Maintenance Program Overview

Learning Outcomes

By the end of this session delegates will be able to:

- Describe the basis on which modern Maintenance
  Programs are developed
- State how to approve and monitor Maintenance
  Programs
- Discuss typical problem areas associated with the process

Maintenance Programs - Requirements

- EASA Certification Specifications (25.1529 Appendix H for large aircraft)

- EASA Part M M.A.302 requires all applicable aircraft to be maintained in accordance with an approved Maintenance Program.The maintenance Program and any subsequent amendments shall be approved by the competent authority (M.A.302)

- Air Navigation Order article 25

Contents

- Objectives
- Approval of the maintenance program
- Maintenance Program –General
- Effective of the maintenance program
- Maintenance Review Board
- Optimization of the the maintenance program
- Operators Maintenance program
- Summary

Maintenance Programs

A Maintenance Program is a document which describes the specific maintenance tasks and their frequency of completion, necessary for the continued safe operation of those aircraft to which it applies. (ICAO).

A Maintenance Program establishes compliance with instructions for continuing airworthiness issued by type certificate, supplementary type certificate holders and organizations that publish data in accordance with Part 21, instructions issued by the competent authority, instructions defined by the owner or the operator (MA302).

Maintenance Programs - Requirements

- EASA Certification Specifications (25.1529 Appendix H for large aircraft)
- EASA Part M M.A.302 requires all applicable aircraft to be maintained in accordance with an approved Maintenance Program. The Maintenance Program and any subsequent amendments shall be approved by the competent authority (M.A.302)
- Air Navigation Order article 25

Maintenance Programs

Initial maintenance proposals are derived from the design process. These processes will identify: Airworthiness Limitations (AWL's), Certification Maintenance Requirements (CMR's), Maintenance Significant Items, (MSI) and Structurally Signification Items (SSI).

This information may be utilised in the maintenance

Maintenance Programs – MRB Aims

- To ensure realization of the inherent safety and reliability levels of the aircraft
- To restore safety and reliability to their inherent levels when deterioration has occurred
- To obtain the information necessary for design improvement of those items whose inherent reliability proves inadequate
- To accomplish these goals at a minimum total cost, including maintenance costs and the costs of resultant failures

Maintenance Programs - MRB

- Maintenance Review Board (MRB) is a regulatory body
- The International Maintenance Review Board Policy Board (IMRBPB) is a chartered organization of regulatory authorities that recognizes the ATA MSG 3 process as an acceptable standard
- The MRB process is intended to be a collaborative one involving airline operators, manufacturers and regulatory authorities

Maintenance Programs - MRB

- The scheduled maintenance development process, comprises representatives of the operators, the manufacturers of the airframe and engine, and the regulating authorities
- Management of the development activities is accomplished by an Industry Steering Committee (ISC)
- Maintenance Working Groups (MWG) will be established depending on the complexity of the aircraft, I.e. systems, powerplant, zonal and structures
- The developed maintenance activities will be submitted for approval, to the Maintenance Review Board (MRB)

Maintenance Programs - MRB

- The working procedures are detailed in a Policy and Procedures Handbook (PPH).
- The Maintenance Review Board (MRB) reviews the maintenance proposals submitted by Industry Steering Committee (ISC)
- Once accepted by ISC the maintenance proposal becomes the MRB Report Proposal (MRBR(P))

Maintenance Programs - MRB

MSG-3 Analysis Procedure

After the MSI's have been selected the following must be identified for each MSI:

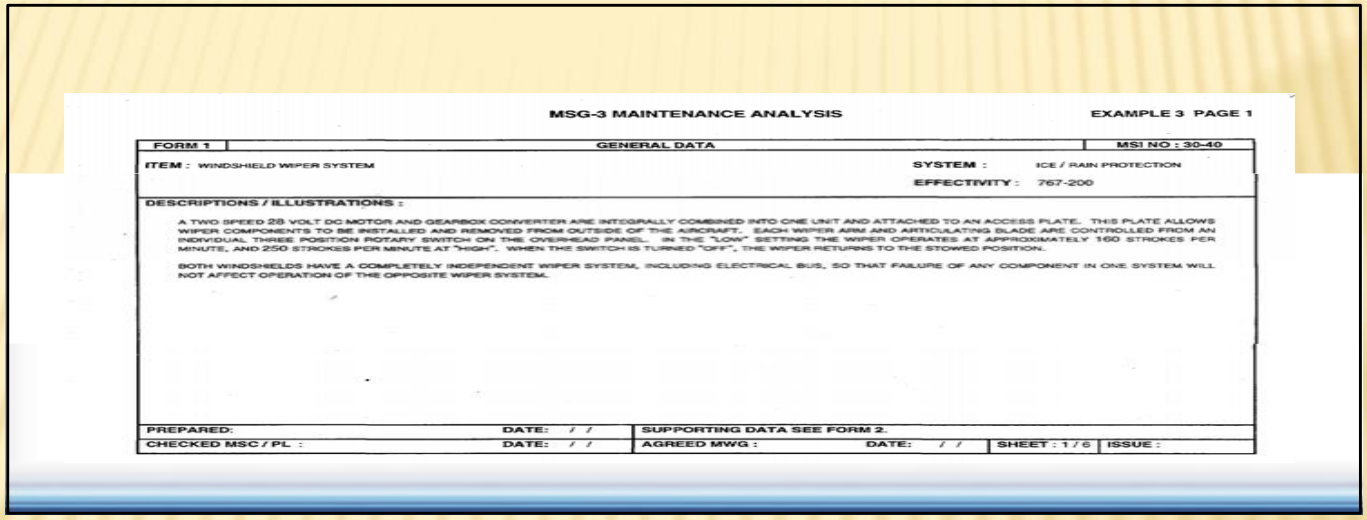
a) Functions(s) – the normal characteristic actions of the item.

b) Functional Failure(s) – Failure of an item to perform its intended function within specified limits.

c) Failure Effect(s) – what is the effect of a functional failure

d) Failure Causes(s) – why the functional failure occurs

Maintenance Programs - MRB



MSG-3 MAINTENANCE ANALYSIS EXAMPLE 3 PAGE 1

FORM 1	GENERAL DATA	MSI NO : 30-40
ITEM : WINDSHIELD WIPER SYSTEM	SYSTEM : ICE / RAIN PROTECTION EFFECTIVITY : 767-200	

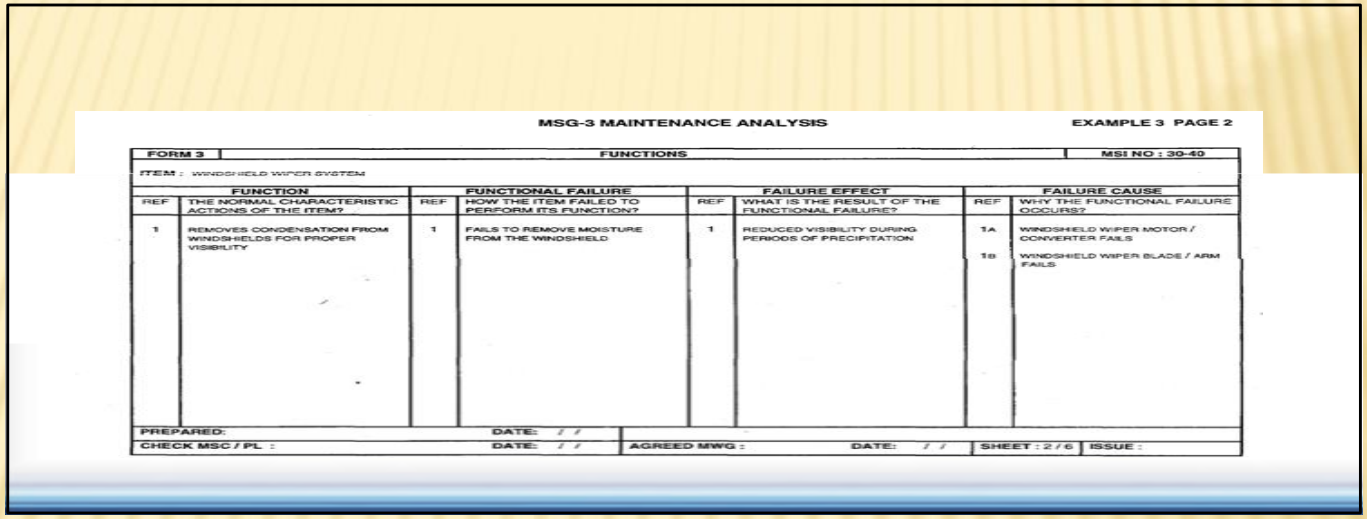
DESCRIPTIONS / ILLUSTRATIONS :

A TWO SPEED 28 VOLT DC MOTOR AND GEARBOX CONVERTER ARE INTEGRALLY COMBINED INTO ONE UNIT AND ATTACHED TO AN ACCESS PLATE. THIS PLATE ALLOWS WIPER COMPONENTS TO BE INSTALLED AND REMOVED FROM OUTSIDE OF THE AIRCRAFT. EACH WIPER ARM AND ARTICULATING BLADE ARE CONTROLLED FROM AN INDIVIDUAL THREE POSITION ROTARY SWITCH ON THE OVERHEAD PANEL. IN THE "LOW" SETTING THE WIPER OPERATES AT APPROXIMATELY 160 STROKES PER MINUTE, AND 250 STROKES PER MINUTE AT "HIGH". WHEN THE SWITCH IS TURNED "OFF", THE WIPER RETURNS TO THE STOWED POSITION.

BOTH WINDSHIELDS HAVE A COMPLETELY INDEPENDENT WIPER SYSTEM, INCLUDING ELECTRICAL BUS, SO THAT FAILURE OF ANY COMPONENT IN ONE SYSTEM WILL NOT AFFECT OPERATION OF THE OPPOSITE WIPER SYSTEM.

PREPARED:	DATE: / /	SUPPORTING DATA SEE FORM 2.			
CHECKED MSC / PL :	DATE: / /	AGREED MWG :	DATE: / /	SHEET : 1 / 6	ISSUE :

Maintenance Programs - MRB



MSG-3 MAINTENANCE ANALYSIS

EXAMPLE 3 PAGE 2

FORM 3	FUNCTIONS	MSI NO : 30-40

ITEM : WINDSHIELD WIPER SYSTEM

FUNCTION		FUNCTIONAL FAILURE		FAILURE EFFECT		FAILURE CAUSE	
REF	THE NORMAL CHARACTERISTIC ACTIONS OF THE ITEM?	REF	HOW THE ITEM FAILED TO PERFORM ITS FUNCTION?	REF	WHAT IS THE RESULT OF THE FUNCTIONAL FAILURE?	REF	WHY THE FUNCTIONAL FAILURE OCCURS?
1	REMOVES CONDENSATION FROM WINDSHIELDS FOR PROPER VISIBILITY	1	FAILS TO REMOVE MOISTURE FROM THE WINDSHIELD	1	REDUCED VISIBILITY DURING PERIODS OF PRECIPITATION	1A	WINDSHIELD WIPER MOTOR / CONVERTER FAILS
						1B	WINDSHIELD WIPER BLADE / ARM FAILS

PREPARED:	DATE: / /				
CHECK MSC / PL :	DATE: / /	AGREED MWG :	DATE: / /	SHEET : 2 / 6	ISSUE :

Maintenance Programs - MRB

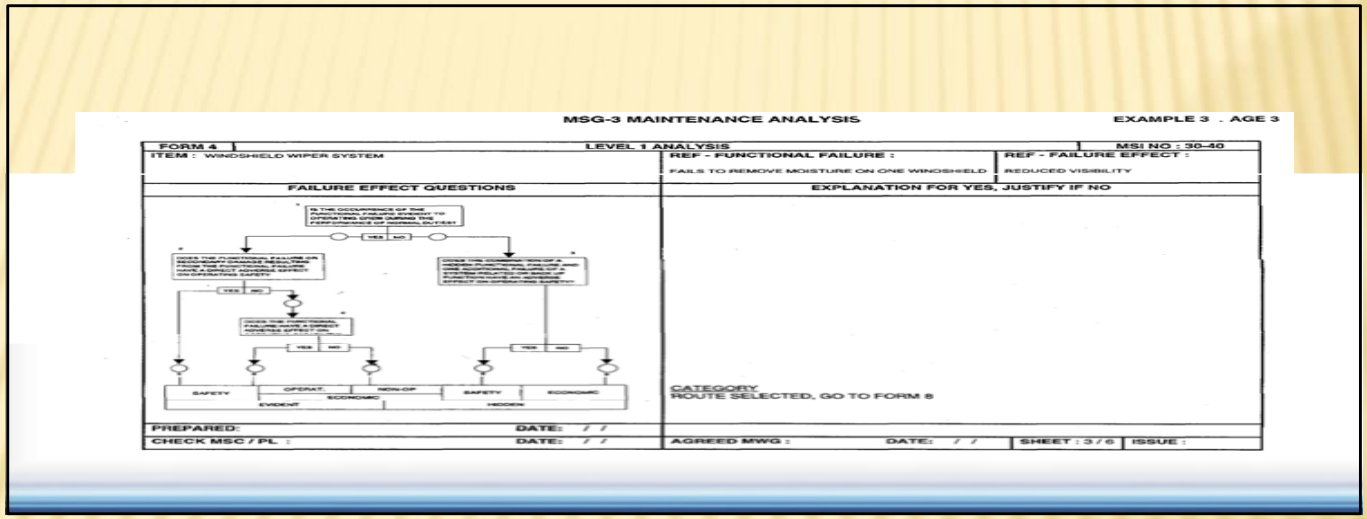
MSG-3 Logic Analysis

The decision logic has two levels form each MSI:

Level 1 requires the evaluation of each Functional Failure for the determination of the Failure Effect Category (FEC)

Level 2 assesses the Failure Causes before selecting a task

Maintenance Programs - MRB

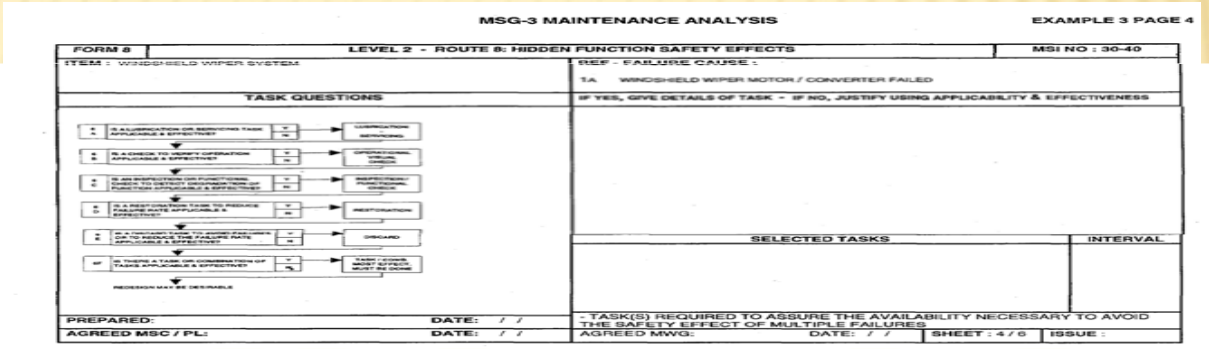


MSG-3 MAINTENANCE ANALYSIS — EXAMPLE 3 . AGE 3

FORM 4	LEVEL 1 ANALYSIS	MSI NO : 30-40
ITEM : WINDSHIELD WIPER SYSTEM	REF - FUNCTIONAL FAILURE : FAILS TO REMOVE MOISTURE ON ONE WINDSHIELD	REF - FAILURE EFFECT : REDUCED VISIBILITY

FAILURE EFFECT QUESTIONS	EXPLANATION FOR YES, JUSTIFY IF NO
	CATEGORY ROUTE SELECTED, GO TO FORM 8
PREPARED: DATE: / /	
CHECK MSC / PL : DATE: / /	AGREED MWG : DATE: / / SHEET : 3 / 6 ISSUE :

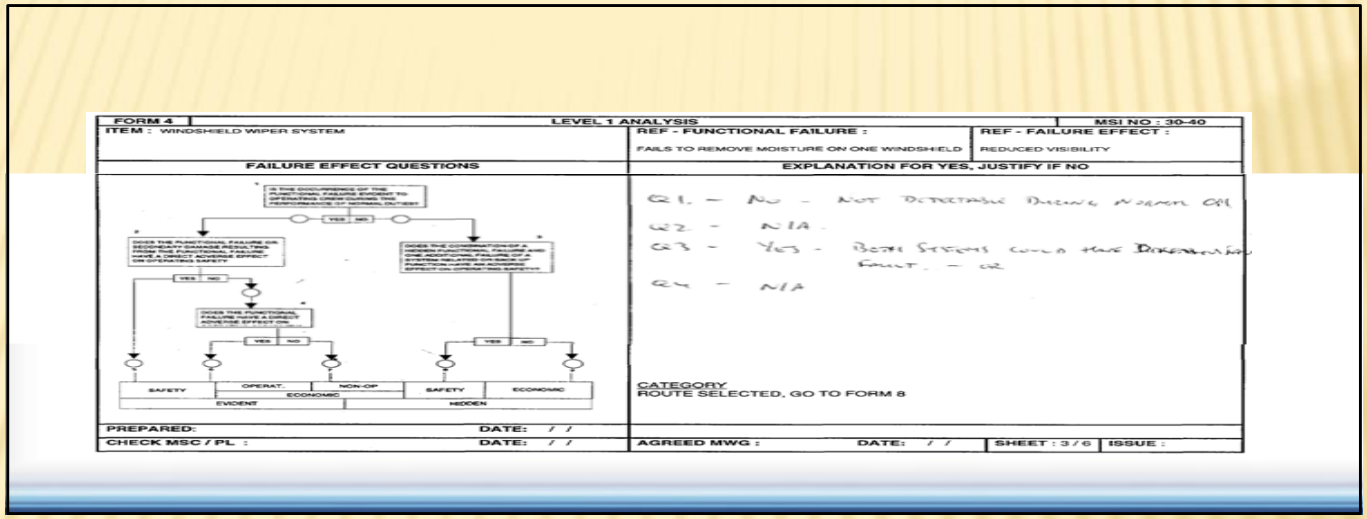
Maintenance Programs - MRB



MSG-3 MAINTENANCE ANALYSIS — EXAMPLE 3 PAGE 4

FORM 8	LEVEL 2 - ROUTE 8: HIDDEN FUNCTION SAFETY EFFECTS	MSI NO : 30-40
ITEM : WINDSHIELD WIPER SYSTEM	REF - FAILURE CAUSE : 1A WINDSHIELD WIPER MOTOR / CONVERTER FAILED	
TASK QUESTIONS	IF YES, GIVE DETAILS OF TASK - IF NO, JUSTIFY USING APPLICABILITY & EFFECTIVENESS	
SELECTED TASKS	INTERVAL	
PREPARED: DATE: / /	- TASK(S) REQUIRED TO ASSURE THE AVAILABILITY NECESSARY TO AVOID THE SAFETY EFFECT OF MULTIPLE FAILURES:	
AGREED MSC / PL: DATE: / /	AGREED MWG: DATE: / / SHEET : 4 / 6	ISSUE :

Maintenance Programs - MRB



FORM 4 | LEVEL 1 ANALYSIS | MSI NO : 30-40

ITEM : WINDSHIELD WIPER SYSTEM

REF - FUNCTIONAL FAILURE : FAILS TO REMOVE MOISTURE ON ONE WINDSHIELD

REF - FAILURE EFFECT : REDUCED VISIBILITY

FAILURE EFFECT QUESTIONS

EXPLANATION FOR YES, JUSTIFY IF NO

Q1. – NO – NOT DETECTABLE DURING NORMAL OPS

Q2. – N/A

Q3. – YES – BOTH SYSTEMS COULD HAVE DIFFERENT FAULT – OR

Q4 – N/A

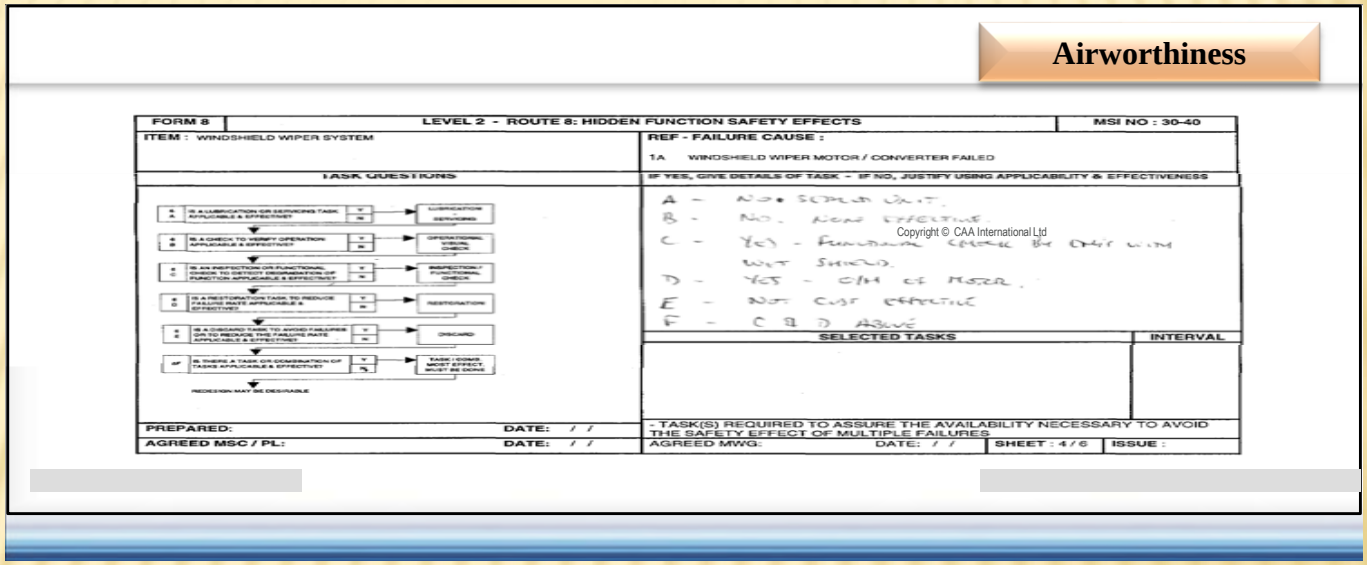
CATEGORY
ROUTE SELECTED, GO TO FORM 8

PREPARED: DATE: / /

CHECK MSC / PL : DATE: / /

AGREED MWG : DATE: / / SHEET : 3 / 6 ISSUE :

Maintenance Programs - MRB



Airworthiness

FORM 8	LEVEL 2 - ROUTE 8: HIDDEN FUNCTION SAFETY EFFECTS	MSI NO : 30-40
ITEM : WINDSHIELD WIPER SYSTEM	REF - FAILURE CAUSE : 1A WINDSHIELD WIPER MOTOR / CONVERTER FAILED	
TASK QUESTIONS	IF YES, GIVE DETAILS OF TASK - IF NO, JUSTIFY USING APPLICABILITY & EFFECTIVENESS	
	A - NOT SCHEDULED UNIT. B - NO. NOT EFFECTIVE C - YES - FUNCTIONAL CHECK BY CREW WITH WIPER SWITCH. D - YES - O/H OF MOTOR. E - NOT COST EFFECTIVE F - C & D ABOVE	
	SELECTED TASKS	INTERVAL
PREPARED: DATE: / /	- TASK(S) REQUIRED TO ASSURE THE AVAILABILITY NECESSARY TO AVOID THE SAFETY EFFECT OF MULTIPLE FAILURES	
AGREED MSC / PL: DATE: / /	AGREED MWG: DATE: / /	SHEET : 4 / 6 ISSUE :

Maintenance Programs - MRB

Significant Structural Items (SSI):

- Selected at the highest manageable level

Structural Damage Resources

- Accidental Damage
- Environmental Deterioration (Calendar Time)
- Fatigue Damage (Flight Cycles)

Maintenance Programs - MRB

Failure Effect Categories FEC (First Level)

Once the analysts have answered the applicable first level questions, they are directed to one of the five Effect Categories;

- Evident Safety (Category 5)
- Evident Operational (Category 6)
- Evident Economic (Category 7)
- Hidden Safety (Category 8)
- Hidden Non-Safety (category 9)

Maintenance Programs - MRB

Zonal Program – Zonal inspections are the general visual inspections. They are intended to detect deterioration of the original installations within the defined zones. Such as: corrosion, cracks and evidence of fluid leaks/overheat/duct damage, security and condition of wiring. Security and condition of components.

Maintenance Programs - MRB

- On completion of the MRB process the MRBR is signed off by the appropriate regulatory authority
- From the MRBR, the aircraft manufacturer will produce a Maintenance Planning Document (MPD) for use by the operator of the aircraft

Operators Maintenance Program

Where does the operator find the information?

- Maintenance Planning Document (or similar)
- Maintenance Review Board report
- Aircraft Maintenance Manual (Chapter 5)
- Airworthiness Limitations Document

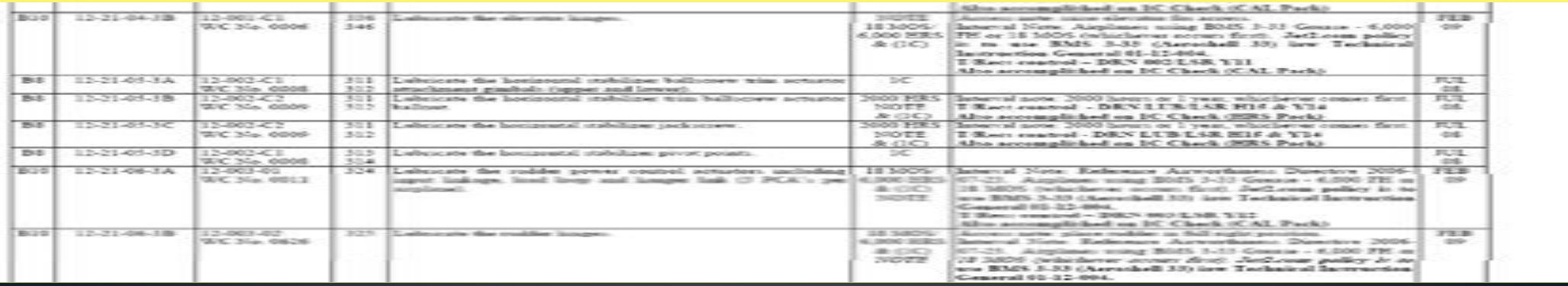
Aircraft Flight Manual

Operators Maintenance Program

- Preface (operator details, aircraft details, utilization, check cycle, etc)
- Inspection standards to be applied
- Variations procedure to task or check frequencies
- Review procedure
- Optimization/Evolution procedure
- Details, including frequency of all scheduled maintenance tasks

Operators Maintenance Program

- Specific tasks linked to specific operations
- Life limited components
- Limited pilot owner maintenance
- Reflect applicable regulatory requirements
- Repetitive maintenance tasks derived from modifications and repairs
- Task cards
- Reliability program



Approval of the Maintenance Program

- The authority designated The competent authority by the Member State of registry …shall verify that maintenance Programs in compliance with M.A.302.

- Indirect approval when the aircraft is managed by an M.A. Subpart G organization the MP and its amendments may be approved by procedure established by the organisation (M.A.302)

Approval of the Maintenance Program

- An aircraft can only be maintained to one Approved Maintenance Program
- To move an aircraft from one Program to another will involve submitting an amendment to the CAA for approval
- A review of the differences between the Programs carried out this may result in the need for a 'Bridging Check' to cater for any differences


flying 101
sun roof
co-captain
(the other pilot on the PA system)
front door
nose cone
(radar, antenna
and a
fuel tanks
cargo door
wing #2

Approval of the Maintenance Program

- Maintenance Programs should be developed from Type Certificate Holder / Supplemental Type Certificate Holder (TCH / STCH) information.
- Maintenance Program Checklist – Form SRG1724
- The purpose of the maintenance Program check list if to assist owners and operators in the submission with a view to ensuring that the Maintenance Programs submitted to the CAA are standardized and include all items that are required by Part M.A.302, AMC M.A.302 and also any other additional CAA nationally required items.
- Available on CAA Website

Approval of the Maintenance Program

The approval verification should consider the following items:

- Program rules
- System / powerplant rules & requirements
- Structural Program & associated rules & requirements
- Zonal Program & associated rules & requirements
- All tasks are identified by their MSI / SSI
- STC/Modifications inspection requirements

Approval of the Maintenance Program

- FEC and CMR’s positively identified
- Airworthiness Limitations
- The usage parameters with a FEC of 5 & 8 or which are
  CMR should be carefully considered
- Buyer Furnished Equipment (BFE)
- Ageing Aircraft
- Repeat Inspection of Repairs Maintenance

■Program Tasks traceability to source document (MPD, MRBR, MM Chapter 5, Operators Requirements)

Aircraft MTWA <2730kgs

- Light Aircraft Maintenance Schedule – Aeroplanes/Helicopters (LAMS) published and approved by CAA
- Generic schedule applicable to piston engined aircraft <2730kg (non EASA)
- Light Aircraft Maintenance Program – Aeroplanes/ Helicopters (LAMP) published and approved by CAA
- Generic schedule applicable to piston-engined aircraft <2730kg Part M, M.A.302 Compliant when customized

Aircraft MTWA <2730kgs

LAMS/LAMP are generic and therefore it is important that:

- The Owner/Operator completes the introductory details
- The Program is customized for Airworthiness Life
  Limitations, Overhaul and Test Periods
- The Program is customized for Additional Inspections

■CAP 543 or equivalent is used

Effectiveness of the Maintenance Program

- The operator is required to continue to monitor the effectiveness of the maintenance Program (EASA Part M.A. 302 (a))
- The operator may elect to 'Contract' continuing airworthiness tasks to another appropriately approved organization (EASA Part M Subpart G)
- The process required to monitor the effectiveness is dependent upon methodology applied by TC holder

Effectiveness of the Maintenance Program

- Reliability Programs are designed to supplement the operators Program for maintaining aircraft in a continuous state of airworthiness (ICAO)
- Reliability Programs should be developed for aircraft maintenance Programs based upon maintenance steering group (MSG) logic or those that include condition monitored components or that do not contain overhaul time periods for all significant system components (EASA)
- Reliability Programs need not be developed for aircraft not considered as large aircraft or that contain overhaul time periods for all significant aircraft system components

Effectiveness of the Maintenance Program

- The purpose of a reliability Program is to ensure that the aircraft maintenance Program tasks are effective and their periodicity is adequate
- The reliability Program may result in the escalation or deletion of a maintenance tasks, as well as the de- escalation or addition of a maintenance task

■A reliability Program provides an appropriate means of monitoring the effectiveness of the maintenance Program

Effectiveness of the Maintenance Program

The reliability Program procedure may include monitoring of:

- Pilots Reports, Technical Logs
- Aircraft Maintenance Access Terminal / On-board Maintenance System readouts
- Maintenance Worksheets
- Component Removals and Workshop Reports
- Reports on Functional Checks AND Special Inspections
- Stores Issues/Reports
- Air Safety Reports
- Reports on Technical Delays and Incidents
- Other sources (ETOPS, RVSM, CAT II/III)

Optimization of the Maintenance Program

The optimisation process should be set out in the operator or maintenance organisation CAME / MOE / Maintenance Program / Manuals.

Where large transport aircraft Programs are developed using MSG methodology, the operator optimisation process should include methodology which itself is based upon MSG processes or similar.

Optimization of the Maintenance Program

Anything can be escalated if appropriately justified!

Some things require more justification than others:

- CMR and any Airworthiness **Limitations** are type certification issues, and can only be varied with the TC holders support
- AD's intervals can only be escalated with the specific approval of the NAA
- Proceed with extreme caution for items such as CMR, FEC 5 & 8, SSI

Optimization of the Maintenance Program

A Maintenance Program approved for one Operator and one maintenance organisation does not mean automatic approval at another.

A Maintenance Program is unique to the operational environment, utilisation, modification status, maintenance and inspection standards applied.

Optimisation of the Maintenance Program

Optimisation could result in the following changes to the
Approved Maintenance Program;

- Change to compliance interval category (FH, FC, Calendar, Check etc)
- Escalation or reduction of compliance interval
- Revision of task/process (insp, CK, FC, OPC etc)
- Revision of accomplishment instructions
- Deletion of Task or Process
- Revision of work scope
- Addition of tasks

Optimization of the Maintenance Program

- Changes to a scheduled Maintenance Program should be made in an incremental and controlled manner where possible, by Trial Extension or sampling Programs
- ‘Sample’ size and review period (gates) to be agreed with NAA (Typically 10% - 15% of fleet)
- Type Certificate Holders support
- Increment to be agreed with NAA
- ‘Rate of Change’ may be high for a new type recently introduced to service more conservative for old types or inexperienced operator / maintenance organizations

Optimization of the Maintenance Program

Justification could include audit of;

- Maintenance Standards (line and base)
- Data Collection
- Data Processing
- Deferred / Carry Forward Defects
- Aircraft Utilisation

‘NIL Defects’ is not in itself, justification for escalation or deletion

Optimization of the Maintenance Program

Pireps and ‘Technical Delay’ summaries alone, do not provide justification for escalation/task deletion.

Additional data from the reliability Program should be included;

- Component Strip Reports
- Component Reliability Data
- Occurrence and Safety Report Rates
- Workpack Non Routine Card Rates
- Test/Flight Test Report Findings
- ‘Safety’ (e.g. FEC 5/8) Defect Rates

■‘Global’ Data - Where Obtainable from TC Holder

Maintenance Programs Summary

Summary:

- TC Holder recommendations should form the basis of the operators maintenance Program
- The Operator is responsible for monitoring effectiveness of the maintenance Program and the process should be audited
- The maintenance Program process brings together maintenance and design
- The maintenance compliance and inspection standards play a significant role in an effective Maintenance Program and should be audited
- The competent authority shall verify that the maintenance Program is in compliance