



SAFETY MATTERS
FOUNDATION

AVIATION SAFETY / HUMAN FACTORS / FATIGUE SCIENCE

PUBLIC REPORT / PLAIN-LANGUAGE GUIDE

Are India's Pilot Duty Rules Keeping Pilots Alert?

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Safety Matters Foundation · CIN U85300HR2021NPL096553

What the science says about pilot fatigue under India's flight duty rules, explained without jargon

PREPARED FOR

Pilots, passengers and the public

Version 1.3 · 27 October 2026 | Companion to SMF White Paper 01 · new page 14: three plain facts

EVIDENCE BASE

OpenNeuro human sleep studies · Three-Process Model of alertness · EASA field research · DGCA CAR Section 7 Series J Part III

VERSION 1.2 New page, added 27 October 2026

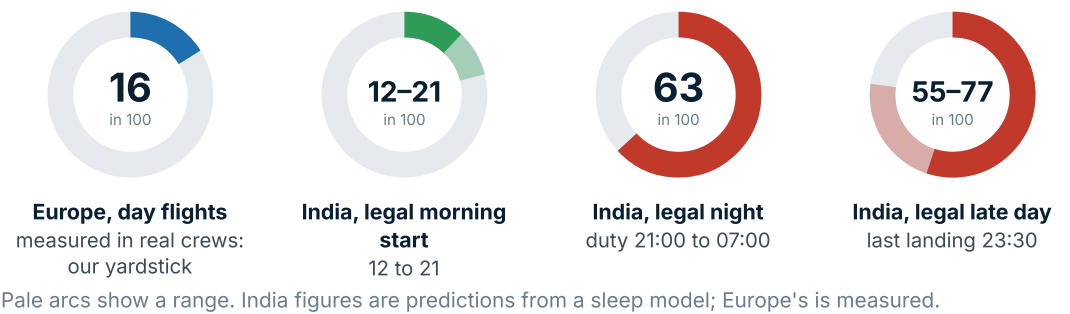
Start here

The question: do India's rules on pilot working hours keep pilots awake enough to fly safely?

Short answer: by day, mostly yes. At night and late in the evening, often not.
A duty can follow every rule and still leave most of the crew sleepy.

The whole guide in one line

Out of every 100 pilots, how many are sleepy as they begin the last landing?



Blue = Europe, measured.

Red = India, legal duties. Night is about 4 times higher.

How to read "63 in 100". Like a weather forecast that says "63% chance of rain". It is not a count of 63 named pilots. It means that on that kind of duty, about 63 of every 100 pilots would be expected to feel sleepy.

Words you will meet in this guide

Sleepiness score	A 1 to 9 scale on which people rate themselves. 7 = sleepy; 8 = fighting to stay awake. Scientists call it KSS.
DGCA	India's aviation regulator. It writes the duty rules (the "CAR").
EASA	Europe's aviation safety agency. It measured real crews; its 16 in 100 is our yardstick.
ICAO	The UN's aviation agency. Its standards say duty rules must keep pilots alert.
Duty period	From the moment a pilot reports for work until the last landing (FDP).
Landing (sector)	One flight, from take-off to landing.
Body-clock low	2 to 6 a.m., when the body most wants to sleep.
FRMS	Letting airlines manage fatigue with their own data instead of fixed limits.

Keep this page open while you read

Key message: a legal duty can still be a tiring duty. The fix is in the rules, not in the pilots.

Important: some figures in this report are model predictions, not direct headcounts.

Key findings at a glance

1. Legal, but sleepy at night.

On a legal night duty about 63 in 100 crew are likely to be sleepy, about four times the rate Europe measured on day flights. Nights in a row do not get easier: 62 in 100 on the second night and 66 on the third, as lost sleep piles up.

Simple meaning: even when the duty is legal, many pilots may still feel sleepy at night.



2. Late evenings are the hidden risk.

In 452 real working days flown by five Indian pilots, legal days that ended between 8 p.m. and midnight left about twice as many crew sleepy as days that ended earlier. With four landings, they were sleepier than the average night duty.

Late evening duties can feel almost like night duties to the body.



3. Early starts cost the night.

For a 6 a.m. departure the pilot is awake for 3 of the 4 hours when the body most wants to sleep. Five such mornings in a row take the share of sleepy crew from 31 in 100 to 55 in 100.

A 6 a.m. flight often starts with a 2:30–3:00 a.m. wake-up.



4. Real logbooks: mostly within the rules, with edge cases.

In four pilots' logbooks, 10 to 15 of 350 working days went past a limit, mostly by a few minutes around midnight or 6 a.m. Some long-haul night flights ran 9.2 hours where the normal night limit is 8, under an exemption with no published fatigue evidence. On such a flight, 55 in 100 crew would be sleepy at landing.

Most duties were inside the rules, but some cases went over the limit by minutes.



5. The rules were switched off when it mattered.

The night rules were suspended for one large operator five weeks after they took full effect, and other relaxations have run since. The regulator was reported in October 2026 to have told operators that all of them will end in March 2027. India's regulator is not yet equipped to let operators manage fatigue themselves.

Some protective night rules were later relaxed or suspended.



The question, and the short answer

The UN's aviation agency, ICAO, says every country's pilot duty rules must be based on **science, knowledge and real experience**, so that pilots stay alert enough to fly safely (Annex 6, Standard 4.10.1). India's regulator, the Directorate General of Civil Aviation (DGCA), rewrote its rules in 2024: night now runs from midnight to 6 a.m., a night duty may have only two landings and last at most 10 hours, and pilots get longer weekly rest.

This is the core message of the report.

By day, mostly yes. At night and late in the evening, no. The rules keep pilots reasonably alert on ordinary daytime flying. But they still allow night duties, late-evening finishes and runs of early mornings where a large share of pilots are predicted to feel sleepy, even when the operator follows every rule. What matters most is the hour a pilot starts work:

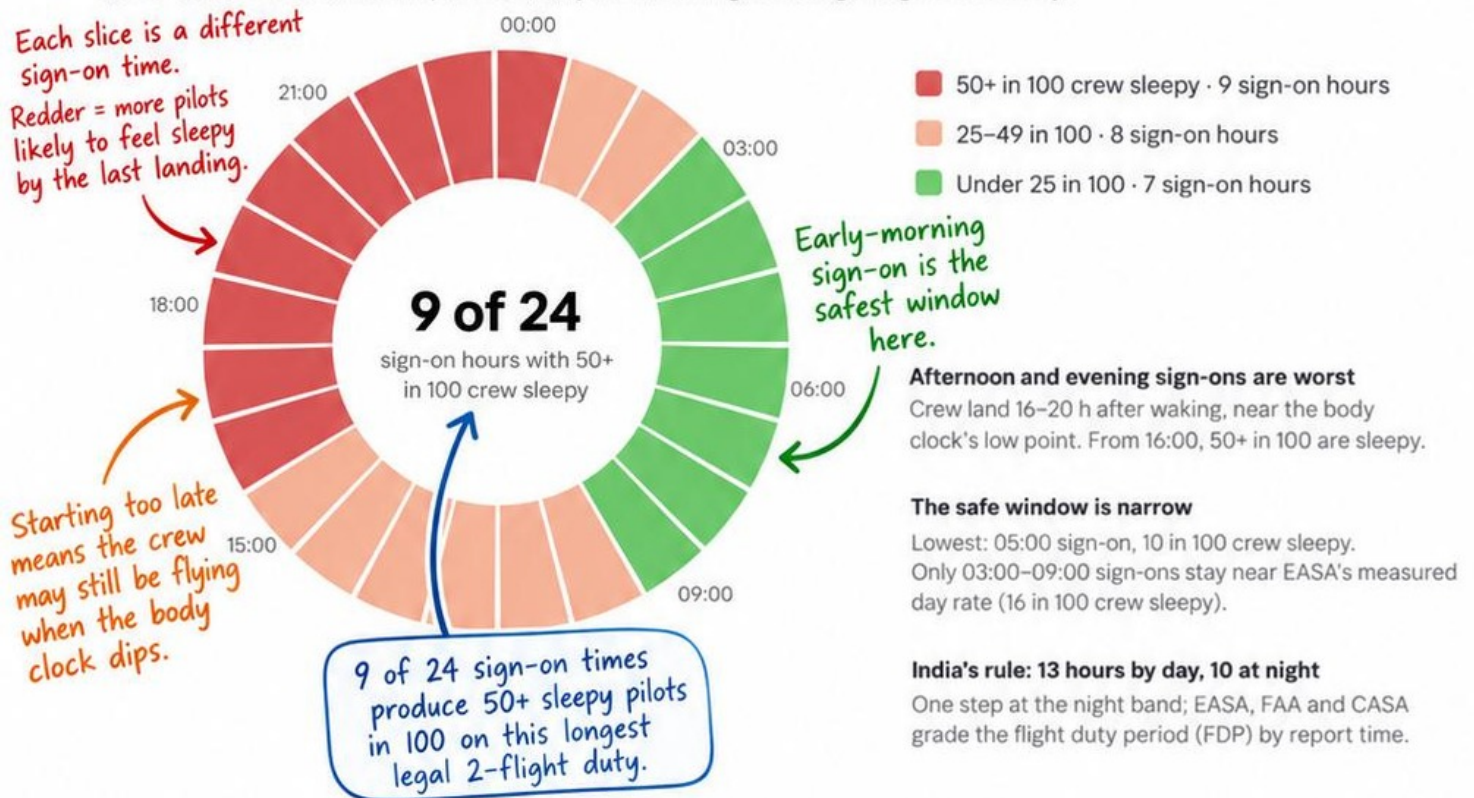
Pilots said it first. In Safety Matters Foundation's surveys of Indian pilots (542 in 2022, 530 in 2024), 71% said they had often felt too tired to fly, 66% had fallen asleep or had microsleeps on duty, and 40% feared reporting fatigue. This study reaches the same answer independently, from sleep science and real rosters.

Pilots reported this before the modelling did.



Only an early-morning sign-on keeps the longest legal duty near the daytime rate

Each slice is the hour a pilot signs on for duty. Colour = how many crew in 100 are predicted sleepy (KSS 7+ on the 1-9 Karolinska Sleepiness Scale) by the last landing of the longest legal 2-sector duty.



Read '64 in 100' as: of every 100 crew signing on at 20:00 for this duty, about 64 are predicted to rate themselves sleepy (KSS 7 or more) by the last landing.

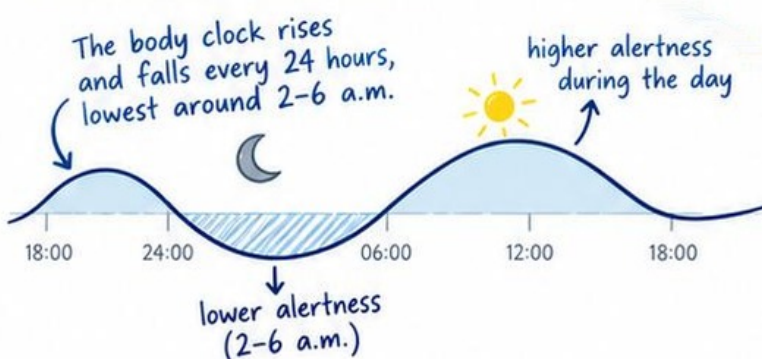
Figure 1. Fatigue model with accumulated sleep debt · the longest two-flight duty India allows, starting at each of the 24 hours

How to read the numbers

Most numbers here look like "63 in 100 pilots sleepy". Imagine 100 pilots flying exactly the same duty. People differ, so the model predicts that as they start the descent for the last landing about 63 of them would rate themselves 7 or more on a 1–9 sleepiness scale, which scientists call "sleepy". It is a forecast for one kind of duty, like "63% chance of rain", not a count of Indian pilots. The yardstick: with Europe's air safety agency (EASA) measured real crews on ordinary day flights, about **16 in 100** were sleepy.

"63 in 100" is like a weather forecast: a prediction for this kind of duty, not a count of Indian pilots.

Two forces drive tiredness. From the moment you wake, sleep pressure builds like a phone battery draining; only sleep recharges it. Separately, the body clock raises and lowers alertness like a tide, lowest between about 2 and 6 a.m. Night flying combines a flat battery with a low tide. And when sleep is cut short night after night, the shortfall carries over, like a debt.



The longer you stay awake, the more the "battery" drains.

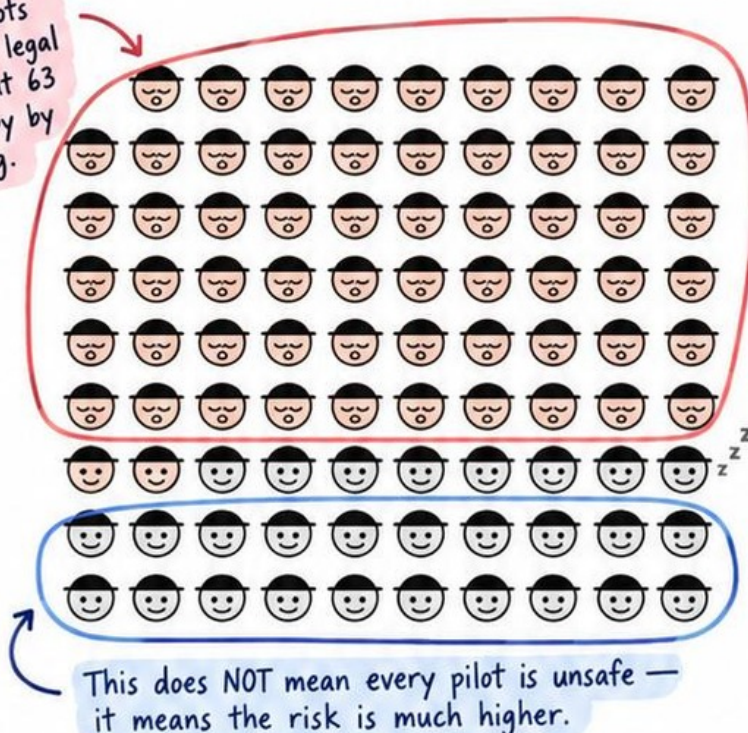


Europe measured about 16 in 100 sleepy on ordinary day flights — this is the reference point used throughout the report.

What "63 in 100" looks like

Imagine 100 pilots on the same first night after days off. Starting the last descent, about 63 would be sleepy.

Imagine 100 pilots doing the same legal night duty. About 63 might feel sleepy by the last landing.



Sleepy = 7 or more on the 1-9 sleepiness scale.

- 63 sleepy
7 or more on the 1-9 sleepiness scale
- 37 less sleepy
people differ: sleep, age, body clock

For comparison

On ordinary day flights, Europe measured about 16 sleepy in 100.

Europe's ordinary day-flight figure was about 16 in 100 sleepy.

It is a forecast, not a head count

Like "63% chance of rain": a model checked against real European crews.

Sketch for illustration. Figure from this guide's model for a legal 21:00-07:00 night with 2 landings.

Figure 2. Sketch: what '63 in 100' means

Night flying is hard because both problems happen together: long wakefulness + body-clock low.

Two forces behind tiredness: a draining battery and a falling tide

Sketch for illustration, not to scale.

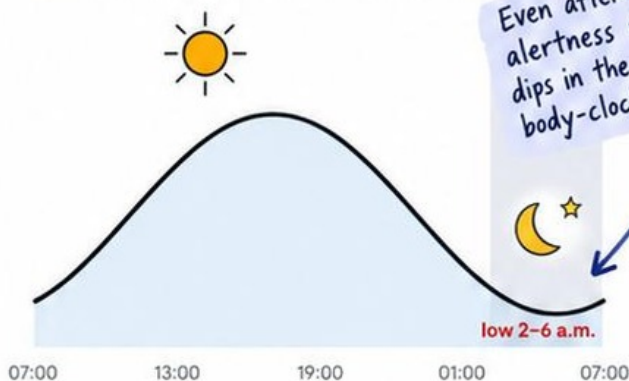
1. The battery: hours awake

Drains from the moment you wake. Only sleep recharges it.



2. The tide: the body clock

Rises and falls every 24 hours, even after a good sleep.



Night flying = a nearly flat battery + the lowest tide, at the same time

That is why the last landing of a night duty is the sleepest moment of the job.

Figure 3. Sketch: the battery and the tide

In plain English: a legal duty can still be a tiring duty.



In plain words. A score of 7 means you feel sleepy but can still keep your eyes open. At 8 you are fighting to stay awake: the point at which a sensible driver would pull over.

Score 7 = sleepy.
Score 8 = fighting sleep.



Night work + long time awake = higher risk of fatigue

1. Nights: the biggest risk

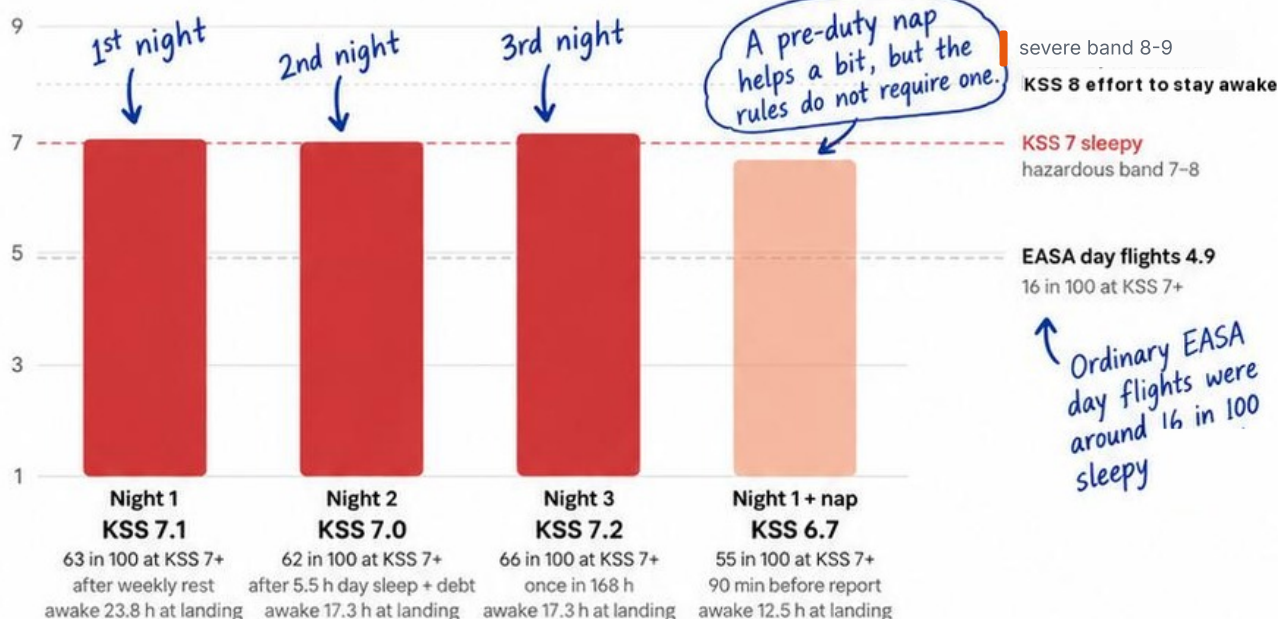
A pilot who reports at 9 p.m. for a legal 10-hour night has usually been awake since morning and flies through the body clock's low point. As they start the descent for the last landing, about **63 in 100** are predicted to be sleepy and 40 in 100 at 8 or more, which means fighting to stay awake.

The rules allow two nights in a row (three once a week). Pilots sleep in the day between them, but daytime sleep is shorter and lighter, so the shortfall builds: **62 in 100** on the second night and **66 in 100** on the third. A 90-minute nap before the first night helps a little (55 in 100), but nothing in the rules requires one.

Sleep debt carries over when daytime sleep is short.

Consecutive nights do not get easier: night 3 is sleepest, KSS 7.2; 66 in 100 crew at KSS 7+

Average KSS (Karolinska, 1–9) at the last top of descent, legal 21:00–07:00 night with 2 landings (CAR 6.1.4, 13.1) · EASA-matched model



Read 63 in 100 as: of every 100 crew flying this night, about 63 would rate themselves sleepy as they begin the last landing.

Figure 4. How sleepy pilots get over legal nights in a row · model prediction



Did you know? Operators asked DGCA to allow a third landing at night. The model predicts that would raise the share of sleepy pilots from about 63 in 100 to about 74 in 100.

If a third landing is allowed at night, fatigue may get worse.

2. Late evenings: the hidden risk

A day that ends just before midnight counts as a day duty, so it may include up to six landings. Yet by the last landing the pilot has been awake 16 to 20 hours and is heading into the body clock's low point. On a legal day landing at 11:30 p.m., **55 in 100** pilots are predicted to be sleepy with four landings, and **77 in 100** on a six-landing turboprop day.

Evening flights still hit the body clock's low point.

A duty that ends at 11:30 p.m. is still called a "day duty", but the body does not care about that label.

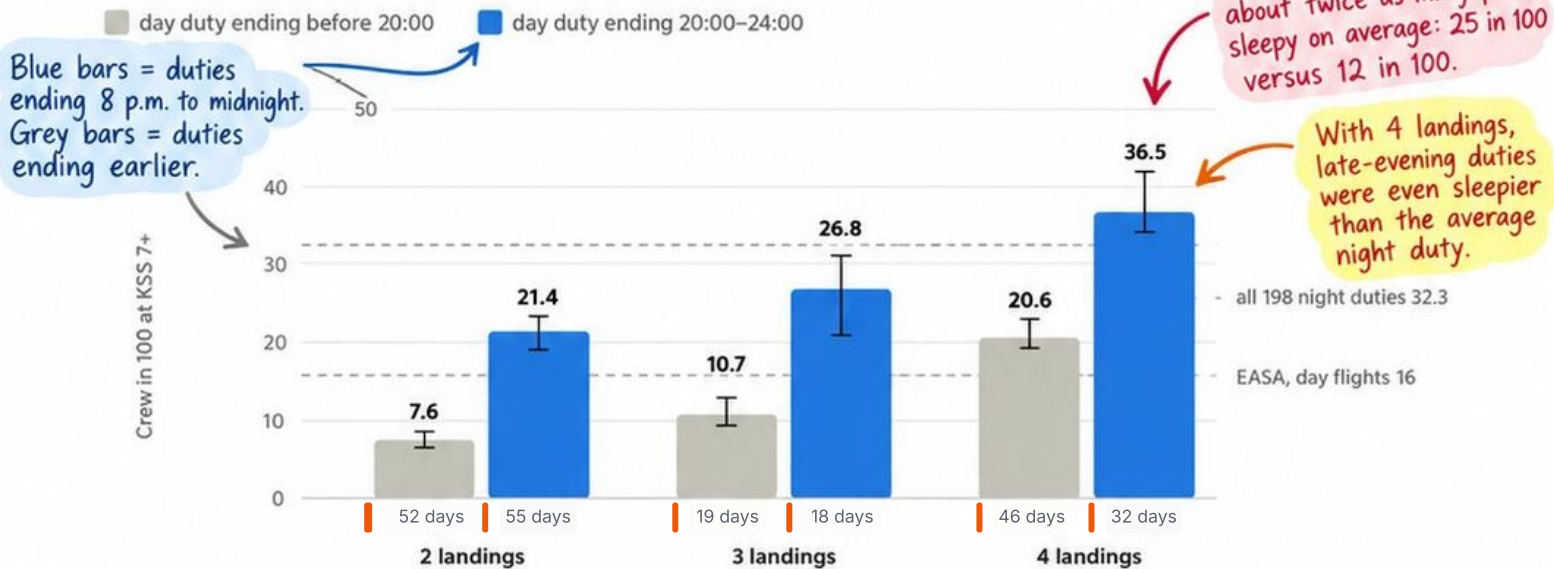


By the last landing, the pilot may have been awake 16–20 hours.

The real records show the same thing. Across 452 working days flown by five pilots in 2025–26, legal days ending between 8 p.m. and midnight left 25 in 100 crew sleepy on average, against 12 in 100 for days ending earlier, at every number of landings. A four-landing day ending after 8 p.m. (36 in 100) was sleepier than the average night duty (32 in 100). Every one of the five pilots flew such days.

Legal day duties ending 20:00–24:00 are 1.8–2.8 times as sleepy, at every landing count

222 real day duties, five pilots, 2025–26 · sleepy pilots in 100 at the last landing; thin lines = likely range



Model prediction for an average crew on each real duty, not a measurement of these pilots. Names, operators and airports removed. The statistics behind the ranges are in the full report, section 7.

Figure 5. Five pilots' real duties, 2025–26 · names, operators and airports removed



In plain words. The rules draw a hard line at midnight. The body does not: a day that ends at 11:30 p.m. is nearly as tiring as one that ends at 1 a.m., but it can carry three times as many landings.

The legal line is midnight. The body clock is gradual, not sudden.

3. Early starts: the plane leaves after the low, the pilot does not

For a 6 a.m. departure, Indian pilots told the 2022 survey they wake at about 3 a.m. They then shower, drive (45 minutes door to door in the AAIB accident report; 25 minutes on average to seven Indian airports with no traffic) and report at about 5 a.m. Three of the four hours of the body's low point are spent awake.

Going to bed early does not fix it: trying to fall asleep at 9 p.m. is like trying to eat a big dinner straight after lunch. Pilots measured with wrist monitors slept about 5½ hours before starts between 4 and 5 a.m., over an hour less than before a 9 a.m. start.

Five early mornings in a row. Getting up at 2:30 a.m. for five 6 a.m. departures with four flights a day, the share of sleepy pilots climbs every day, from 31 in 100 on day 1 to 55 in 100 on day 5, as about 19 hours of sleep debt pile up. India's rules already stop this exact run, because a 6 a.m. departure counts as night duty (two in a row, two landings). But a run of 7 a.m. departures is allowed with no limit, and climbs from 22 to 35 in 100 over five days.

Going to bed early is not a full fix – sleep before very early starts is usually shorter.

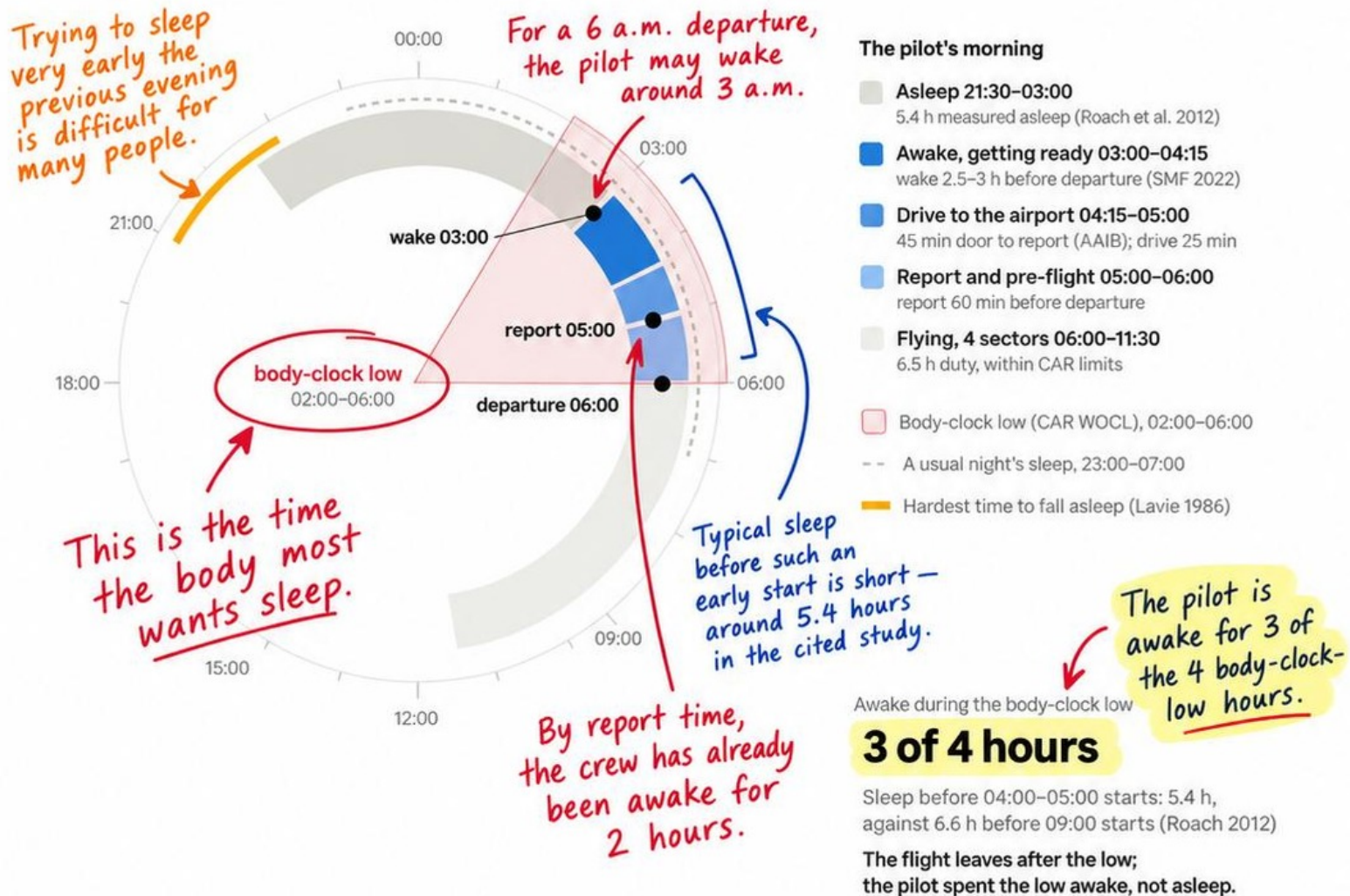
This is why early starts 'steal' part of the night.

A 6 a.m. departure often means waking around 3 a.m.



A 06:00 departure: the pilot is awake for 3 of the 4 hours of the body-clock low

One early-start morning on a 24-hour clock · times from Indian survey, transport and sleep data



Wake time: SMF 2022 pilot survey. Sleep: Roach et al. 2012, wrist monitors on 70 pilots. Transport: AAIB accident report (45 min); OSRM drive times to 7 Indian airports (mean 25 min). The usual-night ring is illustrative for a day-working adult. Not a roster of a named pilot.

Figure 6. Illustrative 06:00 departure · wake time: SMF 2022 survey; sleep: Roach et al. 2012; transport: AAIB accident report and drive times to 7 Indian airports



In plain words. Sleep debt works like a credit card. Paying the minimum each night keeps the statement looking the same for a while, but the balance keeps growing, and the pilot is the last to notice. In laboratory studies, people allowed 4 hours a night for two weeks made as many attention slips as people kept awake for two whole nights, yet said they felt only a little sleepy.



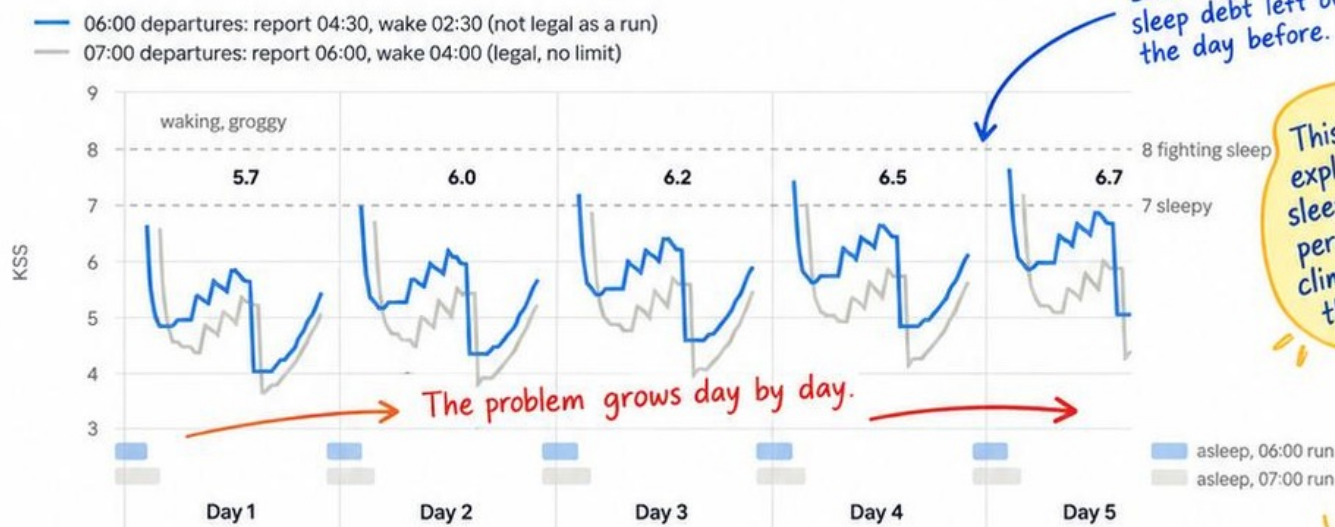
Sleep debt works like a bill that keeps growing if you only partly repay it.



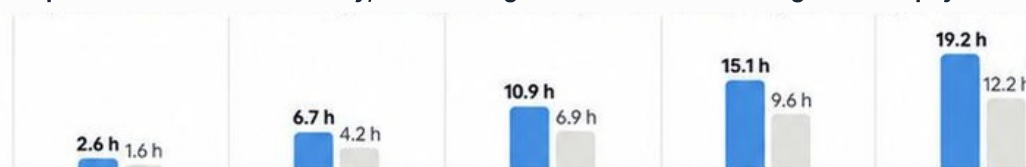
So even though the plane departs after 6 a.m., the pilot's day began in the middle of the night.

Five early departures in a row: with sleep debt counted, sleepiness climbs every day

Average sleepiness score (1–9) of the crew, 4 landings a day · model prediction



Sleep debt carried into each duty, in hours: it grows faster than short nights can repay it



Model prediction, not a count. The 06:00 run is not allowed by the rules; the 07:00 run is allowed with no limit. How sleep debt is calculated is explained in the full report.

By Day 5, the carried sleep debt is much larger than on Day 1.

Figure 7. Five early starts in a row: sleepiness climbs as sleep debt builds · model prediction

4. What real rosters and logbooks show

Thirteen pilots shared real rosters and logbooks from 2023 to 2026. We removed all names, operators, flight numbers and airports.

- **Before the 2024 rules**, four pilots' months in 2023 averaged **31 in 100** crew sleepy per working day, about twice Europe's day level. On 37 of 67 days 25+ in 100 were sleepy; on 11, 50+ in 100 (4 still legal). *The newer rules improved things, but not enough.*
- **Under the 2024 rules**, five short-haul pilots' records from 2025–26 average **24 to 25 in 100**: better, but still well above Europe's 16. Nights and late evenings remain the sleepiest days.
- **Long flights abroad** (Boeing 777, 787 and A350 logbooks, 99 landings) averaged about **17 in 100** at landing, because pilots take turns to sleep in a bunk. Landing at home in the small hours or the morning was hardest: about **30 in 100** for landings between midnight and noon, against about 10 later in the day. On two flights where no rest was logged, it was **51–55 in 100**.
- **Coming home after a few days abroad**. On a layover the body clock slowly moves to local time, by about an hour to an hour and a half a day. After three or four nights on the US east coast, a flight landing in India at 11:30 a.m. feels to the body like about 5:30 a.m. In the model, sleepy pilots at that landing rise from about **13 in 100** after one night away to about **27 in 100** after four. In the logbooks, ultra-long flights home from North America after two to four days away averaged about **20 in 100**, against 7 if the body had stayed on India time. India's rule treats crew as fully adjusted to local time after 48 hours; the science says it takes about a week from the US east coast, and Europe's rules allow for this in-between state. Late-evening homecomings are the exception: the shifted clock makes them easier.
- **Edge cases**. In 350 working days in four pilots' logbooks, 10 to 15 went past a night or duty-length limit, mostly by minutes around midnight or 6 a.m. On long-haul, a two-pilot flight lasted 9.2 hours through the night,

Real rosters from 13 pilots were used here, with names removed.

Short-haul rosters under the 2024 rules were still well above Europe's day-flight reference.

Bunk rest helps on long-haul, but homecomings in the small hours or morning are still harder.

The body clock does not switch instantly after 48 hours abroad.

All the duties at a glance

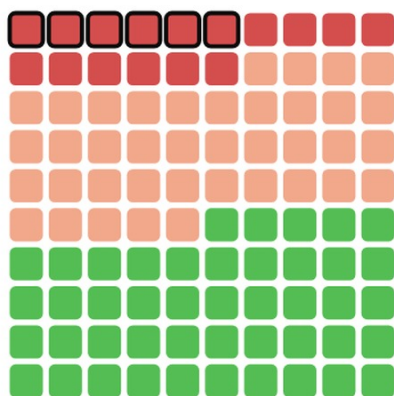
Picture 100 duties as 100 squares. In four pilots' 2023 rosters, before the 2024 rules, 55 in 100 duties left at least 25 in 100 pilots sleepy by the last descent, and 16 in 100 left 50 or more. Under the 2024 rules, in 452 duties of five pilots in 2025–26, that falls to 42 in 100 and 7 in 100. On long-haul flights, 26 in 100 landings reached 25 in 100 pilots sleepy. Better, but still well above what Europe measured on ordinary day flights (16 in 100).

The 2024 rules helped, but 42 in 100 duties still leave 25 in 100 pilots or more sleepy

Each grid is 100 duties (long-haul: 100 landings). Colour = pilots in 100 predicted sleepy at the last top of descent.

2023, before the 2024 rules

4 pilots · 67 duties



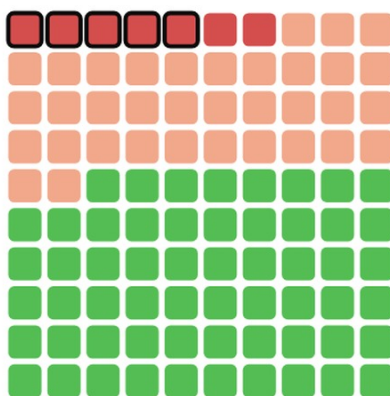
55 in 100 duties at 25+ · 16 at 50+

outlined: still legal today

■ fewer than 25 in 100 pilots sleepy

2025–26, under the 2024 rules

5 pilots · 452 short-haul duties



42 in 100 duties at 25+ · 7 at 50+

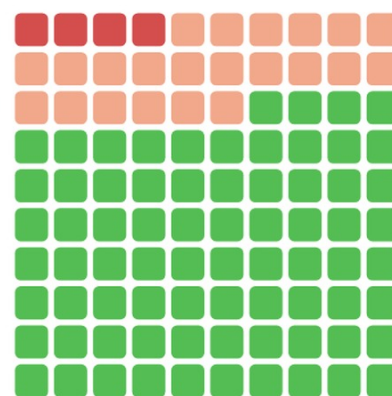
outlined: within the duty and landing limits

■ 25–49 in 100

■ 50 in 100 or more

2024–26, long-haul

4 pilots · 99 landings



26 in 100 landings at 25+ · 4 at 50+

counted per landing

■ and within the rules checked

Model prediction for an average crew on each duty, not a count of sleepy pilots. Names, operators and flight numbers removed.

Four 2023 rosters (67 duties), five pilots' 2025–26 duties (452) and four long-haul logbooks (99 landings) · each grid scaled to 100 · names, operators and flight numbers removed · model prediction

In plain words. Each grid is 100 duties, not 100 pilots. A red square is a duty on which about half or more of the pilots flying it would be expected to feel sleepy by the last landing. Compare the first two grids: the 2024 rules turned some red and orange squares green, but 42 in 100 recent duties are still orange or red.

Read this if you are a passenger

What this means if you fly

- **This guide does not say flying in India is unsafe.** Most duties keep pilots reasonably alert.
- The thin margins are on flights that **land late at night or in the early morning**, after a long day, a run of nights or a run of very early starts.
- The fix is in the rules, not in passengers' hands: **duty limits that look at the clock**, and a **real chance to sleep** before every duty.

Normal night limit was 8 hours, but this flight was longer under an exemption.

The report says no fatigue evidence for that exemption has been published.

landing at 9:11 a.m., where the normal night limit is 8 hours. It was flown under an exemption DGCA gave the operator; no fatigue evidence for it has been published. The pattern deserves a check by DGCA.

- **One long night, start to finish.** A pilot flew in as a passenger the night before, flew two flights through the night, then flew home as a passenger at dawn. Only the two flights they operated count towards the night flying limits. Counting the flight home, they were on duty 11 hours 25 minutes, 25 minutes more than the 11-hour duty limit as written, unless a permission not shown on the roster applied. By the time they got home they had been awake about 20 hours, which in laboratory studies impairs performance about as much as a blood alcohol level above India's drink-drive limit.

Only some parts of the whole night counted towards the formal limit – but the pilot was awake for much longer.

About 20 hours awake can impair performance badly.

Pilots agree. 83% of pilots in the 2024 survey were worried about tiredness from nights in a row, and 73% in 2022 named runs of early departures as what tires them most.

Pilot surveys and the modelling point in the same direction.

5. When the rules were switched off



This is a policy issue, not just a biology issue.

In December 2025, five weeks after the new night rules took full effect, DGCA suspended the most important ones for one large operator after it cancelled flights on a massive scale, until 10 February 2026. Every kind of duty this allowed again leaves more pilots sleepy than a normal day flight, 66 in 100 or more on the late ones. The government told Parliament that the operators' safety risk assessments were checked by DGCA before any relaxation was allowed, but none of them has been published, so nobody outside can see what fatigue evidence they used.

Key protection relaxed only five weeks after full effect.

5 weeks

Other relaxations from the 2024 rules ran to 30 April 2026 and later ones to 31 October 2026; the regulator was reported in October 2026 to have said all will end by **March 2027**. In 2025 operators asked for more, including a shorter "night" (midnight to 5 a.m.), a third landing at night and less recovery after nights in a row, and they want to manage fatigue with their own data-driven systems (FRMS) instead of fixed limits.

If the evidence is not public, outsiders cannot check it.

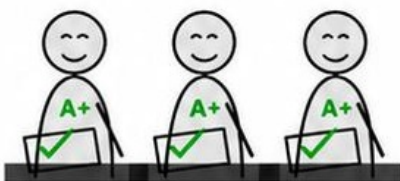


Why it matters. ICAO's audit of India gave a good overall score, about 86 out of 100. But its lowest mark, about 51 out of 100, was for having enough qualified technical staff: the very inspectors who would have to check an operator's fatigue data. Allowing FRMS now would be like letting students mark their own exams before there are enough teachers to check the marking.

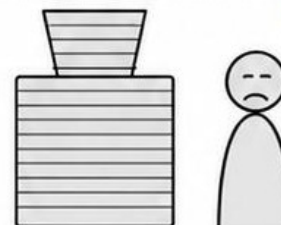
FRMS before enough inspectors: students marking their own exams

Cartoon. FRMS lets an operator set its own limits if its data shows pilots stay alert. Someone has to check that data.

Operators, marking their own fatigue data



The regulator's inspectors



The report argues: do not let them self-manage fatigue until the regulator has enough expert inspectors.

ICAO's order

1. Sound fixed limits 2. Real fatigue data 3. Then FRMS, only where inspectors can check it. (ICAO Doc 9966, para 6.1)

ICAO audit: 51 out of 100

for qualified technical staff, India's lowest mark

Cartoon for illustration. Audit figure: ICAO State Safety Briefing for India, 2023, from the 2022 audit.

Figure 8. Cartoon: FRMS before enough inspectors

What should change

Fix the rules first, collect Indian data next, and only then consider

Recommended order:

fix the rules first → collect Indian evidence → only then consider FRMS.

Three steps, in this order

Following ICAO's guidance: solid basic rules come before operator-run fatigue systems (FRMS)



Figure 9. Recommended order · 3 steps

1. **Set duty limits by the time a duty starts**, as Europe, the US and Australia do, not by one fixed "night" band.
2. **Limit late-evening days** that end close to midnight, for example to four landings. *Limit late-evening duties.*
3. **Protect runs of nights and early mornings**: rest before the first night, and limits on the second and third nights and on long runs of early starts, where sleep debt builds. *Protect runs of nights and early starts.*
4. **Guarantee an 8-hour chance to sleep** in every rest period. *Guarantee enough chance to sleep.*
5. **Count jet lag the way the body does**: replace the 48-hour switch with a gradual rule, as Europe does, and after two to four days abroad avoid homecoming flights that land in the Indian morning, when the shifted body clock is at its lowest. *Treat jet lag gradually, not as an on/off switch.*
6. **Measure Indian pilots' fatigue** the same way everywhere, and run an independent study of real pilots.
7. **Any exemption must come with fatigue evidence and an end date.** *Publish fatigue evidence for exemptions.*

Does India pass the international test? *Short answer: partly.*

ICAO Annex 6: India meets the form, not yet the three requirements

Annex 6 Part I, Standard 4.10.1, Appendix 7 and Doc 9966 · this review's assessment, not a legal finding

THE THREE REQUIREMENTS OF STANDARD 4.10.1, AND THEIR AIM

1. Scientific principles Std 4.10.1		Partly met Night rules follow science; no extra checks past a 10 h duty day
2. Knowledge Std 4.10.1		Partly met Matches EASA, FAA, CASA on many limits, not all
3. Operational experience Std 4.10.1		Not demonstrated Reports set aside as perceived; no alertness data published
Aim: adequate alertness Std 4.10.1		Not met 62-66 in 100 pilots sleepy on legal nights, up to 77 late

Science = partly.

Knowledge = partly.

Operational experience = not shown.

The report says alertness at night is not adequately protected.

SUPPORTING TESTS

Prescriptive limits set Std 4.10.1(a)		Met Current rules limit flight time, duty day, duty and rest
Risk-based deviations 4.10.1(b), App. 7		Not met Exemptions rest on operator risk checks; none published
Fatigue monitored Doc 9966		Partly met Exemptions tracked punctuality, not fatigue

Some rule limits exist, but the harder questions are where the gaps appear.

Science and knowledge: partly met. Operational experience: not shown by public evidence. Alertness at night: not met.

Figure 10. ICAO Annex 6 Part I, Standard 4.10 · our assessment

Partly. Science: partly, because the night rules follow it but late evenings and runs of early starts do not. Knowledge: partly, because India is as strict as other countries on some rules but not others. Real experience: not shown, because no measurements of how tired Indian pilots actually are have been published. And the aim, alert pilots, is not met at night.

How this was done, and how sure we are

The numbers come from a well-established sleep-and-body-clock model, tuned on two laboratory sleep-loss studies (157 volunteers, 118 of whom gave usable sleepiness ratings) and adjusted to match what Europe measured in real working pilots. It also carries sleep debt from one day to the next, calibrated on laboratory studies of people kept short of sleep for two weeks. It was run on duties at India's legal limits and on thirteen pilots' real rosters and logbooks. These are predictions for an average crew, not measurements of Indian pilots; individuals vary, and the model was tested 13 different ways. Nights and late evenings came out well above Europe's day level in every test.

The full evidence, with methods, statistics and references, is in the companion report: *Science-Based Review of India's Flight Duty Time Limitations*.

About Safety Matters Foundation

Safety Matters Foundation (SMF) is an independent, not-for-profit aviation safety organisation in India (CIN U85300HR2021NPL096553), founded by Capt. Amit Singh FRAeS. It studies aviation safety, human factors, accident investigation and safety culture, and publishes its work free. Its national surveys of Indian pilots (542 pilots in 2022, 530 in 2024) give pilots a direct voice on fatigue. It also publishes independent reviews of accident investigation reports, the mindFly blog and the mindFly Katha podcast. This guide accompanies SMF White Paper 01, *Science-Based Review of India's Flight Duty Time Limitations*.

Disclaimer

This guide explains an independent scientific review in plain language. No one commissioned the review, and it received no external funding. It is not legal advice and does not accuse any operator, pilot or official. The sleepiness numbers are model predictions for an average crew, not measurements of real pilots, and they are rounded, so small variations from the full report may be observed. Rosters and logbooks had all names and identifying details removed before analysis. The guide reflects the rules and sources available on 27 October 2026. Mention of DGCA, EASA, ICAO or any other body does not mean they endorse this guide, and SMF accepts no liability for decisions taken on the basis of it.

Spotted a mistake? Please write to admin@safetymatters.co.in. Confirmed corrections will be acknowledged and published.

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VERSION 1.1 + 1.2

What's new: we tested the guide against real pilots

Since the first edition we checked our numbers against new evidence. **Nothing in this guide changes. The new evidence backs it.**



Every number was worked out again

Every figure was produced again from scratch and came out the same.

*Checked twice,
same answer*



Real pilots' sleep, measured with a wristband

24 airline pilots wore sleep wristbands for two weeks. For every 100 minutes in bed, they slept about 75. Using their real sleep, typical duties still leave about **24 to 28 in 100** crews sleepy at the last landing.

*Time in bed is
not the same as
sleep: a phone
charged to 75%*



Sleep in the bunk on very long flights

On flights of 15 hours or more, pilots slept under 3 hours in a 7-hour rest. Very long flights then leave about **8 to 14 in 100** crews sleepy at landing, instead of 4 to 8 in 100. Still far fewer than on night flights at home.

*A bunk is
not a bed*



What pilots themselves report

We read 1,586 fatigue reports US airline pilots sent to NASA. Night flying and the body clock come up most: in **23 in 100** reports. The same duties this guide warns about.

*Pilots say
the same thing*



What India's accident investigators found

Mumbai, 2013. An aircraft landed without clearance while the runway was closed for an inspection. The crew were on a midnight round trip, within the duty rules. India's investigators found that **crew fatigue contributed**.
Mangalore, 2010. The investigation found the captain had slept for much of a night flight, and that waking just before landing may have impaired his judgment.

*An official
finding, not
our opinion*

Legal does not always mean rested. India's own accident investigators have said so in an official report.

Version 1.2 (27 October 2026): easier to read. A new "Start here" page with a word list; one way of writing numbers throughout ("N in 100"); simpler chart captions; a box for passengers on page 9. No finding changed.

Sources: Abdelaziz et al., Cureus 2023 (24 airline pilots); Signal, Gale and Gander 2005 (in-flight sleep); NASA Aviation Safety Reporting System 2009–2026; Aircraft Accident Investigation Bureau, India (Mumbai 2013 serious incident); Court of Inquiry, Mangalore 2010. Details: Annexes F and G and section 9 of the full report.

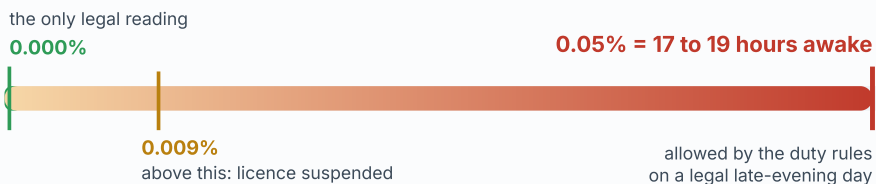
VERSION 1.3 New page, added 27 October 2026

Three facts that say it plainly

No model needed for these. They come from the law, from pilots themselves and from India's own investigators.

Zero alcohol allowed. Not zero fatigue.

India grounds a pilot for any trace of alcohol, and suspends the licence above 0.009%. But after 17 to 19 hours awake, people perform about as badly on some tests as at **0.05% blood alcohol**: more than five times the level that costs a pilot their licence. A legal late-evening day can keep a pilot awake that long by the last landing.



*The same
impairment:
banned from
a bottle, legal
from a roster*



Tired before the next flight even starts

In a 2022 survey of 542 Indian pilots, **43 in 100** said they were already fatigued for their next flight. 71 in 100 said they had often been too tired for cockpit duty, 66 in 100 had fallen asleep unplanned or had microsleeps on duty, and **97 in 100** said DGCA is not doing enough.



Mangalore, 2010: 158 people killed

The aircraft was landing at dawn after a night return flight. The Court of Inquiry found the captain had slept for most of the recorded cruise, and that this "could have led to sleep inertia", impairing judgment, "accentuated while flying in the Window of Circadian Low": the body-clock low.

*Starting the
day already
tired*

A pilot with a trace of alcohol is stopped at the door. A pilot impaired by the roster is not even asked.

Sources: Williamson and Feyer, Occupational and Environmental Medicine 57 (2000); CAR Section 5, Series F, Part III (Rev 5, 9 February 2026) and Aircraft Rules 1937, Rule 24; Safety Matters Foundation Pilot Fatigue Survey 2022 (542 responses); Report of the Court of Inquiry, VT-AXV (2010). Late-evening hours awake: full report.

*An official
finding, not
our opinion*