



Applying Fatigue Management Scientific Principles and the Importance of Operational Knowledge

70 YEARS
1945—2015
Flying better. Together.

Science in FTL



...regulations shall be based upon scientific principles and knowledge...



...rules based on scientific knowledge and best practices...



...taking into account the latest scientific and technical evidence...



➤ **NTSB Recommendation:**

“...flight duty limits based on fatigue research, circadian rhythms, and sleep and rest requirements”

➤ **ICAO Definition:**

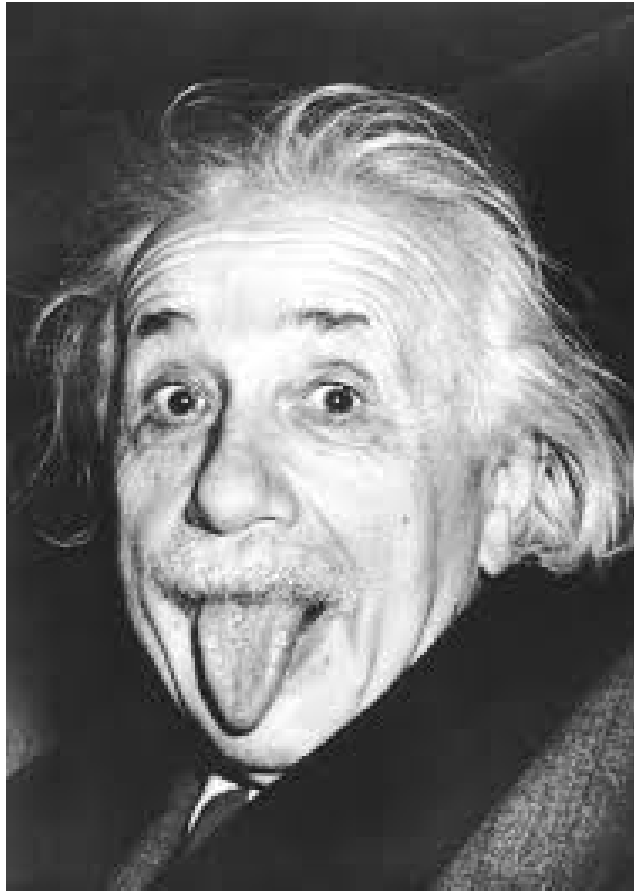
“A data driven means of continuously monitoring and managing fatigue-related safety risk based upon scientific principles and knowledge as well as operational experience”



Federal Aviation Administration

- The underlying philosophy of the rule is that no single element of the rule mitigates the risk of fatigue to an acceptable level; rather, the FAA has adopted a system approach, whereby both the carrier and the pilot accept responsibility for mitigating fatigue. The carrier provides an environment that permits sufficient sleep and recovery periods, and the crewmembers take advantage of that environment. Both parties must meet their respective responsibilities in order to adequately protect the flying public.
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Not Complicated Science



Basic Human Physiology





Scientific Principles

- Getting enough sleep (both quantity and quality) on a regular basis is essential for restoring the brain and body.
- Reducing the amount or the quality of sleep, even for a single night, decreases the ability to function and increases sleepiness the next day.
- The circadian body clock affects the timing and quality of sleep and produces daily highs and lows in performance on various tasks.
- Workload can contribute to an individual's level of fatigue. Low workload may unmask physiological sleepiness while high workload may exceed the capacity of a fatigued individual



Sleep

Sleep is a critical and basic human biological requirement for survival.

Even partial sleep deprivation can lead to serious consequences.

- Most people need between 6 and 10 hours of sleep
- The average adult requires 8 hours
- Regularly sleeping less than 6 hours can reduce performance

Continuous Wakefulness

- Hours of Continuous Wakefulness is another factor related to fatigue
- The longer you go without sleep, the worse your alertness and performance become
- Sleep is the only way to restore alertness





Circadian Factors

Humans are hard-wired to experience two periods of physiological sleepiness each day:

- ↗ 2-6 a.m. (Window of Circadian Low, or WOCL)
- ↗ 2-6 p.m. (Afternoon Nap Window)



Workload

- The nature and amount of work to be done (including time on task, task difficulty and complexity, and work intensity).
 - Time constraints (including whether timing is driven by task demands, external factors, or by the individual).
 - Factors relating to the performance capacity of an individual (for example experience, skill level, effort, sleep history, and circadian phase).
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Operational Knowledge and Experience

- Non-scientific knowledge acquired through conducting specific operations over time
 - Hands-on experience managing fatigue related risk in those specific types of operations
 - Organizational culture
 - likely behaviour and customs in the workforce
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Here is how these principles are used to create regulatory limitations



Flight Time Limitations

- Sleep
- Circadian
- Workload

******Limits Are Hard******

Maximum Flight Time Limits: Unaugmented Flightcrew

<u>Time of Report (Acclimated)</u>	<u>Maximum Flight Time (hours)</u>
0000 – 0459	8:00
0500 – 1959	9:00
2000 – 2359	8:00

- Time Awake

Maximum Flight Time Limits: Augmented Flightcrew
13 Hours: 3 Pilots
17 Hours: 4 Pilots



- Sleep
- Time Awake
- Workload

Flight Duty Period Limits: **Unaugmented Operations**

Scheduled Time of Start (Acclimated Time)	Maximum Flight Duty Period (hours) For Lineholders Based on Number of Flight Segments						
	1	2	3	4	5	6	7+
0000 – 0359	9:00	9:00	9:00	9:00	9:00	9:00	9:00
0400 – 0459	10:00	10:00	10:00	10:00	9:00	9:00	9:00
0500 – 0559	12:00	12:00	12:00	12:00	11:30	11:00	10:30
0600 – 0659	13:00	13:00	12:00	12:00	11:30	11:00	10:30
0700 – 1159	14:00	14:00	13:00	13:00	12:30	12:00	11:30
1200 – 1259	13:00	13:00	13:00	13:00	12:30	12:00	11:30
1300 – 1659	12:00	12:00	12:00	12:00	11:30	11:00	10:30
1700 – 2159	12:00	12:00	11:00	11:00	10:00	9:00	9:00
2200 – 2259	11:00	11:00	10:00	10:00	9:00	9:00	9:00
2300 – 2359	10:00	10:00	10:00	9:00	9:00	9:00	9:00

- Sleep
- Circadian

- Workload
- Operational Knowledge

Flight Duty Period Limits: Augmented Operations

- Sleep
- Circadian

- Sleep
- Time Awake
- Workload

Scheduled Time of Start (Acclimated Time)	Maximum Flight Duty Period FDP (hours) Based on Rest Facility and Number of Pilots					
	Class 1 Rest Facility		Class 2 Rest Facility		Class 3 Rest Facility	
	3 Pilots	4 Pilots	3 Pilots	4 Pilots	3 Pilots	4 Pilots
0000 – 0559	15:00	17:00	14:00	15:30	13:00	13:30
0600 – 0659	16:00	18:30	15:00	16:30	14:00	14:30
0700 – 1259	17:00	19:00	16:30	18:00	15:00	15:30
1300 – 1659	16:00	18:30	15:00	16:30	14:00	14:30
1700 – 2359	15:00	17:00	14:00	15:30	13:00	13:30

- Operational Knowledge
- Sleep
- Wakefulness

1. **“Class 1 rest facility”** means a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the flightcrew member to control light, and provides isolation from noise and disturbance.
2. **“Class 2 rest facility”** means a seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or flightcrew members.
3. **“Class 3 rest facility”** means a seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.



Rest

- Sleep

- Sleep
- Workload

- 10 Hours (non-reducible) with an 8 hour uninterrupted sleep opportunity
- 30 consecutive hours free from all duty in any 168 consecutive hour period
- More than 60 degrees travel while away from base for 168 hours or greater
- 56 consecutive hours upon return to base to include 3 physiological nights (2200 - 0700)

- Circadian
- Sleep
- Operational Knowledge

Cumulative Limitations

➤ Flight Time Limitations:

- 1000 block hours in any 365 consecutive calendar day period
- 100 block hours in any 672 consecutive hours (28 days)

➤ Flight Duty Period Limitations:

- 60 FDP hours in any 168 consecutive hours (7 days)
- 190 FDP hours in any 672 consecutive hours

- Sleep
- Circadian
- Workload
- Operational Knowledge



Thank you for your attention