UNIVERSIDADE DA BEIRA INTERIOR
Covilhã | Portugal

05-Manutenção

Fabricação e Manutenção de Aeronaves (10384)

2013

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Objetivos

- Support the students with the knowlage of Aeronautic Maintenance in the following areas:
  - 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

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.

- Reliability is a probability. This means that failure is regarded as a random phenomenon that the likelihood to occur varies over time according to the given probability function.

Reliability

- Reliability is predicated on "intended function“: Generally, this is taken to mean operation without failure.
- Reliability applies to a specified period of time. In practical terms, this means that a system has a specified chance that it will operate without failure before time t.
- Reliability is restricted to operation under stated (or explicitly defined) conditions. This constraint is necessary because it is impossible to design a system for unlimited conditions.

Reliability

- **RELIABILITY & 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

- **Inherent Reliability : is the best reliability a given design can expect. This is the target reliability that a maintenance plan strives to maintain.**

Reliability Concepts

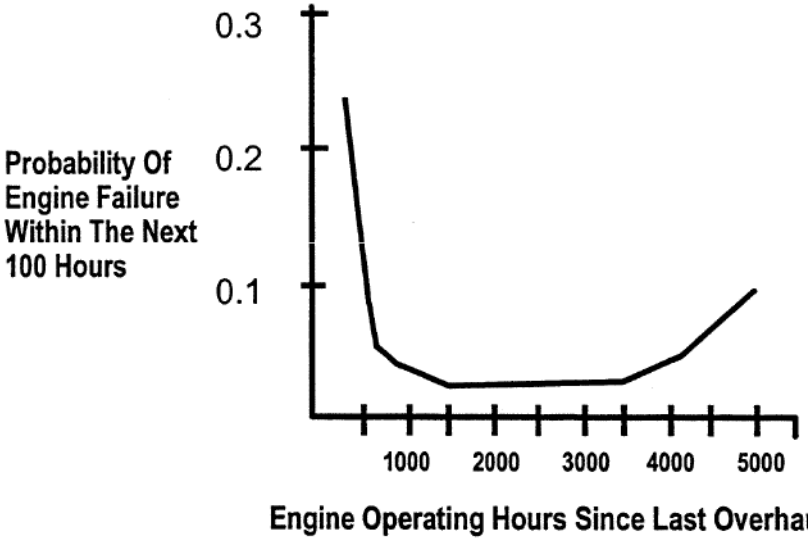
- **Useful Life:** the time interval beginning at a given instant of time under given conditions (manufacture, installation, store etc.) and ending when the failure rate becomes unacceptable, or when the item is considered non-repairable as a result of a fault or for other relevant factors;

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

- **Functional 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.

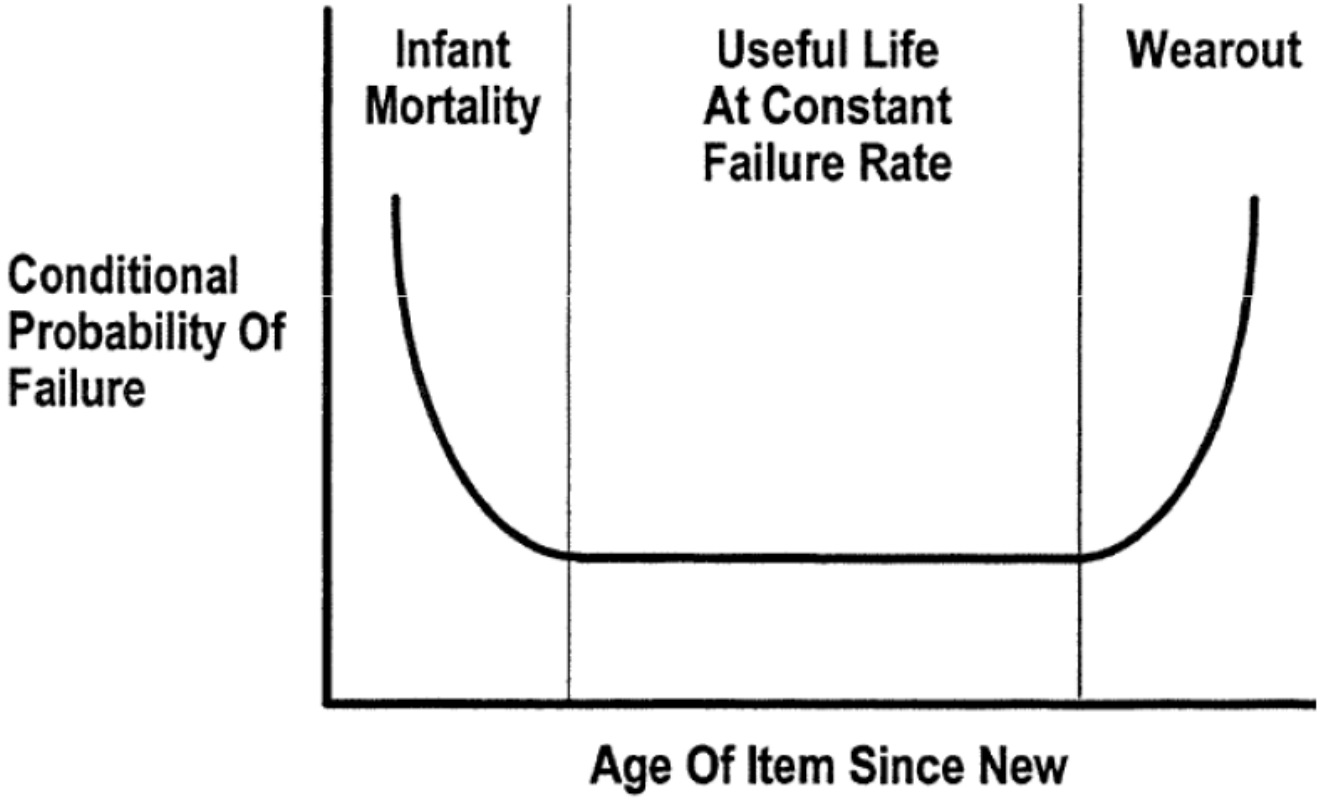
Reliability Concepts

- **Potentional Failure**: a detectable condition which indicates a functional failure is about to happen.
- Failure detection:
  - Evident function: can be detected and evaluated by the crew;
  - Hidden Function: not detectable by the crew;
- Conditional Probability of Failure:



Reliability Concepts

- Failure Pattern Versus Age:



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.

Reliability Concepts

- **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.

- **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.

Reliability Concepts

- **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.
  - $MTBUR = \frac{Q_{AC} \times FH}{UR}$,
    Q_{AC} – number of units in the aircraft;
    FH – unit flight hours during the time considered;
    UR – number of unscheduled removal.
- Alert Level: is a numerical value when exceeded by a reliability measure (e.g. the URR), indicates that there is a high probability of new exceptional problems.
  - $AL = \bar{x} + K \times \sigma$,
    σ - Standard Deviation
    $\bar{x} = \frac{\sum x}{N}$,

Reliability Concepts

- **Unscheduled Removal Rate (URR):** is defined as the number of unscheduled removals performed per 1000 component-hours where:

$$URR = 1000 \times \frac{UR}{FH \times Q_{AC}}$$

Reliability Program

- The reliability program is a group of techniques and procedures that aim to contribute to the monitoring of the airworthiness and operationally of a fleet.

- Essentially, the reliability program consists in the collection, processing and systematic analysis of the fleet data, regarding the functionality of flight systems and flight equipment, allowing to get statistics that display if systems/components levels of reliability are lower or higher than expected.

Reliability Program

- From this data evaluation may result measures to be taken to improve the fleet airworthiness control, trough:
  - Modification of the Maintenance Program and/or maintenance procedures;
  - Modification of the inspections contents;
  - Incorporation of a modification;
  - Technical staff training;
  - Improve supply procedures;

Reliability Program

- The study of reliability contributes for:
  - Extending the life of the systems/components;
  - Enable improvements in Maintenance Program;
  - Contribute to the safety of the aircraft during the special operations, such as: ETOPS, RVSM, CAT II/III, among others;
  - Improve the operation utilization of the aircraft.

- The main topics to have a head to study the fleet reliability:
  - Type of operation (high/low/seasonal);
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