Israel Air Force Aging Aircraft and Tear Down Inspection (TDI) for Zukit

Lt. Guy Shahar, Maj. Yossi Yoresh, Lt. Col Boaz Englender
Israel Air Force - Fighters maintenance branch

*Lt. Col Sason Bar Moshe, Lt. Col Arie Atzmoni, Lt. Col Halevi Rotem
Israel Air Force - Structural Branch

Abstract

The IAF operates several aging fleets. Among them are the CH-53, AH-1, C-130, F-16 A/B and Zukit.
IAF has developed criteria and methodology for classifying a fleet as an aging fleet and tailoring specific maintenance policy for such fleets.
The tools chosen to reduce the risk of operating aging aircraft are - Lead The Fleet (LTF), Analytical Condition Inspection (ACI) and Tear Down Inspection (TDI). Although those are well known tools, they are not an essential part of the users ASIP.
One of the first activities conducted as part of this effort was a Tear Down Inspection for the IAF training aircraft - Zukit. The IAF structures branch is working on implementing the other tools as well.
The TDI findings resulted in several urgent activities and emphasized the need for these tools and their benefits.
IAF aging aircraft methodology, plans and the Zukit TDI are presented.

Keywords: Zukit, Corrosion, Tear Down inspection (TDI), Aging Aircraft.
* Presenting at the aging aircraft conference.

Israel Air Force ASIP

IAF operates more than 20 types of aircraft - fighters, cargo, helicopters, commercial, light transportation and UAVs.
Most of the IAF aircraft were manufactured by US companies, some manufactured in EU and some by Israel Aircraft Industry (IAI).
Most of the fleet is maintained solely by the IAF, with the lead of the structure engineers at the IAF's HQ.
Structural maintenance is implemented in 3 levels – Operational level, intermediate level and depot level.
Every base has its' own independent capability of maintaining structures – including small manufacturing shops and repairing capabilities and NDI Group. Some bases also have a structure engineer in the base. Maintenance policy is built and controlled by HQ

IAF Structures branch is the guide and lead for the structure activities in the IAF - for the entire fleet. The branch includes the following groups - NDI, Fatigue and DT, Material, Tools and Structures technology.

Recently, IAF is focusing in defining special maintenance activity for aging aircraft and aircraft with higher risk of prolonged usage.

IAF is implementing Aircraft Structure Integrity Plans for the entire fleet. The plans implemented are a combination of the OEM recommendation, the lead user (eg USAF / Army) maintenance policy and IAF structures engineer recommendation.

The IAF's ASIP is built on three main data sources:
Tests - Durability tests are the most important tool in ASIP. The data from these tests are used for the fatigue and DT analysis and fleet structural maintenance plan (FSMP).
Fatigue and DT analysis (OEM support) – The IAF is collecting recorded usage data or for the entire fleet. When recorded data is not available, the IAF performs pilot questioners. The data is transferred to the OEM for IAF's unique Fatigue and Damage Tolerance Analysis.
Lead user data - The third and a very important part of the IAF ASIP is data transferred from other users. In most of the cases, USAF or the ARMY has the most aged fleet in fatigue and corrosion damage. Safety and economic issues are being addressed by the lead user who usually finds the problem and work the solution before our equivalent fleet accumulates the same damage.

If any one of these 3 sources is missing, structural integrity risk is higher than normal.

Aging and high risk fleet – definitions

There are many definitions for Aging aircraft but they can be divided to two technical definitions:

a) When the aircraft is exceeding the design goal or the durability tests envelope – Loosing the test envelope is a significant risk increase to structure integrity even if there is full analysis to support the maintenance policy.
b) When the structure exhibit significant damage (MSD, WFD, MED, sever corrosion, etc.) – Some aircraft exhibit significant damage in large areas before they get to the designed service life. This may be caused by design problems, sever usage, or highly corrosive environment.

Two other parameters that may be caused by aging of a fleet are used to identify fleet with higher risk:

a) When OEM support is reduced/ eliminated – This process is part of aging aircraft characterization.
b) When IAF is the lead user in damage accumulation – Although a lot of effort is done in testing and analysis, some problems will only be found during operation of the fleet. Therefore, the user who accumulates the most damage is usually the first one to find it and therefore have higher risk than other users. As a fleet age, the lead user may decide to stop operating the fleet and IAF may become the lead user. This means a higher risk to safety and availability. Another cause of higher risk is implementing a major modification using user's personnel, tools, training and procedures. The difference in those parameters may lead to unique problems. Therefore, for this structure configuration, the user implementing the modification may be considered as a lead user.

IAF used these 4 definitions to identify a fleet need for special attention and activity.

Tools for aging and high risk fleet

Three well known tools are considered for implementation in order to reduce the risk. This tools are not a common part of the ASIP done by users:

Lead the Fleet (LTF) – Create a group of aircraft that will lead the fleet in damage accumulation. As a goal, a 600 - 1000 fh in advance of the rest of the fleet is needed. This group shall be flown and maintained similarly to the rest of the fleet, but in a higher rate. Once you rich the flight hour goal, an extensive inspection program should be implemented.

Using LTF method may lead to problems identifying before they affect the whole fleet and prepare a solution.

Creating a LTF group in a uniform fleet is very difficult. One way to handle it is to select a group of aircraft with unique usage (like aggressors) as LTF.

This tool may be used to reduce the risk when becoming a lead user.

Analytical Condition Inspection (ACI) – This inspection policy is derived from USAF ACI policy as presented in AFMC 21-102.

The ACI ground rules are:

a) Inspect locations that are not required by the maintenance policy.
b) The ACI locations are decision by engineering judgment. For example, inspect areas that are not being looked at through the service life of the aircraft.
c) Inspect only small part of the fleet.
d) If damage is found in more than one aircraft, add the inspection to the regular maintenance policy and remove it from the ACI program.

This tool may be used to reduce the risk for all aging / higher risk fleet.

Tear Down inspection (TDI) – The TDI can be implemented only when a fleet or part of a fleet is removed from the air force. This tool may be used to reduce the risk when flying out of the durability test envelope or when becoming lead user. More than one aircraft is needed in order to increase reliability of this tool.

Zukit Tear Down Inspection

Zukit is a twin jet engine training aircraft originally called Fouga. The aircraft was designed and manufactured in France by Fouga (who was later acquired by A'rospatiale) and has been operational in the Israeli Air Force since the 60th. In early 80th, Israel Aircraft Industry (IAI) upgraded the aircraft and named it Zukit. Structural maintenance policy includes O/I level. Periodic Depot Maintenance was deleted in recent years and some of its tasks were moved to I level. In the last few years, an increase number of structural findings were identified, which emphasize the need for an unconventional way to maintain and insure the structural integrity of this fleet.

IAF decided to perform the TDI without outsourcing by using the same structural and NDI technicians that maintain the rest of the fleet. The TDI included structure and wiring. Depot and base manpower (and equipment) were used for this task. A structural engineer project manager was selected.

The process of TDI planning included: aircraft selection, a detailed schedule planning, manpower requirements and allocation, fixtures and tools, logistic issues, paint stripping, defining inspection areas, risk management, data collection and documentations.

The aircraft disassembled to its components and cut wherever was needed in order to allow sufficient access for NDI.

Detailed NDI inspections were developed as the project progressed. The NDI procedure included fluorescent penetrate inspection (FPI), magnetic particle inspection (MPI), eddy current (EC), ultrasonic inspection (UT), radiographic testing (RT) magneto – optic inspection (MOI) and visual inspection.

The TDI cost 1500 man hours and lasted 8 month.

The Zukit TDI revealed no wiring issues. Several structural problems were found. The most sever findings were exfoliation corrosion at the outboard wing beam (AU4G1 French alloy similar to Al2024 T3). The corrosion depth was up to half of the beam's thickness. The corrosion location was not accessible at intermediate or depot level inspection. As a result of this finding, the fleet was grounded immediately and an urgent visual inspection using endoscope was developed and performed. This inspection did not require any removal or disassembly of the wings .Additional 9 AIRCRAFT were found corroded.
The second sever finding was exfoliation corrosion at the horizontal/vertical stabilizer beam. This finding which was similar to the corrosion findings in the wings (and was detected by the same NDI method) required the exchanging of the stabilizers of 7 aircraft.
These TDI findings emphasize the need for proactive and preventive methodology for structural integrity of aging fleets. This plan can save catastrophic failures and fleet grounding.

Summary and conclusion

IAF has several aging aircraft that requires focused attention and activity.
IAF defined criteria to identify aging and high risk fleet and defined 3 tools in order to reduce the risk. The tools, LTF, TDI and ACI are well known but they are not part of the common ASIP implemented by users.
Use of these tools may not fully replace lack of lead user, durability test or OEM support, but may reduce the risk and allow higher availability and economic maintenance.
The Zukit TDI finding emphasizes the need for proactive and preventive methodology for structural integrity of aging fleets. This plan can save catastrophic failures and fleet grounding.

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