

**MINISTRY OF DEFENCE**

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**STANDARDS FOR DEFENCE RELIABILITY AND MAINTAINABILITY ASSURANCE  
ACTIVITY - MAINTAINABILITY DEMONSTRATIONS**

**WARNING**

**This is a Draft Document  
Not to be Used as an Agreed  
Defence Standard**

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The following changes have been incorporated into the new issue of this Def Stan:

<b>Clause No.</b>	<b>Change Made</b>	<b>Reason for Change</b>

## Contents

0	Introduction.....	iv
1	Scope.....	3
2	Warning .....	3
3	Normative References .....	3
4	Definitions .....	4
5	Purpose .....	4
6	Aim.....	4
7	Practical Considerations .....	4
8	Planning .....	5
9	Benefits .....	6
10	Constraints.....	6
11	MOD PM.....	6
12	Demonstration Coordinator .....	6
13	User/maintainer .....	7
14	Contractual Issues .....	7
15	Invitation to Tender (ITT) and Response .....	7
16	The Contract .....	8
17	Preparation and Issue of Maintainability Demonstration (MD) Directives .....	8
18	Demonstration Characteristics .....	9
19	Form of Demonstration.....	10
20	Modifications .....	11
21	Role of MDP during Maturity of Maintainability Prediction.....	11
22	Data Classification from Maintainability Demonstration Programmes .....	11
23	Fault Insertion.....	12
24	Data Recording .....	12
25	Data Analysis .....	12
26	Component Handling .....	13
<b>Annex A Guidance on the Contents of a Maintainability Demonstration Programme (MDP) Plan and a Maintainability Demonstration (MD) Directive .....</b>		<b>14</b>
A.1	MDP plan checklist.....	14
A.2	MD Directive checklist.....	14

## Foreword

### AMENDMENT RECORD

Amd No	Date	Text Affected	Signature and Date

### REVISION NOTE

This standard is raised to Defence Standard 00-42 (Part 6) Issue 3 to update its content.

### HISTORICAL RECORD

This standard supersedes the following:

Defence Standard 00-42, Part 6, Issue 2 dated 24<sup>th</sup> September 2010.

The complete Def Stan 00-42 comprises:

Reliability and Maintainability Assurance Activities

- Part 1: One-Shot Devices/Systems
- Part 3: R&M Case
- Part 4: Testability
- Part 5: In-Service Reliability Demonstrations

- a) This standard provides testability requirements for MOD practices, procedures and requirements during the design process.
- b) This standard is raised to issue 3 to update its content on behalf of the Ministry of Defence (MOD) by the Reliability Advice and Guidance Group for UK Defence Standardization (DStan).
- c) This standard has been reached following broad consensus amongst 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, DStan shall be informed so that a remedy may be sought.
- d) Please address any enquiries regarding the use of this standard in relation to an invitation to tender or to a contract in which it is incorporated, to the responsible technical or supervising authority named in the invitation to tender or contract.
- e) Compliance with this Defence Standard shall not in itself relieve any person from any legal obligations imposed upon them.
- f) This standard has been devised solely for the use of the MOD and its contractors in the execution of contracts for the MOD. To the extent permitted by law, the MOD hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, liability resulting from negligence) for any loss or damage however caused when the standard is used for any other purpose.

## **0 Introduction**

Maintainability is the characteristic of the design and installation of a system which determines the ability of the system to be restored following a fault or failure to its previous operational capability. The MOD seeks to achieve a high level of maintainability in its systems which, coupled with good reliability, will ensure through life costs are optimized. The level of maintainability achieved is dependent on the requirements imposed, the level of logistic support provided and the inherent design constraints of the system. This Part of the Defence Standard describes the purpose, rationale and procedures for the demonstration of maintainability.

A Maintainability Demonstration (MD) may not be appropriate to every project. However, where considered appropriate, a MD or series of MDs could form part of a maintainability demonstration programme (MDP); this would be an integral part of the overall procurement strategy and included in the project Integrated Test Evaluation and Acceptance Plan (ITEAP).

# STANDARDS FOR DEFENCE - RELIABILITY AND MAINTAINABILITY ASSURANCE ACTIVITY - MAINTAINABILITY DEMONSTRATIONS

## 1 Scope

**1.1** This Part of the Defence Standard gives guidance to staff on the considerations for, and the undertaking of, a MDP. It describes the factors that the sponsor and MOD Project Manager (PM), advised by the R&M Panels, should consider before deciding whether an MDP is appropriate to the procurement strategy. It provides direction on the requirements for MDPs at the specification, invitation to negotiate (ITN) and final contract stages. Guidance is also given on the preparation of the MDP plan and directive.

**1.2** The requirements for a MDP will vary between systems and between Services; this Part of the Standard provides general direction so that common procedures can be applied. A MDP for an off-the-shelf system should be considered in the same way as for any other type of system.

## 2 Warning

The Ministry of Defence (MOD), like its contractors, is subject to both United Kingdom and European laws regarding Health and Safety at Work. Many Defence Standards set out processes and procedures that could be injurious to health if adequate precautions are not taken. Adherence to those processes and procedures in no way absolves users from complying with legal requirements relating to Health and Safety at Work.

## 3 Normative References

**3.1** The publications shown below are referred to in the text of this standard. Publications are grouped and listed in alpha-numeric order.

Note: Def Stan's can be downloaded free of charge from the DStan web site by visiting <http://www.dstan.dii.r.mil.uk> for those with rli access or <https://www.dstan.mod.uk> for all other users. All referenced standards were correct at the time of publication of this standard (see 3.2, 3.3, & 3.4 below for further guidance), if you are having difficulty obtaining any referenced standard please contact the DStan Helpdesk in the first instance.

BS EN 60706-3	Maintainability of Equipment, Verification and Collection, Analysis and Presentation of Data
BS EN 60706-5	Maintainability of Equipment, Testability & Diagnostic Testing
BS 4778	Quality Vocabulary
BS 5760-18:2010	Reliability of Systems, Equipment and Components: Guide to the Demonstration of Dependability Requirements – The Dependability Case
IEEE 1633™ -2008	IEEE Recommended Practice on Software Reliability
Def Stan 00-42 Part 3:	Reliability and Maintainability Assurance Guide R&M Case
Def Stan 00-42 Part 4:	Reliability and Maintainability Assurance Activity Testability

Def Stan 00-44	Reliability & Maintainability Data Collection and Classification
Def Stan 00-45	Using Reliability Centred Maintenance to Manage Engineering Failures
Def Stan 00-49	MOD Guide to R&M Terminology Used in Requirements
Def Stan 00-52	The General Requirements for Product Acceptance and Maintenance Test Specifications and Test Schedules
	Military Aviation Authority Regulatory Publications

**3.2** Reference in this Standard to any normative references means in any ITT or contract the edition and all amendments current at the date of such tender or contract unless a specific edition is indicated.

**3.3** In consideration of clause **3.2** above, users shall be fully aware of the issue and amendment status of all normative references, particularly when forming part of an ITT or contract. Responsibility for the correct application of standards rests with users.

**3.4** DStan can advise regarding where normative reference documents are obtained. Requests for such information can be made to the DStan Helpdesk. How to contact the helpdesk is shown on the outside rear cover of Def Stans.

## **4 Definitions**

**4.1** For the purpose of this Defence Standard the definitions given in the text and in Def Stan 00-49 apply, together with the following:

**4.1.1** Platform. A platform is 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 MDP.

**4.2** For terms not defined in either the text or in Def Stan 00-49 then BS 4778 shall apply.

## **5 Purpose**

**5.1** The purpose of an R&M Case (Def Stan 00-42 Part 3) is to provide “a reasoned, auditable argument to support the contention that a defined system will satisfy the R&M requirements”. If it is anticipated that areas of maintainability risk will not be mitigated by the R&M Case then the MOD PM should decide if an MDP, will be required to demonstrate that the contractor has achieved the level of maintainability specified on a particular system. If a Maintainability Demonstration Programme (MDP) is required, then consultation is needed, at an early stage, between the MOD PM, specialist advisers, including MOD R&M specialists, and industry. Within the MOD, such consultation will usually take place within the R&M Panel that will take account of the practicality of demonstrations required. This consultation should result in an MDP Plan.

## **6 Aim**

**6.1** The MDP verifies the maintainability features of a system against contract requirements using a production standard system under agreed environmental, usage and support conditions.

## **7 Practical Considerations**

**7.1** The cost and planning effort involved in an MDP can be considerable and needs to be recognised at the outset. To be effective and convincing, a demonstration should be conducted under conditions which represent, as closely as possible, the operational maintenance environment specified and planned for the system. This requires consideration of the timing of the MDP as well as the standard of system available, the environment, staff and the support infrastructure required.

**7.2** A MDP could be planned to occur during development, production and/or after in-service use but the timing of a MDP affects both the contractor's and purchaser's risk. The closer the MDP is to the in-service date the less likelihood of embodying any proposed changes. Early undertaking of a MDP could be affected by development or production issues, a settling-in period might be required. Projects have to determine when to conduct the MDP and this needs to align with other contractual statements regarding timing of achievement, such as "maintainability shall be achieved at first entry to Service". Procedures adopted during a settling-in period should be declared; and include identification and embodiment of improvements and modifications. A compromise could be to conduct preliminary MD's during development; this would enable shortfalls to be addressed whilst reducing the likelihood of issues when the system enters service.

**7.3** The system used for the MDP should be as close as possible to the production standard. Whilst an MDP could be conducted on a system under development, the differences between the development and production standard system should not affect the maintainability characteristics. For a system the plan may allow for preliminary MDs of specific sub-systems whilst development of other parts is still in progress.

**7.4** The environment for the MDP needs to be representative of the original specification. Consideration needs to be given to what extent the environment, if any, needs to be simulated and how effective the simulation is. It should be recognised that the further the demonstration environment deviates from the specified operational environment the less likely demonstrated maintainability levels will represent those experienced in service.

**7.5** The logistics needs of MDP will be considerable and may include spare parts, fuel, lubricants, support equipment, specialist facilities and appropriate trained manpower. The quantities and standards of all support equipment (e.g. tools, test equipment, servicing equipment, handling equipment and technical documentation and publications), including Government Furnished Equipment (GFE) needs to be defined. Most importantly, it needs to be representative of the in-service system and not specially prepared or provided. Fully trained personnel with appropriate dress (especially chemical, biological, radiological and nuclear (CBRN) dress and / or arctic dress) will be required. Consideration needs to be given to the potential cost of providing the logistic needs. The assessment of the logistic needs and support should be made at the earliest possible time by the MOD PM since some resources, such as trained manpower, may need to be allocated several years in advance. A MDP may also affect long-term planning of training, military exercises and deployments by the user.

**7.6** Whenever possible the technical publications (e.g. handbooks, operating and maintenance instructions) used to conduct the MDP should be of the same standard, quality and issue as those to be used when the system is in-service. This will allow for the validity of these publications to be demonstrated, but may not always be possible for early MDPs. In these instances interim documents need to be agreed.

## **8 Planning**

**8.1** In the early stages of a project the design of the system will not necessarily be sufficiently far advanced for a detailed MDP Plan, an initial draft plan or strategy should identify the likely number and type of MDs to be held, the acceptance criteria, and as much other detail as possible. This is likely to be sponsored by the MOD PM, in conjunction with a R&M Working Group (R&MWG), but authorship of the plan could then transfer to potential contractors to develop. The MDP Plan should be an integral part of the PTs project documentation set and form part of the ITEAP. From this, the R&MWG should be able to advise the sponsor of the likely resources required to undertake the MDP and develop it as the project moves to the specification stage. The detail contained in the final MDP plan should be sufficient for the resources necessary to conduct the MDs to be estimated more accurately by both MOD and prospective contractors. The MDP plan needs to be tailored to the system and the particular Service involved. Guidance on the content of the sections of the MDP plan is at annex A.

**8.2** The importance of an MDP plan cannot be over-emphasized. Preparatory work will be required by both the user and the contractor and the ability of both parties to influence a MDP needs to be recognised. Early identification of this work and discussions between both the user and the contractor will ensure that all actions are complete or in hand for the start of the MDP and that the demonstration, or series of demonstrations, achieves its objectives.

## **9 Benefits**

**9.1** Provided that the contract conditions and remedies are clearly specified and the required support is provided, an MDP can offer many benefits. An MDP can:

**9.1.1** Fulfil the MOD PM's requirement that certain maintainability criteria, relative to the contract requirement, have been achieved. It can also provide the baseline against which continuing operational maintainability can be assessed.

**9.1.2** Extend the contractual influence and provide motivation for the achievement of good maintainability throughout the design and development phases.

**9.1.3** Provide clear evidence upon which to base contractual action.

**9.1.4** Provide, to both the user and the contractor, a clear indication of the maintainability features of a system in service use.

**9.1.5** Provide the user with additional training and experience before the system enters into service.

**9.1.6** Provide an indication of the adequacy of handbooks and procedures.

## **10 Constraints**

**10.1** An MDP may introduce a number of constraints. These can be minimized by careful and early planning. Potential constraints include the following aspects:

**10.1.1** An MDP may concentrate the maintainability features of a design into specific areas and allow other areas to be ignored.

**10.1.2** The employment/use of representative personnel, tools and system for the undertaking of a realistic demonstration need to be identified and agreed.

**10.1.3** Maintainability needs to be specified quantitatively such that it can be measured. If a qualitative attribute, such as ease of maintenance, is to be demonstrated then the conditions need to be clearly specified at the outset to avoid disputes later.

**10.1.4** Cost and planning effort involved in an MDP can be considerable and needs to be recognised at the outset.

## **11 MOD PM**

**11.1** The MOD PM, will have overall responsibility (unless otherwise stated in the contract) for issuing the MDP plan and the MD directive, implementation of the MDP and review of results.

## **12 Demonstration Coordinator**

**12.1** The Demonstration Coordinator is responsible for liaison between MOD, the users, the maintainers and contractors; and for coordination of all necessary facilities prior to and during demonstration. Reporting to the PM on a regular basis, the Demonstration Coordinator, will refer unresolved disputes regarding categorising of activities to the PM, and coordinating a final report of the demonstration for submission to the PM. The report will be used to determine the basis of contractual compliance.



## 13 User/maintainer

**13.1** The users/maintainers will normally be service staff and training should be provided to ensure that those allocated represent the skill level of those who will operate or maintain the system. However, it may not be possible to provide users and it may be necessary for the contractor to undertake the operation with full visibility by the MOD. The responsibilities of each need to be fully defined in the MD directive but will generally comply with the following:

**13.1.1** The user is responsible for the operation of the system during the MDP. The user may also be responsible for promptly investigating all activities arising in accordance with the agreed maintenance policy and any additional policies agreed for the MDP. In particular, the user is responsible for making available to the AT all relevant data relating to the operation of the system.

**13.1.2** The maintainer is responsible for the maintenance of the system during the MDP and for inspection of the system, when appropriate, to identify qualitative problem areas. The maintainer is responsible for promptly investigating all activities reported by the user in accordance with the agreed maintenance policy and any additional policies agreed for the MDP. In particular, the maintainer is responsible for making available to the AT all relevant data relating to the support of the system.

## 14 Contractual Issues

**14.1** The MDP can aid with determining if some of the R&M requirements have been met. It would not be unreasonable to link final system and contractual acceptance to a MDP. This serves to highlight how important R&M is to the MOD, and should be used to motivate a contractor to deliver the required maintainability. This would be the case where payment is linked to successful completion of an MDP.

## 15 Invitation to Tender (ITT) and Response

**15.1** If the MOD produces an outline MDP plan then this plan should accompany the ITT; and should tell the contractor in as much detail as possible how the MOD will assess the maintainability of the system. If an MDP is specified by the MOD it is essential that the system specification contains quantitative and/or qualitative requirements which will be assessed in the MDP. Alternatively, if the MDP plan is produced by the contractor then this should be based on the draft MDP provided in the ITT and will become a requirement of the contract. Approval of the Contractor MDP plan needs to be specified in the contract.

**NOTE** Ideally, maintainability needs to be specified quantitatively such that it can be measured however, if a qualitative attribute such as ease of maintenance is to be demonstrated, the conditions and operator skill sets, need to be clearly specified at the outset.

**15.2** The requirement for a MDP as part of contractual acceptance needs to be declared within the ITT documentation, which should include sufficient information to determine the user's commitments and enable contractors tendering for the work to assess the financial and technical risks associated with an MDP. Typically, the following information needs to be included:

- a) The maintainability parameters to be demonstrated.
- b) The level of statistical confidence to which the customer requires the specified maintainability parameters to be demonstrated.
- c) The scope of the demonstration (i.e. a definition of the extent of the system or subsystem to be demonstrated, the environment and operational factors) required to assure the MOD / user.
- d) The resources to be made available by the customer and the user.
- e) The customer's and the contractor's responsibilities during the MDP.
- f) Any operational constraints limiting the MDP.

- g) Any proposed payment retention until successful completion of the MDP.
- h) Start and finish dates.

**15.3** This information is subsequently made binding in the contract. Evidence of achievement of the requirement should be linked to milestone payments to provide motivation for the contractor to achieve the maintainability level specified.

**15.4** In response to the ITT, the contractor will be expected to define how they intend meeting the contractual requirements of a MDP. Often the customer will request that the contractor shall provide as part of its tender response a draft demonstration plan which will define how the contractor proposes to conduct and manage a MDP. The plan should include amongst other things details of the maintainability requirement and the basis for demonstrating contractual acceptance including the demonstration risks.

## **16 The Contract**

**16.1** It is important to define carefully in the contract the scope or boundaries of the system or sub-system being subjected to the demonstration. In many cases this will be more easily specified by noting the exceptions or exclusions.

**16.2** The demonstration requirements (which should be embodied in the draft demonstration plan submitted by the contractor as part of the tender response) need to be included in the contract. The contract should detail the criteria for contractual acceptance or rejection of the complete MDP, or individual aspects of the demonstration. Also included will be information on the action required of the contractor in the event of non-compliance with the requirement, e.g. to incorporate, at the contractor's expense, modifications as they see fit to bring the performance of the system up to the specified levels together with the need for additional trialling and/or analyses necessary to enable compliance to be demonstrated.

**16.3** It is essential that R&M clauses in the specification and contract are accurate, comprehensive, unambiguous and consistent with each other. Any inconsistency or ambiguity between what has been stated in the requirement and the demonstration plan will almost certainly lead to complications in the future and potentially to an unenforceable contract.

**16.4** The contract needs to cover the complete conduct of the demonstration. Wherever possible, the demonstration requirements in the contract should be comprehensive to avoid the need for future clarification or amendment. However, it can be the case in procurements where there is an extended period between award of contract and the conduct of a MDP, circumstances change which may require modification to the demonstration approach and its contractual application. Where amendments to the contract are unavoidable they should be very carefully considered before implementation to avoid the overall contract being undermined or invalidated.

**16.5** The contract and the requirement for a MDP need to state the maintainability parameters to be demonstrated. In some cases, time and cost constraints may prevent a realistic assessment of all specified maintainability parameters.

**16.6** The parameters of the MDP need to be clearly set out in both the contract and the demonstration plan, and the areas of risk for both customer and contractor should be clearly identified. The parameters for the MDP need to be compatible with the specification, the R&M programme and the demonstration plan. The statistical risks shall be evaluated as part of the demonstration plan and the confidence levels associated with the particular demonstration established.

## **17 Preparation and Issue of Maintainability Demonstration (MD) Directives**

**17.1** For a system, each MD that forms part of the MDP needs an MD Directive which will be the primary managerial document relating to the conduct of the demonstration. To be fully effective, the MD Directive documents:

- a) All managerial responsibilities;

**Unclassified**

- b) All facilities necessary, including funding and personnel, together with the timescales for their implementation;
- c) The procedures for conduct of the MD including;
  - i) An appropriate test methodology to allow for exclusion of any bias and promote statistical validity.
  - ii) An acceptable maintenance task sampling procedure.
- d) All relevant contractual requirements, amplified as necessary with detailed guidance on their interpretation;
- e) The method of analysis of the test results;
- f) All relevant definitions with descriptions;
- g) Classification criteria to be applied to the maintenance actions generated by activities attributed to, or caused by, an error in contractor supplied documentation, publications or software.

NOTE Where appropriate projects may combine the MD Plan and Directive.

**17.2** The issue of individual MD directives enable contractors and MOD departments involved to finalise arrangements for the provision of facilities and resources. A MD directive is a detailed document to instruct all concerned on what is to be done, when, where and by whom. It is issued under the authority of the MOD PM in conjunction with the sponsor since it will inevitably involve the commitment of some MOD resources. It may be prepared by the MOD or the contractor as previously decided by the R&MWG and stated in the contract. Guidance on the content of the MD Directive is at Annex A.

NOTE Those responsible for drafting the MD directive are cautioned against copying paragraphs verbatim from other directives. Each MD directive needs to be tailored to suit the type of system and demonstration regardless of whether the pass/fail criteria are quantitative or qualitative.

## 18 Demonstration Characteristics

**18.1** Testability should be demonstrated as an integral part of the maintainability demonstration, or separately as a series of sub-system and/or system demonstrations, the results of which contribute to the demonstration of maintainability.

**18.2** Testability may be specified at all levels of design. However, at the sub-system and system levels it may not be possible to insert or simulate functionally significant faults: this may be due to build or physical restrictions. Where this is the case, more emphasis should be placed on the requirements of the testability design analysis and testability design review process.

**18.3** Where specific testability goals or requirements have been placed, as defined by Def Stan 00-42 Part 4, or Def Stan 00-52, the pass/fail criteria and method of demonstration shall be agreed within the contract. Data collection and the analysis of data should be in accordance with Def Stan 00-44.

**18.4** Maintainability characteristics can be measured during:

- a) Replenishment tasks: Typically, replacement of fuels, lubricants and stores consumed during operations.
- b) Scheduled maintenance: Preventative maintenance carried out in accordance with an established timed schedule derived using recognised and auditable Reliability Centred Maintenance principles (Def Stan 00-45).

- c) **Unscheduled maintenance:** Maintenance carried out before its scheduled time to correct a fault or degraded condition.

**18.5** Measures can then be taken either quantitatively e.g. 'Mean Active Repair Time' (MART), or qualitatively in terms of the 'ease of maintenance'. Having considered the relative merits of each, the appropriate one, or a combination of them, should be selected.

**18.6** Tasks selected should be based upon:

- a) Predicted failure rates;
- b) The failure mode and effects analysis;
- c) The inability to diagnose and/or isolate the failure;
- d) The complexity of failure rectification;
- e) Specific tasks identified to be evaluated;
- f) Interfaces with other systems.

**18.7** Effort should be expended on ensuring that the MDP does not concentrate the maintainability features of a design into only specific areas and allow other areas to be ignored.

## **19 Form of Demonstration**

**19.1** A variety of methods are available to demonstrate the maintainability of a system. The method chosen needs to be appropriate to mitigate risks while being proportional to the value it will contribute to the project. For a quantitative assessment refer to BS EN 60706 and Def Stan 00-42 Part 4 which provide specific guidance on the type of plan most appropriate to the requirement specified.

**19.2** Bench demonstration (factory intrinsic). This form of demonstration is undertaken under specified factory, workshop or similar conditions. It is generally applicable at subsystem level before a design can be considered suitable for platform installation. It would be undertaken during subsystem development to provide early assurance that the specified maintainability requirements will be satisfied. Ultimately, it would be carried out on the subsystem in its proposed production build configuration to verify that the required maintainability levels had been achieved prior to design approval by the contractor.

**19.3** Platform installed demonstration (platform intrinsic). This is undertaken with the subsystem installed in its platform, thus providing a more realistic environment than the bench demonstration. It can be used for measuring maintainability levels during subsystem development and just prior to design approval. However, it is more likely to be undertaken to ensure that all contractual requirements have been satisfied. It could form the basis of any in-service MDP.

**19.4** Simulated demonstration (platform intrinsic (modified)). A suitable platform may not always be available to accommodate a platform installed demonstration. In such an event, a test may be conducted on an approved representation of the platform. This test should not negate the requirement to undertake a platform-installed demonstration as soon as a platform becomes available.

**19.5** Complete platform demonstration. This form of demonstration is to be undertaken when the maintainability of the complete platform needs to be established. In determining the quantitative maintainability level for the complete platform it is not envisaged that every subsystem would be subject to a maintenance activity. Selection of maintenance tasks and their evaluation would be selected in accordance with the guidance at serial **22.6**. A qualitative assessment however would be expected to cover most of the subsystems installed. A complete platform demonstration could also form the basis of any in-service MDP.

## 20 Modifications

**20.1** During a lengthy demonstration there may be a need to incorporate modifications for operational or safety reasons. Specific modifications to improve maintainability may be acceptable during any settling-in period. But, once this is concluded a period of stable configuration (no further modifications) will apply during the demonstration during which modifications will only exceptionally be allowed. Modifications at this stage can only be approved by the MOD PM. The effect of any modifications on the maintainability and reliability of the system will need to be considered and methods agreed to attribute any effects, good or bad.

## 21 Role of MDP during Maturity of Maintainability Prediction

**21.1** The maintainability design process begins with the establishment of the overall system maintainability goals, and continues by conducting maintainability predictions. The respective purposes are to manage the total system maintainability programme and to determine whether the system design has the potential to satisfy the specified requirement. The predictions are also a necessary prerequisite of task selection for a MDP. The application of Integrated Logistic Support (ILS) procedures, and in particular the Logistic Support Analysis (LSA) process, will provide a major input into determining the overall system maintainability goals. The LSA tasks will address various maintenance aspects and ensure that data is available to be fed back into the design activity. The maintainability demonstrations will produce data to test and evaluate the outputs from the LSA programme.

**21.2** As the prediction process is iterative and allows prediction refinements as the design matures, trials or tests (preliminary MDs) may be considered necessary to verify predictions, check that the maintainability requirements are being incorporated into the design, determine whether maintainability goals are likely to be achieved and provide feedback for possible design improvements. Such trials or tests should adopt the principles and procedures of a MD for the maintainability assessment elements. In addition, they should address any known differences between the trial environment and the in-service environment and the possible effects that the differences may have on the validity and therefore the accuracy of any classification.

## 22 Data Classification from Maintainability Demonstration Programmes

**22.1** The classification of the evidence recorded during the MDP will enable the success of the demonstration and in turn contractual compliance to be determined. Not only is it important to record the facts as each maintenance activity is undertaken during the demonstration but that the maintainability requirement is sufficiently detailed to support its measurement.

**22.2** A compliant activity is where the maintainer is able to restore the system to its operational capability in accordance with the maintainability requirements employing the resources provided.

**22.3** A non-compliant activity is where the maintainer is unable to restore the system to its operational capability in accordance with the maintainability requirements employing the resources provided.

**22.4** The cause of non-compliance may be as a result of any of the following:

- a) Inadequate procedures within technical publications
- b) Inadequate diagnostics
- c) Inadequate training
- d) Inadequate tools
- e) Inadequate access

**22.5** Once correctly assessed the classification should stand unchanged; however where non-compliance has been rectified by for example the modification of diagnostic software, additional tools or the updating of

maintenance procedures and processes, etc. then at the discretion of the MOD PM such non-compliance may be deemed non-attributable in terms of system acceptance.

## **23 Fault Insertion**

**23.1** The requirement and method for inserting faulty/defective items/components into the system under test need to be fully detailed.

**23.2** The acceptable methods of fault simulation are:

- a) Insertion so that the test team are unaware of the fault inserted. This would be used when maintainer diagnostics are involved. The fault insertion and removal would be carried out in an adjacent location, leading to a significant increase in duration and cost.
- b) Insertion so that the test team are aware of the fault. This would normally be used if diagnosis is automatic or where time is not critical but processes and procedures are. This will reduce the time duration of the demonstration.

**23.3** The chosen method will be important to the supplier in a competitive situation as the information will be used by the supplier to estimate the costs of all aspects of the demonstrations, including the possible financial risks and any additional design activities to ensure meeting the contract without a possibility of further retest.

## **24 Data Recording**

**24.1** Consideration needs to be given to the scope and detail of the data required during the demonstration. Specific data gathering procedures should be considered as should the need for an Automatic Data Processing (ADP) method. The latter can speed up the collection and analysis of the data particularly if the AT is not required permanently at the system site. During the demonstration, documentation in the form of data sheets should be completed as the actual demonstration tasks progress. Each data sheet will form a record of the demonstration steps performed and should be signed off by the representatives of the contractor and the approved witnesses from the MOD or their designated representatives. These data records could form the major part of the Demonstration Report.

**24.2** Data from a MDP are important to the ILS programme and LSA tasks and for the Services so that they can confirm their manning and training requirements. The data will also provide the baseline information for further planning.

**24.3** For some demonstrations existing procedures for the classification of maintenance activity may provide the necessary information required to determine if compliance has been achieved; in many instances however extra information will be required such as ease of access, strip and assembly time, suitability of tools, test equipment and manuals, maintainer skill set, the use of mechanical handling equipment (MHE) and so forth. A common data set should where possible be used for each of the maintainability activities to be demonstrated which will make the analysis of individual activities easier to assess when required.

## **25 Data Analysis**

**25.1** The analysis of the results for contractual purposes should be straight-forward if all the rules have been clearly established at the outset. It is important to consider the data which may be of value to the contractor or the in-service manager should corrective action be needed. In cases where the demonstration was not conducted in accordance with the plan (sometimes for very good reasons) maintainability specialist advice should be sought to determine the best method of analysis or the need to repeat any aspects as appropriate.

**25.2** Where trialling has or will be conducted in more than one location or by different staff at different times it is important to ensure that as far as practically possible these are conducted, recorded and classified in accordance with the same criteria and employing the same plans modified only to accommodate the specific location and the resources employed. Where this is not practical or beyond the control of the PM then particular attention needs to be paid too:

- a) periods of storage;
- b) configuration control;
- c) maintenance procedures;
- d) learning curve;
- e) the need to prevent use of the system outside of its specified usage boundaries.

In addition, the timing and time-scale need to be chosen to balance the conflicting priorities of an early result, which enables feedback to influence ongoing production, and the longer time-scale demanded for demonstration accuracy.

## **26 Component Handling**

**26.1** Components removed for whatever reason, but particularly those removed as faulty (i.e. not introduced as part of the demonstration), will need special identification to ensure that they are not inappropriately returned to the supply chain. System labels over-stamped with "System X Maintainability Demonstration" will assist with tracking and identification. Comprehensive repair reports will be required quickly by the AT to enable agreement to be reached on whether the fault is attributable to any ongoing reliability assessment or not. It is important to understand the root cause of faults to ensure that maintenance activities do not themselves induce faults or wear that will result in premature failures. The use of a closed loop data recording system such as a DRACAS (Data Recording and Corrective Action System) across the project will facilitate the correlation of data and ease the management burden.

**26.2** The spares support for MDP activity should be provided over and above the normal DEFCON 82 or Advance Order List (AOL) provision. Such action is desirable and necessary to prevent items being lost into the "investigation loop" thereby reducing repair pools. Arrangements for the disposal of components and the necessity for contractor visibility of removed components need to be addressed and balanced against the requirements of the Service.

## **Annex A**

### **Guidance on the Contents of a Maintainability Demonstration Programme (MDP) Plan and a Maintainability Demonstration (MD) Directive**

#### **A.1 MDP plan checklist.**

**A.1.1** The MDP Plan should include:

- a) organisation responsible - points of contact;
- b) the quantitative parameters to be demonstrated;
- c) the qualitative parameters to be demonstrated;
- d) the time-phasing of the demonstration(s);
- e) the location, i.e. in-service environment or supplier facility;
- f) environmental conditions, if relevant;
- g) fault insertion;
- h) maintenance task selection;
- i) Demonstration Methodology. method of conducting the demonstration;
- j) Elements of Demonstration: the numbers of systems available for the demonstration(s) and their build standard;
- k) the Technical Publications and documentation, processes and procedures;
- l) provision of Support Resources, i.e. tools, test equipment, spares facilities, personnel etc;
- m) skill set and training
- n) implications of failing the demonstration(s), the funding of design changes and the requirement for further retest;
- o) the data to be recorded, methods to be used in recording data obtained in the demonstration and the format of the test report;
- p) confidence statements.

#### **A.2 MD Directive checklist.**

**A.2.1** In view of the individual nature of each project each MD Directive will also be individual and needs to be tailored to the requirements of each project. The directive is required to address each of the items, but in far greater detail than, in the MDP plan. Additionally the following need to be addressed as detailed in the checklist below:

- a) terms of reference for individuals and committees involved in the MD;
- b) fault description;
- c) scheduled maintenance;

**Unclassified**



- d) testability/ Built-in Test Considerations;
- e) repair tracking;
- f) component handling;
- g) disposal of components;
- h) spares;
- i) data capture, routing, recording, classification and retention.

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