



GUIDELINES ON FATIGUE MANAGEMENT IN ATC ROSTERING SYSTEMS





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1. INTRODUCTION

The rules to manage fatigue can be interpreted differently. To improve fatigue management, there is a need for standards and recommendations, which are embedded in the safety management and rostering systems.

This document aims to facilitate and support the implementation of the fatigue operational requirements in the Air Traffic Control (ATC) environment. A literature review was undertaken on the shift work fatigue prescriptive limits according to European Commission (EU) Regulation 2017/373, guidance based on scientific principles and guidelines from recognised sources e.g.:

- Scientific literature review;
- European Union (EU) working time directive (2003/88/EC);
- International Civil Aviation Organisation (ICAO) manual for professional career of Air Traffic Controller (ATCO) and Doc 9966;
- ICAO Eastern and Southern African (*ESAF*) recommendation on rostering;
- EUROCONTROL rostering best practices;
- EUROCONTROL fatigue guide;
- CANSO Human Performance Standards of Excellence;
- EMSA (European Maritime Safety Agency) and IMO – International Maritime Organisation related fatigue documents;
- ERA – European Union Agency for Railways related fatigue documents;

The following paragraphs describe the key requirements from these regulations and standards together with suggestions on how the eight shift-work fatigue prescriptive limits can be applied.

It is planned that this document will be integrated into the main deliverables from the Operational Excellence Programme Topic - Work Stream 06 Human Resources - on **Enhanced Rostering Practices**, which will consider other aspects of the rostering system. Namely, the Topic will also address other aspects of the rostering systems leading up to better human resources HR planning in function of increasing the performance and productivity of an ANSP organization.

This document is a guideline derived from scientific studies on mostly busy en-route ATC centres. In most cases, the guidelines will be applicable to less busy ATC units. However, when considering deviating from recommended figures for fatigue elements in this document, it is recommended to perform safety and human factors assessments.

The overall effectiveness of a rostering system in managing risks from occupational fatigue stems from a balanced variety of elements, complementing each other. While any of the eight parameters of EU373/2017 sets a limit of its own, together they are designed as a system. Thus, certain elements may compensate for others.

The guidelines in this document shall not be applied in isolation by looking only at fatigue elements of an ATM roster. Rather, they should be applied as a whole.

When implementing (or expanding) a fatigue risk management system (FRMS) at ANSP level, this document could be considered useful guideline for other categories of staff that perform shift work, such as ATSEP, MET, AIS, Flow, etc..

2. SCIENTIFIC BASIS FATIGUE AND SHIFTWORK

Fatigue is a consequence of many factors of the working organisation and environment (Della Rocco & Nesthus 2005; FAA 2009, 2016; Gawron, et al 2011; Rudin-Brown & Filtness, 2022) such as:

- working times, time of day;
- duty length;
- shift sequence;
- shift rotation and shift change;
- workload;
- stress;
- stability and predictability of rosters; and
- resting time, number of breaks, and how working time is arranged over months (i.e. shift schedules).

These factors on fatigue have a consequence on safety (Fletcher, et al, 2003), human performance (Dawson & McCulloch, 2005) well-being and health. This has been widely described in research literature (Tucker and Folkard, 2012; Reinberg, et al, 2015).

Organisational factors (Gander, et al, 2011) impact fatigue in the workplace and justify a holistic approach towards fatigue management (Drogoul, et al, 2017). Rostering in ATM should consider the: organisation of duty cycles (i.e. sequences of duties) and planning breaks within the duties (Cabon, et al, 2011, Dall'Ora, et al, 2016, Terenzi, et al, 2022). Several studies have found that shifts of 12 h or longer are associated with potential safety hazards.

In addition, a good roosting system should be able to adjust to an unexpected situation, last minute changes, specific local situations and crises (Drogoul & Cabon, 2021).

A multidimensional approach encompassing individual (personal factors and strategies), work (workload, complexity, uncertainty and environmental issues), and organisational levels (roosting, staffing, management support, special needs) was deemed necessary, in order to deliver sound and workable recommendations on how best to manage fatigue within a safety-critical activity such as air traffic control (Drogoul, et al, 2021, Peukert & Meyer, 2022).

The following are the main findings from scientific research:

- **Night Work:** Working at night is not natural for humans, should be limited to the minimum and not be repeated too often. Night shifts are common in ATC (EUROCONTROL 2018, ICAO 2016).
- **Shift Type Mixture:** Mixing the type of shifts (morning, day, afternoon, night) is recommended to mitigate fatigue (Terenzi, et al, 2022).
- **Early Morning shifts:** The negative effects of repeated early morning shifts (starting between 5 and 7) such as sleep deprivation and sleepiness can be as severe as the impact of night shift. (Akerstedt et al., 2004; Monk et al., 1996; Tucker et al, 1998).
- **Forward rotating shift and shift length:** Forward rotating shifts (delaying the start of the shift by at least one hour per day) and 8 hours shifts versus 12 hours shifts are associated with a lower sleep debt. (Monk, Folkard, Wedderburn, 1996).
- **Fast rotations:** Fast rotations (targeting a change from one type of shift to a different one every day with a maximum of two repetitions) limit the exposure to night work and may prevent cumulative effects. (Vetter, Fischer, Matera, Roenneberg, 2015). An example of fast forward rotation for morning, afternoon, night, rest, and off is – MANROOMANROO. An example of forward only rotation could be MMAANROO.

In break planning at night, organisations should not only favour sleep length, but also consider the negative impact of sleep inertia while returning to operation, boredom and sleepiness during windows of circadian low (WOCL) and low workload periods (Wertz et al, 2006; EUROCONTROL, 2006).

3. REGULATION REQUIREMENTS & OTHER RECOGNISED AUTHORITIES

3.1 Introduction

In designing any shift-work practices or schedules, a review of the regulatory requirements and the legal framework that should be applied is required. This underpins the constraints that the shift schedules need to operate. It is necessary to understand and have an interpretation on:

- What EU legislation (regulations and directives) should be applied?
- Are these regulations directly applicable or are directives that are planned to be transposed into national regulation?
- What national regulation and working agreements need to be considered?

In the case of EU regulations, the following regulation needs to be considered:

- EU working time directive 2003 (2003/88/EC) European Commission (EC) Implementing Regulation EU 2017/373

Other international standards especially in the non-EU context are:

- EUROCONTROL Shift work Practices Study (2006);
- ICAO manual for professional career of ATCO (2001);
- ICAO and IFATCA Fatigue Management Guide for Air Traffic Service Providers (2016)¹;
- ICAO doc 9966;
- ICAO *ESAF* recommendation on rostering²;
- The International Labour Organisation (ILO) recommendation;
- CANSO standard of excellence in Human Performance Management (2019)³;
- IMO Guidelines on Fatigue 24 January 2019.

It is important to clarify the history of the evolution of these regulations. In Europe, a milestone on fatigue, occupational health and safety in shift roster design was the adoption of EU Working Time Directive (2003). This was followed later with specific sector (aviation) regulations (EU 2017/373). While the Directive itself allows for derogations in the case of activities involving the need for continuity of service and in the case of shift work activities, or as by means of collective agreements, it sets the improvement of workers' safety, hygiene and health at work as an objective that should not be subordinated to purely economic considerations.

Although EU 2017/373 outlines the specific laws pertaining to the implementation of a Fatigue Risk Management system, they do not specify the exact rostering criteria. EU 2017/373 recommends implementing the ICAO Manual 9966 Annex D guidelines for ATM rostering. However, these guidelines are only intended to guide ANSPs and are not auditable. Each EU State has additional requirements pertaining to specific national employment and occupational health and safety laws.

¹ <https://www.unitingaviation.com/publications/FM-Guide-Air-Traffic-SP/>

² <https://www.icao.int/ESAF/Documents/meetings/2016/Air%20Traffic%20Services%20System%20Capacity%202016/ATNS-Guidelines%20to%20reduce%20fatigue%20in%20operational%20environment.pdf>

³ https://canso.fra1.digitaloceanspaces.com/uploads/2021/04/canso_standard_of_excellence_in_human_performance_management.pdf

For this reason, these EUROCONTROL guidelines are developed to provide an amalgamation of up-to-date science and allowance for these National laws so that ANSPs can implement safe parameters for rostering and fatigue management.

3.2 EU Working Time Directive 2003

The EU Working Time Directive 2003 (2003/88/EC) is intended to protect public and private sector workers from the health and safety risks associated with excessive or inappropriate working hours. It requires EU countries to guarantee the following rights for all workers:

- **Weekly working hours:** A limit to weekly working hours, which must not exceed 48 hours on average, including any overtime and a minimum daily rest period of 11 consecutive hours in every 24 hours.
- **Rest breaks:** Gives rights to daily and weekly rest breaks and the right to a rest break during working time.
- **Annual Leave:** Paid annual leave of at least four weeks per year.
- **Night work:** Extra protections for night workers such as:
 - Length of night work should not exceed an average of eight hours in any 24-hour period;
 - Night workers whose work involves special hazards or heavy physical or mental strain do not work more than eight hours in any period of 24 hours during which they perform night work.
- **On Call:** The interpretation of the working time directive was clarified through a number of rulings in the European Court of Justice. The “SIMAP and Jaeger” judgement indicates that any time in which a worker is 'on call' at home or in the workplace and is ready to provide services, is counted as working time regardless of whether the worker is providing active services during that time.

3.3 Regulation (EU) 2017/373

Requirement **ATS.OR.320** states that “Any air traffic control service provider shall develop, implement and monitor a rostering system in order to manage the risks of occupational fatigue of air traffic controllers through a safe alternation of duty and rest periods. Within the rostering system, the air traffic control service provider shall specify **eight** elements for shift work fatigue prescriptive limits:

1. maximum consecutive working days with duty;
2. maximum hours per duty period;
3. maximum time providing air traffic control service without breaks;
4. the ratio of duty periods to breaks when providing air traffic control service;
5. minimum rest periods;
6. maximum consecutive duty periods encroaching the night-time, if applicable depending upon the operating hours of the air traffic control unit concerned;
7. minimum rest period after a duty period encroaching the night-time⁴; and
8. minimum number of rest periods within a roster cycle.

Rostering within the limits of these 8 factors, is considered a **prescriptive approach** and provides the constraints to build a rostering system.

The selection and regular revision of an appropriate structure and of appropriate values of the rostering system, in accordance with ATS.OR.320(a) and which fit the intended operations, should be based upon:

- (1) scientific principles;
- (2) data gathered by the air traffic control service provider; and

⁴ Night-time is defined according with 9966 ICAO doc as the period 18.00-06.00

(3) best practices.

- It is necessary to consider the **scientific evidence** when developing an effective rostering system to prevent fatigue
- **Training** should be provided on scientific principles affecting fatigue and sleep science to support the development and implementation of a rostering system and staff consultation.

Another important part of the ATS.OR.320 is that *“air traffic control services provider shall **consult** those air traffic controllers who will be subject to the rostering system, or, as applicable, their representatives, during its development and its application”*.

- **Individual Preferences and Fatigue**
Controllers working a statutory number of hours may prefer longer shifts in order to have longer continuous periods away from work, and rostering that results in several consecutive days off duty at regular intervals is often highly prized. This practice **must not** be achieved at the expense of unacceptable fatigue risk.

3.4 ICAO Guidelines

The ICAO Manual for Professional career for Air Traffic Controllers Guide‘ 2001’, recommended the following working conditions for ATCO doing shift duty:

- Work shift cycles should be based on having at least 2 consecutive days free per week (‘week’ here is understood as a 7-day period not necessarily Mon- Sun);
- Work shifts that include night work should have a morning, afternoon, and night rotation system (forward rotation);
- Consecutive night shifts are not recommended;
- Shift systems should not include night work on the same day a morning shift ends;
- At least 30 hours of rest are recommended after working a night shift;
- With alternate shifts, there should be no more than 3 consecutive morning shifts per week.
- Operational time and its resting periods should not exceed 32 hours a week. (i.e. the Weekly average is derived from total yearly amount);
- Each daytime shift or shift of intense activity should not exceed 8 hours including rest period;
- At least 12 consecutive hours of rest should be provided for between shifts;
- Operational controllers should spend no more than 2 consecutive hours at work (i.e. in position) and this period should be reduced to 90 minutes for controllers working in a radar environment. This operational time can be reduced according to the amount of traffic being handled;
- Controllers should have at least 1 hour for meals in the morning and evening shifts and 40 minutes in the case of shifts of less than 8 hours;
- Controllers working night shifts should have at least 1 hour of rest.

Doc 9966 mentions the following typical values:

- The duty period may not exceed 12 hours;
- The aggregate of duty period hours may not exceed 200 hours within a defined period of 720 consecutive hours or 30 consecutive days;
- There must be at least 12 hours between the end of one duty period and the beginning of the next;
- No more than 6 consecutive days of duty shall be worked;
- If the maximum number of consecutive days of duty is rostered, there shall be a minimum interval of 60 hours between the end of one consecutive period of duty days and the next;
- No period of operational duty shall exceed 2 hours;
- No operational duty shall exceed 2 hours without there being a break taken during or at the end of that period;
- A break should total not less than 30 minutes;

- A duty which covers all or part of the period of night duty shall not exceed 10 hours;
- No more than 3 consecutive duties shall be worked which cover all or part of the period of night duty;
- A minimum period of 54 hours shall occur between the end of duties which cover all or part of the period of night duty and the commencement of the next period of duty;
- No more than 3 on-call duties shall be worked in a 7-day period;
- The maximum length of on call period of duty where the ATCO does not attend the place of work shall be 20 hours.

ICAO Eastern and Southern African Office (ESAF) (2016) proposed the following rostering guidelines and reminded States that these limits shall not exceed other applicable legal obligations with regard to working time limitations:

- **Maximum hours per duty period should not exceed 8 hours:** “It should not exceed 12 hours, provided that the extension is validated by a safety risk assessment”.
- **Maximum consecutive working days with duties:** “Recommended consecutive working days should not exceed 5 days”.
- **Fixed forward rotation:** Where applicable, fixed forward rotating roster principles should be applied, e.g., morning shifts, followed by afternoon shifts, ending with night shifts and off days.
- **Maximum consecutive ATCO duty periods encroaching Windows of Circadian Low (WOCL):** “The number of consecutive early morning shifts shall not exceed two. In such cases, it shall be ensured that the minimum rest period thereafter it is 24 hours before commencement of the next shift. This is applicable to shifts encroaching the WOCL starting before 7am”.
- **Minimum rest period:** “The average rest period after a duty period should be 11 hours in order to allow for adequate time that includes rest, sleep, meals, preparing for sleep and life admin”.
- **The ratio of duty periods to breaks:** “Breaks within a duty period should be planned according to workload, complexity of ATC provision, time of the day, type of rostering system. The minimum duration of a break should be 30 minutes”.
- **Maximum time providing ATC service without breaks:** “The maximum time providing an ATC service should be 2 hours for personnel providing ATC service working with visual terminals and/or radar displays. Intervals can be reviewed periodically or when an increase in traffic load was experienced. ATSU’s experiencing low traffic loads for prolonged periods of time may extend shift sessions to 3 hours”.
- **Night duty:** “Maximum consecutive ATCO duty periods encroaching the WOCL, such as night shifts, should not exceed 2, provided that they are followed by at least a 48-hour rest period by the end of the second ATCO duty period encroaching the WOCL. Upon the conclusion of a period of night duty, any ATC personnel shall be rostered a day off”.
- **Late PM shift followed by an early AM shift:** “Rostering an individual for a late afternoon shift followed by an early morning shift should be avoided where possible or be limited to a single occasion per individual per cycle”.
- **Off days in a cycle:** “Operational staff shall be rostered for a minimum 2 sets of 2 or more consecutive days off per cycle. Where possible, 3 sets of 2 consecutive days off per cycle is recommended”.

Note: The following table comprises of the most relevant existing regulations and recommendations. It can be read from left to right. The first column is the existing EU regulations followed by the recommended parameters. The other three columns indicate historical or other recommendations that are linked or informative for comparison.

Mapping of Existing relevant legislation and guidelines				
Current Corresponding EU 2017/373 Requirement - rosters shall be measurable on the following:	ICAO 9966 Annex D: recommended parameters	ICAO Manual for Professional career for Air Traffic Controllers Guide:	ICAO ESAF	UK CAA Guidance (SRATCOH)
Maximum number of hours per duty	The duty period may not exceed 12 hours.	Each daytime shift or shift of intense activity should not exceed 8 hours including rest period.	Maximum hours per duty period should not exceed 8 hours: It shall not exceed 12 hours, provided that the extension is validated by a safety risk assessment.	Except as indicated in b) and (c) below the maximum hours per duty period should not exceed 10 hours
Maximum hours work per week (Mon-Sun)	The aggregate of duty period hours may not exceed 200 hours within a defined period of 720 consecutive hours or 30 consecutive days.	Work shift cycles should be based on having at least 2 consecutive days free per week.	Where applicable, fixed forward rotating roster principles should be applied, e.g., morning shifts, followed by afternoon shifts, ending with night shifts and off days.	The maximum number of consecutive working days with duty should not exceed either 6 days or consecutive periods of duty totalling 50 hours within 6 days, whichever is achieved earlier.
	There must be at least 12 hours between the end of one duty period and the beginning of the next.	Work shifts that include night work should have a morning, afternoon, and night rotation system (forward rotation).		
Maximum consecutive day shifts	No more than 6 consecutive days of duty shall be worked.		Maximum consecutive working days with duties: Recommended consecutive working days should not exceed 5 days.	The maximum number of consecutive 'morning' duty periods should not exceed 5 days.

<p>Maximum consecutive shifts including nights</p>	<p>If the maximum number of consecutive days of duty is rostered, there shall be a minimum interval of 60 hours between the end of one consecutive period of duty days and the next.</p>	<p>Shift systems should not include night work on the same day a morning shift ends.</p>	<p>Minimum rest period: The average rest period after a duty period should be 11 hours in order to allow for adequate time that includes rest, sleep, meals, preparing for sleep and life admin.</p>	<p>Not more than 2 ‘early starts’ should be worked in a period of 144 hours (6 days). AND, Consecutive ‘early start’ duties should not be permitted where both duties commence before 0600. AND, In determining the maximum number of consecutive ‘morning’ duty periods, ‘early start’ duty periods should be counted, and those commencing before 0600 should count double.</p>
		<p>Consecutive night shifts are not recommended.</p>	<p>Night duty: Maximum consecutive ATCO duty periods encroaching the WOCL, such as night shifts, should not exceed 2, provided that they are followed by at least a 48-hour rest period by the end of the second ATCO duty period encroaching the WOCL. Upon the conclusion of a period of night duty, any ATC personnel shall be rostered a day off.</p>	
<p>Normal provision of air traffic</p>	<p>No period of operational duty shall exceed 2 hours.</p>	<p>Operational controllers should spend no more than 2 consecutive hours at work (i.e. in position) and this period should be reduced to 90 minutes for controllers working in a radar environment. This operational time can be reduced according to the amount of traffic being handled.</p>	<p>Maximum time providing ATC service without breaks: The maximum time providing ATC service should be 2 hours for personnel providing ATC service working with visual terminals and/or radar displays. Intervals can be reviewed periodically or when an increase in traffic load was experienced. ATSUs</p>	<p>The maximum time providing ATC service without a break should not exceed 2 hours.</p>

			<p>experiencing low traffic loads for prolonged periods of time may extend shift sessions to 3 hours.</p>	
<p>Maximum duration of provision of air traffic control services without a break / no period of duty shall exceed</p>	<p>No operational duty shall exceed 2 hours without there being a break taken during or at the end of that period.</p>	<p>Controllers working night shifts should have at least 1 hour of rest</p>		<p>Notwithstanding point (a), at units where workload for any part of the day is judged to be low and the activity is spasmodic rather than continuous, the maximum time providing ATC service without a break, at these times, should not exceed 4 hours. AND, notwithstanding points (a) and (b), for a controller on an 'early start duty' (see AMC1 .45 Duty period) commencing before 0600, all operational duty periods shall be limited to 1.5 hours. For a controller on an 'early start duty' commencing at or after 0600, the first operational duty period shall be limited to 1.5 hours.</p>

<p>Ratio between duty periods and breaks in the provision of air traffic control services</p>	<p>A break should total not less than 30 minutes.</p>	<p>Controllers should have at least 1 hour for meals in the morning and evening shifts and 40 minutes in the case of shifts of less than 8 hours.</p>	<p>The ratio of duty periods to breaks: Breaks within a duty period should be planned according to workload, complexity of ATC provision, time of the day, type of rostering system. The minimum duration of a break should be 30 minutes.</p>	<p>The ratio of operational duty periods to breaks should be 1:4; for example, 15 minutes break for 1 hour operational duty period</p>
<p>Maximum number of hours per night duty</p>	<p>A duty which covers all or part of the period of night duty shall not exceed 10 hours.</p>			<p>The maximum time providing ATC service without a break should not exceed 2 hours.</p>
<p>Maximum number of consecutive duty periods extending into the night, if required by the operating hours of the ATC unit concerned.</p>	<p>No more than 3 consecutive duties shall be worked which cover all or part of the period of night duty.</p>	<p>With alternate shifts, there should be no more than 3 consecutive morning shifts per week.</p>	<p>Maximum consecutive ATCO duty periods encroaching Windows of Circadian Low (WOCL): The number of consecutive early morning shifts shall not exceed two. In such cases, it shall be ensured that the minimum rest period thereafter it is 24 hours before commencement of the next shift. This is applicable to shifts encroaching the WOCL starting before 7am.</p>	<p>(c) The maximum hours for a 'morning' duty period should not exceed 8 ½ hours.</p>
<p>Minimum duration of the rest period following a duty period extending into the night</p>	<p>A minimum period of 54 hours shall occur between the end of duties which cover all or part of the period of night duty and the commencement of the next period of duty.</p>	<p>At least 30 hours of rest are recommended after working a night shift.</p>	<p>Night duty: Maximum consecutive ATCO duty periods encroaching the WOCL, such as night shifts, should not exceed 2, provided that they are followed by at least a 48-hour rest period by the end of the second ATCO duty period encroaching the WOCL. Upon the conclusion of a period of night duty, any ATC personnel shall be rostered a day off.</p>	<p>(d) Within 720 consecutive hours (30 days) the aggregate of periods of duty should not exceed 300 hours, provided that periods of duty (excluding on call duty) do not exceed 200 hours.</p>

	<p>No more than 3 on-call duties shall be worked in a 7-day period.</p>	<p>Operational time and its resting periods should not exceed 32 hours a week . (i.e. the Weekly average is derived from total yearly amount)</p>	<p>Off days in a cycle: Operational staff shall be rostered for a minimum 2 sets of 2 or more consecutive days off per cycle. Where possible, 3 sets of 2 consecutive days off per cycle is recommended.</p>	
	<p>The maximum length of on call period of duty where the ATCO does not attend the place of work shall be 20 hours.</p>	<p>At least 12 consecutive hours of rest should be provided for between shifts.</p>	<p>Late PM shift followed by an early AM shift: Rostering an individual for a late afternoon shift followed by an early morning shift should be avoided where possible or alternatively be limited to a single occasion per individual per cycle.</p>	

3.5 The International Labour Organisation (ILO)

The ILO recommends that “the maximum hours of attendance at the place of work per week by ATCOs should normally be less than the generally accepted number of attendance per week completed by other workers in civil aviation in the state concerned.”

3.6 EUROCONTROL References

The EUROCONTROL Shift-work Practices Study (2006) is the document highlighted as guidance material related to the Regulation (EU) 2017/373 requirements. This study highlighted the following:

- **Shift solution** – three important elements
 - forward rotation;
 - need for extended free time after night shift;
 - reduction in the number of successive nights.
- **Efficiency:** Research indicates that there is a growing trend towards individual rostering in staff planning and allocation.
- **ATCO Involvement:** The involvement of ATCOs in the definition of rostering systems is described.
- **Minimum of Consecutive Days:** Operational staff shall be rostered for a minimum 2 sets of 2 or more consecutive days off per cycle. Where possible, 3 sets of 2 consecutive days off per cycle is recommended.
- **Free time:** Minimum 2 free evenings/week.

4. PROPOSED SHIFT WORK FATIGUE PRESCRIPTIVE LIMITS

This chapter provides a set of recommendations for each of the 8 shift-work fatigue prescriptive limits indicated in (EU) 2017/373 based on the review of the regulation requirements and standards outlined in chapters 2 and 3. It is important to state that these recommendations are cumulative and non-exclusive. Those limits can be extended or reduced in the case of local or organisational circumstances but as described in FRMS approach, those derogations to the current scientific or good practice limits should be demonstrated by data and local assessments.

4.1 Maximum consecutive working days with duty

The standard should be either:

- 5 days or fewer duties there are no extra constraints on the number of rest days;
- **or** a maximum 6 consecutive duty days (without off days), allowing 54 hours of rest (2 consecutive nights and no duty starting early morning).

The recommendations:

- take into account the need for regular nights without constraint and the need to socialise and rest at the same ratio of days at work and days off as other workers;
- should not be averaged over the year. In the case of seasonal traffic, having 3 days off every 4 days in winter and autumn does not justify one day off every 10 days for the summer.

For example: up to 4 consecutive days allow 30 hrs., after 5/6 days allow 54 hrs.

4.2 Maximum hours per duty period

- The maximum hours per duty period should not exceed 8 hours. From fatigue perspective only ops time is counted. Normal office hours should be done according with national laws. It is recommended, that non-ops duties are included as an intrinsic part of rosters. One method of achieving this is pre-assigning non-ops duties into the yearly average for an operator (see section 5.4 Non-Ops duties and 5.7 Mandatory Training) and then use the remaining days for Ops duties while respecting fatigue guidelines.
- If the maximum hours per duty period exceeds 8 hours, it should be validated by a safety risk assessment and the length of a duty period should never exceed 12 hours.
- The safety risk assessment in this case needs to demonstrate that increased working time over 8 hours does not increase fatigue risk (i.e. demonstration of low exposure due to low workload or effective mitigation in place). The use of tools such as 'complexity' monitoring or the use of operational risk matrices are advised for objective calculation of safety impact.
- ANSPs publish annual, monthly or shift cycles maximum overtime based on various national regulations or labour conditions. These guidelines suggest that the maximum allowed overtime may be self-regulated provided the fatigue guidelines are respected and if they are spread evenly in time across the workforce, i.e., ATCOs irrespective of the age are doing a similar amount of overtime across similar shifts (morning, afternoon or night). In principle, operational staff may use as much overtime as is needed to ensure rosters and performance can be maintained. However, it is the intention of these guidelines that any overtime used does not exceed the prescribed fatigue limitations.

The following is an example of an 8 hour forward rotation shifts. Other combinations are also possible and practised.

MORNING	06:30-14:30	07:15-15:15	08:00-16:00
AFTERNOON	11:00-19:00	11:45-19:45	12:30-20:30
LATE AFTERNOON	14:00-22:00	14:45-22:45	15:30-23:30
NIGHT		23:00-07:00	

The above sample indicates a roster with 4 rotations – Morning, Afternoon, Late Afternoon and Night where a staggering approach is foreseen for 3 of the rotations i.e. Morning, Afternoon and Late Afternoon. Using staggering the Organisation will bring gradually staff into the shift at different intervals based on the Sector Opening Times. In the above example:

- for the Morning shift the first bunch of staff arrives at 06.30 to change the Night shift, followed by 2 staggered arrivals at 45 min intervals 07.15 and 08.00.
- Similarly for the -Afternoon and Late Afternoon the staggered approaches will bring overlaps to ensure relief or re-enforcement of staff complement in the shift to serve best performance, manage fatigue and wellbeing and reduce delay.

	MORNING	AFTERNOON	LATE AFTERNOON	NIGHT
NUMBER OF SHIFTS	4	4	4	4
PERIODS	10X45MIN	10X45MIN	10X45MIN	10X45MIN
WORKING TIME	7X45 MIN	7X45MIN	7X45MIN	5X45MIN
TOTAL OF SHIFT	5HRS15MIN	5HRS15MIN	5HRS15MIN	3HRS45MIN
%	70,00%	70,00%	70,00%	50%
WITH ARR/BRF	65.6%	65.6%	65.6%	46.8%
% INCLUDING ARR/BRF	72%	72%	72%	53%
TOTAL OF SHIFT PER 32 DAYS	21 HRS	21 HRS	21 HRS	15HRS
TOTAL EVERY 32 DAYS	78/120HRS	65%		
16X30MINUTES ARR/BRF	8HRS			
TOTAL 32 DAYS INC ARR/BRF	86/128HRS	67%		

NOTE: The following decoding is to be used when reading the above example:

- **MORNING** – a morning shift that usually starts after 06.00 (night-time is defined according with 9966 ICAO doc as the period 18.00-06.00);
- **AFTERNOON** –an afternoon shift that does not overlap significantly with night-time;
- **LATE AFTERNOON** –an afternoon shift that overlaps significantly with night-time (in other examples the late afternoon shifts are absorbed in night shifts);
- **NIGHT** – a night shift that covers most of the nigh-time of 18.00-06.00 defined in ICAO;
- **NUMBER OF SHIFTS** – self-explanatory i.e., the number of wither morning, afternoon, late afternoon or night shifts;
- **PERIODS** –chunks of a shift time that are used to compute the total shift and working time in position during shift;
- **WORKING TIME** – sets periods when ATCOs are sitting in position during the shift;
- **TOTAL SHIFT** –the total working time in position during shift;
- **%** - the proportion of working time in position versus total duration of shift (it can be different during day shifts and night shifts as in the example above).

4.3 Maximum time providing air traffic control service without breaks

- The maximum time providing an ATC service should be 2 hours for personnel providing an ATC service working with visual terminals and/or radar displays;
- The break intervals should be reviewed periodically or when an increase in traffic load is experienced. Air Traffic Services Units (ATSUs) experiencing low traffic loads for prolonged periods, may extend shift sessions to 3 hours;
- Non-surveillance traffic services (e.g., Towers) may provide air traffic services shift sessions up to 4 hours if traffic and complexity is low (the definition of low traffic and complexity to be specified by the local arrangements). We recommend the development of

a complexity index to define the type of Units where the time in position can increase and vary (e.g. as per the FAA ATC Complexity formula, or equivalent);

- Digital/remote towers should be considered as ATS Units performing services with surveillance. The recommended maximum time working in position should be no longer than 2 hours or 3 hours respectively, as explained above.

NOTE: ANSPs should be aware of the risk of underloading in extremely low traffic scenarios when ATCOs have prolonged time-at-workstation periods. When dealing with extreme workloads we recommend using the prevention and mitigation strategies from the EUROCONTROL - Study Report on Selected Safety Issues for Staffing ATC Operations – 2006 – Section 3 - Workload extremes.

Controller's workload in this context refers to cognitive workload. It is generally agreed that a) the controller's workload is a subjective and individual response by a controller to given task load situation, and b) personal factors (e.g., skill, experience, stress) or other contextual factors (e.g., time pressure, noise, stressors, distraction, organisational change issues) can influence workload.

The greatest staffing challenge during workload extremes is matching available workforce to the current traffic level. A mismatch between the two can impact controller fatigue, and perhaps even jeopardise safety. However, it is clear that the high-workload situation is not the only one for concern; low-traffic periods carry their own risks (e.g. reduced vigilance and therefore possible failure to notice critical events).

The following mitigation strategies should be used during periods of extreme traffic situation (low or high levels):

- Management should review recurring peaks in terms of impact on existing letters or agreements (LoAs), rostering schedules and procedures;
- Minimum staffing levels arising from daily and seasonal traffic variations should be respected. That is only allow staffing to fall below these minimums when a requisite reduction in capacity is implemented or when anticipated traffic levels are below expectations;
- Supervisors should be trained to monitor staff workload and assess individual and team performance limits at a given moment in time, considering time in position, duration of shift, and workload context;
- Recognise that low workload has its own hazards; to manage this consider approving extra curricula activity;
- Consider introducing support tools to improve vigilance during low workload, e.g., system alarms;
- Traffic prediction tools and actual workload measurement tools should be used.

4.4 The ratio of duty periods to breaks when providing ATC service

- Breaks within a duty period should be planned according to expected workload, complexity of ATC provision, time of the day, type of rostering system. The minimum duration of a break should be 30 minutes;
- Breaks should be more frequent during night shift (and may be shorter) though some ATCOs prefer less but longer breaks for a nap especially after midnight;
- Beyond the need for a 30-minute break, the enforcement of a specific ratio of duty period to break is not as essential as it relates strongly to the length of service. For example for fatigue prevention, a shift of 4h30 with 2h of sector time, then a break of 30 minutes, then 2h of sector time (ratio of 80% work and 20 % break) is better than an enforcement of 25 % break on a shift of 11h. Different values may be established in conjunction with different duty period lengths.

4.5 Minimum Rest Periods

- The rest period after a duty period should be 11 hours (which is calculated for 8 hours sleep plus 3 hours for commuting and eat) to allow for adequate time that includes rest, sleep, meals, preparing for sleep and personal administration. A possible equivalent criterion might be: “not less than the length of the duty period and in any case not less than 8 hours”;
- It is recommended that this should not be deviated from, e.g. by allowing ATCOs to decide if they want a shorter recuperation time. The need for commuting, meals... etc... should be taken into account to ensure 8 hours are available for sleep. The motivation of extra income or condensed shift allowing longer period off after a cycle do not permit additional fatigue risk.

4.6 Maximum consecutive duty periods encroaching the night time, if applicable, depending upon the operating hours of the air traffic control unit concerned












- Maximum consecutive ATCO duty periods encroaching the night period (00:00 to 06.00 as described by European Aviation Safety Agency (EASA), should not exceed 2, and should be followed by at least a 48-hour rest period by the end of the second ATCO duty period encroaching the night-time.
- Some ANSPs would argue that they encroach the night-time just for 30 minutes or an hour and this limitation is extreme for them but in the development of good practice and the introduction of Fatigue Risk Management System (FRMS) the first step of prescriptive limits need to be absolute. Later on, when data collection will be in place, an optimal FRMS could be put in place, which demonstrates the acceptable level of derogation.

4.7 Minimum rest period after a duty period encroaching the night-time.

This section clarifies the number of night shifts and time to rest after (either in the middle of the shift or at the end of the shift cycle)

- Upon the conclusion of a period of night duty, any ATC personnel shall be rostered a sleeping day, **and**.
 - **after 1 night shift inside the duty cycle:** 1 night free from duty (the next shift should start after one night and not before 09.00);
 - **after 1 night shift at the end of the cycle:** Minimum 2 nights free from duty, e.g.. after 1 night shift ATCOs get 1 sleeping day + 1 day off (one unlimited free night plus a second free night).
Note: After 2 consecutive night shifts the same principles apply – the first night shift is inside the duty cycle as above and the second night need to be the end of the cycle.
- The sleeping day is not a day off. After a night shift ending at 06.00, 07.00 or 08.00 AM the period from 07.00 or 08.00 until the next morning is to recover from sleep deprivation for the night duty. The day off will start day 24 hours after the ending time of the night shift.

The following are some illustrations good practices to follow and practices to be avoided.
Legend:

 MORning	 Afternoon	 Night
 Sleep (Rest Day)	 Sleep On-call (Stand-by)	 Off
 Off On-call (Stand-by)	 Medical Check	 Refresher Training
 Mission	 Office Work	

DOs:

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7
Chris Goodman	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12	Sat 13	Sun 14
Chris Goodman	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC MOR

DON'T:

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12
Chris Goodman	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC MOR

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC MOR

4.8 Minimum number of rest periods within a roster cycle

In the context of these guidelines the roster cycle⁵ means: The period of time required for a repetitive pattern of work to achieve a single rotation of the pattern. For example, the roster pattern involving 6 days on and 3 days off continuously is a 9-day roster cycle. At the conclusion of each roster cycle each full-time individual member will have been rostered the equivalent amount of time.

- Operational staff shall be rostered for at least 2 sets of 2 or more consecutive days off per month. Where possible, 3 sets of 2 consecutive days off per month is recommended.
- It is important to ensure regular weekends (i.e., one Saturday & Sunday per month in Europe) are embedded where possible in roster cycle to enable the ATCO to unwind and recover from fatigue and keep social contact with family and friends.

DO:

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12	Sat 13	Sun 14	Mon 15	Tue 16	Wed 17	Thu 18	Fri 19	Sat 20	Sun 21	Mon 22	Tue 23	Wed 24	Thu 25	Fri 26	Sat 27	Sun 28	Mon 29	Tue 30	Wed 31
Chris Goodman	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12	Sat 13	Sun 14	Mon 15	Tue 16	Wed 17	Thu 18	Fri 19	Sat 20	Sun 21	Mon 22	Tue 23	Wed 24	Thu 25	Fri 26	Sat 27	Sun 28	Mon 29	Tue 30	Wed 31	
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF

DON'T:

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12	Sat 13	Sun 14	Mon 15	Tue 16	Wed 17	Thu 18	Fri 19	Sat 20	Sun 21	Mon 22	Tue 23	Wed 24	Thu 25	Fri 26	Sat 27	Sun 28	Mon 29	Tue 30	Wed 31	
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF

⁵ <https://www.lawinsider.com/dictionary/roster-cycle> (definitions of roster cycle)

5. ATC APPLICATION OF THE 8 PRINCIPLES

5.1 (EU) 2017/373 requirements & current rostering practices

In different countries the national laws and collective agreements, set limits for a prescriptive approach. Consequently, ANSPs' rostering systems and practices may fall short of the requirements of the (EU) 2017/373.

5.2 Monthly roster cycle and condensed shifts

When there is only a monthly limit of hours and a person takes the second half of the month as holidays, the person may have many shifts for the first two weeks. This, however, should be done within the existing parameters avoiding condensed shifts that are breaking the limits.

5.3 Seasonality

In ATCUs experiencing high seasonal variability, ATCOs have lower workload in the winter, and higher workload in the summer. In cases of seasonal traffic, having, for example 3 days off every 4 days in winter and autumn does not justify only one day off every 10 days for the summer. Hours and days off for fatigue management should not be averaged over the year.

DO:

1. Allocate more MS (missions), OF (office work), RT (refresher training) during the low traffic periods.

January

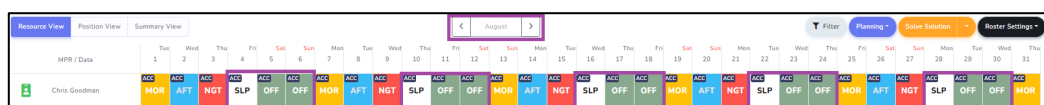


2. January + August, same year, balanced Off's:

January



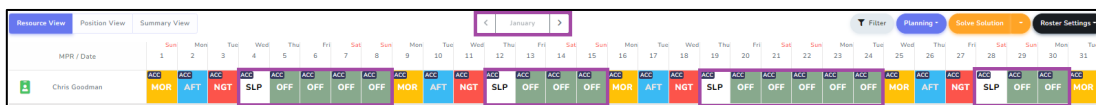
August



DON'T:

3. January + August, same year, unbalanced Off's:

January (allocate more Off's to compensate for Summer workloads):



August (allocate less Off's due to increased workload, but compensate with Off's accrued during the low traffic period):

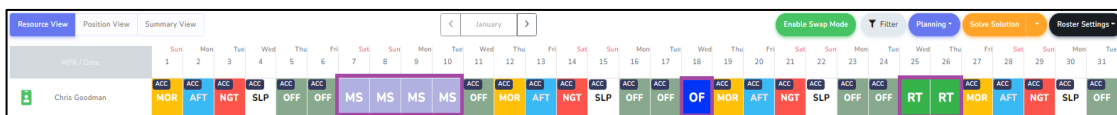


5.4 Non-Ops duties

ATCOs are often tasked for other duties, (e.g., safety management, training and operational project development). Some ANSPs are not counting these tasks in the ATCOs rosters, or do not include those duties in the protection and limits for fatigue, claiming they are not safety critical. Although this is true in terms of fatigue risks while performing such non-OPS duties, they anyhow limit the ATCOs' opportunities for resting possibilities, thus becoming fatigue factors when ATCOs switch back to operational duties. Although not every shift-work fatigue limit applies to non-OPS duties, it is recommended, that non-OPS duties are included as an intrinsic part of rosters, considering their potential impact with reference to the fatigue principles. One method of achieving this is pre-assigning Non-OPS duties into the yearly average for an operator. Requests for non-OPS duties are then assigned personnel who are available.

From a fatigue perspective, the supervisory position should be treated as non-OPS duties and accounted for in the overall roster. If a supervisor needs to maintain current OPS competency (endorsement) then when required, it should be treated as an OPS duty.

DO:



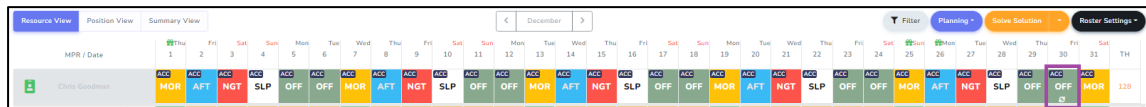
DON'T:



5.5 Stand by Duties

During staff shortages, stand-by duties are often seen as a possible solution to cover all sectors. Under this arrangement, ATCOs are rostered for several standby shifts a month. On the day, there is dynamic management of available staff and workload, and only a few staff are called. The standby shifts done or not done are considered as duty times when designing the roster. Scientific research has demonstrated that on-call duties produce fatigue and should be taken into account (Wuyts, 2012). We recommend only one stand by shift per month per ATCO. Therefore, on-call duties on site or at home should be part of the rostering system within fatigue limits. Unrealised on-call duties time at home may be recuperated in the following duty roster, within the limits.

DO:

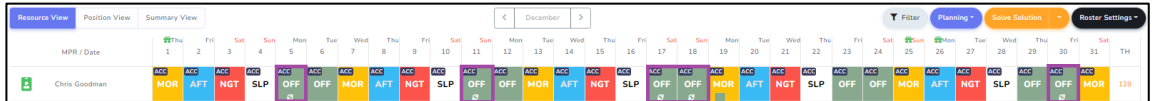


1 stand by duty in the month



Max 2 stand-by duties in the month

DON'T:



Too many stand-by duties in the month (should be no more than 1 max 2)

5.6 Arrival times

ATCOs are sometimes rostered and arrive at the ATSU but later released, as they are not required to work as planned. It is recommended that these planned duty hours although not working hours should be counted. The start of duty should include time for briefing and handover prior to time on position.

5.7 Mandatory Training

ATCOs are required to follow several mandatory training sessions such as TRM, CISM refreshers, etc. The total number of mandatory training days should be known in advance each year.

It is recommended that mandatory training is treated as a safety task (non-operational duty) and that fatigue management principles are respected to ensure staff are fit for duty. Assigning a number of non-operational days per year is a suitable method. This is subtracted from the average yearly hours and therefore accounted for within the rules prescribed in section 4.

DO's:

MPR / Date	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue
Chris Goodman	ACC	ACC	ACC	ACC	ACC	ACC	RT	RT	RT	RT	RT	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC

DON'T's:

MPR / Date	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue
Chris Goodman	ACC	ACC	ACC	ACC	ACC	RT	RT	RT	RT	RT	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC

6. ADDITIONAL CONSIDERATIONS

The following are some additional guidelines to take into account when managing shift schedules and are based on good practices in European ANSPs.

6.1 Rostering and staffing

Rostering and staffing are closely linked. The implementation of a roosting system is mandatory to improve safety by managing the risk of fatigue (and prevent hiding staff shortages). Several recommendations may not be applicable if a severe shortage of staff exists. Even if not specified in (EU) 2017/373, an evaluation and assessment of appropriate staffing levels should be the first step before implementing a roosting system.

6.2 Age

Impact of the ageing population should be considered as older controllers may become more tired from shift work. Less night shift-work may be advisable as controllers approach retirement age. Age-related services or reduction of working time (reduction of night shift or global reduction of duties) could be considered.

6.3 Sleeping after night shift

Priority should be given to sleeping after a night shift. This should be part of education on fatigue and sleep. A night shift worker may have a tendency to do other things before thinking about sleeping. In addition to the priority to sleep, the longer a person is awake after sleep deprivation, the less efficient will be his or her sleep. Calling the day immediately following the night shift a sleeping day also helps to emphasise the priority of sleep.

Sleeping day: Always indicate the sleeping day in a roster (it is a daytime for sleeping). Do not label this a 'day-off'.

It should be noted that fatigue management is a shared responsibility and ATCOs should observe the rest and off-time periods to maintain their fitness for duty. Sleep and rest are aspects of the personal conduct. These can as also be topics for team resource management (TRM).

DO:

Resource View	Position View	Summary View		Thu	Fri	Sat	Sun	Mon	Tue
MPR / Date			1	2	3	4	5	6	
Chris Goodman			ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	

DON'T:

Resource View	Position View	Summary View		Mon	Tue	Wed	Thu	Fri	Sat
MPR / Date			1	2	3	4	5	6	
Chris Goodman			ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF	

6.4 Schedule stability and predictability

Uncertainty and instability of schedules create stress for controllers. Many ANSPs undergo several changes to rosters up to and including the day of the shift. Such changes to schedules should be avoided. Once the roster is published by the ANSP, multiple short notice republishing should be minimised.

A duty should be predictable up to 6 months before a shift but no later than 90 days, to allow for personal planning. This predictability significantly reduces stress. It also reduces the risk of being unable to sustain a watch. A solution to ensure predictability is to employ fixed watch systems and assign personnel to watches. However, many ANSPs prefer individual tailored rosters to avoid inefficient planning (team rosters induce staff leakage). This is achievable with advanced software. Time of day for duty should be predictable and consistent and the number of consecutive days of unscheduled duties should be limited. Individual rostering, does not mean the roster will be unpredictable for individuals; a roster issued for 3, 6 or more months in advance can ensure the required predictability and stability.

6.6 Shift Structure

- **Fixed forward Rotating:** Where applicable, fixed forward rotating roster principles should be applied, e.g. morning shifts, followed by afternoon shifts, ending with night shifts and off days (Cabon et al, 2002a, b, Cruz, et al, 2002). It is strongly recommended that backward rotation patterns be avoided. If utilised, a safety case should be created and additional mitigations outlined;
- **Fast rotation:** fast rotation between shift are strongly advised;
- **Number of consecutive morning shifts** should also be controlled:
 - Starting between 4.00 and 6.00: Maximum 2 and Maximum 3 if the duty start time is delayed of at least 1 hr compared to the day before;
 - Starting between 6.00 and 9.00= maximum 3;
 - Starting between 4.00 and 9.00: Maximum 4 starting later every day (1 hour of delay at least per day);
- **Rest after morning shifts:** 1 night minimum free of duty before an afternoon or a night shift

DO:

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7
Chris Goodman	ACC OFF	ACC MOR	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC OFF

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC NGT	ACC SLP	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC OFF

MPR / Date	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11
Chris Goodman	ACC OFF	ACC MOR	ACC MOR	ACC MOR	ACC AFT	ACC AFT	ACC OFF	ACC NGT	ACC SLP	ACC OFF	ACC OFF

DON'T: backward rotation

Resource View	Position View	Summary View					
MPR / Date			Thu	Fri	Sat	Sun	Mon
			1	2	3	4	5
Chris Goodman	ACC	ACC	ACC	ACC	ACC	ACC	ACC
	NGT	AFT	MOR	OFF	OFF		

6.7 OJTIs

Specific consideration should be given to rostered periods of OJT (On-The-Job Training). We recommend using the prevention and mitigation strategies from the EUROCONTROL (2006) Study Report on Selected Safety Issues for Staffing ATC Operations (section 7 - On-The-Job Training). For Example:

- **Roster plans:** Provide an operational roster allowing OJTs to give adequate briefing and debriefing times to OJTIs and students/trainees;
- **OJT sessions:** Avoid ad hoc OJT, i.e. OJT should be formalised, planned, structured and integrated with employee orientation;
- **Ratio OJTI to student:** As far as practicable, have a single OJTI or a small group of OJTIs allocated to a student (from the pedagogical and organisational point of view);
- **Number of OJT sessions in Ops room:** Restrict the number of OJT sessions in the Ops room at any one time to avoid trainees in adjacent positions;
- **Number of OJT students/trainees in the system:** Restrict the total number of OJT students/trainees in the system at any one time;
- **Supervisor:** Where possible a supervisor should be available during OJT to manage the environment.

6.8 Additional considerations

The following are some additional considerations based on good practice within the European ANSP community.

- Consider reducing the number of Night shift at a certain age;
- Swap and exchange of shift only possible with another ATCO in the same condition of resting and shift exposure;
- Admin time accounted as duty time for fatigue limits in the rostering system;
- As far as possible plan one real weekend (Saturday Sunday) per month completely free from duty embedded in the planning of ATCOs;
- Specific consideration should be given when in the roster the ATS Units have periods of SPO – Single Person Operations – we recommend using the prevention and mitigation strategies from the EUROCONTROL - Study Report on Selected Safety Issues for Staffing ATC Operations – 2006 – section 5 - Single Person Operations (SPO).

The following Mitigation strategy should be envisaged when planning SPO.

Prior to making a decision to introduce SPO, a risk assessment should be undertaken to validate the decision. Equally, within the unit safety case, contingency plans should be developed for unplanned SPO. Furthermore, prior to implementing SPO, it is recommended that:

- an operational supervision concept that supports SPO should be developed;
- the system design supporting the SPO concept should be verified;
- operational staff should be specifically trained to transition between two into one and one into two where relevant.
- operational staff should be trained in relevant human factors issues e.g. threat and error management training.

6.9 Monitoring of Fatigue

The following methods are recommended to monitor fatigue:

- the use of 'Time in Position' (TiP) technology;
- rostering software;
- specific reporting forms for fatigue;
- ATCO surveys;
- the combination of rostering software with other human resources software;
- a combined dashboard with links to occurrence data and barrier model analysis.

7. CONCLUSIONS

The rules on fatigue can be interpreted differently. To improve fatigue management, there is a need for standards/recommendations, on rostering practices. These guidelines have taken into account the key requirements from regulations/standards together with suggestions on how the eight shift work fatigue prescriptive limits could be applied.

In designing any shift work, practices or schedules an understanding of the regulatory requirements and the legal framework, that should be applied, is required as it underpins the constraints that the shift schedules need to operate. It is necessary to understand and have an interpretation on:

- What EU legislation should be applied?
- Are these legislations directly applicable through regulation (e.g. EU 2017/373) or transposed into national regulation for Directives (e.g. 2003/88/EC)?
- What national regulation and working agreements needs to be considered?

Rostering within the limits of the 8 shiftwork fatigue prescriptive limits indicated in (EC) 2017/373 shall be considered a **prescriptive approach** and provides the constraints to build a rostering system. In addition, the following considerations should be taken into account:

- It is necessary to consider the **scientific evidence** when developing a fatigue efficient rostering system.
- **Training** should be provided to be aware of the scientific principles affecting fatigue and sleep science to support developing a rostering system and staff consultation.
- The selection and the **regular revision** of an appropriate structure and values of the rostering system.
- **Consultation with staff** who will be subject to the rostering system, or, as applicable, their representatives, during its development and its application.

In addition to operational knowledge, scientific principles used to construct ATC rosters and in applying prescriptive limits should provide evidence that those limits are not exceeded and that requirements are met. The process should be data driven from their own real and local data. Collection of data and demonstration of the impact of fatigue risk in the Safety Management System(SMS) will enable ATSUs on a second step to adjust those limits and move towards an optional FRMS.

This document is a guideline derived from scientific studies on mostly busy en route ATC centres. In most cases, the guidelines will be applicable to less busy ATC units. However, when considering deviating from recommended figures for fatigue elements in this document, it is recommended to perform safety and human factors assessments.

The overall effectiveness of a rostering system in managing risks from occupational fatigue stems from a balanced variety of elements, complementing each other. While any of the eight parameters of EU373/2017 sets a limit of its own, together they are designed as a system. Thus, certain elements may compensate for others.

The guidelines in this document shall not be applied in isolation by looking only at fatigue elements of an ATM roster. Rather, they should be applied as a whole.

When implementing (or expanding) a fatigue risk management system (FRMS) at ANSP level, this document could be considered useful guideline for other categories of staff that perform shift work, such as ATSEP, MET, AIS, Flow, etc..

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The material is necessarily shortened and summarised at a reasonable detailed level. Readers are strongly encouraged to read some of the original works in the References.

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HTML LINKS REGULATIONS etc.

Regulation	Link
Working Time Directive	EUR-Lex - 32003L0088 - EN - EUR-Lex (europa.eu) Working Conditions - Employment, Social Affairs & Inclusion - European Commission (europa.eu)
SIMAP and Jaeger judgement:	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:62002CJ0151&from=IT
EU 2017/373	https://www.easa.europa.eu/downloads/125141/en

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ICAO doc 9966:	https://www.icao.int/safety/fatiguemanagement/FRMS%20Tools/Doc%209966.FRMS.2016%20Edition.en.pdf https://skybrary.aero/sites/default/files/bookshelf/26494.pdf

ACROYMNS AND ABBREVIATIONS

ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATS	Air Traffic Services
ATSUs	Air Traffic Services Units
ATSEP	Air Traffic Safety Electronics Personnel
CANSO	Civil Air Navigation Service Organisation
COOs	Chief Operating Officers
CSM	Critical Stress Management
EASA	European Aviation Safety Agency
EC	European Commission
EMSA	European Maritime Safety Agency
ERA	European Union Agency for Railways
ESAF	Eastern and Southern African
EU	European Union
EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration
FRMS	Fatigue Risk Management System
ICAO	International Civil Aviation Organisation
ILO	International Labour Organisation
OJTIs	On the Job Training Instructors
OR	Organisational Requirements
SMS	Safety Management System
SPO	Single Person Operations
TiP	Time in Position
TRM	Team Resource Management
WOCL	Windows of Circadian Low

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