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Evaluation and Analysis of Commercial Aircraft Maintenance Programs

An analysis of the application of modern Commercial Aircraft Maintenance Programs using MSG-3 decision logic as a tool was carried out. Maintenance programs developed with MSG-3 perspective is considered.

The Maintenance Program (MP) document has been established to give a coordinated view of all checks or tasks periodically performed on airframe systems, structure, power plant and aircraft components in purpose of ensuring reliability of components and detecting or preventing any fault which could affect the airworthiness of the aircraft maintained in the Operator`s fleet.

Today's development of MP using MSG-3 logic as a tool allows to effectively solve such tasks that are required to restore or maintain an aircraft's functional systems, components and structures in an airworthy condition with minimal cost. The MP based on such approach includes the scheduled maintenance tasks required by the latest approved issue of the Manufacturer's Maintenance Planning Data documents, "Airworthiness Limitations (AWLs) and Certification Maintenance Requirements (CMRs)" and Maintenance Review Board, complemented by additional maintenance tasks considered for their effectiveness on quality and/or economy. MSG-3 adjusted the decision logic flow paths to provide a more rational procedure for maintenance tasks definition. MSG-3 logic uses a consequence of failure approach. From the very beginning, any functional failure has to be assessed for consequence of failure and was assigned one of two basic categories – Safety and Economic. The Aircraft Maintenance Program is composed of following documents:

- Maintenance Program System, Structure and Zonal Inspection Programs defines the task and the periods (interval/frequencies) at which each part of the aircraft, engines, APU's, components, accessories, equipment, instruments, electrical and radio apparatus and associated systems and installations have to be inspected or checked, together with the degree of inspection. It also defines the periods at which items are cleaned, lubricated, replenished, adjusted and tested.
- Component Operating and Storage Limit (COSL) defines the task to be periodically performed on aircraft components after an operative or storage period. It also defines the periods at which overhauls and/or replacement by new or overhauled parts should be made.
- Reliability Program.
- Supplements the overall maintenance program for maintaining aircraft in a continuous state of airworthiness.

The maintenance practices and procedures to satisfy the MP should be to the standards specified in the Type Certificate Holder's Maintenance Instructions (Airplane Maintenance Manual, Structure Repair Manual, Service Bulletins etc.).

Permitted variation of intervals prescribed in MP can be used on non-regular basis and may be applied just in case of real necessity with report and/or approval to

National Aviation Administration (NAA). Extension of interval for C1-Check or more (C2, C3, C4 and SI6R6, SI8R4 etc.) checks must be approved by National Aviation Authority (NAA).

Check interval escalation procedure is one of the most MP components. The objective of the interval escalation procedure is to obtain from the NAA the upgrading of the check interval of a scheduled check.

To substantiate a request for escalation of a check interval, a special study is performed by Operator. This study is based on the findings during the performance of previous checks of the same level on the concerned fleet.

Minimum requirements before applying for the interval escalation:

- Define the number of task accomplishments for evaluation;
- A minimum of 90% interval utilization;
- An escalation step should range approximately 20% of the present applied interval;

Procedure:

- Review maintenance records for findings for each item of the Maintenance Program with concerned check interval;
- If findings occur, analyze the consequences of an upgrading of each item to the new interval at a safety and economical point of view;
- Produce report (study per ATA chapter and consequences to the MP, identification of tasks request to NAA for interval escalation;
- Once approved, update Maintenance Program.

Engine condition monitoring is one of the most effective maintenance practices used in MP. The objective of engine condition monitoring is to follow-up the evaluation of the engine health and performance of installed engines on the aircraft and allows:

- assess the present status of health of the engine;
- evaluate, anticipate and correct degradations and malfunctions of the engines;
- identify engine related system malfunctions and system indication problems;
- evaluate effects of the maintenance activities and operational events affecting performance of the engines;
- reduce unscheduled maintenance;
- to plan removal of the engines;
- reduce overhaul costs.

Fatigue Related Inspection Program is an integral part of Structural Maintenance Program. For aviation constructions, the most important characteristic is fatigue durability. Increasing the efficiency of structures, improving their characteristics, resource extension, is impossible without solving the problems associated with assessing the fatigue durability of structural elements. Where the initial scheduled maintenance program does not ensure timely detection of potential fatigue damage in a structural item, supplemental fatigue related inspections will be required for all of the Operators` fleet.

The Air Transport Association (ATA) led to the development of a new, task-oriented, maintenance process defined as MSG-3. The process adopted a decision tree methodology with the primary purpose of separating safety-related items from economic and defining adequate treatment of hidden functional failures.

Under MSG-3 logic, activities are assessed at the system level rather than the component level. In other words, if it can be demonstrated that the functional failure of a particular system had no effect on operational safety, or that the economic consequences were not significant, there was no need for a routine maintenance activity. As an example, using traditional maintenance procedures, the smaller and less complex DC-8 required more than 4,000,000 man-hours on major structural inspections to reach the same 20,000 hour structural inspection interval. Cost reductions of this magnitude are of obvious importance to any organization responsible for maintaining large fleets (Fig.1).

The objective of the MSG decision logic process is to develop a scheduled maintenance program that ensures maximum safety and reliability for the equipment at the lowest possible cost. Elimination of scheduled overhauls not only led to major reductions in labor and material costs, but also reduced spare engine inventories required to cover back maintenance costs by 50 %.

Table 1.

Northwest Airlines MSG-3 analysis of the DC-9. Reliability increased to 98%.

Interval Check	Traditional MP		Post-MSG-3 Analysis		Man-hour Savings
Months	Flow Days	Man Hours	Flow Days	Man Hours	%
18	16	12,00	7	5.25	56
36	40	30,00	30	25,00	25
108	50	37,50	40	30,00	20

Conclusions

To gain the officially recognized maintenance program terminologies, processes and common practices, the sustaining organization must implement a properly adjusted a MSG-3-based maintenance program. This approach allows separating safety-related items from economic and defining adequate treatment of hidden functional failures and excessive maintenance.

References

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