AS 3960—1990

Australian Standard®

Guide to reliability and maintainability program management

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Australian Electrical and Electronic Manufacturers' Association

Australian Nuclear Science and Technology Organisation

Australian Organization for Quality

Department of Defence

Federal Chamber of Automotive Industries

Federation of Automotive Products Manufacturers

Institute of Quality Assurance

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PREFACE

This Standard was prepared by the Standards Australia Committee on Reliability and Maintainability, under the direction of the Quality and Reliability Standards Board to supersede AS 1211, *Reliability of electronic equipment and components*, Part 1—1977: *Terminology*, Part 2—1972: *Reliability concepts*, and Part 3—1977: *Reliability program for equipment.*

It is one of a number of Standards to be prepared on various aspects of reliability and maintainability.

It is based largely on BS 5760, *Reliability of constructed or manufactured products, systems, equipments and components:* Part 1: *Guide to reliability and maintainability programme management.* Consideration was also given to IEC Publication 300, *Reliability and maintainability management*, and this Standard is compatible with that publication.

This Standard extends the scope of the AS 1211 series beyond the confines of electronic hardware and increases the detail in which the subject is treated. The presentation of material has been re-formatted so as to provide clear guidance on the separate tasks required for effective reliability and maintainability program management.

CONTENTS

FOREWORD

A standardized systematic approach to reliability and maintainability of manufactured and constructed products is essential to ensure that pertinent statements are consistent and unambiguous in all communications. As well as providing a basis for the preparation of reliability and maintainability programs, this Standard can be used in preparing documents concerned with the specification of reliability and maintainability or the reporting of reliability and maintainability data or tests. Maintainability is applicable for systems and equipments that are repaired following failure.

It is vital that reliability and maintainability be considered in a manner similar to the other characteristics of a system, equipment or item, from its design conception to the end of its working life, and that the reliability and maintainability experience of one generation of products, engineers or technology is used by the next. This requires that each factor affecting reliability and maintainability at any stage in the life of an item be identified and considered in its relationship to the other factors. A reliability and maintainability program is the formalization of this procedure. It may be necessary to divide such a program into two parts, one of which may be the concern of the designer and manufacturer, and the other the concern of the user. It is most important that consideration be given to the reliability and maintainability of items or parts which are used by one manufacturer but produced by another, i.e. subcontractor evaluation and vendor appraisal (see AS 1821, AS 1822, AS 3901 and AS 3902).

Satisfactory reliability and maintainability have traditionally been achieved by the use of codes of practice or methods of working that have been shown by experience to give good results for established products. However, with the increase in pace of change and performance expectations, it is no longer sufficient to consider reliability and maintainability in purely qualitative terms when their achievement often demands the specification of quantitative criteria. Accordingly, the onus should be on all parties (i.e. the designer, supplier, purchaser or any other responsible authority) to specify quantitative requirements wherever possible.

With the need to satisfy competing constraints, including stricter health and safety requirements, the advent of new materials and pressure to reduce costs, reliability and maintainability should be expressed in quantitative terms if they are to be given their proper weight. For example, a product may be required to achieve at least a certain useful life, not to exceed a certain failure rate or to have an extremely high availability. Quantitative statements relating to reliability and maintainability should then be made which may be accompanied by stipulations that certain codes of practice be followed.

One aspect of quantitative reliability and maintainability that requires emphasizing is that often reliability and maintainability can be predicted even for products of new design and high cost, such as a ship's propulsion system or a new kind of nuclear reactor pressure vessel, but only if there is sufficient knowledge of the processes leading to failure, including data based on the statistical analysis of observations made.

The designer's or user's confidence that reliability and maintainability requirements will be met depends on the following:

(a) Adequacy of the data about failures.

(b) Correct interpretation of such data in the existing environment.

(c) A disciplined approach to the specification and design of the product or service.

Data should be obtained about failures from the following sources:

(a) Reliability testing.

(b) Field data.

(c) Knowledge of the physical processes leading to failure.

A reliability and maintainability program sets out to provide products with acceptable levels of reliability and maintainability at an acceptable cost rather than products with improved reliability and maintainability regardless of cost. For this reason the quantitative approach is essential. The qualitative approach can be effective in improving reliability and maintainability but the improvement can not be quantified.

In general terms and philosophy this Standard is equally applicable to all parts of a system, including the software. The subject of software reliability and maintainability is considered to be a separate discipline, and the techniques of software reliability and maintainability are not dealt with in detail in this Standard, except where they interface at the system level.

However, it is important to recognize that software as a product is different from all other engineering products in that it is not tangible, and it does not wear out. Software exhibits faults, but, unlike hardware faults, they originate in undetected errors in the software specification, design logic and the coding process. These errors generate faults only when that part of the program is executed and specific (input) conditions exist. The errors mature into failures when they affect the response of the system. Such software-induced system failures exhibit time dependency because the range of system inputs may vary with time, and the process of a mistake maturing into a failure is of uncertain duration and depends on the application of the system. Software reliability and maintainability assurance is therefore not a question of showing, avoiding or compensating for changes such as wear, but of attempting to detect or limit the effect of mistakes in design.

While systems have always had a logic content, the advent of computers has afforded the opportunity to incorporate very large, complicated and often subtle logic structures. These structures often exceed the capability of the human mind to perceive them in total and thus the difference in scale of the logic now possible brings a greater chance of human error at all stages of the life cycle.

STANDARDS AUSTRALIA

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Guide to reliability and maintainability program management

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This Standard provides guidance on reliability and maintainability program management of manufactured and constructed products. It discusses the essential features of a comprehensive program for the planning, organization, direction and control of resources to produce systems, equipment and components which will be reliable and maintainable. In management terms it is concerned with what has to be done, and why, and when and how it has to be done, but it cannot be specific about who should do it and where, because organizations and projects vary widely.

Section 2 reviews the essential features of a comprehensive reliability and maintainability program, setting out a logical framework in which the activities described in the other Sections can take place.

Section 3 describes the steps that should be followed when a specification of reliability and maintainability is drafted. The Section provides guidance on the inclusion of reliability and maintainability clauses in specifications relating to the performance, construction, testing and installation of manufactured products, and indicates the nature of the reliability and maintainability statements appropriate to each specification.

Section 4 is an introduction to the means by which quantitative values can be assigned to the reliability and maintainability of systems, equipment and components at various stages in their life cycle, and the factors that influence that assignment.

Section 5 describes the processes of assimilation and utilization of the data on which assessment and prediction of reliability and maintainability are based.

Appendix A provides the user with a supplementary list of terms for reliability and maintainability, taken from IEC Publication 271, which are not found in AS 1057.

NOTES:

1. Appendix B provides an explanation of reliability and maintainability terminology.
2. Appendix C provides a complete index of terms for reliability and maintainability.
3. Many but not all of the program elements described in this Standard are applicable to the achievement of reliability and maintainability of services.

1.2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS

1057 Quality assurance and quality control—Glossary of terms

1199 Sampling procedures and tables for inspection by attributes

1821 Suppliers quality systems for design, development, production and installation

1822 Suppliers quality systems for production and installation

2490 Sampling procedures and charts for inspection by variables for percent defective

2529 Collection of reliability, availability and maintainability data for electronics and similar engineering use

2530 Presentation of reliability data on electronic and similar components

3900 Quality systems for engineering and construction projects

3900 Quality systems—Guide to selection and use

3901 Quality systems for design/development, production, installation and servicing

3902 Quality systems for production and installation

BS

5760 Reliability of systems, equipments and components—
Part 2: Guide to the assessment of reliability

IEC

271 List of basic terms, definitions and related mathematics for reliability

1.3 DEFINITIONS. For the purpose of this Standard the definitions given in AS 1057 and the terms listed in Appendix A of this Standard apply.