



TECHNICAL REPORT

GEIA-STD-0009™

REV. A

Issued 2008-08
Revised 2020-05

Superseding GEIA-STD-0009

(R) Reliability Program Standard for Systems Design,
Development, and Manufacturing

RATIONALE

The GEIA-STD-0009 was revised and approved with minor changes on December 2019 by G-41 SAE Committee as 5 years document cycle. It was better aligned to recently revisited TA-HB-0009.

TABLE OF CONTENTS

1.	SCOPE	5
1.1	Approach	5
1.2	Reliability Program Plan and Reliability Case	6
1.3	Tailoring	6
1.4	Organization	6
1.4.1	Structure of Objectives	7
1.4.2	Development and Flow of Information Between Objectives	8
2.	INFORMATIVE REFERENCES	8
3.	DEFINITIONS	9
4.	OBJECTIVE 1: UNDERSTAND CUSTOMER/USER REQUIREMENTS AND CONSTRAINTS	11
4.1	Introduction (Informative)	11
4.2	Mission and Goals (Informative)	11
4.3	People and Organizations (Normative)	12
4.4	Supporting Information (Normative)	13
4.4.1	Input Information (Normative)	13
4.4.2	Developed Information (Normative)	13
4.5	Activities, Methods, and Tools	14
4.5.1	Activities (Normative)	14
4.5.2	Methods and Tools (Informative)	20
5.	OBJECTIVE 2: DESIGN AND REDESIGN FOR RELIABILITY	20
5.1	Introduction (Informative)	20
5.2	Mission and Goals (Informative)	20
5.3	People and Organizations (Normative)	20
5.4	Supporting Information	22
5.4.1	Input Information (Normative)	22
5.4.2	Developed Information (Normative)	22
5.5	Activities, Methods, and Tools	23

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2020 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE GEIASTD0009A

For more information on this standard, visit
<https://www.sae.org/standards/content/GEIA-STD-009A>

Documents
Document Sharing Hub

5.5.1	Activities (Normative)	23
5.5.2	Methods and Tools (Informative)	26
6.	OBJECTIVE 3: PRODUCE RELIABLE SYSTEMS/PRODUCTS	26
6.1	Introduction (Informative)	26
6.2	Mission and Goals (Informative)	26
6.3	People and Organizations (Normative).....	26
6.4	Supporting Information	27
6.4.1	Input Information (Normative)	27
6.4.2	Developed Information (Normative)	28
6.5	Activities, Methods, and Tools	28
6.5.1	Activities (Normative)	28
6.5.2	Methods and Tools (Informative)	30
7.	OBJECTIVE 4: MONITOR AND ASSESS USER RELIABILITY	30
7.1	Introduction (Informative)	30
7.2	Mission and Goals (Informative)	31
7.3	People and Organizations (Normative).....	31
7.4	Supporting Information	32
7.4.1	Input Information (Normative)	32
7.4.2	Developed Information (Normative)	32
7.5	Activities, Methods, and Tools	33
7.5.1	Activities (Normative)	33
7.5.2	Methods and Tools (Informative)	37
7.6	Outputs and Documentation (Normative)	37
8.	NOTES	38
8.1	Revision Indicator.....	38
ANNEX A	METHODS MATRIX (INFORMATIVE)	39
ANNEX B	RELIABILITY BEST PRACTICES LIST (INFORMATIVE).....	46
ANNEX C	KEY DOCUMENTS MATRIX (INFORMATIVE)	49
ANNEX D	KNOWN FAILURE DEFINITION AND SCORING CRITERIA (NORMATIVE)	50
ANNEX E	ACRONYMS (INFORMATIVE)	51
Figure 1	Information flow between objectives	8
Figure 2	Objective 1 inputs, activities, and output.....	12
Figure 3	Objective 2 inputs, activities, and outputs.....	21
Figure 4	Objective 3 inputs, activities, and outputs.....	27
Figure 5	Objective 4 inputs, activities, and outputs.....	31
Table 1	Organization of standard	6

FOREWORD

Since the cancellation in 1998 of MIL-STD-785B, *Reliability Program for Systems and Equipment Development and Production*, the government has not released a replacement government reliability standard for use in contractual documents that describes the kinds of reliability management practices and reliability design and testing activities the customer will want developers to propose. A reliability standard is needed that aligns with best practices, but is not prescriptive in terms of reliability tasks or methods to be performed. Rather, developers are considered equal partners in deciding which reliability methods are applicable. This standard addresses those needs.

This standard is intended to align best practices of reliability management, design and testing with reliability methods that provide the most value and the least risk in terms of achieving reliable products. The demand for highly-reliable systems/products prompted the development of a new standard that specifies a scientific approach to reliability design, assessment, and verification, coupled with integrated management and systems engineering. This standard defines “what to do” in order to design and build reliability in, then maintain high reliability when the system/product is in the hands of the user.

INTRODUCTION

The main body of this standard consists of the following four objectives:

1. Understand Customer/User Requirements and Constraints
2. Design and Redesign for Reliability
3. Produce Reliable Systems/Products
4. Monitor and Assess User Reliability

It is important to note that this standard is focused on the attainment of Operational Reliability that meets the customer's documented expectation and requirements. Operational Reliability includes hardware and software failures, but also includes other common failure causes, such as manufacturing, operator error, operator maintenance, training, quality, etc. These other failure causes are often associated with human factors, but may also include a design element associated with the failure causes. These non-hardware/software failure causes often contribute up to 30% or more to the Operational Reliability failure rate and must be considered early in development for a comprehensive and successful reliability program.

The Working Group reviewed various documents before drafting this standard, especially Military Standard 785, Reliability Program for Systems and Equipment Development and Production, which was cancelled in July 1998, and the new industry standards that were issued at that time as alternatives:

- IEEE 1332, Standard Reliability Program for the Development and Production of Electronic Systems and Equipment, 1998
- SAE JA1000, Reliability Program Standard, June 1998

The two commercial standards are quite similar, consisting primarily of the first three objectives above, but lacking substance with respect to the essential, reliability program activities.

In August 2005, the U.S. Department of Defense published the DoD Guide for Achieving Reliability, Availability, and Maintainability (hereafter the “RAM Guide”). The RAM Guide was structured using the three objectives from the commercial standards, plus the fourth objective listed above. The RAM Guide provided ample guidance or “how to” with respect to each objective, but did not identify the activities or “what to do” in order to achieve each objective. Only the reliability portion of the RAM Guide was used by the Working Group to:

1. Base this standard on the four objectives above,
2. Identify those activities essential to the achievement of these objectives, and
3. Draft implementing language.

A separate implementation guide, TA-0009 has been developed for this standard. In addition, the RAM Guide can also be used for this purpose. It focuses on what can be done as part of a robust systems-engineering process in order to achieve satisfactory levels of reliability, successfully demonstrate them during operational test and evaluation, and sustain them throughout the system/product life cycle. Cross references from objectives of this standard to the RAM Guide are as follows:

GEIA-STD-0009 Objective	RAM Guide Chapter
Objective 1: Understand customer/user requirements and constraints	Chapter 3 focuses on development of RAM metrics and pre-acquisition activities
Objective 2: Design and redesign for reliability	Chapter 4 focuses on successful approaches for designing-in reliability through pre-production testing
Objective 3: Produce reliable systems/products	Chapter 5 focuses on the production reliability starting with limited production
Objective 4: Monitor and assess user reliability	Chapter 6 focuses on monitoring and managing reliability once it is in the hands of the user

Although GEIA-STD-0009 was designed for use with the DOD RAM Guide, the Guide is not required to use this standard. A copy of the guide is available on the internet at URL [http://www.acqnotes.com/Attachments/DoD%20Reliability%20Availability%20and%20Maintainability%20\(RAM\)%20Guide.pdf](http://www.acqnotes.com/Attachments/DoD%20Reliability%20Availability%20and%20Maintainability%20(RAM)%20Guide.pdf) or by contacting OUSD (AT&L) DS/SE/ED via ATL-ED@OSD.MIL.

Finally, a successful reliability program is greatly dependent on the demonstrated level of commitment by users, customers, and developer's program management, particularly at the upper levels. This commitment can be reinforced by ensuring that the reliability program is an integral part of the business strategy with an optimum funding profile for design, development, verification and demonstration, and operation.

1. SCOPE

This standard requires the developers and customer/users working as a team to plan and implement a reliability program that provides systems/products that satisfy the user's requirements and expectations. The user's requirements and needs are expressed in the form of the following four reliability objectives:

- **The developer shall solicit, investigate, analyze, understand and agree to the user's requirements and product needs.** The developer, working with the customer and user, shall include the activities necessary to ensure that the user's requirements and product needs are fully understood and defined, so that a comprehensive design specification and Reliability Program Plan can be generated.
- **The developer shall use well-defined reliability- and systems-engineering processes to develop, design, and verify that the system/product meets the user's documented reliability requirements and needs.** The developer shall implement a set of engineering activities (included in this standard as normative activities and informative activities, refer to [Section 3](#)) so that the resulting system/product satisfies the customer's documented requirements and needs.
- **The multifunctional team shall verify during production that the developer has met the user's reliability requirements and needs prior to fielding.** The developer shall include activities that assure the customer that the reliability requirements and product needs have been satisfied.
- **The multifunctional team shall monitor and assess the reliability of the system/product in the field.** The team is responsible for identifying the data elements to assess the reliability of the system/product in the field and to ensure the data collected are accurate and complete. The team will establish a closed-loop feedback method to flow recommended improvements (corrective actions) for monitoring reliability growth.

1.1 Approach

This standard defines a systematic approach to engineering or reengineering a system/product, incorporating best practices that have evolved considerably in recent years. The systematic approach of this standard is applicable for:

- Completing corrective actions,
- Making refinements,
- Developing derivatives,
- Producing modifications,
- Updating existing products,
- Creating and realizing new systems,
- Allowing for the safe and cost-effective disposal (retirement) of a system/product.

This approach is incrementally applied in an engineering life cycle framework that can be implemented during any one or more phases of an enterprise-based life cycle (for example, during production, operations, support, or disposal). The defined approach has two premises:

- A system/product is an item that may consist of hardware, software, firmware, facilities, data, materials, personnel, services, techniques, and processes.
- The engineering of a system/product is accomplished by applying a set of processes to each element of its hierarchy by a multifunctional team of people who have the requisite knowledge and skills.

1.2 Reliability Program Plan and Reliability Case

This standard requires customers and developers operating as a multifunctional team to cooperatively define, document and integrate their reliability processes to ensure systems/products are developed and manufactured to be highly reliable and sustainable over their life cycle. The Reliability Program Plan and Reliability Case are integral to this process. At the beginning of a new development or major modification program, the development team in conjunction with the user, should employ a continuous assessment process to define and document the capability and limitations imposed by the level of reliability, maintainability, system health, and availability with an emphasis on the operational impacts. Whereas the Reliability Program Plan takes a forward view by describing the activities together with any applicable success criterion that are to be undertaken to demonstrate that the Reliability requirements objectives have been achieved, the Reliability Case provides a retrospective view. The Reliability Case provides the record (evidence) of how well the requirements have been demonstrated at each program phase and provides the evidence that the developer achieved the reliability requirements.

The evidence is typically a sequence of reports that demonstrate the developer's actions and analyses to achieve the reliability requirements. A well-documented Reliability Case will greatly benefit any acquisition process, but the retrospective view (as compared to the forward view of the Reliability Program Plan) has historically allowed it to be neglected if the acquisition program has been successful at achieving the reliability requirements defined in the Reliability Rationale. If the reliability requirements are not clearly achieved, the benefits of the Reliability Case increase immensely as the Reliability Case documents the steps that were taken to meet Reliability requirements. The Reliability Case evolves from the direction of the customer and the developer as the project matures. Initially the customer is the acquisition organization; eventually, it is the user.

1.3 Tailoring

This standard does not specify the details concerning "how to" engineer a system/product for high reliability. Nor does it mandate the methods or tools a developer would use to implement the process requirements. The tailoring is dependent upon customer's funding profile, developer's internal policies and procedures, and negotiations between the customer and developer.

1.4 Organization

The standard is organized as described in Table 1:

Table 1 - Organization of standard

Section	Title	Description
2	Informative References	Lists other standards that are referred to in the text.
3	Definitions	Gives definitions for words that are used in a specific technical way in the body of the standard. Only those terms for which the normal dictionary definition does not suffice are included.
4	Objective 1: Understand Customer/User Requirements and Constraints	The first objective defines the reliability requirements, assessment/success criteria, controls and responsibilities of all organizations involved for program success.
5	Objective 2: Design for Reliability	The focus of this second objective is on designing a system/product that satisfies reliability specifications, user requirements, and is both producible and sustainable.
6	Objective 3: Produce Reliable Systems/Products	The purpose of this objective is to ensure that systems/products are manufactured with minimum impact on the inherent reliability during the execution of Objective 2.
7	Objective 4: Monitor and Assess User Reliability	The purpose of this objective is to establish and execute the requirements of a field reliability monitoring system comprised of data collection, analysis, maintenance and closed-loop feedback activities

Table 1 - Organization of standard (continued)

Annex A	Methods Matrix	Methods and tools that support the normative activities in Objectives 1 through 4
Annex B	Reliability Best Practices	Describes the recommended reliability program best practices that may be used to ensure that the reliability program requirements are met during the execution of Objectives 1 through 4.
Annex C	Key Documents Matrix	Provides references for the detailed “how to” for the various reliability activities for each objective.
Annex D	Known Failure Definition and Scoring Criteria	References to mandatory failure definition and scoring criteria of the DoD Services.
Annex E	Acronyms	List of acronyms used in this standard

1.4.1 Structure of Objectives

Each of the four reliability objectives described herein is structured as follows:

- Introduction
- Mission and Goals
- People and Organizations
- Supporting Information (Normative)
 - Input Information (Normative)
 - Developed Information (Normative)
- Activities, Methods, and Tools
 - Activities (Normative)
 - Methods and Tools (Informative)
- Output and Documentation (Normative)

The *Introduction* briefly introduces the objective. The subsection, *Mission and Goals*, provides additional background and context that are needed so one can develop a clear understanding of this objective. It is followed by a *People and Organizations* subsection which introduces considerations of personnel and organization that must be addressed when designing reliability into a product. The *Supporting Information* subsection contains two parts. The first part, *Input Information*, lists essential input information that is needed in order to accomplish this design-for-reliability objective. The second part, *Developed Information*, lists the information that is developed during the accomplishment of this objective. As shown in Figures 1 thru 5, the input information feeds the processes and methods contained in *Activities, Methods, and Tools*. Application of these processes and methods should result in a reliable product. *Activities, Methods, and Tools* contains two parts, a normative (mandatory) set of activities and an informative set of methods and tools that are provided for guidance information only. The developed information that is ultimately provided to other objectives in this standard is listed under *Outputs and Documentation*.

1.4.2 Development and Flow of Information Between Objectives

[Figure 1](#) depicts the information that flows into and out of each objective; the inputs to each objective are often the outputs of another objective.

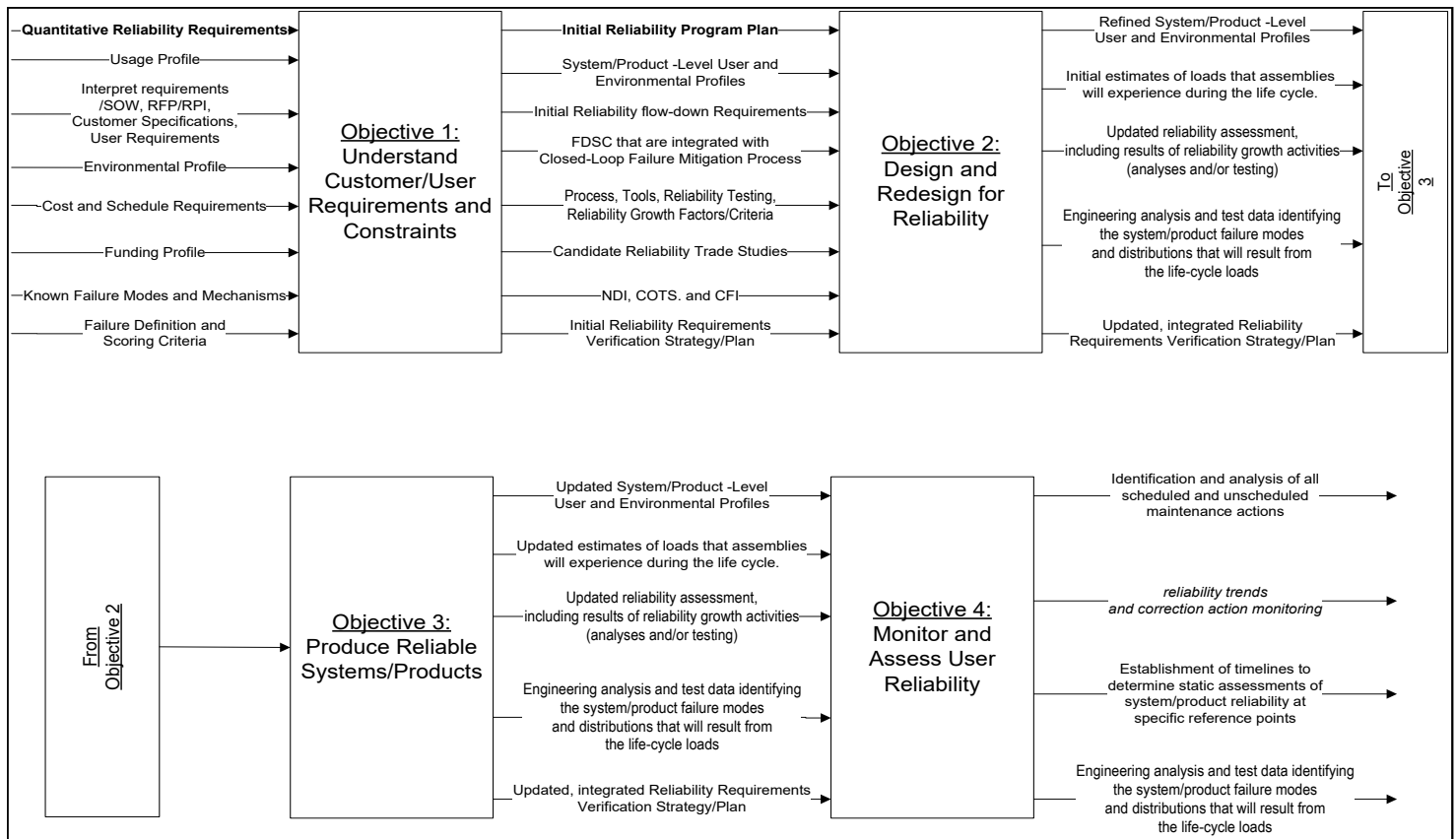


Figure 1 - Information flow between objectives

2. INFORMATIVE REFERENCES

The following references were used as guidance for the development of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

Crow, Larry H., *Operational Reliability Management*, CRR 522, Crow Reliability Resources, Inc., May 2008

DOD Guide for Achieving Reliability, Availability, and Maintainability, August 3, 2005

GEIA 632 (An American National Standard), *Processes for Engineering a System*

IEEE 1332-1998 (An American National Standard), *Standard Reliability Program for the Development and Production of Electronic Systems and Equipment*, 2 October 1998

MIL-STD-785B Military Standard, *Reliability Program for Systems and Equipment and Development and Production*, 15 September 1980

Reliability Information Analysis Center (RIAC) *Blueprints for Product Reliability*, 15 May 1996

SAE 1001 *Integrated Project Processes for Engineering a System* published October 9, 2018

SAE JA1000 1998-06 (An American National Standard), *Reliability Program Standard*

SAE JA1000-1 1999-03 (An American National Standard), *Reliability Program Standard Implementation Guide*

Tiku, Sanjay, *Reliability Capability Evaluation for Electronics Manufacturers*, Ph.D. dissertation, University of Maryland, 2005

3. DEFINITIONS

For the purposes of the standard, the following definitions apply.

Term	Definition
Customer	An individual, organization, or enterprise that commissions the engineering of a product, is a prospective purchaser of the product, or is the acquirer of the product.
Capability Maturity Model Integration	Capability Maturity Model Integration (CMMI) provides guidance for defining and improving an organization's processes and the organization's ability to manage the development, acquisition, and maintenance of products and services. CMM Integration places proven practices into a structure that helps the organization assess its organizational maturity and process area capability, establish priorities for improvement, and guides the implementation of these improvements.
Design Reliability	The set of design, development, and manufacturing tasks by which reliability is achieved.
Developer	An enterprise or organization that performs the process requirements of this standard.
Engineering	The engineering of a system/product is accomplished by applying a set of processes to each element of the hierarchy by a multifunctional team of people who have the requisite knowledge and skills.
Environmental Loads	Defined stressing conditions as the result of exposure to natural environments during system/product use. Some typical natural environment stressing conditions are storage and operating temperatures, humidity, diurnal cycles, and solar loading.
Failure	The events, or inoperable state, in which any item or part of an item does not, or would not, perform as previously specified under stated conditions for a stated period of time.
Failure Mechanism	The physical, chemical, electrical, thermal, or other process that results in failure. For example: fatigue, fracture, electro-migration, electrical overstress, depletion of material due to mechanical, chemical, electrical, thermal, or other stress.
Failure Mode	The consequence of the mechanism through which an item fails (e.g., short, open, fracture, excessive wear, etc.).
Induced Failure	A failure due to a condition and not due to its own internal failure pattern (e.g., operating outside of specified requirements, environments, or operational procedures, improper handling, support equipment, or operator error).
Informative Material/Activities	Explanatory material to help the user understand the standard (the informative parts). The informative material is annotated and is contained in notes and informative appendices.
Inherent Failure	A failure that occurs without being caused by the failure of another item.
Inherent Reliability	A measure of reliability which is related to an item's design and its application and is not caused by the failure of another item when the system/product is operated in the specified operation and support environments for a specified duration.

Term	Definition
Life Cycle Loads	Stressing conditions as the result of exposure to normal system/product use. Some typical system/product stressing conditions are packaging, handling, shipping and transportation, power on/off cycles, mechanical shock, vibration and maintenance activities (scheduled, unscheduled, recalls, retrofits, and software upgrades).
Logistics Footprint	The user's/customer's burden (inventory/equipment, personnel, facilities, transportation assets, supply, and real estate) to deploy, move, and sustain a system/product for a given service use profile.
Multifunctional	A group of individuals representing various product disciplines such as engineering, manufacturing, software, quality, reliability, etc.
Non-operational Reliability	A measure of reliability that is related to an item's non-operating design and its application when the system/product is stored in an environmentally protected and/or unprotected location.
Normative Material/Activities	The portion of the standard that prescribes mandatory implementation (the standard itself). Conformance to the standard is judged solely on the basis of the normative material in this standard.
Operational Reliability	A measure of the system's/product's performance during the item's operational life that includes the combined effect of the item's design, installation, quality, environment, operation, maintenance, and repair.
Quality Function Deployment	Quality Function Deployment is designed to help planners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs. This technique yields graphs and matrices.
Reliability	Reliability is the ability/probability of failure free performance of the system/product, over the expected service use profile and environmental conditions over a given period of time. Reliability is expressed in terms of operational reliability and non-operating reliability.
Reliability Activity	The set of design, development, manufacturing, and maintenance tasks performed to identify, quantify, and qualify product characteristics in terms of attributes, tolerances, and the test and inspection requirements necessary to produce a reliable, available, and maintainable product.
Reliability Assessment	An activity that quantitatively evaluates reliability using a model, failure definitions and scoring criteria, and the applied life cycle loads and environmental loads.
Reliability Case	A reasoned, auditable argument created to support the contention that a defined system/product satisfies the reliability requirements. The Reliability Case report documents the reliability evidence and arguments from the Reliability Case to support the program phases.
Reliability Model	A methodology for estimating the system's/product's ability to meet the specified reliability requirements.
Reliability Verification	Formally determining whether the customer's quantitative reliability requirements have been met.
Shall	A mandatory requirement to be followed in order to conform to this standard.
Should	Indicates that there are several possibilities: one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is discouraged but not prohibited.
Supplier	Provides a product or group of products to a customer. The supplier can be a vendor that has a product that does not need development, or a developer that must develop the product or products.
System/Product	A system/product is an end item that may consist of hardware, software, firmware, facilities, data, materials, personnel, services, techniques, and processes.

Term	Definition
Systems Engineering	A branch of engineering whose responsibility is creating and executing an interdisciplinary process to ensure that customer and user's needs are satisfied in a high quality, trustworthy, cost efficient, and schedule compliant manner throughout a system's entire life cycle, from development to operation to disposal.
Technical Review	An event at which the progress of the technical effort is assessed relative to its governing plans and technical requirements.
User	Individual, organization, or enterprise that uses, applies, or operates the product.
Verification	Confirmation by examination and provision of objective evidence that the specified requirements to which the end product is built, coded, or assembled have been fulfilled.

4. OBJECTIVE 1: UNDERSTAND CUSTOMER/USER REQUIREMENTS AND CONSTRAINTS

4.1 Introduction (Informative)

The focus of the first objective is to develop an understanding of the customer's system/product reliability requirements and constraints (both internal and external) and clearly communicate the developer's understanding of the customer's requirements. The first objective defines the reliability requirements, assessment criteria, controls, and responsibilities of all organizations involved in order to ensure program success. [Figure 2](#) graphically depicts the operation of this Objective.

Reliability is the ability/probability of the system/product to perform its intended functions over the expected user and environmental profile for a given period of time. The failure definitions must be coordinated with the customer because not all failures (hardware, software, firmware, process, procedure, or user) are reliability failures but must be assessed for potential corrective action. Reliability requirements are quantifiable and measurable metrics used to assess the compliance of the contractual requirements.

4.2 Mission and Goals (Informative)

The mission of this objective is to assemble a multifunctional team (user, customer, and developer) to

1. understand the customer's requirements, failure definitions, user and environmental profiles, and
2. influence the design based on the user's needs and constraints.

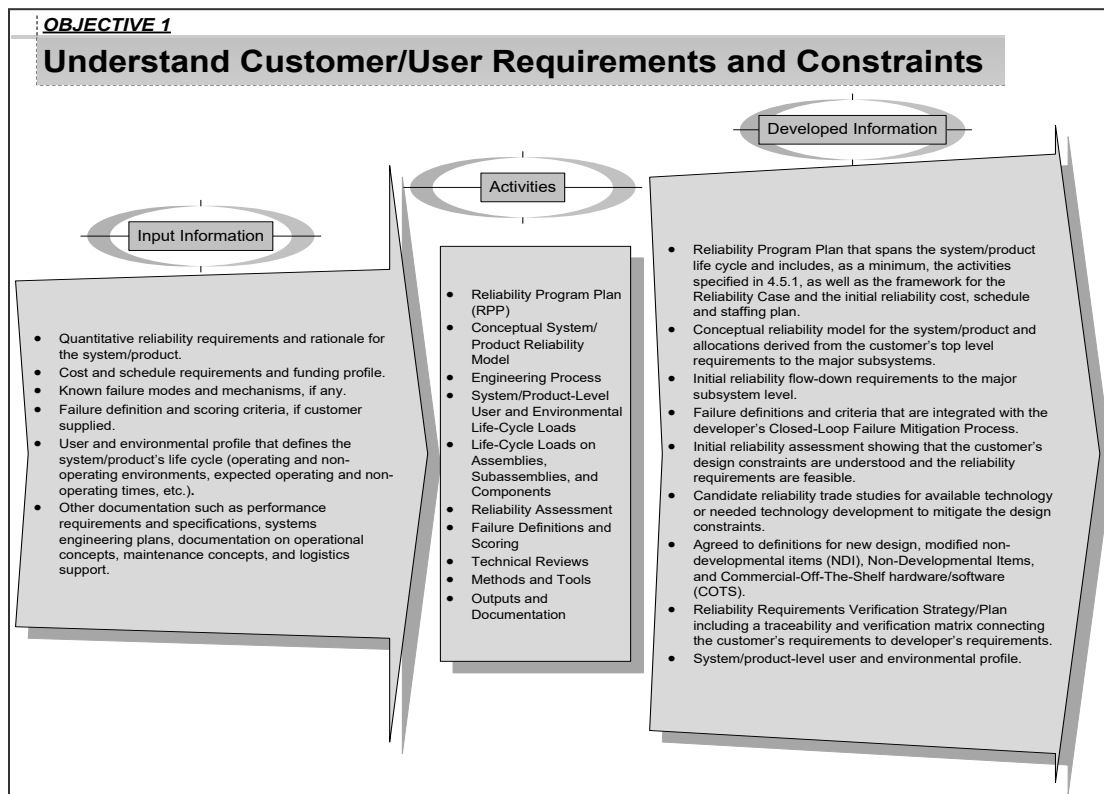


Figure 2 - Objective 1 inputs, activities, and output

4.3 People and Organizations (Normative)

Multifunctional groups shall collaborate during each phase of the program, perceive and mutually understand specific goals and objectives, and define and develop the system/product reliability requirements using a number of industry tools such as Quality Function Deployment (QFD).

Customer-User Communication: The customer community must collaborate with the users to define the desired capabilities for a system/product. This capability definition includes design reliability and operational reliability in the smallest logistics footprint. The logistics footprint is a function of system/product's embedded diagnostics and the customer's system/product support plan (spares, maintenance, training, and technical manuals).

Customer-Developer Communication: The customer must communicate the user's desired reliability and performance requirements for the system/product to the developer. The developer's engineering organizations must analyze the requirements and establish a dialogue with the customer so that the developer can complete a detailed requirements analysis to ensure that the requirements are understood and feasible. The developer **shall** communicate the acceptance of the requirements or recommend an alternative to the customer. This communication is necessary to ensure eventual system/product suitability. These communications between the developer and customer should be documented.

User/Customer-Developer Communication: The system/product reliability feasibility assessment (i.e., the assessment of the feasibility of achieving the user/customer requirements) **shall** be completed to the same level as the customer's specification to the developer.

System/product engineering and reliability engineering functions **shall** be responsible for implementing and executing the design-for-reliability methodology over the system/product's life cycle.

The customer will ensure that sufficient funding is available for the developer to provide a system/product that meets requirements when operated and maintained by the user over the system/product's life cycle. The goal is to apply the optimum funding profile for design, development, verification, and deployment at the appropriate time.

4.4 Supporting Information (Normative)

The information listed under Input Information is required in order to enable the developer to design, produce, and deliver a system/product that meets requirements and is suitable to the end user. This information may be provided by the customer or may be jointly developed by the customer/user and developer.

4.4.1 Input Information (Normative)

The following information is required before a reliable system/product can be designed:

- Quantitative reliability requirements and rationale for the system/product.
- Cost and schedule requirements and funding profile.
- Known failure modes and mechanisms, if any.
- Failure Definition and Scoring Criteria, if customer supplied.
- User and environmental profile that defines the system/product's life cycle (operating and non-operating environments (including storage), expected operating and non-operating times, etc.). For example, miles traveled, percent terrain type, hours of operation, rounds fired, e.g.
- Other documentation, such as performance requirements and specifications, system/product engineering plans, system/product test plans, documentation on operational concepts, maintenance concepts, and logistics support.

Rationale for the reliability requirements should include, as applicable,

1. Requirements for availability, maintainability, testability, durability, and system health defined as embedded diagnostics, Built-In Test (BIT), and prognostics,
2. Customer/user design constraints (e.g., technology, manpower, training, and logistics port),
3. Desired maintenance concepts,
4. Reliability estimates, support concept, and limitations for similar systems/products, and
5. Data on how the system/product will be packaged, handled, shipped, and transported.

4.4.2 Developed Information (Normative)

During the course of designing reliability into a system/product, a considerable amount of information will be developed. In many cases, input information to this objective will be expanded on and updated. The activities in [4.5.1](#) will result in the developer generating this information. The information developed **shall** include:

- Reliability Program Plan that spans the system/product life cycle and includes, as a minimum, the activities specified in [4.5.1](#), as well as the framework for the Reliability Case and the initial reliability cost, schedule, and staffing plan.
- Conceptual reliability model for the system/product and allocations derived from the customer's top level requirements to the major subsystems.
- Initial reliability flow-down requirements to the major subsystem level.

- Failure definitions and criteria that are integrated with the developer's Closed-Loop Failure-Mode Mitigation Process.
- Initial reliability assessment showing that the customer's design constraints are understood and the reliability requirements are feasible.
- Candidate reliability trade studies for available technology or needed technology development to mitigate development and associated risks.
- Agreed-to definitions for new design, Non-Developmental Items (NDI), modified NDI, Customer-Furnished Items (CFI), and Commercial-Off-The-Shelf (COTS) hardware/software.
- Reliability Requirements Verification Strategy/Plan including a traceability and verification matrix connecting the customer's requirements to developer's requirements.
- System/product-level user and environmental profile.

4.5 Activities, Methods, and Tools

This section is divided into two parts. The first part specifies the normative activities that the developer **shall** perform. The second part is informative in nature and lists methods and tools that the developer may consider to effectively support the normative activities.

All activities, methods, and tools used should be evaluated and applied in a manner that adds demonstrated value to the program, at an optimized life cycle cost and utilization of resources, in support of the stated mission and goals of this Objective.

4.5.1 Activities (Normative)

4.5.1.1 Reliability Program Plan (RPP)

The developer **shall** develop a program for designing, manufacturing, and sustaining reliable systems/products. The RPP **shall** be tailored to each system/product. An RPP should ideally be developed both by the developer (delineating those activities required to meet customer reliability requirements) and the customer (who provides an expansion of the required activities to include the tasks and customer-supplied resources to support and confirm the attainment of reliability requirements). The developer may identify and include additional activities not identified herein. The RPP is initially prepared early in the program and is periodically updated and coordinated with the customer.

The RPP **shall**:

- Plan for the attainment of customer reliability requirements.
- Provide visibility into the management and organizational structure of those responsible and accountable (both developer and customer) for the conduct of reliability activities over the entire life cycle.
- Define all resources (e.g., personnel, funding, tools, and facilities) required to fully implement the reliability program.
- Include a coordinated schedule for conducting all reliability activities throughout the system/product life-cycle.
- Include detailed descriptions of all reliability activities, functions, documentation, processes, and strategies required to ensure system/product reliability maturation and management throughout the system/product life cycle.
- Document the procedures for verifying that planned activities are implemented and for both reviewing and comparing their status and outcomes.
- Manage potential reliability risks due, for example, to new technologies or testing approaches.

- Ensure that reliability allocations, monitoring provisions, and inputs that impact reliability (e.g., user and environmental loads) are flowed down to subcontractors and suppliers.
- Include contingency-planning criteria and decision-making for altering plans and intensifying reliability improvement efforts.
- Include, at minimum, the normative activities identified throughout this standard.
- Include, when applicable, additional customer-specified normative activities.

All of the normative activities identified in Objectives 1 - 4 shall be considered for use in preparing the RPP:

- System/Product Reliability Model and Requirements:

Describe:

1. The methods and tools that will be used to build and refine the system/product reliability model and requirements,
2. The extent to which detailed component stress and damage models will be incorporated in the system/product reliability model,
3. How the system/product reliability model and requirements will be updated as the system/product design evolves and as failure modes are identified during the analysis of test and field failures, and
4. How the system/product reliability model and requirements will be used to identify reliability-critical items.

- Engineering Process:

Describe:

1. How it will be ensured that the normative reliability activities are an integral part of the systems-engineering process,
2. How reliability-improvement actions will routinely be incorporated into the design and manufacture of the system/product,
3. How it will be ensured that design rules that impact reliability, including parts, materials, process review, selection, and control, parts stress derating, electrical, mechanical, thermal, and other guidelines are adhered to,
4. How reliability-critical items will be identified, managed, and controlled, and
5. How the reliability impact of system/product design changes and supplier change notices will be monitored and evaluated.

- System/Product-Level User and Environmental Life-Cycle Loads:

Describe:

1. How and when the developer will develop, refine, and verify the estimates of system/product-level user and environmental life-cycle loads, and
2. Requirements, if any, for access to customer assets.

- Life-Cycle Loads on Subsystems, Assemblies, Subassemblies, and Components:

Describe:

1. How and when the developer will prepare and refine estimates of the life-cycle loads that subordinate assemblies, subassemblies, components, COTS, NDI, and CFI will experience as a result of system/product-level user and environmental loads, and
2. How and when teams (a) developing assemblies, subassemblies, and components and (b) selecting and integrating items not specifically developed for this system/product, will receive these estimates and updates.

- Identification of Failure Modes and Mechanisms:

Describe:

1. How and when failure mechanisms and modes that may result when the estimated life-cycle loads are imposed on the system/product will be identified for items specifically developed for this system/product as well as for items being selected and integrated into it, and
2. How the developer will ensure that test and field failures are analyzed to root cause.

- Closed-Loop Failure-Mode Mitigation Process:

Describe:

1. Strategies for monitoring, assessing, prioritizing, and communicating the status of test and field failures throughout the organization,
2. Strategies for identifying, developing, and approving design and/or process corrective actions to eliminate root failure causes throughout the system/product life cycle,
3. How the implementation of corrective actions will be verified and their effectiveness tracked,
4. How lessons learned will be documented, reviewed, and communicated, and
5. How root-cause analysis of test and field failures will be used to improve the reliability of the system/product.

- Reliability Assessment:

Describe:

1. How and when reliability assessments will be performed (including, when applicable, customer-specified reliability values that must be achieved at various points during development) and documented in the Reliability Case,
2. Which assessment methods will be used, and
3. How design and process changes are documented, monitored, and evaluated for their impact on reliability.

- Plan Design, Production, and Field Reliability Verification:

Describe:

1. The strategy for verifying the satisfaction of customer reliability requirements, and
2. The activities to be performed and processes to be used that will ensure that inherent reliability levels are not degraded during subsequent phases of the system/product life cycle.