Safety Issue in Hands-on Aircraft Training Procedures

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Abstract

Malaysian Institute of Aviation Technology (MIAT) is one of the institutes under Universiti Kuala Lumpur (UniKL). As a technical university, the programmes offered at the university emphasizes on learning by doing through effective use of latest technology and industry standard equipment. It also focuses on integrating learning of theoretical knowledge with practical skills incorporating social and generic skills. As one of UniKL branch campus, UniKL-MIAT offered courses on aircraft maintenance technology, manufacturing and management. All the courses involved hands-on training on aircrafts, stationed in the institute hangar. The students have to attend 60% of their study either in the workshop or the hangar, working with real aircraft and industry equipments, most of the time following strict industrial safety procedures. This hands-on session is the niche of MIAT in providing aircraft training, and also it is part of the requirements from the Department of Civil Aviation (DCA) in order for MIAT to be certified under the global system of aviation certification. Thus, the safety rules and regulations practiced in the institute, must follow the strict procedures set by DCA and practices by airlines and aircraft industry. This paper will describe the safety procedures for hands-on training in MIAT and how is the training conducted. A case study will be presented to emphasis the importance of safety issue. The paper will come up with a proposal for all hands-on training, to follow strict safety procedures as required by the industry.

Keywords: Safety Issues, Hands-On, Aircraft, Aviation, Practical

1. Introduction

Aviation industry, in many ways, being similar to other high-tech, high risk, and tightly coupled organizations works with the view that ‘accidents are inevitable’[1]. Accident investigation reports in the 1980s and 1990s provided the impetus for links between organisation’s safety management processes and accident [2][3][4]. Organisational practices affecting the performance and reliability of safety systems are the ways in which safety is managed in aviation organizations; leading to either ‘good’ or ‘lax’ safety culture [5]. Aspect of safety culture are found in the shared attitude of care and concern throughout the organization [6, and in the visible commitment of senior management to safety [7].

Aviation organizations design safety management systems with the view that there will always be threats to safety: an essential component of ensuring safety is about identifying and managing threats before accidents occurs. The effectiveness of a safety management system depends on how well it permeates in the fabric of the organization ‘the ways in which things are done ‘ so that a positive safety culture is generated and maintained in an ongoing manner.

2. Safety management in UniKL MIAT

UniKL MIAT is committed to ensure a safe and healthy environment for everyone working and studying in the premises. The following are the policies adopted by UniKL MIAT for the implementation of the safety and health program. [8]

- UniKL MIAT will strive, through a process of continual improvement to fully integrate safety and health into all facets operations and activities.
- UniKL MIAT will comply with applicable regulations and other requirements for it activities and maintain best practices in safety, health and environment.

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- Provide the necessary re-courses, training program and information to help employees and students lead a safe and healthful life.
- Provide safe working places, tools, equipment and materials free of preventable hazards.
- Provide effective safety management at all levels within the organization through comprehension inspection, reporting and follow up practices.

3. UniKL MIAT Aircraft Training Procedures

The Maintenance Training Organisation Exposition (MTOE) serves to lay down the organizational structure, resources, policies, processes and procedures of UniKl MIAT in performing aircraft maintenance training program within it scope of approval to the standards of the DCA, Malaysia as holder of Maintenance Training Organisation Approval. UniKl MIAT has adopted Joint Aviation Requirements 147 (JAR 147) document to develop the MTOE including the standards of the safety requirement which every students must adhere and follow. [9]

4. On the Job Training (OJT) or Hands-On

Knowledge is an essential component of competence, but for it to provide an effective basis for skill, maintenance personnel must be given the opportunity to practice the task so as to adapt the knowledge [10]. The training aspect that's related to good performance of task is the On the Job Training (OJT). To carry out a proper OJT, it has to be structured.

Structured OJT can be an effective training method, when developed and delivered properly. However it does not exist in a vacuum. Rather it is part of the overall work and training environment in which the students in UniKL MIAT must performed. The following guide provides general characteristics:

- developed as an integral component of the overall technical and skill training program.
- based on written, agreed upon, and measurable performance standards.
- designed and delivered in a systems framework that includes information presentation, demonstration, practice and evaluation.
- designed to provide initial, recurrent and remedial training.
- used to standardize procedures and to provide consistent training among students.
- conducted by experienced Instructors whom have:
  - demonstrated exemplary performance and task mastery
  - strong interpersonal communication skill
  - been trained in structured OJT techniques and adult learning principles.
- delivered in segment that
  - are planned, scheduled and frequent
  - include keeping complete, up-to-date trainee performance records.
  - organisational changes that might result in improved job performance

5. Safety Issues in Hands-on Training

5.1 Tool Control

This is a sensitive topic among training aircraft personnel. The fact is that modern turbine-powered aircraft are in tolerant of the misplaced tool. Organizations that do not have tool control programs usually develop them as soon as they destroy their first engine. This problem is of some interest to the aviation safety as there is a good chance that the errant tool will be discovered in an undesirable manner during flight. The solution to the problem depends on whether the tools are company-owned or students-owned. Company-owned tools are fairly easy to control. It's just a matter of spending the money and doing it. Students-owned tools are not so easy. The solution depends on what the maintenance technicians are willing to accept. As professional maintenance technicians, they are probably very much aware of the problem.

5.2 Hazardous Waste Disposal

Aircraft Maintenance generates a certain amount of hazardous waste in the form of solvents, paints, oils, hydraulic fluids, etc. The handling of this is largely an industrial safety problem, but sometimes there are some flight safety aspects. Fuel spills, for example, sometimes occur during ramp operations with the (EGR) Engine Ground Run crew involved. Aircraft Training Organisation is expected to have in-hand the necessary equipment to contain and collect spilled fuel or anything else they can reasonably foresee.

5.3 Bogus Parts

This is a serious problem throughout the industry. The truth is that bogus parts are almost impossible to detect at the user level. The only real protection against them is in the reputation and certification procedures of the parts supplier. Company policy on purchase of parts should be an item of interest to the aviation safety supervisor.

5.4 Technical Data

Modern aircraft and engines cannot be adequately maintained without current manuals and technical data. There must be a system for ensuring that Airworthiness Directives (ADs) and Service Bulletins (SBs) are reviewed for applicability. These days, the technical data for many aircraft and engines are provided on microfiche format with regular updates and revisions. If the microfiche reader has a printout capability, this provides some advantages to the maintenance technician and UniKl MIAT students as the appropriate page can be printed and taken to the aircraft for reference. There is at least one disadvantage to this system. When hard copy revisions are received, a technician usually reviews them for important changes as they are posted to the manual.

5.5 Hangar Safety

An aircraft hangar is a fairly unique work environment. The potential for injury to personnel or damage to aircraft is very high. Basically, we're dealing with a work situation that never looks the same. Aircraft are not always spotted in the same location. The maintenance being performed varies from day to day. It is difficult to organize all these variables into an effective hangar safety program.

5.5.1. Electrical Systems

It is possible that the hangar needs different electrical currents. If so, the receptacles should be clearly marked as to the voltage available at that receptacle. There should be a central circuit breaker (CB) panel within the hangar and there should be a lockout system where some lines can be locked out at the CB panel while they are being worked on. The type of receptacle used for various voltages should be consistent throughout the hangar.

5.5.2. Air Pressure Systems

If possible, the compressor should be located outside of the hangar. The pressure should be reduced to that needed for normal maintenance and the outlet lines should be marked with the maximum available pressure. Except for special applications, 15 psi is adequate for most maintenance activities, although *some* air-driven tools require more. The maximum pressure used should be 30 psi or less.

5.5.3. Cords and Lines

The electrical and pressure lines must be run from the source to the aircraft where they are needed. This means the cords and hoses must be trailed across the floor. Wooden channels should be constructed to protect the cords and hoses from damage and eliminate tripping hazards to personnel.

5.5.4. Equipment Racks

Much of hangar maintenance involves removing panels from aircraft. They have to be put somewhere. Equipment racks should be provided so the panels are not set on the floor of the hangar where they become a hazard to personnel and are vulnerable to damage.

5.5.5. Hangar Work stands

Hangar work stands should be equipped with wheel brakes and safety rails around the perimeter of the work stand. If the work stand is designed to be raised or lowered, there should be a mechanical locking device to prevent inadvertent collapse of the stand.

5.5.6. Heaters

Combustion heaters installed in the aircraft will not be operated in the hangar. Portable heaters may be used if they are attended and approved for use in hangars. Obviously, there are work situations where there is risk of flammable vapors where the portable heaters should not be used. Portable heaters should be placed as far from the aircraft as the ducting will permit.

5.5.7. Hangar Safety Equipment

Each hangar should be equipped with eye wash fountains, deluge showers, and first-aid kits. These should be positioned in easily accessible locations close to major work areas.

5.5.8. Fire Protection

Hangars may or may not have built-in fire extinguishing systems. If so, there should be procedures for regular testing and inspection and clear instructions on how the system is to be used. If not, the hangar is dependent upon portable extinguishing equipment and notification of the fire department. In this case, there should be an adequate number of fire extinguishers available at clearly marked and accessible locations around the perimeter of the hangar. In addition, a dedicated telephone line or alarm system to the fire department should be installed, clearly marked and regularly tested.

5.5.9. General Housekeeping

The most important aspect of hangar fire prevention is probably house keeping. Work areas should be clean and free of debris and waste materials. Proper receptacles for waste materials should be available and spills of fuel or hydraulic fluid should be cleaned up immediately. Additionally, good housekeeping practices will provide a safe workplace.

5.5.10. Hangar Floor

The floor should be painted with a light colored paint that is specifically designed for hangars. It should have a skid-resistant surface and be easy to clean. In addition, it should reflect light. This has the effect of improving the lighting of the entire hangar and improving aircraft maintenance. Equipment for cleaning up minor fluid spills should be readily available. If the hangar incorporates a drainage system, the grates should be removable and the drain should empty into a suitable holding tank for future disposal.

5.5.11. Hangar Door

Improper operation of hangar doors is responsible for a significant number of personnel injuries and aircraft damage. Regardless of how the door works, it is a large piece of moving structure. Once it is set in motion, it is difficult to stop. Closing the door is more of a hazard than opening it. Some door switches have guards to prevent the door from being accidentally closed. Others have door closed lockouts wherein the door cannot be closed unless the lockout is removed. Anytime the door is opened, it should be opened at least ten feet. This is so that anyone in the opening when the door is closed will have a few seconds to escape.

5.6. Maintenance Shop Safety

Aircraft maintenance shops are less unique than hangar maintenance operations and tend to resemble activities found in many industries. Thus, OSHA standards are applicable to all maintenance shops. Our primary concern is the aircraft-unique activities which require additional safety precautions. Good safety practices start with the layout of the shops. There should be adequate lighting and ventilation. There should be ample workspace so that people working on one machine (or workbench) do not interfere with another. Aisles should be marked and kept free of debris and obstructions. Exits should be marked and accessible. The number of workers permitted in a shop should be limited to the number necessary for the job. Shops should not be used as break rooms or lunch rooms. Administrative offices should be separated from the shops. All machinery should be anchored to the floor (or workbench) and electrical machinery should be grounded. Appropriate personal protective equipment [PPE) should be available at each machine. Machinery with moving parts should have suitable mechanical guards installed. Portable power tools should be centrally stored and regularly inspected. Personal power tools should not be permitted.

5.6.1. Compressed Air Systems

Air pressure should be limited to 30 psi (except for the tire shop or air driven tools that require greater pressure) and should be reduced to 15 psi if used for general cleaning. Air nozzles should incorporate a spring loaded finger switch or "deadman" switch. Face shields or goggles should be worn when compressed air is used for cleaning. Compressed air should never be used to clean chips or dirt off personal clothing.

5.6.2. Compressed Gas Storage

Compressed gas cylinders should be stored upright and secured to the wall unless stored in carts designed for that purpose. Cylinder caps should be installed except for the cylinder currently in use. Gas cylinders should be stored by compatibility groups. Cylinders of flammable gasses should be stored separately. Oxygen cylinders should be stored away from flammable gas cylinders and away from petroleum products.

5.6.3. Flammable Storage

The storage of flammables (paints, hydraulic fluids, etc.) should be limited to that immediately needed in the shop area and they should be stored in suitably marked cabinets approved for flammable storage. Bulk storage of flammables should be in a separate building designed for that purpose. Maximum quantities for shop and bulk storage are found in OSHA standards.

5.6.4. Solvents

Operations requiring the use of solvents should be ventilated and isolated from other activities. The choice of solvents should always consider toxicity and the nature of the waste created. As with any chemical, Material Safety Data Sheets (MSDS) on the solvent should be available to the workers. If needed, aprons, gloves and face shields should be available along with eye wash fountains and deluge showers.

5.6.5. Electrical Shops And Electrical Maintenance

By OSHA regulation, electrical systems need to be de-energized using tag-out and lock-out devices. These are devices wherein technicians, using their own padlocks, can have positive assurance that a circuit cannot be energized while it is being worked on. If a machine uses other forms of energy besides electricity (hydraulic or gravity) these should also be de-energized. If a circuit breaker opens during electrical maintenance, it should not be reset until the reason it opened is determined. Electrical and avionics shops should have grounded workbenches and non-conductive floor mats. They should also have extra safety equipment in the form of wooden canes, poles, and ropes that can be used to rescue a person who has become part of an electrical circuit. These are usually maintained on an electrical safety board accessible to all personnel.

5.6.6. Battery Maintenance

All aircraft batteries outgas hydrogen and can be a fire hazard. Most aircraft battery compartments are designed for in-flight ventilation only and their batteries should be charged in the shop; not on the aircraft. Battery shops should be separated from all other maintenance activity and the shop area should be well ventilated. The ventilation system should include an automatic cutoff of the charging system if the ventilation blower or fan fails.

5.6.7. Aircraft Painting Shops

Painting operations are high hazard activities. Chemical paint strippers and aircraft paints are toxic. Thus, the paint shop (or hangar) must be separated from other maintenance activities and must be well ventilated. Protective garments and breathing equipment are necessary. In addition, used paint stripping chemicals become toxic waste and must be collected and either recycled or disposed of. Painting and stripping operations both fall under OSHA regulations.

5.7. Aircraft Jacking

Aircraft jacking is a specialized activity that has high risks of both personnel injury and aircraft damage. All aircraft maintenance manuals specify procedures to be used in jacking that aircraft.

5.7.1. Jacking Area

The area selected for jacking should be free of all equipment not directly involved in the jacking operation or the maintenance to be performed after the aircraft is on jacks. There is always some reason for the aircraft to be on jacks and, as a general rule, other maintenance activities should not be permitted while the aircraft is on jacks. The area should be marked with rope stanchions or, at the very least, signs identifying an aircraft jacking operation. Only those people directly involved in the aircraft jacking or subsequent maintenance should be permitted in the area.

5.7.2. Outside Jacking

If the aircraft must be jacked outside, consider the wind limitations. These are usually found in the maintenance manuals for the aircraft to be jacked. If none are specified, a maximum surface wind of 15 mph is normally used. If the wind is higher than the maximum permitted, it may be possible to select another area that is sheltered from the wind.

5.7.3. Inside Jacking

It is almost always better to jack an airplane inside a hangar or maintenance dock. This eliminates the wind problems and allows better control of the area. One consideration is the type of engine or pump used to provide pressure to the jacks. It should be of a type approved for use in a hangar and it should be grounded and positioned a minimum of 25 feet from the aircraft.

5.8. Aircraft Tire Servicing

An aircraft tire should be treated as a pressurized container. Its failure mode always involves release of that pressure and, in the flight line environment, this presents a considerable hazard to personnel. Modern aircraft tire pressures can be well over 200 psi, which is lethal as far as human beings are concerned. Every year, there are fatalities related to aircraft tire servicing; all of them unnecessary.

5.8.1. Pressure Measurement

Before doing anything to a tire, it is always a good idea to check for hot brakes or an overheated wheel assembly. Not only will this affect any pressure measurement, but it can be a hazard in itself. It usually takes several minutes to achieve peak wheel temperatures after a heavy braking situation. Tire manufacturers define under inflation as anything less than 95% of the required inflation pressure. This means that the inflation pressure can only be accurately measured using a precision pressure gauge that has been correctly calibrated. The date of current calibration should be on the gauge itself.

5.8.2. Inflation Gas

The gas of choice for aircraft tires is dry nitrogen. The reason is that the oxygen in compressed air reacts with the rubber in tires at high pressure and temperatures. Aside from tire deterioration, this can actually produce a combustible gas within the tire and lead to an explosion. The nitrogen used should be a Class 1 oil-free nitrogen commonly called "water-pumped" nitrogen.

6. Conclusion

For reasons stated above, a safety inspection of aircraft maintenance activities really looks at two aspects of maintenance; how well the work is being done and how safely it is being done. These two aspects are largely inseparable [10]. It is very difficult to look at one without looking at the other. Finally, this study has provided an overview on how safety is managed in the Aviation Training Organisation such as UniKl MIAT. Based on the findings, it is concluded that any aviation training organizations could do better in managing safety and improve safety culture in industries.

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