MIL-STD-2155(AS)
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MILITARY STANDARD

FAILURE REPORTING, ANALYSIS

AND

CORRECTIVE ACTION SYSTEM

AMSC N3637

RELI

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DEPARTMENT OF DEFENSE
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Failure Reporting, Analysis, and Corrective Action System

MIL-STD-2155(AS)

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FOREWORD

A disciplined and aggressive closed loop Failure Reporting, Analysis, and Corrective Action System (FRACAS) is considered an essential element in the early and sustained achievement of the reliability and maintainability potential inherent in military systems, equipment, and associated software. The essence of a closed loop FRACAS is that failures and faults of both hardware and software are formally reported, analysis is performed to the extent that the failure cause is understood, and positive corrective actions are identified, implemented, and verified to prevent further recurrence of the failure.

Corrective action options and flexibility are greatest during design evolution when even major design changes can be considered to eliminate or significantly reduce susceptibility to known failure causes. These options and flexibility become more limited and expensive to implement as a design becomes firm. The earlier a failure cause is identified and positive corrective action implemented, the sooner both the producer and user realize the benefits of reduced failure occurrences in the factory and in the field. Early implementation of corrective action also has the advantage of providing visibility of the adequacy of the corrective action in the event more effort is required. Early and detailed attention to each failure or fault as it occurs should limit the situation in which prioritization of open investigations causes a backlog which results in a number of correctable deficiencies being left to field service to resolve over the years.

It is recognized that there are pragmatic limits to the resources in time, money, and engineering manpower to expend on an analysis of a particularly complex failure occurrence or the implementation of preferred corrective actions. These limits are determined by item priority, program urgency, available technology, and engineering ingenuity. These limits will vary from program to program. The acquiring activity has the responsibility of determining these limits in light of accepted norms established in successful programs or even higher standards of performance as warranted by a particular program.

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1. SCOPE

1.1 Purpose. This standard establishes uniform requirements and criteria for a Failure Reporting, Analysis, and Corrective Action System (FRACAS) to implement the FRACAS requirement of MIL-STD-785. FRACAS is intended to provide management visibility and control for reliability and maintainability ... improvement of hardware and associated software by timely and disciplined utilization of failure and maintenance data to generate and implement effective corrective actions to prevent failure recurrence and to simplify or reduce the maintenance tasks.

1.2 Application. This standard applies to acquisitions for the design, development, fabrication, test, and operation of military systems, equipment, and associated computer programs. This standard primarily applies to the program phases of demonstration and validation and full scale development.

1.2.1 Relationship to other requirements. This standard, in addition to implementing the FRACAS requirement of MIL-STD-785, is intended to complement the requirements of MIL-STD-470, MIL-STD-781, MIL-STD-1679, and MIL-STD-2068.

1.2.2 Integration with other activities. The FRACAS effort shall be coordinated and integrated with other program efforts such as reliability, quality assurance, maintainability, human engineering, system safety, test, parts, materials, and processes control, configuration management, and integrated logistics support to preclude duplication of effort and to produce integrated cost effective results.

2. REFERENCED DOCUMENTS

2.1 Issue of documents. The following documents of the issue in effect on the date of invitation for bid or request for proposal, form a part of this standard to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models and Related Terms
MIL-STD-470	Maintainability Program for Systems and Equipment
DOD-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-721	Definitions of Terms for Reliability and Maintainability

MIL-STD-781	Reliability Design Qualification and Production Acceptance Tests: Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1679	Weapon System Software Development
MIL-STD-2068	Reliability Development Tests

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Terms. Meaning of terms not defined herein are in accordance with the definitions in MIL-STD-280 and MIL-STD-721.

3.2 Acquiring activity. That activity (government, contractor, or subcontractor) which levies FRACAS requirements on another activity through a contract or other document of agreement.

3.3 Closed loop failure reporting system. A controlled system assuring that all failures and faults are reported, analyzed (engineering or laboratory analysis), positive corrective actions are identified to prevent recurrence, and that the adequacy of implemented corrective actions is verified by test.

3.4 Contractor. The term "contractor" is defined as any corporation, company, association, or individual which undertakes performance under the terms of a contract, letter of intent or purchase orders, project orders, and allotment, in which this document may be incorporated by reference. For the purpose of this standard, the term "contractor" also includes Government operated activities undertaking performance of a task.

3.5 Corrective action effectivity. The date or item serial number when corrective action will be or has been incorporated into the item.

3.6 Failure. An event in which an item does not perform one or more of its required functions within the specified limits under specified conditions.

3.7 Failure analysis. A determination of failure cause made by use of logical reasoning from examination of data, symptoms, available physical evidence, and laboratory analysis results.

3.8 Failure cause. The circumstance that induces or activates a failure mechanism; e.g., defective soldering, design weakness, assembly techniques, software error, etc.

3.9 Failure Review Board. A group consisting of representatives from appropriate contractor organizations with the level of responsibility and authority to assure that failure causes are identified and corrective actions are effected.

3.10 Failure symptom. Any circumstances, event, or condition associated with the failure which indicates its existence or occurrence.

3.11 Fault. A degradation in performance due to failure of parts, detuning, misalignment, maladjustment, and so forth.

3.12 Laboratory analysis. The determination of a failure mechanism using destructive and nondestructive laboratory techniques such as x-ray, dissection, spectrographic analysis, or microphotography.

4. GENERAL REQUIREMENTS

4.1 Contractor responsibility. A closed loop failure reporting, analysis, and corrective action system (FRACAS) shall be implemented by the contractor and his subcontractors. The system shall be maintained for reporting, analysis, and correction of hardware failures and software errors that occur in contractually specified levels of assembly during in-plant tests and that occur at installation or remote test sites. Failures occurring in specified levels of assemblies in tests at subcontractors' facilities shall be integrated into the contractor's data collection system for tracking and incorporation in the failure summary and status reports. The contractor's existing data collection, analysis, and corrective action system shall be used with modification only as necessary to meet the requirements specified by the acquiring activity.

4.2 FRACAS planning. FRACAS planning involves the preparation of written procedures for the initiation of failure reports, analysis of failures, and the feedback of corrective actions into design, manufacturing, and test process. The contractor's procedures for implementing FRACAS and for tracking and monitoring failure analysis and corrective action status shall be described in the FRACAS plan. Flow diagrams that depict failed hardware and failure data flow also shall be documented in the plan.

4.3 Failure Review Board. A Failure Review Board (FRB) shall be established to review failure trends, corrective action status, and to assure adequate corrective actions are taken. The personnel appointed by the contractor to act on the FRB shall be identified in the FRACAS procedures and the scope or extent of their authority shall be identified. The FRB shall meet on a regular basis to review failure data from appropriate inspections and tests including subcontractor test failures. The FRB shall have authority to require failure investigations and analyses by other contractor organizations and to assure implementation of corrective actions. The acquiring activity reserves the right to appoint a representative to the FRB as an observer. If the contractor can identify and use an already existing function to perform the FRB functions, then a description of how the existing function will be employed to meet acquiring activity requirements shall be provided for acquiring activity review.

4.4 Failure documentation. Records shall be maintained for all reported failures, failure investigations and analyses, assignable failure causes, corrective actions taken, and effectiveness of corrective actions. These records shall be organized to permit efficient retrieval for failure trending, failure summary and status reports, knowledge of previous failures and failure analyses, and corrective action monitoring. Failure documentation shall include a uniform reference identification to provide complete traceability of all records and actions taken for each reported failure.

5. DETAILED REQUIREMENTS

5.1 Failure reporting. Failures and faults that occur during appropriate inspections and tests shall be reported. The failure report shall include information that permits identification of the failed item, symptoms of failure, test conditions, built-in-test (BIT) indications, and item operating time at time of failure. All software problems identified during the inspections and tests shall be reported in accordance with the requirements of MIL-STD-1679. Procedures for initiating failure reports shall include requirements for verifying failures using BIT, when applicable, and for collecting and recording corrective maintenance information and times. All failure reports and software problem reports shall be verified for accuracy and correctness and submitted on standard forms. The format of the form(s) used to record failure and associated data is important only to the extent that it simplifies the task of the data recorder, provides for item and data traceability, and provides the information required by the acquiring activity as it becomes available

5.2 Failure analysis. Reported failures shall be evaluated or analyzed as appropriate to determine the cause of failure. FRACAS procedures shall include requirements for documenting the results and conclusions of failure investigations and analyses. Analysis of government furnished material (GFM) failures shall be limited to verifying that the GFM failure was not the result of the contractor's hardware, software, or procedures. The verification of the GFM failure shall be documented for notification to the acquiring activity. The failure analysis of other than GFM failures shall be conducted at the lowest level of hardware or software necessary to identify the causes, mechanisms, and potential effects of the failure and to serve as a basis for decisions on the corrective action to be implemented. The investigations and analyses of failures shall consist of any applicable method (e.g., test, application study, dissection, x-ray analyses, microscopic analysis, etc.) that may be necessary to determine failure cause.

5.3 Failure verification. All reported failures shall be verified as actual or an explanation provided for lack of verification. Failure verification is determined either by repeating the failure mode on the reported item or by evidence of failure (leakage residue, damaged hardware, BIT indication, etc).

5.4 Corrective action. When the cause of a failure has been determined, a corrective action shall be developed, documented, and implemented to eliminate or reduce the recurrence of the failure. Corrective action implementation shall be approved by responsible contractor personnel (and acquiring activity as required). Unless otherwise specified, change control procedures shall be in accordance with DOD-STD-480.

5.5 Failure report close-out. Each reported failure shall be analyzed and corrective action taken in accordance with the requirements of this standard in a timely manner so as to obtain immediate benefits of the corrective action and to minimize an unmanageable backlog of open failures from occurring. All open reports, analyses, and corrective action suspense dates shall be reviewed to assure timely failure report close-outs. A failure report shall be considered closed-out upon completion of corrective action implementation and verification or rationale in those instances where corrective action was not implemented. The rationale to support no corrective action shall be documented and approved by responsible authority.

5.6 Identification and control of failed items. All failed items shall be conspicuously marked or tagged and controlled to assure disposition per contract requirements. Failed items shall not be opened, distributed, or mishandled to the extent of obliterating facts which might be pertinent to an analysis. Failed items shall be controlled pending authorized disposition after completion of failure analyses.

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APPENDIX A

APPLICATION AND TAILORING GUIDE

10. GENERAL

10.1 Scope. This appendix provides notes for the guidance of the acquiring activity in generating the contractual requirements for failure reporting, analysis, and corrective action system (FRACAS).

10.2 Tailoring requirements. Each provision of this standard should be reviewed to determine the extent of applicability. Tailoring of requirements may take the form of deletion, addition, or alteration to the statements in Sections 3, 4, and 5 to adapt the requirements to specific item characteristics, acquiring activity options, contractual structure, or acquisition phase. The tailored FRACAS requirements are specified in the contractual provisions to include input to the statement of work, contract data requirements list (CDRL), and other contractual means. The depth and detail of the FRACAS effort will be defined in appropriate contractual and other program documentation.

10.3 Duplication of effort. A review of the contractual requirements is necessary to avoid duplication of effort between the reliability program and other program efforts such as quality, maintainability, test, safety, and integrated logistics support. Identification of the coincident generation of FRACAS tasks or use of such tasks by the reliability program and other disciplinary areas is required in the reliability program plan or other appropriate program documentation to avoid duplication of effort by the acquiring activity and the contractor.

10.4 Relationship of FRACAS to FMECA. Although the respective FRACAS and Failure Mode Effects and Criticality Analysis (FMECA) effort are designed and capable of being performed independently of each other, there is a synergistic effect when the two efforts are coupled. An FMECA is an analytically derived identification of the conceivable hardware failure modes of an item and the potential adverse effects of those modes on the system and mission. The FMECA's primary purpose is to influence the system and item design to either eliminate or minimize the occurrences of a hardware failure or the consequences of the failure. The FRACAS represents the "real world" experience of actual failures and their consequences. An FMECA benefits the FRACAS by providing a source of comprehensive failure effect and failure severity information for the assessment of actual hardware failure occurrences. Actual failure experience reported and analyzed in FRACAS provides a means of verifying the completeness and accuracy of the FMECA. There should be agreement between the "real world" experience as reported and assessed in the FRACAS and the "analytical world" as documented in an FMECA. Significant differences between the two worlds are cause for a reassessment of the item design and the differing failure criteria that separates the FRACAS and FMECA.

20. REFERENCED DOCUMENTS (Not Applicable)

30. DEFINITIONS (Not Applicable)

40. GENERAL REQUIREMENTS

40.1 Importance of FRACAS. The requirements for a FRACAS normally will apply to the development of systems, equipment, and associated software subject to validation or full scale development (FSD). This early implementation of a FRACAS is important because corrective action options and flexibility are greatest during design evolution. The earlier failure causes are identified, the easier it is to implement corrective actions. As the design matures, corrective actions still can be identified, but the options become limited and implementation is more difficult.

40.2 Data items. The implementation of FRACAS requirements will involve some form of contractor prepared plan, document, form, or data. If any of these are to be received by the acquiring activity, they are deliverable items. Each separate data item identified for delivery must be included on a DD Form 1423 which must be included as a part of the request for proposal (RFP) and contract. Each DD Form 1423 entry must refer to an authorized Data Item Description (DID) and must include a specific contract reference that specifies and authorizes the work to be done for each data item. Refer to governing directives for specific information on how to complete the DD Form 1423.

50. DETAIL REQUIREMENTS

50.1 FRACAS planning and documentation.

50.1.1 Primary objective. The primary objective of a closed-loop FRACAS is to document failures and faults and to disseminate the data. The timely dissemination of accurate failure information is necessary so remedial actions may be taken promptly to prevent the recurrence of the failure or fault.

50.1.2 Request of FRACAS plan. If a FRACAS plan is requested in the RFP, the contractor should be asked to describe how he plans to implement the FRACAS. He should be asked to identify and discuss the procedures that will be used to control failure report initiation, failure analyses, and the feedback of corrective actions into the design, manufacturing, and test process. The plan submitted for review should describe the flow of failed hardware and failure data throughout the contractor's organization.

50.1.3 Requirement addition. The addition of a requirement for a Failure Review Board (FRB) will provide added assurance that the reporting, analysis, and corrective actions taken on identified failures will be controlled. There may be, however, other closely related functions or efforts that are similar to the FRB that should be closely coordinated to assure that duplication of effort is avoided. When an FRB is required by the acquiring activity, the contractor should be asked to identify the personnel appointed to act on the FRB and to indicate the scope or extent of their authority.

50.1.4 Failure data. Failure data is useful only when assembled in manageable aggregates for purposeful evaluation by both the contractor and the acquiring activity. The failure data system should be designed to collect, store, and retrieve failure information and to provide the means for displaying the data in a meaningful form. The outputs of a failure data system should be tailored to provide summaries and special reports for both management and engineering personnel. A useful output of a failure data system is the failure summary and status report. This report will provide information about the failure of like items or similar functions which can be used to provide indications of failure trends and to evaluate the need for and the extent of contemplated corrective actions. The contractor should be asked to define the scope and content of his failure data system and to indicate how it will be maintained.

50.2 FRACAS data collection.

50.2.1 Effectiveness of FRACAS. A FRACAS will be effective only if the input data in reports documenting failures and faults is accurate. Essential inputs should document all conditions surrounding a failure or fault to facilitate cause determination. The failure documentation must provide information on who discovered the failure, what failed, where it failed, when it failed, and how future failures will be prevented.

50.2.2 Failures. During development, system or equipment failures typically occur during tests or operation by the contractor or the acquiring activity. When a failure occurs, the failed item should be identified and all pertinent information about the failure should be documented on a failure report form. The contractor's procedure for failure report initiation should identify and describe the data that should be recorded for both hardware failures and software errors to assure that failures are adequately described and that the proper hardware or software has been reported. In addition, the contractor should have a method for accounting for failure reports and should audit the completed forms periodically to verify that failure reports are being submitted promptly.

50.2.3 Failure analysis. Failure analysis is the determination of the cause of a failure. One of the first steps in any failure analysis is the review of the failure information by cognizant personnel. A failure analysis plan then should be developed to describe the steps the analysis will take and to preclude pre- mature disposal of failed items prior to being subjected to required analyses. Each failure should be verified and then analyzed to the extent necessary to identify the cause of failure and any contributing factors. The failure analysis can range from a simple investigation of the circumstances surrounding the failure to a sophisticated laboratory analysis of the failed parts. The level of analysis always should be sufficient to provide an understanding of the cause of failure so that logically derived corrective actions can be developed.

50.2.4 Results of failure analysis. The results of failure analysis should be fed-back to cognizant personnel so they can decide on an appropriate course of action to alleviate the problem. Corrective action to alleviate a problem may range from new controls implemented in manufacturing or test to a change in design or changing a part to one better suited to operational requirements. The generated corrective action should be documented in detail so that it can be implemented and verified at the proper level. After a corrective action is implemented, it should be monitored to assure that the corrective action has removed the failure causes and has not introduced new problems.

60. DATA ITEM DESCRIPTIONS (DID)

60.1 Data. When this standard is used in an acquisition that incorporates CDRL, DD Form 1423, the data requirements identified below shall be developed as specified by an approved DID, DD Form 1664, and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and DD Form 1423 is not used, the contractor shall deliver the data specified below in accordance with the contract or purchase order requirements. Deliverable data sourced to this standard are cited in the following paragraphs.

Paragraph	Applicable DID	Data Requirement
4.2	DI-R-21597	Failure Reporting, Analysis, and Corrective Action System Plan
4.4	DI-R-21599	Report, Development and Production Failure Summary
5.1	DI-R-21598 DI-R-2178	Failure Report Computer Software Trouble Report

DIDs related to this standard will be approved and listed as such in DOD 5000.19L, Vol. II, AMDSL. Copies of DIDs required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center, or as directed by the Contracting Officer.

Preparing activity:
Navy - AS
Project No. RELI-N035

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
3b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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