

# How much maintenance is too much?

Some preventative maintenance may actually result in more failures.

**Joseph P. Marksteiner**

TRADITIONALLY, maintenance activities have been thought to always improve safety – more inspections and more frequent refurbishment of components equals greater safety. But some experts, including human factors pioneer Professor James Reason from the University of Manchester, have proposed that more maintenance may not be better and, in some cases, too much may be worse.

Advances in human factors training, error-proofing procedures, improved and more robust designs, and better maintenance manuals, will all help reduce maintenance-related problems in the future.

However, it may take years for aeroplanes and engines currently in service to benefit from design and procedural advancements. Many will still be flying 10 maybe even 20 years into the 21st century with very few changes to the basic hardware or the maintenance procedures. But, what about today? Some current maintenance practices and philosophies may be causing more problems than they are preventing.

**Is the cure worse than the disease?** Research has shown that maintenance error accounts for nearly one-third of all in-flight engine shutdowns. As you'd expect, the likelihood of an engine shutdown resulting from maintenance error increases with the complexity of the task.

For example, the probability of oil quantity checking and servicing causing an in-flight shutdown is thought to be less than one in a million. However, the probability of error increases for procedures like chip detector inspections (one engine shutdown per 38,400 events) and hydro-mechanical fuel control changes (one engine shutdown per 400 events).

And the risk escalates dramatically when

these procedures are performed on multiple engines without an intervening flight. Even when different mechanics perform the maintenance the probability of multiple-engine shutdowns may still be unacceptably high.

In-flight engine shutdowns can occur when parts fail or wear out. If the likelihood of failure increases with age, replacing parts at some

extensive inspection or replacement program. Assumptions used in safety analyses are necessarily conservative – but overly conservative assumptions can drive excessive maintenance activity and may result in a greater rate of engine shutdowns than would have existed without the maintenance activity.

It is likely that enough information is available to develop estimates of engine shutdowns due to maintenance that are as valid as the estimates for engine shutdowns due to component failures.

**Data sources:** There are some valuable sources of data and information to help estimate the risk associated with maintenance activity. The maintainers know which inspections and installations are difficult, time consuming or error prone. Databases detailing accidents, incidents, and other significant events can also provide valuable information. Unfortunately, incomplete incident reports or inaccurate coding may affect the quality and accuracy of the information.

Another source is mean time between failure (MTBF) and mean time between removal (MTBR) data on components. This information can provide estimates for the number of times components are changed which can be compared to engine shutdowns or other events.

Inventory turnover of filters, o-rings, and seals particular to the installation of specific parts may provide component change/replacement data when MTBF or MTBR data are not available.

The probability of maintenance error needs to be considered when determining the frequency of inspection and replacement programs. Too much maintenance has been shown to increase costs and decrease safety.

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predetermined interval should reduce the number of failures and in-flight shutdowns. However, as James Reason has suggested, the maintenance activity intended to prevent system failures may actually result in more engine failures.

When the failure rate of a part can be estimated, and the risk of the maintenance activity required to replace that part is also known, it is possible to determine a replacement interval that minimises the likelihood of an in-flight engine shutdown.

Good information and reasonable assumptions are essential to develop realistic estimates for engine shutdowns due to hardware failures. The same is true for developing realistic estimates for engine shutdowns due to maintenance activity.

Often only one or two events result in an



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