Introduction:

The aviation maintenance system is heavily dependent upon people being able to perform their jobs reliably and efficiently. The advent of modern industrial processes, the globalization of the economy, and the proliferation of information technology, among other factors, have contributed to the creation of a 24-hour society in recent times. As the demand for 24-hour availability of goods and services has risen over the past few decades, the prevalence of shift work has likewise increased. Further the opportunity to work abroad and constant migration to pursue better avenues by Aircraft Maintenance Personnel (AMP) have brought a great challenge for managers to manage the shift optimizing the available manpower resources. Managing the shift with shortage of maintenance personnel should have obvious outcome of over-stressing the individual and development of fatigue. At times, such fatigue development if not suitably addressed can become contributory factor for casual approach in maintenance which may lead to human error. Often, various incident and accident investigation report has attributed human error as a weakest link in the safety chain and without attention can become safety hazard.

Therefore, it is advisable that in line with pilot and Cabin crew every organization should frame policy for AMP duty time limitations and adequate rest period.

Whilst this AAC has been prepared primarily for those who are engaged in aircraft maintenance certification activities, however, it is also relevant to all other personnel related with aircraft maintenance. The term Aircraft Maintenance Personnel (AMP) used in this circular is generic and beside certifying personnel may also include technicians, inspectors, supervisors, managers and planners associated with the aircraft maintenance.
Purpose:

Though there have been Duty Time Limitation (DTL) prevalent for Pilot and Cabin crew for some considerable time but no serious thought has been perceived in this area for Aircraft Maintenance Personnel (AMP). Purpose of this AAC is to highlight the major concerns in the area of DTL for AMP and to provide guidelines to Aircraft Maintenance Organization (AMO) to frame policy to address the issue without prejudice to any other requirements.

While framing the policy for Duty Time Limitation the factors affecting the physical and mental performance should be looked into to avoid any mistake/error in maintenance committed by AMP which may lead to jeopardize the airworthiness and safety of aircraft.

Human Performance and Degradation:

The Aircraft Maintenance Personnel (AMP) are the central part of the Aircraft maintenance system. It is therefore, very useful to have an understanding of how various parts of their body and mental process function and how performance limitation can influence their effectiveness at work.

The physical and mental human performances are dependent upon vision, hearing, capability of information processing, attention and perception, memory, judgment and ability of decision making.

The physical ability of the AMP could be impaired/ limited by unhealthy working environment, improper lighting arrangement and adverse environmental conditions like extremely hot hanger, rain, cold, etc.

Mental ability of AMP is likely to degrade and eventually fall under certain level if affected by fitness of health, accumulation of stress (domestic/work related), time pressure and deadline to accomplish any work and lack of concentration.

“Tiredness and fatigue can adversely affect performance. Excessive hours of duty and shift working, particularly with multiple shift periods or additional overtime, can lead to problems. Individuals should be fully aware of the dangers of impaired performance due to these factors and of their personal responsibilities.”

Shift work:

Shift work can be defined as any arrangement of daily working hours that differs from the standard daytime hours. As most of the Aircraft maintenance activities are undertaken by shift system therefore impact of shift work in the behavioral pattern of AMP
while carrying out maintenance work should be understood and taken cognizance. The nature of shift systems can vary widely along several dimensions, including the number and length of shifts, the presence or absence of night work, the length of the shift cycles, the start and stop times of each shift, and the number/ placement of days off.

The individual who regularly work atypical hours is at greater risk for physical and psychological impairment or disease than typical day worker. This risk is assumed to originate from the physical and psychological stress that develops from work schedule-related disruptions of their biological functions, sleep, and social and/or family life. Considering Aircraft maintenance and servicing is a Safety Critical occupation with a direct link in the chain of events that can lead to a major aircraft incident/ accident, relationship between shift work and health and safety should be adequately addressed by all organizations.

Following factors which advocates DTL for AMP should be taken cognizance by all organization to avoid any fatigue related error of AMP as contributory factor for weak link in safety chain.

**Effect of shift work on health:**

For sustaining operational requirement, many organizations have to maintain round the clock Aircraft maintenance activities and therefore to maintain 24 hrs, 7 days shift system. The maintenance personnel who are working in this system have to adhere different shift patterns/ time scales for each shift, therefore susceptible various physiological disorders.

**Fatigue/ Sleepiness disorders:**

Circadian (around a day) rhythms are physiological and behavioral functions and processes in the body that have a regular cycle of approximately a day (actually about 25 hours in man).

The different time schedule of shift may cause circadian rhythms and internal body clock desynchronization with sleep/ wake cycle and as a result could be contributory factor for fatigue/ sleepiness at work place.

Sleep is the primary human function disrupted by shift work. Many bodily processes, such as temperature, blood pressure, and heart rate, are at their lowest ebb at night; so, it is not surprising that people who try to work at night and sleep during the day often report that they cannot do either very well. Shift workers who need to sleep during the day may have difficulty in falling asleep and remaining asleep because they are attempting sleep when they are at odds with their circadian rhythms. And, because of the
conflict between work and personal demands, shift workers rarely achieve full adjustment to their shift work schedules.

**Psychological/Emotional Disorders:**

A common finding in shift system is that psychological and emotional distress frequently accompanies shift work although the magnitude of the effects is sometimes low. These findings are consistent with the psychological effects of shifting schedules and the resulting sleep disruption discussed previously. The psychological distress that often accompanies shift work from its onset may be the primary factor that provokes many to leave shift work.

**Gastrointestinal Disorders:**

Gastrointestinal disorders are the most prevalent health complaint associated with shift and night work. Irregular bowel movements and constipation, heartburn, gas, and appetite disturbances are to name the few which people have to manage beside their work.

**Cardiovascular Disorders:**

It is acknowledged fact that there exists relationship between shift work and cardiovascular disease. Various studies in related area reported increased risk of cardiovascular disease in shift workers specially working in groups (e.g. smoking). A mismatch between circadian rhythms and the timing of sleep, problems with family and social life, the behavior of shift workers including poor eating habits and increased tobacco and alcohol consumption are some of the ill effects of working in shift which can increase the risk of cardiovascular disease for maintenance personnel.

**Other Individual Factors:**

Over the age of 45 - 50 years, shift workers increasingly encounter difficulties in altering their sleep-wake cycles. Specifically, aging people experience a decrease in “deep sleep”, an increase in “light sleep”. Due to physiological effects of aging it becomes more difficult to cope up with the work pressure of shift for the people over the age of 50.

**Management of fatigue and sleep disorders in shift work:**

Some of the measures while managing the shift work should be practiced by every organization in order to:

1. Minimise the build-up of fatigue over periods of work
2. Maximise the dissipation of fatigue over periods of rest

3. Minimise sleep problems and circadian disruption

**Daily Limits:**

As performance of maintenance personal exponentially varies with extended period of shift work, therefore, the time schedule of shift should be scrupulously adhered, to avoid fatigue related issues. Generally shift durations are 8 hrs, which may extend due to demand of work. However, working more than 12 hrs should be considered undesirable. Maintenance personnel should get adequate rest period between two shifts.

**Breaks:**

As fatigue builds up over a period of work and that this can be, at least partially ameliorated by the provision of breaks. Therefore, working longer duration without any break should as far as possible be avoided. Duration of break should be planned taking into account the logistic and other constraints.

**Longer Limits:**

As some of the residual fatigue may accumulate over weeks and months despite the provision of rest days, therefore limiting the work which can be undertaken over longer period of time and provision of leave in reasonable time is important.

**Limits on Night Shifts:**

There is good objective evidence that risk is increased at night by about 30% relative to the morning/day shift working staff. The efficiency of working staff also reduces progressively during night shift due to development of fatigue in adverse working condition. The risk becomes more prominent when night shifts are performed successively. Therefore, number of continuous night shift should not exceed more than two and same should be followed by at least two successive days rest period.

Policy for allocation of work during night shift should be framed taking into account the following:-

1. Adequate staffing to commensurate with the anticipated work load.

2. Whether the AMP is in initial or successive night shift. It is desirable that complex/critical tasks are planned earlier leaving the lighter job for the later part of the shift. Allocation of work to AMP should match with the availability of time during the shift and working overtime beyond the night shift should be avoided.
3. Whether work allocation to AMP involves single or multiple type of aircraft/engines.

Guidelines for Good Practices:

1. Employers should consider developing risk management systems to enlighten the AMP in this regard. Risk management system should be a part of the organization policy for overall Safety Management System (SMS).

2. Employer should develop educational programme to increase AMP’s awareness of the problems associated with shiftwork. In particular, it is important to draw their attention to the objective trends in risk with a view to increasing their vigilance at points when risk may be high despite the fact that fatigue may not be. It is also important to provide information on how to plan for night work, and to give guidance on the health risks which seem to be associated with shift work, particularly at night. Educational program/workshop should enlighten the AMP about the ill effects of fatigue and how to recognize them for self/others.

3. AMP should report for duty after adequately rested. AMP should be counselled for sufficient uninterrupted sleep to minimize stress and to dissipate fatigue during the rest period.

4. No scheduled shift should exceed 12 hours. Wherever work allocations involved multiple aircraft/engines in a shift due consideration should be given about the complexity/criticality of the task and quantum of work should be decided accordingly.

5. The finish time of the night shift should not be later than 08:00.

6. A morning or day shift should not be scheduled to start before 06:00, and wherever possible should be delayed to start between 07:00 and 08:00.

7. A minimum rest period of 11 hours should be allowed between the end of shift and the beginning of the next, and this should not be compromised by overtime.

8. A maximum of four hours work before a break should be planned.

9. Scheduled work hours should not exceed 48 hours in any period of seven successive days. Total work, including overtime, should not exceed 60 hours or seven successive work days before a period of rest days. In fact it is desirable that work and rest period
should match each other for effective dissipation of fatigue which builds up over the period of work. Work duration for any individual should also have consideration of their mental condition/stress level during the work and complexity/criticality involved.

10. Wherever possible AMP should be given at least 28 days notice for their work schedule.

11. AMP should be discouraged or prevented from working for other organizations on their rest days, and hence from exceeding the proposed recommendations on work schedules despite their implementation by their main employer.

12. Vigorous campaign shall be made for avoidance of working under the influence of Alcohol / psychoactive substances to cope up with stress / Fatigue by AMP.

AMP who are maintaining and releasing the Aircraft to service are practically ensuring the airworthiness and safety. Therefore, an AMP performing duties whilst fatigued may become potential threat and safety hazard for operation of aircraft if the issue is not properly addressed.

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