UNIVERSIDADE DA BEIRA INTERIOR
Covilhã | Portugal

04-Manutenção

Fabricação e Manutenção de Aeronaves (10384)

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Objetivos

- Support the students with the knowlage of Aeronautic Maintenance in the following areas:
  - Maintenance Programs;
  - Maintenance Process;
  - Reliability

Acronyms and Abbreviations

- AD Airworthiness Directive
- AMO Aircraft Maintenance Organization
- AMP Aircraft Maintenance Programme
- AOC Air Operator Certificate
- ARC Airworthiness review certificate
- ARS Airworthiness review staff
- ATPL(A) Airline Transport Pilot Licence (Aeroplane)
- AWC Aerial Work Certificate
- CAME Continuing Airworthiness Management Exposition
- CAMO Continuous Airworthiness Management Organization
- CDL Control Deviation List
- CPL(A) Commercial Pilot Licence (Aeroplane)
- CTI Circular Técnica de Informação
- DDS Defered Deffect Sheet (Section 4 of Tech Log)
- DOA Disign Organization Approval

Acronyms and Abbreviations

- EPA — European Parts Approval
- FTO — Flyght Training Organization
- HIL — Hold Item List
- MEL — Minimum Equipment List
- NAA — National Aviation Authority
- OC — On Condition
- OH — Overhaul
- PPL(A) — Private Pilot Licence (Aeroplane)
- RET — Removal
- SB — Service Bulletin
- STC — Supplement Type Certificate
- TBO — Time Between Overhaul
- TCDS — Type Certificate Data Sheet
- TLB — Technical Log Book

Maintenance Plan

- Aircraft Maintenance Program must comply with:
  - EASA Parte M, appendix I to AMC M.A. 302.;
  - CTI 01-01 Ed04 (Portuguese Regulation)
- Aircraft Maintenance Program must contain:
  - (i) instructions issued by the competent authority;
  - (ii) instructions for continuing airworthiness issued by the holders of the type certificate, restricted type-certificate, supplemental type-certificate, major repair design approval, ETSO authorisation or any other relevant approval issued under Regulation (EC) No 1702/2003 and its Annex (Part-21);
  - (iii) additional or alternative instructions proposed by the owner or the continuing airworthiness management organisation once approved in accordance with point M.A.302, except for intervals of safety related tasks referred in paragraph (e), which may be escalated, subject to sufficient reviews carried out in accordance with paragraph (g) and only when subject to direct approval in accordance with point M.A.302(b).

Maintenance Plan

- Aircraft Maintenance Program must comply with:
  - (e) The aircraft maintenance programme shall contain details, including frequency, of all maintenance to be carried out, including any specific tasks linked to the type and the specificity of operations.
  - (f) For large aircraft, when the maintenance programme is based on maintenance steering group logic or on condition monitoring, the aircraft maintenance programme shall include a reliability programme.
  - (g) The aircraft maintenance programme shall be subject to periodic reviews and amended accordingly when necessary. These reviews will ensure that the programme continues to be valid in light of the operating experience and instructions from the competent authority whilst taking into account new and/or modified maintenance instructions promulgated by the type certificate and supplementary type certificate holders and any other organisation that publishes such data in accordance with Annex (Part-21) to Regulation (EC) No 1702/2003.

Maintenance Plan

- CDCCL: Critical Design Configuration Control Limitations:
  - identify the critical design features such as proper wire separation, proper installation of a panel gasket, minimum bonding jumper resistance levels, etc., that must be maintained in exactly the same manner throughout the life of the aircraft in order to comply with the type certificate and maintain airworthiness.
  - The purpose of the Critical Design Configuration Control Limitation (CDCCL) is to provide instructions to ensure these critical features are present throughout the life of the airplane and are Inspected and verified when alterations, repairs, or maintenance actions occur in the area.

- Fuel Tank Safety Courses:
  - implemented to train the maintenance and airworthiness personnel to prevent hazards on fuel tank safety issues.

Maintenance Plan

- EWIS: Electrical Wiring Interconnection System
  - GOAL: improve the airworthiness code for large airplanes and the requirements for continued airworthiness in the field of electrical wiring interconnection systems since failures in those systems have been identified as causal factors in several incidents and accidents involving large airplanes.
  - DEFINITION: Any wire, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy between two or more intended termination points

Maintenance Plan

- AD/SB Analysis

Maintenance Process

- Lubrication or Servicing Task
  - Any act of lubrication or servicing for the purpose of maintaining inherent design capabilities.
- Visual Check
  - A visual check is an observation to determine that an item is fulfilling its intended purpose. The check does not require quantitative tolerances. This is a failure finding task.
- General Visual (Surveillance) Inspection
  - A visual examination of an interior or exterior area, installation, or assembly to detect obvious damage, failure or irregularity. This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to enhance visual access to all exposed surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight or droplight and may require removal or opening of access panels or doors. Stands, ladders or platforms may be required to gain proximity to the area being checked.

Maintenance Process

- Detailed Inspection
  - An intensive visual examination of a specific structural area, system, installation or assembly to detect damage, failure, or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate by the inspector. Inspection aids such as mirrors, magnifying lenses, etc. may be used. Surface cleaning and elaborate access procedures may be required.

- Special Detailed Inspection
  - An intensive examination of a specific item(s), installation or assembly to detect damage, failure, or irregularity. The examination is likely to make extensive use of specialized inspection techniques and/or equipment. Intricate cleaning and substantial access or disassembly procedure may be required.

Maintenance Process

- Operational Check
  - An operational check is a task to determine that an item is fulfilling its intended purpose. The check does not require quantitative tolerances. This is a failure finding task.
- Functional Check
  - A functional check is a quantitative check to determine if one or more functions of an item perform within specified limits.
- Restoration Task
  - That work necessary to return the item to a specific standard. Since restoration may vary from cleaning or replacement of single parts up to a complete overhaul, the scope of each assigned restoration task has to be specified.
- Discard Task
  - The removal from service of an item at a specified life limit. Discard tasks are normally applied to so-called single parts such as cartridges, canisters, cylinders, engine disks, and safe-life structural members.

Maintenance Process

- NDT Inspection:
  - Nondestructive testing (NDT) is the process of inspecting, testing, or evaluating materials, components or assemblies for discontinuities, or differences in characteristics without destroying the serviceability of the part or system. In other words, when the inspection or test is completed the part can still be used.
  - Current NDT methods are:
    - Acoustic Emission Testing (AE) and Ultrasonic Testing (UT),
    - Electromagnetic Testing (ET),
    - Laser Testing Methods (LM),
    - Leak Testing (LT),
    - Magnetic Flux Leakage (MFL) and Magnetic Particle Testing (MT),
    - Liquid Penetrant Testing (PT),
    - Neutron Radiographic Testing (NR),
    - Radiographic Testing (RT),
    - Thermal/Infrared Testing (IR),
    - Vibration Analysis (VA),
    - Visual Testing (VT).

Reliability

- **RELIABILITY**: the probability of an element make a specified function, according to given environmental and operational conditions, for a period of time.
- The MSG-3 technique is an approach to the consequence of the failure, which failure's analysis is conducted to the high level. It's used to identify the appropriate maintenance tasks to prevent failures and to maintain the inherent reliability system level.

- **MAINTENANCE**: Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function.

Reliability

- **COMMERCIAL AVIATION MAINTENANCE**: Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function, **and improve the reliability of the item, reducing the number of failures, improving the maintainability of the item, reducing the time of repairs, and increasing the availability, through the ratio:**

$$\frac{\text{Operative Time}}{\text{Inoperative Time}}$$

- **Reliability Centred in Maintenance (RCM): is a process that aims to reduce failures.**

Reliability Concepts

- **Useful Life:** the time interval beginning at a given instant of time under given conditions (manufacture, installation, store etc.) and ending when the failure rate becomes unacceptable, or when the item is considered non-repairable as a result of a fault or for other relevant factors;

- **Rate of occurrence of failure**: Number of failures of an item in a given time interval divided by the time interval;

- **Failure**: Termination of the ability of an item to perform a required function. After failure the item has a fault, which may be complete or partial. “fault” is an event, as distinguished from “Fail”, which is a state.

Reliability Concepts

- **Failure Cause**: Reason leading up to a failure. The reasons may be result of one or more of the following:
  - Design failure,
  - Manufacturing failure,
  - Installation failure,
  - Misuse failure,
  - Mishandling failure, and
  - Maintenance related failure.
- **Fault**: State of an item characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources
- **Schedule Stop**: Outage schedule in advance, for maintenance or other purposes

Reliability Concepts

- **Preventive Maintenance:** Maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.
  The preventive maintenance is always planned, and may be systematic or conditional.

- **Corrective Maintenance:** Maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function.

Reliability Concepts

- **Aborted Take-off (ATO):** A take-off is a phase of the flight in which an aircraft gained a certain speed to get the necessary support to take off. A take-off can be discontinued for any reason.
- **Aircraft Days Out of Service (ADOS):** The cumulated number of elapsed hours and days that the aircraft of a given type were not available for operation (include scheduled maintenance).

- **Aircraft on Ground (AOG):** Indicates that an aircraft is unable to continue or return to revenue service until the appropriate action is taken. The highest priority designation to process a requirement for a spare part(s) and/or maintenance action.

Reliability Concepts

- **Technical delays:** occur when the malfunctioning of an item, the checking of same or necessary corrective action, causes the final departure to be delayed by more than a specified time after the programmed departure time.
- **Diversion (DV):** The landing of an aircraft at an airport other than the airport of origin or destination as a result of the malfunction or suspected malfunction of any item on the aircraft.
- **In-Flight Turn-Back (IFTB):** The return of an aircraft to the airport of origin as a result of the malfunction or suspected malfunction of any item on the aircraft.
- **In-Flight Shutdown (IFSD):** An engine shutdown which occurs at any time an aircraft is airborne or has been committed to becoming airborne.

Reliability Concepts

- **PIREPS**: are the complaints reported by technical crew (and recorded on the Aircraft Technical Log).
- **MAREPS**: are the complaints reported by the maintenance technicians (PART 145 companies) and recorded on the Aircraft Technical Log or in specific reports belonging to Work Packages.
- **Mean Time Between Unscheduled Removals (MTBUR):** performance calculated by dividing the total unit flying hours (airborne) accrued in a period by the number of unscheduled unit removals that occurred during the same period.