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# MX Fatigue *focus*

## DO WE NEED A MX FATIGUE RULE?

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**by Dr. Bill Johnson**

The FAA-Industry maintenance fatigue working group has 25 members. There is equal representation from industry management, labor, government scientists, MROs, and academics. In the Spring of 2010 we conducted an informal E-mail survey to seek the opinion of the group regarding the need for a fatigue-related regulation for maintenance personnel. The response period was short thus we received votes from 21 of the 25 members. The group was small and the survey was informal. The response was unanimous! 100% of the respondents felt that a rule was necessary to move the industry to take action on fatigue issues.

If there had to be a rule what might it look like? That answer can be derived from the table below.

### US Mx Fatigue Rule : What if?

Major Categories	Range of Regs	IFA
Max Scheduled Hrs	8 - 24 Hrs	12 Hrs
Max Hrs. with OT	11 - 24 Hrs	16 Hrs
Max Hrs./Mo	196 - 648 Hrs	288 Hrs
Min Rest between Shifts	11 <small>(Professor)</small>	
Min 24 Hr. Break/Week	48 - 0	
Time of Day	Makes a Diff.	

First of all, there are at least six significant factors that must be considered. They are listed in the first column.

The second column shows a range of hours that exist throughout the world today. The first two rows represent maximum hours per day, ranging from the strict 8 hours, from the books of the Civil Aviation Authority of China, to countries, like the U.S., where there is not a regulation on the number of work hours per day. Row three is the maximum hours per month. The amount of rest between shifts is not regulated but a leading professor, with whom many experts agree, suggests an 11 hours rest between consecutive shifts on row four. Row five shows vast variance among the rules of International Aviation Authorities. The last row merely emphasizes that the time of the shift day is significant as well. In 2008 the International Federation of Airworthiness (IFA) published a position paper regarding fatigue and duty-time in maintenance. The third column shows their recommendations. The IFA suggestions seem to be a reasonable compromise and are also scientifically reasonable.

**The table is merely for discussion.** It is not a proposed rule anywhere in the world. It is generally agreed that an enlightened rule could consider the information in the table but should also offer a means for a company-specific fatigue risk management system to establish duty times that are safe and compatible with production requirements.

# MANAGING FATIGUE IN MX FOR SUPPLEMENTAL OPERATIONS



**NORTH AMERICAN**  
flynaa.com  
**AIRLINES**

By Rudolfo "Rudy" Quevedo

*About the Author: Rudolfo "Rudy" Quevedo currently serves as the Director of Safety for North American Airlines. He is responsible for all aspects of the airline's safety operations including the design and implementation of the carrier's Safety Management System. Rudy has over 30 years experience in the airline business and is a Certified Quality Auditor under the American Society of Quality, an NTSB trained Accident Investigator, and an FAA certified Airframe and Powerplant Mechanic.*

The effects of fatigue have been documented to have a negative impact on maintenance operations in all facets of aviation. These include operations under 14 CFR part 91, 121, 135, and part 145. Part 121 operations are further broken down into Domestic, Flag, and Supplemental operations.

North American Airlines (NAA) operates as a supplemental carrier operating to almost any point on Earth, sometimes on short notice. The carrier operates a fleet of Boeing 757-200 and 757-300LR aircraft, mostly in support of the United States Department of Defense Air Mobility Command, but also providing charter service for an array of customers, such as tour operators, sub-service for other airlines, and even the Bush-Cheney and Obama-Biden Presidential campaigns.

Because supplemental operators such as North American Airlines do not have scheduled service, or operate from typical "stations" it is common to employ the use of flight technicians. These technicians fly with the aircraft and are often supplemented by contract maintenance personnel. Different from flight crews, who normally rest when flights terminate, flight techs must perform maintenance on the aircraft during the ground time between flights. Although flight techs augment their rest with sleep during flight, it is crucial that flight techs and management work together to effectively minimize the effects of fatigue on the operation and ensure safety.

**"...limits duty time for all technicians to no more than 16 consecutive hours of service in a 24 hour period".**

North American Airlines has undertaken several initiatives to minimize the effects of fatigue in its maintenance operations. The NAA Maintenance Operations General Maintenance Manual limits duty time for all technicians to no more than 16 consecutive hours of service in a 24 hour period. This is above the regulatory requirement of "four 24 hour periods in a calendar month, or the equivalent thereof", as stated in 14 CFR 121.377.

Additionally, the NAA Airlines Safety department, in conjunction with maintenance and engineering, has implemented the use of a "Fatigue Questionnaire" which captures important information related to sleep-wake cycles, napping, total duty time, circadian rhythm effects, etc. The questionnaire is used to capture information during event investigations, as well as situations where fatigue may be an issue. In time, NAA hopes to capture sufficient data to develop a Fatigue Risk Management System which would assist in developing science-based work schedules that minimize the effects of fatigue in the NAA system.

Another initiative under way at North American is an evaluation of human fatigue studies and numerous international duty time and scheduling methodologies. This risk management exercise compares various work scheduling schemes against operational and economic impact. The objective is to minimize fatigue where possible and mitigate any possible human performance degradation when operational demands dictate.

While these projects are underway NAA has begun a campaign to educate technicians on the effects of fatigue as well as personal tips aimed at providing "tools" which technicians can use to manage their rest periods and ensure any impact to operational safety is minimized. The NAA intranet safety site is in the process of being enhanced with content and links such as the [FAA's Maintenance Fatigue web site](#).

Because NAA often operates for customers based in other parts of the world, many of which have different standards than the United States, North American Airlines, as well as other supplemental operators like it, continuously seek to enhance its processes to meet world standards.

The NAA Internal Evaluation Program continuously compares NAA processes not only against FAA requirements, but also against other air transport standards such as Department of Defense, International Civil Aviation Organization, IATA Operational Safety Audit, etc. It is with this philosophy that NAA hopes to develop a Fatigue Risk Management System for maintenance personnel.



# Sleep Technology & Duct Tape

by Dr. Bill Johnson



Our parents always told us to turn off the lights, get tucked into a quiet room, and obtain eight hours of good sleep. Enlightened physicians tell us the same thing. All along, sleep science has proven that our parents and doctors were correct. Humans must sleep.

Instead of taking proven sleep advice, we often boast that we can cram all night for an exam or work all night to change an engine, especially when the overtime clock is running. The result however, is unsafe performance on safety-critical tasks. All nighters can result in mental and physical performance that is similar to an alcohol-impaired driver—obviously not fit for duty!

Today our industry is wiser. We have seen the recent fatal accidents and incidents resulting from a fatigued workforce. Government, industry, and individuals all share the blame by having economic tunnel vision or unwillingness to address the many facets of worker fatigue. We can all work collectively or unilaterally to address the issue. Let's look at individual solutions. You can follow medical and FAA guidelines about

## Follow Guidelines or Buy Cool Stuff

fatigue or attack fatigue with technology. This would be like buying new equipment (e.g., golf clubs, football, bowling ball, running shoes) to improve your sports performance. In all cases revisiting and practicing the fundamentals is likely a better performance-improving solution. The positive aspect of new sports equipment is that it renews your attention to the sport. The same is true for sleep performance technologies!

There are many "Cool" technology-based sleep performance devices on the consumer market. Most of them can approximate the quantity and quality of your sleep and show you how often you get to the cycles of necessary deep sleep each night. If you read and follow the directions, you will be able to monitor your sleep data and begin to understand your sleep. Then you can not only improve your sleep, but also learn scientific words to become a pseudo-sleep specialist. You may choose to talk excessively about your sleep and even bore your friends and work colleagues into their own coma-like sleep.

If you grab your credit card and head to the websites you will find many sleep technologies of varying quality and prices. Let's look at three that have similar goals with different approaches. **This discussion is not an endorsement of a particular product.**

The ZEO Personal Sleep Coach (About \$200) is a monitoring device that includes access to sleep coaching software. The data are collected through a wearable headband with a brain activity sensor on your forehead. Zeo comes with support software to help you understand your sleep.



ZEO Sleep Coach

Another top-selling tool is an I-Phone application called Sleep Cycle Alarm Clock. This App is only 99 cents with an I-Phone. Perhaps less sophisticated than the head band monitor, this application uses the I-Phone accelerometer to measure your movement during sleep. It equates your movement to your levels of sleep and provides a chart of your sleep. It also rings your alarm around your set time based on your sleep pattern. It tries to awaken you at an ideal point in your sleep cycle, but will not override your hard-set alarm.

Big spenders can buy a variety of wrist watches (\$700+) that, like the I-Phone, use an accelerometer to record daily measures of your level of activity, amount of likely sleep, and long term activity level. Some of the devices can warn you, with a series of green, yellow, or red lights of your likely sleep-related fitness for duty.



Sleep Watch

## Do these technologies help?

**Yes!** Most importantly, the technologies will help you pay attention to your sleep habits and disruptions. You will begin to notice what time you go to bed and wake up and that you get better sleep when the room is cooler, quieter, and dark. The devices may help demonstrate that watching TV in bed is not sleep. The technology may also serve like a home blood pressure device or a bathroom scale, which help warn you when you should seek additional professional advice. Therefore, I contend that the sleep technology devices have value – they make you pay attention when you neglect the fundamentals of good sleep.

## Why the duct tape?

Why the duct tape? The I-phone device requires that you place the device near your pillow so that it will record movement. After 2 consecutive nights of tossing and turning and knocking the I-Phone off the bed I resorted to methods learned in A&P School. Duct tape that I-Phone near your pillow to improve the quality of the data.

You can find extensive information and sleep support tools at the FAA website: [www.mxfatigue.com](http://www.mxfatigue.com).



# BEAT Fatigue!

## TIPS AND TESTIMONIALS

### To Sleep, or Not to Sleep: A Couples' Dilemma

BEATING FATIGUE DOES NOT REQUIRE COUPLES TO SLEEP APART by Joy Banks

**QUESTION:** "In my own personal experience, I typically sleep like a baby, but my wife has a very difficult time falling asleep and sleeping soundly, which ultimately ends up waking me up more times than I care to mention in any one given night. We have discussed many options to combat this, but none really are appealing to either of us, to be honest. Any suggestions?"

--Written by an Aviation Maintenance Technician

**Answer:** How many times has your sleep been disrupted by your partner because of snoring, watching TV in bed, restless movement, or other annoyances? This is a common dilemma shared by many couples that could lead to fatigue and other problems. For this reason, some couples have decided to sleep separately. A [study by the National Sleep Foundation](#) found that 23% of couples sleep apart. However, for one quarter of the couples that chose to stick-it-out with their beloved sleep disorder/problem partner, they report having less intimacy or have "lost interest" because they were simply too sleepy.

Sleeping apart is one of those "don't ask, don't tell" situations. Many couples who choose to sleep separately feel they'll never get quality sleep together, so they retreat to guest rooms or couches, but they are reluctant to discuss their sleeping arrangements, fearing that people will assume the worst about their relationship. Some couples have taken it to a whole new level. Home builders reportedly are building houses with dual master bedrooms because many couples, baby-boomers in particular, feel they can't sleep together anymore. The National Association of Home Builders predicts that [by 2015, up to 60 percent of all upscale homes will have dual master bedrooms](#) and bathrooms.

If you or your partner is a member of the glorious baby-boomer generation like myself, then another thing that could lead to sleep disturbances may be the dreaded—menopause. According to the National Sleep Foundation, generally [post-menopausal women are less satisfied with their sleep](#) and as many as 61% report insomnia symptoms.

In addition, post-menopausal women are likely to experience hot flashes, mood disorders, and sleep-disordered breathing; oh, the joys of being a woman! According to an MSNBC report, a study

published in Sleep and Biological Rhythms reported that women sleep less soundly when they share a bed with a romantic partner and, surprisingly, [men actually sleep better](#) when they sleep next to a mate; unless, of course, your mate snores. The study concluded that generally [women tend to be lighter sleepers](#) because they historically have been the ones caring for infants and their brains have adapted their sleep cycle so they don't sleep as deep in order to hear the cries of an infant.

So, when looking at the AMT's statement above, gender issues may or may not be causing the wife's sleep problems. It could actually be that the AMT snores, which disrupts the wife's sleep, which ultimately disrupts the AMT's sleep. Regardless of who is to blame, couple's sleep disturbance issues are a common problem and should not be taken lightly. We all know that lack of sleep can lead to errors and accidents on the job and reduce the quality of our relationships. The National Sleep Foundation found that more than a third of respondents admitted that their partner's disruptive sleep habits have affected the quality of their [relationship](#). For many, just improving their [sleep habits](#) would solve their sleep problems and it certainly would be less expensive than building a new house with two master suites.

Bottom-line, whatever works best for you and your partner is between you and your partner, but if you feel that sleeping apart is your only resort— not necessarily so. Before resorting to separate beds or bedrooms, identify and attempt to resolve those sleep disturbances by first improving your [sleep habits](#).

Consult your doctor if you or your partner snores and have any of the following [symptoms or signs](#):

- ✦ Excessive daytime sleepiness
- ✦ Morning headaches
- ✦ Recent weight gain
- ✦ Awakenings in the morning not feeling rested
- ✦ Awakening at night feeling confused
- ✦ Change in your level of attention, concentration, or memory
- ✦ [Observed pauses in breathing during sleep](#)



Implementing these suggestions and following the information we have provided on the [MX Fatigue Web site](#) may do the trick in putting quality sleep and romance back into your relationship.

# Early Morning Errors On Routine Tasks

by Alan Hobbs

*About the Author: Alan Hobbs, Ph.D. is a senior research associate with the SJSU Foundation, in the Human Systems Integration Division at NASA Ames Research Center, Moffett Field, CA. He was previously an air safety investigator with the Australian Transport Safety Bureau (ATSB). He conducts research and teaches on the subject of human factors in maintenance, and is co-author with Jim Reason of the book "Managing Maintenance Error".*

Most living things have internal clocks synchronized with the 24-hour day/night cycle. In humans, body temperature, hormone levels, and alertness all vary predictably over the 24-hour day. These rhythms are known as "circadian," Latin for "about a day." Some sleep experts believe that the brain is programmed to repair itself during sleep, and the fatigue most of us feel when awake past midnight is the brain trying to shut down for "scheduled maintenance". In the 1950s, it was discovered that human error also shows a circadian rhythm with a peak at around 3 AM, the time when our body clock is telling us to rest.

## Researchers sometimes sort errors into two basic types:

First, there are slips, lapses and fumbles that typically happen when our attention has been distracted from a monotonous, familiar task. These are often called "**absent minded**" errors. We end up doing something we never meant to, we mess up a simple action, or we leave out a step we intended to carry out. Maintenance examples include: dropping a wrench, forgetting to replace an oil cap, or picking up a can of oil instead of Skydrol from stores.

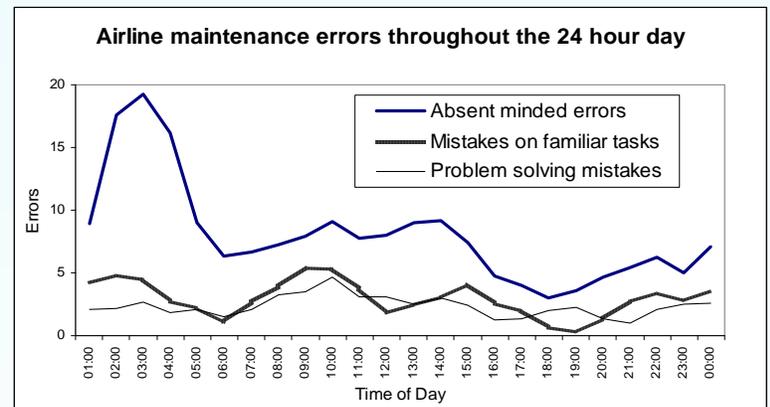
Second there are errors of thinking. These are often called "**mistakes**" to distinguish them from absent minded errors. Some mistakes happen when we have to consciously figure out how to perform a task, and we get it wrong. Perhaps because we lack the necessary expertise, or the task is unfamiliar, or complex troubleshooting is involved.

For example, a technician mis-rigged flight controls because he misunderstood a diagram. Mistakes can also happen on familiar tasks. These mistakes often stem from incorrect assumptions, or a lack of situational awareness. For example, an AMT in the cockpit did not check whether the flap lever was consistent with the position of flaps before starting hydraulics. ...it wasn't, and the flaps began to move.

In a recent study, hundreds of errors reported anonymously by airline maintenance personnel in Australia were examined to see how each type of error varied throughout the 24-hour day. Nearly all the errors were minor and were quickly corrected. Out of several hundred errors, about 60% were absent minded errors on routine or monotonous tasks. The rest were mistakes.

To control for the possibility that the 24-hour pattern of errors might just reflect the number of people working at each hour of the day and night, the number of errors reported at each hour was adjusted to even out any effects of staffing level changes. The results showed that **absent minded errors followed a classic circadian rhythm**, with a peak between 2 and 3 AM. Mistakes did not show any obvious circadian rhythms, but this might have been because there were not enough of them to show a statistically significant pattern.

Every research study comes with cautions. This study does not tell us why the errors occurred. Time of day is just one of many potential causal factors including training, documents, lighting, and fatigue built up over days or weeks. Also, any type of error can happen at



any time, and the results do not mean that nightshift is a good time to perform complex tasks.

Nevertheless, the results are a reminder to be alert to the dangers of fatigue. Everyone involved in maintenance, whether AMTs, inspectors, schedulers, or supervisors, needs to be aware that it gets harder to keep attention focused during the window of circadian low, and this may increase the odds of absent minded errors. Most at risk seem to be routine or monotonous tasks such as re-fitting caps and covers, removing tools, and positioning stands and equipment.

The full report by Alan Hobbs, Ann Williamson, & Hans Van Dongen is in the July 2010 issue of the Journal *Chronobiology International*.

# FATIGUE RISK MANAGEMENT RESOURCES

Fatigue Awareness Posters available for download. Print to your size specifications— as many as you like. [Click here to download High Resolution PDF.](#)



Many fatigue risk management resources are available on the FAA's human factors website. You can access the website at [hfskyway.faa.gov](http://hfskyway.faa.gov) or through an easy link at [mxfatigue.com](http://mxfatigue.com)

