimation, and apportionment methodology; failure mode and effects analysis; the planning, operation, and analysis of reliability testing and field failures, including mathematical modeling; understanding human factors in reliability; and the ability to develop and administer reliability information systems for failure analysis, design, and performance improvement and reliability program management over the entire product life cycle.

# Course Objective:

- This workshop is designed based on body of knowledge published by ASQ. The course kit includes a copy of Certified Reliability Engineer Handbook published by ASQ, additional training material from Institute of Quality and Reliability and a CD with some useful templates and fully functional trial versions of software. Classroom training is supported with hands on exercises and tutorials. Participants are expected to bring scientific calculators and laptop computers for effective learning. Some of the exercises are designed using reliability analysis software and templates.

## Training Methods:

**This interactive Training will be highly interactive, with opportunities to advance your opinions and ideas and will include:**

- Lectures
- Workshop & Work Presentation
- Case Studies and Practical Exercise
- Videos and General Discussions

# Course outline

## Day 1:

- Introduction to Reliability: Definitions: Failure, Reliability, MTTF, MTBF, Failure Rate, Maintainability, Availability etc.
- Product Life Cycle: Bathtub curve, Decreasing Failure Rate (Infant Mortality or Burn-in period), Constant Failure Rate (Useful life), Increasing Failure Rate (Wear-out period)
- Basic Probability and Probability Distributions in Reliability Engineering: Exponential, Weibull, Normal, Lognormal, Examples and illustrations
- Data Collection and Use: Types of data, collection methods, data management and use, Corrective and Preventive Action using failure analysis to find root cause(s)
- Life Data Analysis of Non-repairable Systems: Complete and Censored Data, Identifying distribution, Probability Plotting, Estimating Parameters of the distribution, predicting reliability, Exercises

# Course outline

## Day 2:

- Reliability Modeling and Prediction: Reliability Block Diagrams: Series and parallel systems, combined reliability, redundancy: complete and partial, Physics of failure mode, failure mechanisms, S-N Curve, Stress Strength Analysis using distributions, Monte Carlo Simulation, Markov Models
- Reliability in Design: S-N Curve, Stress Strength Analysis using distributions, Tolerance Analysis: Worst Case Analysis, RMS, Use of Monte Carlo Simulation, Redundancy, Design for X, Derating
- FMEA and FMECA: FMEA Basics, Guidelines for Severity, Occurrence and Detection Ranking, RPN and prioritization for corrective action, revised rating, FMEA team dynamics, Developing DVP&R, Small Group Exercise.
- Human Factors and considerations: Relationship between reliability and human factors, consideration of these factors in designs.
- Reliability Testing: Reliability Test strategies and planning, Environmental considerations, Sampling Plans, Success Run Theorem, Probability Ratio Sequential Testing (PRST), Determination of sample size for testing, Degradation Testing, Software Testing, Stress Screening

# Course outline

## Day 3:

- Reliability Growth and FRACAS: Duane Model, AMSAA model for reliability growth, Exercise(s), Failure Reporting and Corrective Action System (FRACAS)
- Accelerated Life Tests (ALT): Introduction to ALT, Modeling considerations, Arrhenius and other Models, Step Stress Testing, Illustrations and Exercise(s)
- Availability and Maintainability: Definitions, Maintenance Strategies, Preventive and Corrective Maintenance, Nondestructive evaluation, (Predictive Maintenance), Maintenance Time Distributions, Spare Parts Strategy, Reliability Centered Maintenance (RCM).

# Course outline

## Day 4:

- Inferential Statistics: Basic concepts: Null & Alternate Hypotheses, Producer's and consumer's risks, confidence level, point and interval estimates Z, t, F, Chi-square etc.
- Design of Experiments: Plan and conduct Full Factorial Experiments, Fractional Factorials, Taguchi Designs with noise factors (robust design)

## Day 5:

- Warranty Data Analysis: Warranty terms and conditions, uses and limitations of warranty
- Test of comprehension
- Closing Remarks and Wrap up