

## Commercial Aviation's Basic Maintenance, Safety & Services

“Shivansh Upadhyay”

(Aeronautical Engineering, F.G.I.E.T.)  
(Former Trainee Aeronautical Engineer)  
(Indira Gandhi Rashtriya Uran Academy)

“Ashish Kumar Gupta”,

“Sudeep Shrivastava”

(Aircraft Service Engineer, Air India)

“Yogi Raj”

(Aeronautical Engineer, MATS SE.IT)

“Aparna Verma”, “Shubham Dubey”,  
“Atul Kumar Dubey”

“Jeetendra Kumar Gupta”,

(Aeronautical Engineering, F.G.I.E.T.)

(Mechanical Engineering, F.G.I.E.T.)

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**ABSTRACT:** As we all know that the civil is the most bright and the rapid medium of future transport and mobility challenges, to overcome and to face the situation and upcoming demands rapid modernization and skill development of maintenance staff is very necessary because it ensures the safety which is one of the very few key factor of aviation industry. Aviation sector is undergoes very fast modernization process with various development is various section like Structural , Propulsive Electronic and material modernization and to kept these all things under operational and safety parameters it is necessary to update the guidelines and operational manuals time to time and the proper training of the service staff. Maintenance time and service time is also very important in aviation industry so its responsibility of the maintenance engineer is to endure the proper and procedural service of the aircraft to maintain the demand of Operational aircraft fleet for flying operations. To boost up the aviation sector is directly affect the globalization and the development of any nation because it is time effective and reliable so it must will face the global need with the rapid increasing of passengers within upcoming year's demands of huge fleet of aircrafts for the aviation industries. Keywords— Aviation, Maintenance, Global, Transportation, Modernization, Service, Operations, Organizations, Safety.

### I. INTRODUCTION:

From the early evolution the aviation in 1903 to the present modern airliner one things is

still common that is maintenance which is always required and should require proper observation of the maintenance schedules, these schedules varies in accordance with the model and the manufacturer who prescribed its time duration and it must ensures by the engineering division is to take over the aircraft before the schedule maintenance time arrived. The person who is authorization of inspection and maintenance must hold the respective license to that category of aircraft on which it is going to do, issue by the competent civil aviation authority. The maintenance of the aircraft has been carried out by the well trained and licensed holder professionals important point is here that how to maintain the credibility of maintenance task in that sceneries where the number of the aircrafts fleet increasing with the variation in the technology and the demand of skilled workforce to ensure the productive work in a given time phase because the time is one of the very crucial factor in aviation along with safety. Here further we will closely observing the various maintenance procedures of aircrafts of various categories along with the challenges and demands to increase the productivity of manpower to face the future challenges

#### 1.1 Tasks of Maintenance Division

For the airworthiness and safety of the aircraft the maintenance divisions role is very crucial , it endures the safety and availability and safety of aircraft some of its key features are mentioned below

- Answerable for all the maintenance and repair related issues.

- Responsible for availability of fleet for the flying operations.
- To ensure the availability of spare parts and its quality monitoring.
- Up-to-date the date of calibration of the tools and measuring gauges by the responsible authority

## II. SERVICE OF PISTON ENGINE PROPELLER AIRCRAFT



These are the primary and one of the basic for of aircraft fitted with the piston engines and for thrust propellers are mounted on engines. This category of aircrafts are used for the low level , subsonic flights along with easy handling it is maintenance friendly dur to less number of technicality and required not much high level of skilled manpower . Due to the piston engine configuration it requires less fuel and carry fewer loads as compared to jet based aircraft propulsion system which is costly to operate. Earlier military and commercial transport aircrafts are Radial Piston Engine configuration. Nowadays aircraft with this configuration of piston propeller are use operated mainly in primary flight training in various flying academies due to its two great feature less technicality to operate and cost effective to operate and maintain so that less amount of manpower and infrastructure is required for flying operations, it is also using for short transport of essential equipments in a very less time alone with them, it is also mounted in Aerobatic aircrafts.

### 2.1 SERVICE HOURS OF SCHEDULE

Primarily schedule of aircraft is based on flying hour's basis and calendar basis whatever comes first maintenance & inspection schedule must be performed by the well licensed holder's professionals.

**The schedules are classified in various divisions of flying hours and months in case of piston aircraft it is as followed.**

50 HOURS / 3 MONTHS
100 HOURS / 6 MONTHS
200 HOURS / 12 MONTHS
400 HOURS SPECIAL INSPECTION
1000 HOURS COMPLETE OVERHAUL
25 HOURS FOR NEW ENGINE

### 2.3 Basic Service operations of Piston Engine Aircrafts



The operation of maintenance is to be performed by various workshops having their specific work division, contains specified and certified tool equipments and trained staff for the better performance and quality work output

- Quality Control Shop
- Avionics Shop
- Battery Shop
- Instrument Shop
- Bonded Tool Store
- NDT Shop

### 2.4 Instrument Workshop

- Auto Pilot KTS 158 tester
- ALCAL ( 2000 EGT CHT ) Tester
- Pitot Static Leak Tester
- Dead weight pressure gauge tester
- Cable Tentiometre
- Digital Multimetre
- Suction Gauge
- DC Voltmeter
- Thermo Hygrometer
- Portable Fuel Quantity Calibrator
- Gyro instrument test table
- AUR Data test system
- Insulation tester
- DA 40 ( 50 HOUR SERVICE)
- Lubricant ( ENGINE OIL) { 5 Lt. }
- In summer: W100 (THINNER OIL) density.

- In Winter : W120 (THICK OIL) density.
- 4 Cylinder Lycoming Engine ( 4 FUSE)
- Spray Lubs.
- LPS 1 for light area ,surge areas
- LPS 1 for heavy areas.

**Lubricants ( ENGINE OILS ) : ALL CHANGED**

**PowerPlant : Four 4cylinder Lycoming engine**

- (ALL OVERHAULED)
- Detachment of WINGS
- Detachment of HORIZONTAL stabilizer
- Cleaning of airframe
- Calibration of flight instruments
- Inspection of radio instruments
- NDT testing of heavy load bearing parts like flanges , landing gear struts . etc

### 2.5 Non- Destructive Testing

It is one of the crucial and economical method to diagnose the heavy load bearing parts of aircrafts ,during operation o aircraft and with time it cause serve failure during operations due to arise of fatigue and crack causes failure .There are several methods to analyze such cracks which could be external or internal . External cracks can be diagnose easily but the internal one is critically observed and repaired again.



Some of the conventional methodologies are mentioned below with their specifically uses and requirements.

1. Visual Testing
2. Ultrasonic Testing
3. Radiography Testing
4. Eddy Current Testing (Electromagnetic)
5. Magnetic Particle Testing
6. Acoustic Emission Testing
7. Liquid penetran Testing

### 8. Leak Testing

### 2.6 Instrument Landing System

It is very useful system during operation in adverse conditions ensures safe operations.

- It is ground based Landing System use by ground controller for guidance.
- This system is very reliable for landing during Foggy weather when visibility becomes very low.
- It suggest the correct path and descend path for approach towards Runway .



## III. REQUIRED SCHEDULE MAINTENANCE OF JET AIRCRAFT



Required maintenance on the engines includes routine time-interval inspections, changing of oils, and addition of oil, replacement of oil filter, routine time-interval inspections, routine service, spark plug replacement/inspection procedures, cylinder inspection, fuel system inspection and other procedures identified in the checklists of the **IO-360-N1A Engine Service Manual**. If you

complete these checklists, you will have done all the required maintenance for this engine



### 3.1 Maintenance Practices

**A.** Obey all safety precautions and ensure the proper gears and tools before involving in Maintenance area.

**B.** Don't reuse the gasket, O-ring, or seal. Install a new gasket, O-ring, or seal during component installation where a gasket, O-ring, or seal was removed.

**C.** Remove all traces of dirt, dust, debris and accumulated matter from parts. All parts must be clean before they are installed on the engine. For specific cleaning guideline.

**D.** If adhesive tape has been applied to any part, remove the tape and clean the part completely. Remove all tape and residue.

**E.** If it is necessary to use a hammer to install a part, use only a plastic or rawhide hammer.

**F.** Hardware

(1) All cotter pins that are removed must be discarded and not reused. Install a new cotter pin where a cotter pin was removed.

(2) All safety wire and cotter pins must be made of corrosion-resistant steel and installed as a snug fit in holes in studs and bolts for correct locking.

(3) The cotter pin head must install as a snug fit into the castellation of the nut. Unless otherwise specified, bend one end of the cotter pin back over the stud or bolt and the other end flat against the nut.

**G.** If safety wire or safety cable was removed during component removal, be sure to install new safety wire or safety cable during component installation.

**H.** Unless otherwise specified in this manual, refer to the latest revision of the for torque values for hardware fasteners.

### 3.2 Cleaning Processes

There are two processes for cleaning: degreasing and decarburizing.

(1) Degreasing removes dirt and sludge (soft carbon). Soak the component or part in mineral spirits or other degreaser. Refer to the "Soft Carbon Removal" procedure in this chapter

(2) Decarbonizing removes hard carbon with an initial soak of the part in a warm or heated decarburizing solution. After the soak, use a (non-wire) bristle brush, wooden scraper, or grit-blasting (with non-abrasive media as per the "Grit-Blasting" procedure in this chapter) to physically remove the hard carbon. Refer to the "Hard Carbon Removal" procedure in this chapter.

### Weekly Inspection, Aintenance & Tasks Schedule



This inspection schedule is basically to improve the requirement of the operational under the given the given procedure and safety measure this process of of maintenance and inspection package has been carried out within 90 flying hours hours or at maximum 8 days elapsed time whoever occur early from last similar or higher inspection checks . Under this inspection check all the necessary documents and electronics and electronics both hardware and software must be inspected by respective maintenance crew under the supervision of licensed authority and licensed organization.

Things to be carried out within ninety five hours for 8 days elapsed time schedule When you things are there that should be noted before the aircraft comes for

1. Station where aircraft is Park
2. Aircraft registration number issued by regulating authority

3. Date
4. Time period of airframe inspection commencement
5. Number of EQ's attached by quality control division.
6. Number of NRC's attached by line maintenance division.
7. Date of dispatchment

Here the thing which is crucial to note that the task the task package which contain the list and details of various tasks under the grievance procedure mentioned by the issued regulatory authority to the maintenance organization contains several pages along with the date of issue and the date of issue and the date of amendment and updating it also contains several agents for the maintenance task that has to be carried out after successful inspection and quality check additional pages are also available which contain the pre departure task task departure task departure task task and having additional stages for the inspection of of the respective cable of that aircraft and at last few pages contain the Safety Assessment of Foreign Aircraft\_ ( SAFA ) checklist of the aircraft before its been cleared from the maintenance line.

### 3.4 Required tools and equipments

- Fuel tank water training tools and hydro kit.
- Tapered thread gauge for piping.
- TP Gauge (Tyres Pressure Gauge).

### 3.5 Required Materials

The materials which are consumed during that part of maintenance which is necessary these materials are also the part of of other schedule inspection or maintenance of aircrafts\_

1. Hydraulic fluid
2. Engine oil
3. Vinegar Solution
4. Crushed Ice
5. Grease
6. Fuel filter

## IV. AIRFRAME SYSTEM INSPECTION

1. It must be ensured that proper installation of landing gears and its door and care locks and care locks are working properly.
2. It is also necessary to ensure also necessary to ensure that the cover of pitot tube and static port must be on on their desired place.
3. It must be ensured that that some of the documents must be checked and available on board the aircraft those are  
PDR (Preferential departure routes)  
DMR (Data modification request)

CDR (Critical design review)  
PFR (Probability of failure repairs)  
FRB (Failure review board)  
EDTO (Extended diversion time operation)  
Above some important key documents which must be updated and duly available on board the necessary printouts of those documents must be available.

4. You should check some other parameters of the aircraft onboard.

- Certificate of review
- Certificate of airworthiness should check check the validity of it
- WT license Check the validity of it
- Weight and balance schedule of aircraft minimum equipment list MEL
- Other insurance certificate of various divisions
- Valid noise certificate
- Essential permit for the operator
- Airworthiness review certificate
- Technical log sheet of respective aircraft
- Aircraft cockpit and cabin emergency equipment list
- Bomb search procedure sheet duly procedure sheet duly sheet duly updated
- LOPA layout of pax arrangement
- EDTO extended diversion aircraft operation of of significant component list of aircraft

The above mentioned points are very crucial and should be checked before execution of for the stuff if any of the mentioned point is not satisfy it must be reported before execution of any step it is very necessary because it is one of the important safety measure that must be taken by the approve organization or personal who is going to do such inspection\_ or maintenance schedule.

5. It should be be necessary to carry out external and internal journal visual inspection of aircraft parts and component for the condition of mostly preferential like futureless skin near the ribs and each static sports mountain on aircraft external surface like tort or study quotes and the angle of attack sensor sensor it is necessary to rectify those for the best of its operation.

6. It is necessary to carry out external and internal all type of general visual inspections of complete aircraft including gallery cabin and\_cockpit various necessary damage defects and abnormality after operations it should be should be recorded and must be rectified as according to the procedure necessary.

7. It should be ensured that the the aircraft that the aircraft ensured that the the aircraft that the aircraft is compiled with with edto that is extended

diversion time operation time operation documents according to the operational requirements of scheduled and non scheduled flights on their respective routes.

8. Cleaning should be necessary so all the gallery E gallery equipments that is in forward and rear area toilets water taps taps should we check check for water flow and leaks . Cockpit cleaning that is the general cleanliness in cleanliness in cockpit must be insured

9. Fire extinguishers should be properly checked , primarily in crew cabin , cockpit and lavatory fire extinguishers all should be visually checked gor any leakage and unwanted discharge which cause failure during emergency.

10. Cargo compartments must be visually checked any type of leakage could cause decompression in cabin so that the floor linings floor panels and pressure compensation valves should be visibly inspected.

11. One of the most important is the fuel tank inspection water is very hazardous for fuel and fuel tank so it should be drained out from the fuel tank for that diagnosis of water is important so so you must need to collect sample from all the tanks check that visually for any contamination or any foreign particle and after that check the water content by the help of hydraulic it that is the Aquarist detectors. it is also necessary to check the proper amount if flow across Fuel cross feed valve and of fungi or contamination cause blockage affect engine performance.

12. Main landing gears doors must be checked properly and for its smooth operation proper lubrication of hydraulic actuators, cylinders it is necessary.



13. Visual inspection of breaks and wheel tyres must be done. Adequate tyre pressure must be

maintained for the smooth operation it is measure in PSI and the serial number of tyre pressure gauge must be recorded.

## V. EMERGENCY EQUIPMENT CHECK

Checklists are one of the key procedure which should be done properly before and after the operation, it reduces the chance if failure by the pre recognition of the faults and check there availability of the equipments before flights , it also correct the human error chance if anything left behind .

### Cockpit:

- Fire Extinguisher Check
- Crash Axe Check
- Fire Resistive Gloves Check
- Escape Rope Check
- Cockpit Fire Alarm System Check
- Life Vest check
- Emergency Oxygen Mask and system Check

### Cabin;

- Portable Fire Extinguisher Check
- Life Vest Check
- Universal Percaution Kit
- Brackets for Oxygen Bottles
- Infants life vests and belts
- Extension Belts

## VI. AIRCRAFTS LIGHTS INSPECTION

A light plays a very lead role in ease of operation both in days and specially during night operations. On board aircrafts various types are used for various call sign to the ground crew to understand the situation of aircrafts its all internationally recognized on eh basis of illumination & color of lights .Some of the crucial lights are mentioned.

- Navigation Lights
- Landing Lights
- Taxy Light
- Take off Light
- Anti Collisioon Light
- Tail Logo Light

Inspection of all all lights is necessary to check before the final maintenance clearance.

## VII. APU SYSTEM INSPECTION

APU unit is essential part of an aircraft so that's why it should be operational in every good and drastic situation , being as a auxiliary source of power its availability affects the operation of engines and other power required operation of various avionics and lightings. During basic maintenance check it should be properly checked as mention in schedule data.

Some of the points are mentioned under during observation to ensures the safe operations.

1. It should be insured that aircraft is compiled with the EDTO operational requirements of schedule flights routes that has been travel so far since the last inspection.
2. Review of PDR , DMR PER and FFR is information to both pilot and engineer , it should be checked that is there any deviation in EDTO configuration . Must took the review of STS on lower ECAM. Must take action if necessary after all inspection all papers and documents must be attached .
3. Inspection of IDG ( Integrated Drive Generator ) which is main component of power generator It consists of CSD ie the Constant Speed Drive which ensures the constant drive of shaft for non fluctuation in power output. During inspection check IDG oil level should be properly check by the opening of level door and also ensure the cleaning and any leakage . It should be also check of sign NO APU OIL or Filter Clog message through CFDS.
4. After IDG oil level again check APU oil level from APU DATA OIL PAGE and ensure that there is no low oil level RCAM warning
5. Closing of IDG doors properly and grease all the hinges along all the doors got the sake of smooth opening and closing .

### VIII. MAINTENANCE OF RECORD

In an aircraft there are several types of records and document related to agra both on board and on the ground, those documents are directly or indirectly related with the Airworthiness of aircraft for its safe and sure operation under the prescribed ruled and regulations , those records are helpful understanding the status and evaluation of aircrafts. Doll certification standards and procedures are governed by Federal aviation administration "FAA" the main work of FAA is the review of records and inspection Here is the list of some essential and comman documents that is recognised by the FAA during inspection

1. Type certificate data sheet
2. Copies of previous certifications
3. Export certificate of airworthiness
4. Certificate and proof of registration and Re registration
5. Noise standard certifications
6. Internal arrangement and emergency equipment list certificate
7. Material flammability fire saftey standard certificate

8. Summary of aircraft time in service
  9. Airworthiness directive services
  10. Service Bulletin certificate
  11. Certificate maintenance requirements
  12. Install component list with certification tags
  13. Planning your overhaul time and life limited parts status
  14. Engine maintenance record
  15. Auxiliary power unit maintenance record
  16. Weight and balance equipment balance equipment list
  17. Flight manual
  18. Inspection program and Maintained status.
- All above mentioned documents is replica of health of any aircraft so it is mandatory to be up to date or updated al records along with aircrafts to ensure or fulfill its airworthiness requirement.

### IX. FIRE DETECTION SYSTEM AND SAFETY MANAGEMENT

Fire is one of the major threats of Aviation industry. There are various instrument components and Systems present on board the aircraft which cause major threat to catch fire it is very necessary to check all those components and both electrical and electronics wirings present inside the aircraft in both in cabin and in cockpit section. Till now there are various types of fire detection systems that can be mounted on aircraft depends upon the category of aircraft. APU Fire Detection and over heat system is one the system from many necessary systems required for the fire protection of specific parts like that many more systems are mounted onboard the sircraft.

It can be categorized in two area of working:-

1. **Engine Fire Detection System**
  2. **Fuselage Fire Detection System**
- 1. Engine fire detection system:-**  
Engine fire is very conman in aviation industry which claims millions of dollars to industry every years, sometimes in many cases it causes emergency or crash land of aircrafts, engine components are working in very high temperature environment that's why it's very easy for them to catch fire if anything wrong happened. For this various setups has been introduced some are conventional and some are the advanced sensor based used by many airliners to kept the engine safe and reduces the risk of major accidents . Some of the Engine fire detection systems are mentioned below.
1. **Thermal switch system**
  2. **Thermocouple system**
  3. **Optical fire detection system**

From above systems thermal switch and thermocouple systems are very conventional and economical and easily maintained.

**2. Fuselage Fire Detection systems:-**

Fuselage are very vulnerable to fire because it contains curtains, cushions and bypass of many crucial electrical wirings and junctions of various databases . On the life basis its main section of the passengers sitting.

- 1. Photoelectric-Area type detection System
- 2. Photoelectric - Ducted type detection system
- 3. Electronic -Sensor based Smoke detection systems.

**9.1 Actions during Fire**

- 1. Switch off electricity of nearby all the electrical circuits immediately.
- 2. Open main valve of water supply to hose reel to the exact location of the fire.
- 3. Switch the fire alarm bell to alert the others from the fire before fire will expand to abandon the area.
- 4. Open shut of nozzle on hose and direct the hose of water to the seat of fire .

**9.1 Safety of Operations**

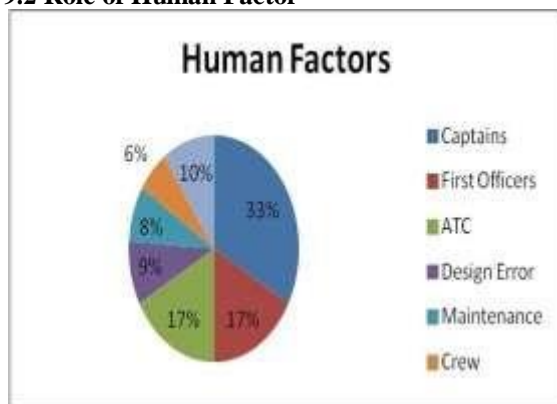
**BEFORE FLIGHT:**

- Inspection of Propeller Blades
- Checking of Control Surfaces movement
- Inspection of Basic Flight Inst.
- Checking Radio Communication
- Landing gear inspection

**AFTER FLIHT**

- Schedule inspection ( No of Hrs of Service)
- Tyre Air pressure
- Fuel Quality Check
- Propeller Alignment
- Air Frame Inspection

**9.2 Role of Human Factor**



Human Factor directly affects the performance of any system that's why in aviation it is challenging and continuous evolving process to face new challenges and more modern machines with

perfection cooperation and coordination between man machine to ensure safe and secure travel.

In the below figure we can better understand how much there is rol o the human factor in aviation industry among various profesonials.

**X. AVIATION ACCIDENTS FACTORS**

Accidents are the truly nightmare for any industry or a family which directly affects the life's. As according to the research the participation of pilot error is the major that

To improve the human error well training and a comfortable working environment is very necessary.

**10.1 Accidents Due to Machine caused**

It is a huge concern and challenge for any industry and within one line its solution is proper maintenance of machine proper calibration and improvising in technology is very necessary.

Machine based errors are classified into two categories

- 1. Maintenance Induced
- 2. Design Induced

**10.1.1 Maintenance Induced**

It totally depends upon the maintenance team and by the help of consistent and precise work we can easily reduce that risk of 12% which is a huge improvement. Manpower is th life line of any industry or organization to process or to operate the machines both so it's very essential for the organization to carefully observe their workers and well trained them for the targeted work to get the desired output .

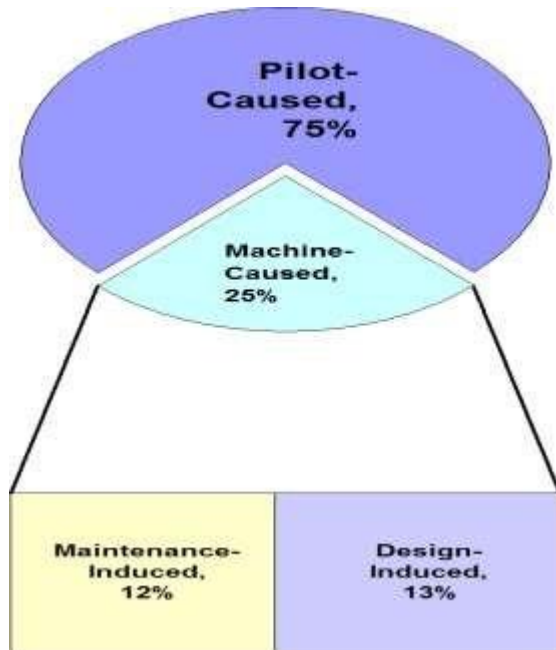
**10.1.2 Design Induced**

It depends upon the if any anomaly in the design, because as we know that the designing of any machine has lots of efforts of whole Research Team & to the final testing phase.

Any anomaly during

the design could cause a major failure during operations of the machine threat lives.





## XI. CONCLUSION

In the last our conclusion is based upon the efficient and quality maintenance work and it could be only achieved by the proper use of man force and machine with great coordination between them if any one lag behind then it will affect the whole work of the system because in aviation or in any major sectors , teamwork and working time is very crucial special in aviation the role of time is very necessary because it is the responsibility of maintenance team to ensure the availability of the aircraft so that it will not handled the flying service operations so for them the time are so limited in that limited time they need to give the efficient work of maintenance. A good working environment is also necessary for efficient work Goodwill among the workers from higher level officers to lower level officers is very necessary for the efficient working. We cannot avoid the necessary human factors to reduce the chances of error proper training must be necessary and it should be observed by the responsible person. Maintenance organization must maintain all its papers and documents before merging in any maintenance operations it insurance that there is availability of all the spare parts and necessary equipments which is required for both the aircraft and by the maintenance personnel. All episodes for the efficient maintenance are just like chain if one of anything will be disturb then the whole system will be efficient less and if the system will be less efficient than it will directly affect the performance of both the man and machine.

Aviation industry has gone through major modernization with every new aircraft lots of new features comes so it's great responsibility of maintenance organization to upgrade all its equipment and give proper training to the operating personals for that desired works.

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