Reliability Definitions

Reliability is an engineering discipline for applying scientific know-how to a component, assembly, plant, or process so it will perform its intended function, without failure, for the required time duration when installed and operated correctly in a specified environment.

Reliability terminates with a failure—i.e, unreliability occurs. Business enterprises observe the high cost of unreliability. The high cost of unreliability motivates an engineering solution to control and reduce costs.

Among living organisms, reliability would be studied in terms of survivors. Unreliability would be studied in terms of mortality.

You may not clearly understand the definition of reliability. However, when your automobile stop functioning during your mission, you will clearly understand the concept of unreliability. You'll also learn about the gut rending reality of the cost of unreliability when you have your automobile restored to a reliable condition.

MIL-STD-721C Definitions of Terms For Reliability and Maintainability gives two definitions for reliability:

1. **The duration or probability of failure-free performance under stated conditions**
2. **The probability than an item can perform its intended function for a specified interval under stated conditions**
   (For non-redundant items this is equivalent to definition (1).
   For redundant items this is equivalent to definition of mission reliability)

Reliability (the absence of failures which defines the probability of the failure free interval) is often confused with availability (% up time). See the table below for a chance failure mode, a one year mission time, and the failure rate required to achieve the specified reliability. More details are described for availability ≠ reliability on this website.

Reliability Is Driven By ⇒ Number Of Failures

Reliabililty	Failures per year	Failures per 10 years	Failures per 100 years
10.00%	2.30		
20.00%	1.61		
30.00%	1.20		
40.00%	0.92		
50.00%	0.69		
60.00%	0.51		
70.00%	0.36		
80.00%	0.22	2.23	
90.00%	0.11	1.05	
95.00%	0.05	0.51	
99.00%	0.01	0.10	1.01
99.50%	0.005	0.05	0.50
99.90%	0.001	0.01	0.10
99.99%	0.0001	0.001	0.01
99.999%	0.00001	0.0001	0.001
99.9999%	0.0000010	0.00001	0.0001
99.99999%	0.00000010	0.000001	0.00001
1 yr mission = 365 days/yr * 24 hrs/day = 8760 hrs/yr			

Just as a reminder --these numbers are based on chance failures modes and #'s can change with other failure modes!

How many failures can you afford?

How much can you afford to spend to avoid failures?

For private enterprise production facilities the key issue is preventing failure of the money making machine called the process. A key problem to quantify is accepting or denying the risk for failure of the process. Pumps, compressors, valves, and computers will fail according the natural law of entropy; however we must consider alternatives for achieving a failure free process to key cash flowing for the corporation. So, consider this practical definition for reliability:

> **Reliability is the probability that a device, system, or process will perform its prescribed duty without failure for a given time when operated correctly in a specified environment.**

Barringer & Associates, Inc. are reliability consultants solving reliability problems for industry using engineering, manufacturing, and business expertise. We specialize in solving reliability problems for profit oriented, capital intensive, continuous process operations. Through our network of reliability experts, we get cost effective engineers assigned to solve your reliability problems efficiently and cost effectively. Our efforts are driven by the high cost of unreliability. We believe in crass commercialism for profitable improvements. If the proposed improvements do not provide financial (or safety) returns, then we reject the improvements as not being worthy of implementation. Our philosophy is NOT to move in with the client—we want to help clients make

improvements and we will teach our clients how to use the science and technology of reliability to make their own improvements as we move along to other tasks.

Our training course in **Reliability Engineering Principles** teaches engineers how to use equipment failure data to reduce the high cost of unreliability. Failure data drive reliability-centered maintenance (**RCM**) programs required for 15-30% of the equipment which can benefit from RCM and we support total productive maintenance (**TPM**) efforts for 60-80% of the equipment in most operating plants.

Our training course in **Life-Cycle-Cost** brings together reliability models, cost details, installation practices, operating practices, and failure data for making good business decisions. The training course uses Monte Carlo simulations in an Excel spreadsheet to simulate failures expected each year and shows how to cost the results over the life of the equipment or project. We support extensive up-front reliability and maintainability efforts to reduce the long term cost of ownership.

Our training course in **Process Reliability** teaches engineers how to study their processes and determine the reliability so that losses can be reduced and profits increased.

Over 2000 engineers have received training in the **Reliability Engineering Principles training** course in the USA, Canada, Europe, and Asia. The **Life-Cycle-Cost training** program integrates business decisions into engineering failure details to show how equipment and projects are managed for the lowest long-term cost of ownership. The **Process Reliability training** program shows how to use production output data to find consistency in the process and calculates losses from reliability issues and from efficiency/utilization problems. These practical courses use software to solve statistical problems while we concentrate our training efforts on how to use data, and reliability-engineering tools cost effectively.

Our software uses Weibull statistics in Monte Carlo models for cost effective business solutions for reliability and availability problems.

We sell Fulton Findings software for Weibull analysis of failure data and we use this software to build Weibull-databases from failure data.

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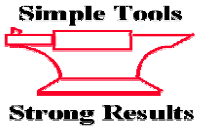

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