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**RELIABILITY AND MAINTAINABILITY
MOD GUIDE TO TERMINOLOGY
DEFINITIONS**

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RELIABILITY AND MAINTAINABILITY

MOD GUIDE TO TERMINOLOGY

DEFINITIONS

PREFACE

i The principle of this Standard is to state explicitly the exact meaning of the Reliability and Maintainability (R&M) terminology used by the Ministry of Defence (MOD) in R&M Defence Standards.

ii The MOD accepts the British Standards concepts of R&M(A) and by inference accepts BS 4778: Part 3 Availability, Reliability and Maintainability Terms but excluding the terms listed in the Defence Standard.

iii The MOD's hierarchical order of preference of sources of referenced definitions for R&M terminology is stated at **2.4**.

iv Users of this Standard shall note that some material may be claimed to be subject to copyright in this or other countries. Copyright, where known, is acknowledged.

v This Standard was prepared by the Committee for Defence Equipment Reliability and Maintainability (CODERM).

vi This Standard has been agreed by the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Defence Standard, the Directorate of Standardization shall be informed so that a remedy may be sought.

vii Any enquiries regarding this Standard in relation to an invitation to tender or a contract in which it is incorporated are to be addressed to the responsible technical or supervising authority named in the invitation to tender or contract.

viii This Standard has been devised for the use of the Crown and its contractors in the execution of contracts for the Crown. The Crown hereby excludes all liability (other than liability for death or personal injury) whatsoever and howsoever arising (including, but without limitation, negligence on the part of the Crown its servants or agents) for any loss or damage however caused where the Standard is used for any other purpose.

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RELIABILITY AND MAINTAINABILITY (R&M)MOD GUIDE TO TERMINOLOGYDEFINITIONS

0 Introduction

The MOD considers the term 'Reliability and Maintainability' (R&M) to be generic and interprets it to encompass related specific concepts such as availability, supportability, testability etc.

Whereas the MOD accepts the concepts of R&M described in BS 4778: Part 3 Section 3.1, and by inference generally accepts the derived definitions, but by reasons of: uniqueness of some MOD R&M terms; extant NATO definitions; exceptions; etc, this Defence Standard is considered necessary towards a rationalization of MOD R&M terms that will facilitate exact and taut specifications/contracts.

1 Scope

This Defence Standard addresses only those R&M terms that are unique to the MOD, are extant NATO definitions, attract particular meaning in an individual Service, are exceptions to MOD's acceptance of BS 4778; or are accredited quotations, selected from the related documents and included for completeness.

All other R&M terms that are adequate and acceptable to the MOD are defined in the Def Stan 00-40 through 00-49 Series or in the documents noted at 2.1.

2 Related Documents

2.1 The following documents and publications are referred to in the text of this Standard:

ARMP-7	NATO R&M Terminology Applicable to ARMPs
BS 4778: Part 3	Availability, Reliability and Maintainability Terms
JSP 110	Joint Service Glossary
MIL-STD-721	Definitions of Effectiveness Terms of Reliability Maintainability, Human Factors and Safety
MIL-STD-1309	Definitions of Terms for Test, Measurement and Diagnostic Equipment
MIL-STD-2165	Testability Program for Systems Equipment
ANSI/IEEE: 610.12	Glossary of Software Engineering Terminology

2.2 Reference in this Standard to any related documents means in any invitation to tender or contract the edition and all amendments current at the date of such tender or contract unless a specific edition is indicated.

2.3 The documents listed may be obtained from the sources shown below:

DOCUMENT	SOURCE
Allied Reliability and Maintainability Publication (ARMP)	Directorate of Standardization Stan 2 Kentigern House 65 Brown Street GLASGOW G2 8EX
British Standard (BS)	BSI Sales Department 389 Chiswick High Road LONDON W4 4AL
Defence Standard (Def Stan)	Directorate of Standardization Stan 1 Kentigern House 65 Brown Street GLASGOW G2 8EX
Joint Service Glossary (JSP 110)	MOD Forms and Publications Branch CSE Mwrawg Road Llangennech Llanelli DYFED SA14 8YP
Military Standard (MIL-STD) American National Standards Institute (ANSI)/ Institute of Electrical & Electronics Engineers (IEEE): 610.12 Glossary of Software Engineering Terminology	Technical Indexes Willoughby Road Bracknell BERKS RG12 4DW

2.4 The above documents are listed in order of preference and hierarchy for the selection of Standards for MOD procurement and hence infer the hierarchal order of preference of sources of MOD R&M terminology.

3 Definitions

accept criteria (see ARMP-7)

acceptable deferred fault (RAF use)

Is a fault on an aircraft or equipment that has had corrective action deferred for operational reasons where the fault does not jeopardize the safety of personnel, aircraft or equipment.

accessibility (see ARMP-7)

activity (or operation) code (RAF use)

Is an aircraft Maintenance Work Order Code which is used to designate the flight phase or when and how a fault was found, the operational effect and whether or not it was a flight safety hazard.

adjust

Is to restore to a specification without re-work or replacement of any entity.

adjustment (see AMP-7)

apportionment

The determination and assignment of the reliability requirements to any entity.

arising (aircraft related term)

An event which results in a unique maintenance action on an equipment, recorded on appropriate maintenance documentation.

assessment team (AT)

A multi-disciplined team (eg R&M, design, maintenance, operations, quality), formed by the MOD and consisting of MOD and/or user staff and contractor representatives. The prime function of the AT is to monitor and provisionally sentence all incidents before formal confirmation by the incident sentencing committee (ISC).

Authority (The) means the Secretary of State for Defence.

authority

Any officer authorized to act on behalf of The Authority in relation to specific matters.

availability (see ARMP-7)

availability - effective (Aeff). (mainly RN use)

The proportion of the defined period during which the equipment is available for use without any performance limitations, assuming that there are no logistic delays.

availability - intrinsic (see ARMP-7)

availability - operational (Ao)

The proportion of the defined operational period during which the equipment is available for use without any performance limitations.

ie $Ao = \frac{\text{uptime}}{\text{uptime} + \text{downtime}}$ measured over an operational period

Operational availability may be expressed by the formula:

$$Ao = \frac{OT + ST}{OT + ST + TPM + TCM + ALDT}$$

where: OT = operating time
ST = standby time
TPM = total preventative maintenance time
TCM = total corrective maintenance time
ALDT = administration and logistics delay time spent waiting for parts, maintenance personnel or transportation

NB: Units will be defined in accordance with Service practice.

battle damage repair

Is essential repair, which may be improvised, carried out in a battle environment in order to return damaged or disabled equipment to temporary service.

battle damage repair - aircraft (RAF use)

Is the maintenance action taken in wartime to maximize the availability of damaged mission capable aircraft.

battlefield day

The battlefield day specifies how the equipment is likely to be used during a typical 24 - hour period in war.

battlefield mission

The battlefield mission specifies how the equipment is likely to be used during a typical war-time mission. This may specify the usage profile for the equipment for a battlefield mission, or it may be comprised of a series of consecutive battlefield days or equipment operating cycles.

build standard

Is the approved specifications, design and contemporary support that comprise the performance and engineering definition.

built-in-test (BIT) (see ARMP-7)

built-in-test equipment (BITE) (see ARMP-7)

cannibalize (cf robbing)

To remove, without subsequent replacement, useful serviceable items from one equipment/system for use on other equipment/systems.

NOTE: These definitions for cannibalize and robbing are a clarification of the Joint Service Glossary (JSP 110) definition.

configuration

Is the functional and physical characteristics of materiel as described in technical documents and achieved in a product.

configuration control (see ARMP-7)**data classification**

Is the process by which incident data are sorted into different categories, (eg cause, significance, maintenance requirement) applicable to the R&M parameters being assessed.

defect (see ARMP-7)**degradation**

Is a gradual impairment of the ability to perform.

(MIL-STD 721)

degradation fault

Is a fault which reduces performance below a specified level, but which does not necessarily terminate the function.

degradation - graceful/gradual. (synonymous terms)

Is the sufficiently long interval between the occurrence of a potential failure, which produces degraded capability, and its decay into functional failure to allow either:

- (a) maintenance/repair intervention to prevent functional failure; or
- (b) action to be taken to avoid or reduce the consequences of functional failure.

design review

Is a formal and independent examination of an existing or proposed design for the purpose of detection and remedy of deficiencies in the requirements and design which could affect such things as reliability performance, maintainability performance, maintenance support performance requirements, fitness for the purpose and the identification of potential improvements.

(BS 4778)

downtime

Is that period of time during which an item is not in a condition to perform a required function. It is the sum of the total preventive maintenance (TPM) time, plus total corrective maintenance (TCM) time plus the total of the administration and logistics delay time (ALDT) spent waiting for parts, maintenance personnel or transportation.

durability

The ability of an item to perform a required function under given conditions of use and maintenance, until a limiting state is reached.

(BS 4778)

effectiveness - operational

Is the degree to which an equipment is capable of fulfilling the purpose for which it was procured.

elapsed time

The actual time an equipment operates between switch on and switch off. Cumulative elapsed times represent the total time an equipment is actually used and may be recorded by elapsed time indicators (ETIs).

elapsed time data (ETD)

That data which is collected when an equipment is being used.

entity

Any part, component, device, sub-assembly, sub-system, functional unit, equipment platform, or system that can be individually considered.

equipment

A generic term for an item which is designed to provide one or more services or functions to the user, or the system of which it forms a part.

equipment reference mark/number (ERM)/(ERN)

An alphanumeric code that uniquely identifies an individual equipment of a particular equipment type.

equipment support-line (see maintenance-line)

fault (see ARMP-7)

fightable

The ability of the complete equipment, less sub-systems not considered absolutely essential, to complete (with a degraded performance) the battlefield mission.

incident sentencing committee (ISC)

A multi-disciplined team (eg R&M, design, testability, operations, quality) selected from the R&M Panel/Project Panel, that should include representatives from the prime contractor, the design authority, MOD project manager and the user. The prime function of the ISC is to examine and formally confirm the sentencing of the assessment team in order to sort and classify the data for R&M assessment.

incident

Is any event indicating a possible non-conformance with the specification and which is reported on the R&M recording system.

interchangeability (see ARMP-7)

in-service reliability demonstration (ISRD)

Is the demonstration of reliability achievement using production standard equipment under agreed in-service environmental, operational, usage and support conditions.

interface

A shared boundary involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity and function of the interconnecting elements and the type and form of function or information to be interchanged between them.

(MIL-STD 1309)

item (see entity)

life policy

Is the policy whereby items are deemed to have a limited life, and which determines the replacement of the items on a preplanned basis for durability, reliability, safety or economic reasons. The period of limited life can include periods of storage as well as Service use.

NOTE: Line replaceable item (LRI), line replaceable unit (LRU) and lowest replaceable assembly (LRA) are synonymous terms used by the RAF, the Army and the RN respectively. The respective preferred terminology is stated below:

line replaceable item (LRI) (RAF use)

Any functional item which can be removed from the equipment as part of a single maintenance action.

line replaceable unit (LRU) (Army use)

An assembly or unit, normally incorporating sub-assemblies or modules mounted together and designed for ease of replacement (normally at the Service operating unit) as an entity and which can be provisioned separately.

lowest replaceable assembly (LRA) (RN use)

A sub-assembly, sub-unit or item consisting of a number of components mounted together (eg on a sub-chassis in or on the outside of a unit) which can be removed for repair or replacement.

main equipment (RAF use)

An equipment designated by the RAF Maintenance Analysis and Computing Division (MACD) as a main equipment and entered on a MOD Form 707B (ADP) maintenance work order.

maintainability demonstration (MD) (see AMP-7)**maintenance**

Is all action taken to retain materiel in, or restore it to, a specified condition. It includes: inspection, testing, servicing, classification as to serviceability, repair, rebuilding, and reclamation.

JSP 110

maintenance authority

Is the Service authority responsible for the maintenance policy.

maintenance - depth (depth of maintenance) (RN & RAF use)

(see annex A, B & D)

- level (level of maintenance) (Army use)

(see annex A & C)

line (line of maintenance/equipment support) (RN, RAF/Army use)

(see annex A, B, D & C)

maintenance policy (see upkeep policy)

A description of the interrelationship between the maintenance echelons, the indenture levels and the levels of maintenance to be applied for the maintenance of an item.

materiel

A generic term encompassing equipment, stores, supplies and spares.

mean time to repair (MTTR) (see ARMP-7)

not repairable at sea

An item of equipment which, either by design or by virtue of a policy of not providing local support in the event of a failure, is deemed not suitable for repair at sea.

off-the-shelf (OTS) equipment (see ARMP-7)

panel

A panel is a group of knowledgeable people operating as a team to deal with R&M at a particular stage in a project. The Army/Land Systems entitle R&M Panels as A, B or C. The corresponding titles in the other two Services/Systems are 'Concept', 'Project' and 'in-Service'.

Concept Panel/Panel A

A panel to provide R&M specialist advice to the equipment sponsor to ensure that the R&M requirements are operationally justified, achievable and clearly stated in the Staff Target and Staff Requirement.

Project Panel/Panel B

A panel to provide R&M specialist advice to the project manager (PM) in respect to the technical specification, formal R&M plans and programmes, and related studies as appropriate, to ensure that the R&M requirements are properly specified and contracted for.

In-Service Panel/Panel C

The in-Service panel that monitors R&M performance in-Service for assurance purposes and, in areas where R&M is found not to meet specified requirements, to provide objective evidence for remedial decisions and/or actions.

R&M Panel

Is the generic term for Concept Panel/Panel A; Project Panel/Panel B; In-Service Panel/Panel C.

platform

May be a ship, armoured or non-armoured vehicle, aircraft, communications network or other complete system which can be subjected in total, or in part, to a maintainability demonstration (MD) and/or an in-service reliability demonstration (ISRD).

probability of mission success

The probability of successfully completing a defined mission without incurring loss of a function which is deemed mission critical.

robbing (cf cannibalize)

The transfer of a serviceable part from one equipment/system to another or from an uninstalled assembly to an equipment/system, to overcome a temporary deficiency in spares.

NOTE: These definitions for robbing and cannibalize are a clarification of the Joint Service Glossary (JSP 110) definition.

reliability (see ARMP-7)
 reliability block diagram (see ARMP-7)
 reliability centred maintenance (RCM) (see ARMP-7)
 reliability demonstration (see ARMP-7)
 reliability demonstration, in-service (ISRd) (see in-service reliability demonstration)
 reliability growth (see ARMP-7)
 reliability growth model (see ARMP-7)
 reliability growth test (see ARMP-7)
 reliability prediction (see ARMP-7)
 reliability qualification test (see ARMP-7)
 reliability stress analysis (see ARMP-7)

repair

That part of corrective maintenance in which manual actions are performed on an item.

(BS 4778)

restoration

That event when the item regains the ability to perform a required function.

(BS 4778)

R&M allocation and apportionment (see ARMP-7)

R&M assurance (see ARMP-7)

R&M assessment (see ARMP-7)

R&M programme plan (see ARMP-7)

R&M model (see ARMP-7)

screening (see ARMP-7)

sentence

Is the allocation of a summary coding to a recorded incident using a formal procedure.

shelf life (see ARMP-7)

software (R&M)

The American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE) 610.12 Glossary of Software Engineering Terminology is the preferred source of software R&M terminology.

specification

The documents that prescribe the requirements of the product or service together with the descriptive means and criteria to assess conformity.

storeroob (RN term) (see robbing)

supportability

The degree to which system design characteristics and planned logistics resources, including manpower, meet system peacetime and wartime utilization requirements.

tailoring (see ARMP-7)

testability

Testability is a characteristic of design which allows the operational status of an entity, and the location of faulty replaceable components within that entity, to be confidently determined in a timely and cost-effective manner. Operational status can mean operable, partly operable or inoperable.

(MIL-STD 2165)

turn-round time

The element of maintenance time needed to replenish consumables and check out an item for recommitment.

(MIL-STD 721)

upkeep policy (RN use) (see maintenance policy)

uptime

Is that period of time during which an item is in a condition to perform a required function. It is the sum of the operating time (OT) plus the standby time (ST).

usable condition (up state)

A state of an item characterized by the fact that it can perform a required function, assuming that the external resources, if required, are provided.

(BS 4778)

user

The individual(s) who, or organization(s) or Service(s) that operate(s) or use(s) the product.

Lines, Depths/Levels of Service Maintenance

A.1 The maintenance concept for Service equipment is constructed on two basic parameters:

- (a) the scope and depth/level of maintenance task to be undertaken;
- (b) the type of organization empowered to fulfil the maintenance task.

A.2 The RN and the RAF use the term "depths of maintenance", but the Army uses the term "levels of maintenance" to define (a) - the maintenance task to be undertaken.

NOTE: The maintenance concept for Army equipment is constructed on two basic parameters: the line of equipment support; and the level of maintenance to be undertaken. The level of maintenance defines the scope and depth of tasks to be undertaken and the line defines the part of the organization to carry out those tasks.

A.3 The RN and the RAF use the term "lines of maintenance", but the Army uses the term "lines of equipment support" to define (b) - the organization empowered to fulfil the maintenance task.

A.4 The respective Service terms "depths of maintenance", "levels of maintenance", "lines of maintenance" and "lines of equipment support" are expanded and defined below:

maintenance - depth A (RN and RAF term) (see annex B & D)

Is maintenance directly concerned with day-to-day preparation. It may include such operations as functional testing, replenishment, servicing, re-arming, role changing, minor modification, fault diagnosis and corrective maintenance by replacement, adjustment or minor repair.

maintenance - depth B (RN and RAF term) (see annex B & D)

Is maintenance that is required on items and assemblies that are temporarily unserviceable, in an unacceptable condition, require servicing or preventive maintenance. This may include scheduled maintenance, embodiment of prescribed modifications, bay maintenance of assemblies and corrective maintenance beyond depth A; but within generally provisioned resources.

maintenance - depth C (RN and RAF term) (see annex B & D)

Is maintenance that is the repair, partial reconditioning and modification requiring special skills, special equipment or relatively infrequently used capabilities that are not economic to provide generally, but which is short of complete strip, reconditioning and reassembly.

maintenance - depth D (RN and RAF term) (see annex B & D)

Is maintenance that is full reconditioning, major conversion or such repair that involves work of this depth/level.

maintenance - level 1 (User) (Army term)
(see maintenance - depth A and annex C).

maintenance - level 2 (Army term)

Is corrective maintenance by replacement, adjustment or minor repair including fault diagnosis and minor authorized modifications, within specified times, using generally provisioned resources.

maintenance - level 3 (Army term)

Is maintenance in greater depth than level 2.

see maintenance - depth C and annex C.

maintenance - level 4 (Army term)

see maintenance - depth D and annex C.

maintenance/equipment support - First Line (RN, RAF/Army term)

Is the organization immediately responsible for corrective maintenance and preparation for use of complete systems or equipment.

First Line organizations normally undertake depth A maintenance (Level 2 maintenance in the Army) but may be authorized to undertake some depth B maintenance (Level 3 maintenance in the Army).

maintenance/equipment support - Second Line (RN, RAF/Army term)

Is the organization responsible for providing maintenance support to specified First Line organizations.

Second Line organizations in the RN and the RAF normally undertake depth B maintenance but may be authorized to undertake some depth C maintenance.

Second Line organizations in the Army normally undertake Level 3 maintenance.

maintenance/equipment support - Third Line (RN, RAF/Army term)

Is the remaining maintenance organizations within the Services, which are neither First nor Second Line, and may include Defence Support Agencies and Government Owned Contractor Operated (GOCO) facilities.

Third Line organizations, although able to undertake all depths of maintenance, normally undertake depth C and D maintenance, in the RN and the RAF, and Levels 3 and 4 maintenance in the Army. There are currently no deployable Army Third Line organizations in the Organization for Battle (ORBAT).

maintenance/equipment support - Fourth Line (RN, RAF/Army term)

Is the industrial organization providing, under contract, support beyond Second Line to the Services.

Fourth Line organizations, although able to undertake all depths/levels of maintenance, normally undertake depths C and D maintenance in the RN and the RAF, and levels 3 and 4 maintenance in the Army.

LINE	ORGANIZATION/SKILL LEVEL	DEPTH	MAINTENANCE TASKS	SUPPORT
1st	Operator or maintainer.	A	Functional testing, replenishment, servicing, minor modifications. Fault diagnosis and corrective maintenance by replacement. Adjustment or minor repair. Scheduled and preventive maintenance.	BITE. Test and measuring instruments. On-board documents and spares. Specific or general purpose measuring or test instruments. On-board spares/stores, or those held by FMG.
	Artificer	B	Preventive maintenance including scheduled maintenance, embodiment of prescribed modifications. Maintenance of assemblies and repair/corrective maintenance beyond Depth A, but within provisioned resources.	
2nd	RN staff of Fleet Maintenance Groups (FMGs) or authorities in support of ship's staff. On-board and shore-side workshops. Artificer.		Repair on items and assemblies which are unserviceable or require preventive maintenance, includes scheduled maintenance embodiment of prescribed modifications, bay maintenance of assemblies and corrective maintenance beyond Depth A, but within provisioned resources.	Expensive and specific support and test equipment. Base or industrial spares or stores.
		C	Repair, partial reconditioning and modification requiring special skills, equipment or capability.	
3rd	Maintenance by dockyard authority. On-board and dockyard workshops. Civilian technicians		Repair, partial reconditioning and modification requiring special skills, equipment and facilities beyond shipborne resources.	
4th	Industrial, under contract. On-board facilities and industrial repair facilities. Civilian technicians	D	Full reconditioning, major conversion or such major repair that involves repair of this depth, or that the ship be docked.	

MATRIX OF RN LINES AND DEPTHS OF MAINTENANCE

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ANNEX B (Concluded)

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MATRIX OF ARMY LINES OF EQUIPMENT SUPPORT AND LEVELS OF MAINTENANCE

LINES OF EQUIPMENT SUPPORT (Maintenance) ORGANIZATION (ESO)		LEVEL OF MAINTENANCE UNDERTAKEN
LINE	DEFINITION	
User		<u>Level 1.</u>
First	The maintenance organization immediately responsible for the maintenance of a unit's complete systems or equipment.	<u>Level 2</u> and, in some cases, <u>Level 3</u> maintenance on the parent unit's specialized equipment.
Second	The maintenance organization responsible for providing maintenance support to specified First Line organizations.	<u>Level 3.</u> (Level 1/Level 2 maintenance on their own vehicles and equipment.)
Third	The maintenance organization responsible for providing maintenance support to First or Second Line. Currently the ESO has no deployable Third Line maintenance organizations in the Organization for Battle (ORBAT); the organizations providing this line of support are static and non-deployable.	<u>Levels 1, 2, 3 and 4.</u>
Fourth	Industry providing, under contract, support to the Army.	<u>Levels 1, 2, 3 and 4</u>

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MATRIX OF RAF LINES AND DEPTHS OF MAINTENANCE

ORGANIZATION	LINES OF MAINTENANCE	DEPTHS OF MAINTENANCE
Aircraft Sqn Regt SAM Sqn Radar site etc	<u>First Line</u> - per definition (see annex A)	<u>Depth A</u> - per definition (see annex A)
		<u>Depth B</u> - per definition (see annex A)
Operational RAF Station Maintenance Bays	<u>Second Line</u> - per definition (see annex A)	<u>Depth C</u> - per definition (see annex A)
		<u>Depth D</u> - per definition (see annex A)
RAF Maintenance Units	<u>Third Line</u> - per definition (see annex A)	
Industry	<u>Fourth Line</u> - per definition (see annex A)	

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The following Defence Standard file reference relates to the work on this Standard - D/D Stan/350/02/13.

Contract Requirements

When Defence Standards are incorporated into contracts users are responsible for their correct application and for complying with contract requirements.

Revision of Defence Standards

Defence Standards are revised when necessary by the issue either of amendments or of revised editions. It is important that users of Defence Standards should ascertain that they are in possession of the latest amendments or editions. Information on all Defence Standards is contained in Def Stan 00-00 (Part 3) Section 4, Index of Standards for Defence Procurement - Index of Defence Standards and Specifications published annually and supplemented periodically by Standards in Defence News. Any person who, when making use of a Defence Standard encounters an inaccuracy or ambiguity is requested to notify the Directorate of Standardization without delay in order that the matter may be investigated and appropriate action taken.