Extended Flight Duty Periods and Flight Safety

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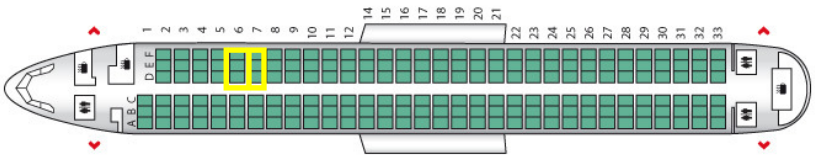
TNO Onboard Crew Rest Study – July 2008

Extended duties: base-to-base flight schedules – 3 legs

average FDP 14:00 hr

1 pilot augmented



B 737-800

Principle

- When max. permissible FDPs are extended, alertness and vigilance may reach unacceptably low levels.

- Extended FDPs require crew augmentation with in-flight relief in order to reduce the negative effects of extended time-on-task on alertness and vigilance to acceptable levels.
  (e.g. levels found at TOD during permissible FDPs).

TNO-DV 2007 C362: Extension of flying duty by in-flight relief (Simons & Spencer, 2007)

Aim of the Study

- Assess quality and effects of the in-flight rest on fatigue and alertness on extended-FDP trips

- Enable a scientifically based advice concerning flight safety

Method

- Flight crew participation: 40
- Pilots scheduled on one extended-FDP duty in their normal 3-4 days duty roster. Test sessions: during one complete duty roster and related days off
- Test sessions: after wake up, pre-duty, before and after in-flight rest period, at TOD, and after reporting off duty

Method

- ✓Actiwatch
- ✓Vigilance and Track Task
- ✓Questionnaires/rating scales

7-point Samn-Perelli Fatigue Scale (SP7)

Rate	Verbal descriptions
1	fully alert, wide awake
2	very lively, responsive but not at peak
3	okay, somewhat fresh
4	a little tired, less than fresh
5	moderately tired, let down
6	extremely tired, very difficult to concentrate
7	completely exhausted, unable to function effectively

The Karolinska Sleepiness Scale-KSS 9 ratings

Rate	Verbal descriptions
1	extremely alert
2	very alert
3	alert
4	rather alert
5	neither alert nor sleepy
6	some signs of sleepiness
7	sleepy, but no effort to keep alert
8	sleepy, some effort to keep alert
9	very sleepy, great effort to keep alert, fighting sleep

Results

Data sets of 36 pilots: 33 male, 3 female; 21 captains and 15 FOs

- Regular duties: mean FDP 9:43 hr (range 3:30-13:40)

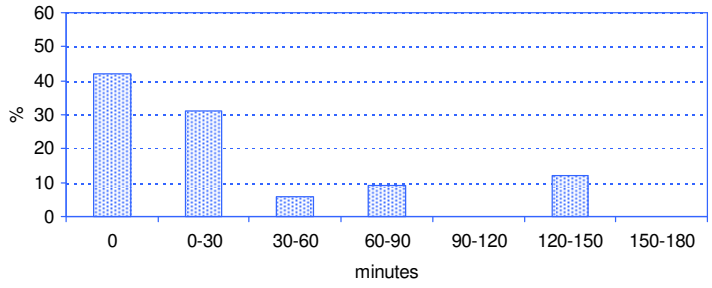
- Extended-FDP duties: mean FDP 13:58 hr (range 12:45-15:55)

  - start between 11:20-15:00 h
  - end between 01:35-06:15 h

Results: Pre-Duty sleep

	GSQS	bedtime	Wake up time	TST subjective
Day off	3.1 (0-12)	01:49 (22:15-07:00)	09:29 (05:00-14:00)	7:17 (2:00-11:00)
Regular Duty	3.7 (0-12)	00:06 (19:00-04:30)	07:40 (01:00-12:15)	6:50 (2:00-10:00)
Extended Duty	2.5 (0-12)	00:42 (21:00-04:00)	08:40 (02:50-11:35)	7:41 (03:20-11:40)

Results: In-flight sleep



- Mean period available for sleep: 135 min
- Pilots, who slept longer, had lower fatigue and sleepiness levels and better vigilance performance at TOD

Results: In-flight sleep

- 42% of the pilots did not sleep at all
- Sleep efficiency (16-37%) was much lower than found in literature of in-flight rest (50-70%)
- Reported sleep disturbing factors:
  - rest facility not comfortable*
  - insufficient ventilation
  - light, noise, surrounding pax
  - lack of privacy in relation to pax

  } Facility conditions not conducive to sleep

- some pilots: rest period during circadian activity phase

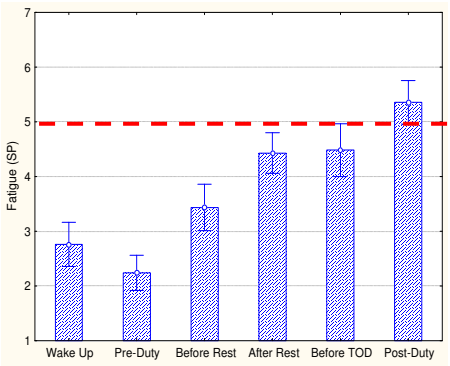
Results: In-flight sleep

*Discomfort issues reported:

- lack of back and neck support
- sticking out of seat belt attachments
- insufficiently reclining arm rests
- cushions too thin

Results: Fatigue & Sleepiness during FDP

Fatigue



Completely exhausted, unable to function effectively

Extremely tired, very difficult to concentrate

Moderately tired, let down

A little tired, less than fresh

Okay, somewhat fresh

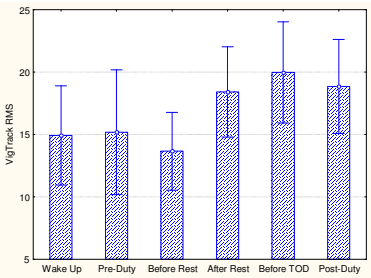
Very lively, responsive but not at peak

Fully alert, wide awake

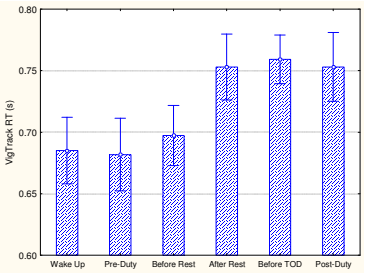
SP level 5 categorised as “Fatigue Class II”, described as ‘Moderate to severe fatigue. Some performance impairment probably occurring. Flying duty permissible but not recommended.’

Results: Vigilance during FDP

Tracking



Reaction Time



At TOD: 32% increase of tracking error compared with pre-duty

11% increase of reaction time compared with pre-duty

Results: Fatigue, Sleepiness, Vigilance during FDP

- Pre-duty fatigue, sleepiness, and vigilance levels equal in regular and extended-FDP duties
- Extended-FDP: significant impairment in rest period
- Longer FDP on extended duties: higher fatigue and sleepiness levels and more vigilance impairment at TOD
- Extended-FDP: circadian phase affected sleepiness levels at TOD and End duty.
- Circadian effects on sleepiness will increase when pilots have no recuperative in-flight sleep.

Conclusions (1)

- Extended-FDPs: no reduction of negative effects of long time-on-task and working during circadian sleep phase.
- Large increases in sleepiness, fatigue, and impairment of vigilance performance related to:
  - long time-on-task
  - non-recuperative in-flight rest
  - flying during the circadian sleep phase

Conclusions (2)

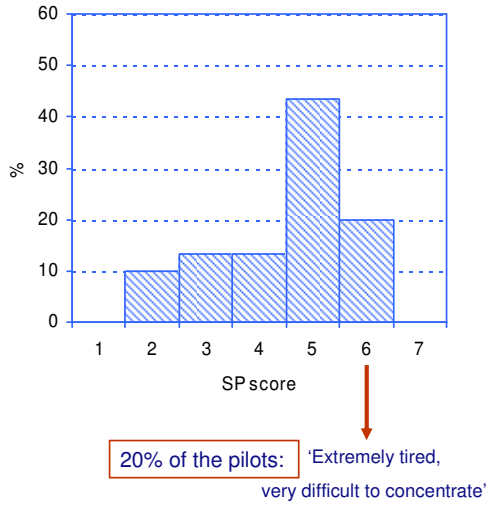
- Conditions of crew rest facility are not conducive to sleep
- Present in-flight rest is not effective:
  - Rest, or sleep, in rest facility not recuperative
  - No benefit for vigilance, fatigue and sleepiness

Conclusions (3)

TOD:

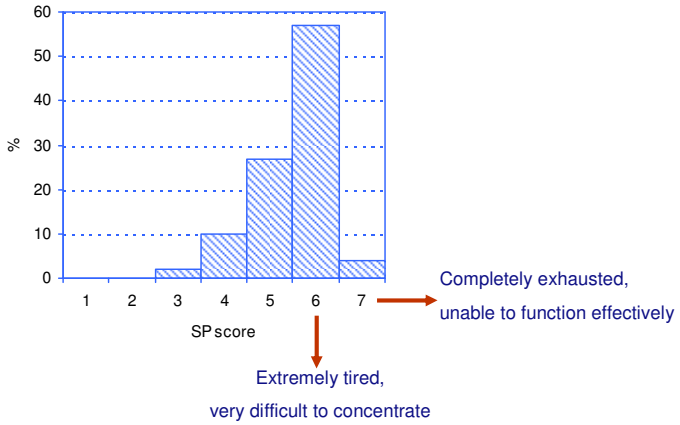
- Impairment of alertness at TOD did not exceed limits associated with unacceptable increase of flight safety risk
- Vigilance indicators come close to the safety limits
- Safe flight performance may be at risk in a subgroup of pilots

Frequency distribution of fatigue scores at TOD



Post Duty:

61% of pilots should take a taxi home or sleep in airport hotel



Recommendations (1)

- Improve efficacy of in-flight rest :

✓ Better separation from passengers

✓ Adapted seats allowing comfortable horizontal sleeping surface

✓ More space around the seat(s) or berth

✓ Noise, Light, Climate control

✓ Use noise & light reducing devices

Recommendations (2)

- Optimize alertness during an extended FDP :

✓ Promote optimal use of rest facility

✓ Promote sufficient pre-duty sleep at home

✓ Combat sleep inertia by resuming flight tasks 15-20 min after rest

✓ Promote post duty opportunities provided:

- Take a taxi, or stay in an airport hotel

Recommendations (3)

- If no feasible solution can be found to realize recuperative in-flight sleep: reschedule present extended operations and provide crew with sufficient sleep at slipping station before the return flight

- Implement a Fatigue Risk Management System (FRMS) to better match operational needs and fatigue-related flight safety considerations