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Standard

Performance-Based Anomaly Detection and Response Analysis

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American National Standard

Performance-Based Anomaly Detection and Response Analysis
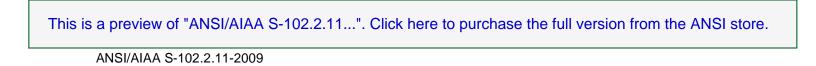
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Abstract

This standard provides the basis for developing identification and response methods for system anomalies or faults that pose unacceptable risk. The requirements for contractors, planning and reporting needs, and analytical tools are established. The linkage of this standard to the other standards in the new family of performance-based reliability and maintainability standards is described.

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Foreword

Although the terms quality and reliability are often used interchangeably they have different meanings. *Quality* as used in this standard, is the ability of a product to meet the workmanship criteria established by an organization. A different, but often used, definition of quality: Quality is the set of all desired attributes that can be put in a product. In this sense, quality cannot be achieved without achieving the desired reliability. *Reliability* is the ability of a product or system to perform its intended function(s) for a specified time or operating cycles. A high-quality product may not be a high-reliability product even though it conforms to stringent workmanship specifications. The ISO 9000 series standards that establish the ability of an organization to consistently produce high-quality products do not necessarily establish that same organization's ability to consistently deliver high-reliability products. Consequently, the ISO 9000 series certification process, which serves as the main international reference for Quality Program requirements in business-to-business dealings, is not the appropriate reference for international or domestic R&M Program requirements. A more suitable reference is the suite of AIAA S-102 performance-based reliability and maintainability (R&M) standards, which provide a framework for quantifying and improving the performance of R&M practices.

As Annex A shows, there are 35 standards in the AIAA S-102 performance-based R&M standards document tree. These standards provide criteria for rating the capability of R&M practices and they represent proven approaches for planning and implementing the product life cycle R&M program. The S-102 R&M capability-rating criteria allow organizations to:

— specify a level of R&M Program performance

— plan the activities to achieve a level of R&M Program performance

— appraise the performance of an R&M Program or individual practice

— identify the activities necessary to improve the performance of an R&M Program or individual practice

The S-102 R&M capability-rating criteria (Annex B in all S-102 standards) are intended to aid organizations in assuring their R&M Programs are a "value-added" contribution to the product development effort. *There is no intent to prescribe a universal methodology for quantifying the evaluation or improvement of R&M Programs or individual practices.* The S-102 R&M capability-rating criteria reflect the collective body of knowledge of the S-102 Working Group, which was chartered by the AIAA Standards Executive Council to develop and approve the S-102 standards. The S-102 Working Group is composed of R&M experts that represent the Government and industry sectors affected by the S-102 standards.

This standard establishes uniform requirements for a performance-based anomaly detection and response (ADR) analysis. The principles of ADR analysis as promoted in a performance-based approach can be learned from this document alone, but its proper use requires careful planning, for which the prerequisite is, understanding associated S-102 documents and identifying the desired R&M data products in the systems engineering process. This standard provides the following:

— it provides consistent criteria for rating the "capability" of the ADR analysis process

— it provides consistent criteria for rating the "maturity" of the ADR analysis data

— it calls for the use of knowledge-based approaches to identify, analyze, and manage failure modes that pose unacceptable risk using appropriate detection, verification, isolation, and response methods

— for a Capability Level 3 or above ADR analysis process, it calls for the collection and review of existing lessons learned, and the generation and formal approval of new lessons learned, and

— for a Capability Level 4 or above ADR analysis process, it calls for the use of predefined R&M data parameters to facilitate the exchange of ADR analysis data products among computer-aided analysis tools and other project databases.

At the time of approval, the members of the AIAA Performance-Based Reliability & Maintainability Standards Working Group were:

Tyrone Jackson (Chair)	SRS Technologies
Lily Lau	The Aerospace Corporation
David Oberhettinger	NASA Jet Propulsion Laboratory
Walt Willing	Northrop Grumman Electronic Systems
Steve Harbater	Northrop Grumman Integrated Systems
Alazel Jackson	Raytheon Space and Airborne Systems
Jan Swider	Pratt & Whitney Rocketdyne, Inc
Jeff Merrick	Merrick Consulting
Ken Gibson	Boeing Space and Intelligence Systems
James French	RMS Partnership
Dawson Coblin	Lockheed Martin Space Systems Company
Ari Jain	Reliability Consultant
Terry Hardy	Federal Aviation Administration

The above consensus body approved this document in June 2006.

The AIAA Standards Executive Council (Mr. Amr ElSawy, Chairman) accepted the document for publication in July 2008.

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1   Scope

This standard establishes uniform requirements and criteria for a performance-based anomaly detection and response (ADR) analysis process. The performance-based aspect of this standard requires that the organization's ADR analysis capability be rated according to predetermined criteria for process capability and data maturity.

1.1   Purpose

The primary purpose of the ADR analysis is to develop identification and response methods for system anomalies or faults that pose unacceptable risk. Depending on how it is performed, an ADR analysis can be used to develop different types of ADR systems. For this standard, an ADR system is defined as an established function for detecting, verifying, isolating, and responding to a specified set of system functional failure modes. The minimum activities that constitute the baseline practice for ADR analysis are the following:

— timely establishment of ADR system requirements and design criteria that meet the user's needs;

— timely establishment of ADR analysis technical performance metrics (TPM);

— timely collection and evaluation of necessary engineering information [e.g., signal lists, specs, interface control drawing (ICD), test data, operational data, schematics, and product failure mode, effects, and criticality analysis (FMECA)] to identify all functional failure modes that pose unacceptable risk;

— timely creation of a functional failure analysis (FFA) dataset that defines the detection, verification, isolation, and response methods, as applicable, for each identified functional failure mode;

— timely validation of each FFA dataset; and

— timely documentation of the ADR Analysis. The FFA is a systematic methodology for identifying and responding to functional failure modes that require such actions as defined by the FMECA or other failure analysis such as system test; failure reporting, analysis, and corrective action system (FRACAS); system safety; or risk management.

1.2   Application

This standard applies to acquisitions for the design, development, fabrication, test, and operation of commercial, civil, and military systems, equipment, and associated computer programs. This standard provides capability-rating criteria that are intended to categorize the capability of sets of commonly used activities in ADR analysis practices. The capability criteria provide the logical order of activities for improving the effectiveness of an existing ADR analysis practice in stages. To use these criteria to improve an existing ADR analysis practice, establish minimal-acceptance criteria and compare them to the activities of that practice. The minimal-acceptance criteria may include all or only some of the activities in one of the predefined capability levels in this standard. This comparison identifies the activities that need to be added to the existing ADR analysis practice.

This standard also applies to the integration of the ADR analysis database with a project R&M database system. However, specification of this standard shall not be construed as a requirement for the contractor to use a particular computer-aided design (CAD) system. Rather, the ADR analysis shall be implemented using the computerized tools of the contractor's choosing given that those tools are validated to process input data and generate output data that are compatible with the data definitions in this standard.