

Aviation Masterclass: ATS Surveillance Systems

Doc 4444 (PANS-ATM) & AIP India Standards for CPL/ATPL

Concept

A comprehensive operational and regulatory deep-dive into Air Traffic Services (ATS) Surveillance Systems.

Regulatory Application

Based entirely on ICAO Doc 4444 (PANS-ATM) and AIP India standards.

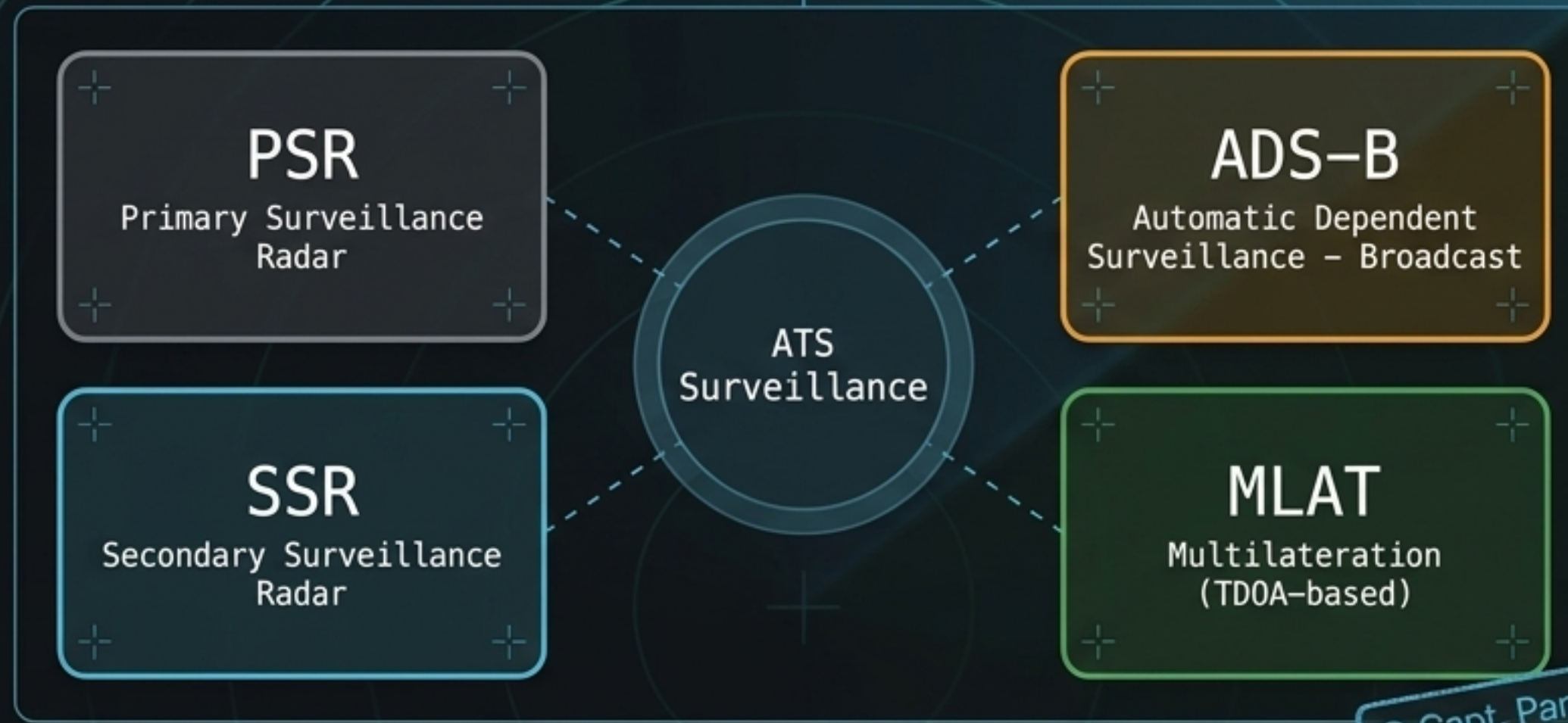
Exam Tip

Master the exact spatial, temporal, and altitude tolerances-precision is the key to passing DGCA Air Regulations.

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DGCA EXAM ALERT: High Probability Topic – Expect 3-5 questions from this chapter alone, specifically targeting separation minima and transponder codes.

The ATS Surveillance Family Matrix



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Regulatory Application

- PSR: The supplementary backstop. Used when other systems alone do not meet ATS requirements.
- SSR: Can be used ALONE for separation IF transponder carriage is mandatory and ID is established/maintained.

Exam Tip

Remember that SSR requires avionics (a transponder), whereas PSR bounces radio waves off the raw metal of the aircraft.

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Q: Secondary Surveillance Radar (SSR) information may be used alone in the provision of separation between aircraft provided?
A: Aircraft identification is established and maintained by use of discrete SSR codes.

Critical Distinction: ADS-B vs. ADS-C

Both rely on aircraft navigation systems to automatically transmit data, but the transmission routing is fundamentally different.

ADS-B (Broadcast)



- Unencrypted signal goes to ALL receivers in range.
- Used by ATC and other aircraft (TCAS/traffic display).
- Suitable for busy, high-density airspace.
- Foundation for NextGen tracking.

ADS-C (Contract)



- Signal goes to specific ATSU/AOC only.
- Based on a point-to-point digital contract defining data type and reporting conditions.
- Used for oceanic and remote area surveillance.

Exam Tip

Think of ADS-B as shouting in a crowded room, and ADS-C as sending a private text message to a specific controller.

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High Probability: Although the names are similar, ADS-C data is ONLY generated in response to a request within the terms of an ADS contract held by the ground system.

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System Deep Dive: Multilateration (MLAT) & TDOA



Concept & Application

- MLAT locates aircraft using Time Difference of Arrival (TDOA).
- Requires NO additional avionics (uses standard Mode A, C, S, and ADS-B replies).
- Highly accurate for surface movement and terminal areas.

Exam Tip:

Separation based on MLAT symbols and PSR blips is measured between the CENTRES of the position symbols/blips.

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Q: Separation based on MLAT position symbols and PSR blips shall be applied so that:

A: The distance between the CENTRES of the position symbols and PSR blips... is never less than a prescribed minimum.

ATC Application: Radar Services & Vectors

Radar Contact means the radar identity of the aircraft has been established. Direct two-way communication is required for all radar services.



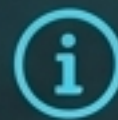
Radar Control Service

For aircraft operating within controlled airspaces.



Radar Advisory Service

For aircraft operating within Class F airspace.



Radar Information Service

For identified aircraft operating in any part of FIR.

Exam Tip

When ATC says 'Resume own navigation', it means ATC vectors are terminated; you are responsible for maintaining the airway using your instruments.



VECTORS = MAGNETIC HEADINGS ONLY

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Q: When a RADAR operator says: 'fly heading 030°', the pilot must fly heading:
A: 030° compass in still air conditions (thereby flying the compass heading).

ATC Application: PSR Identification Procedures

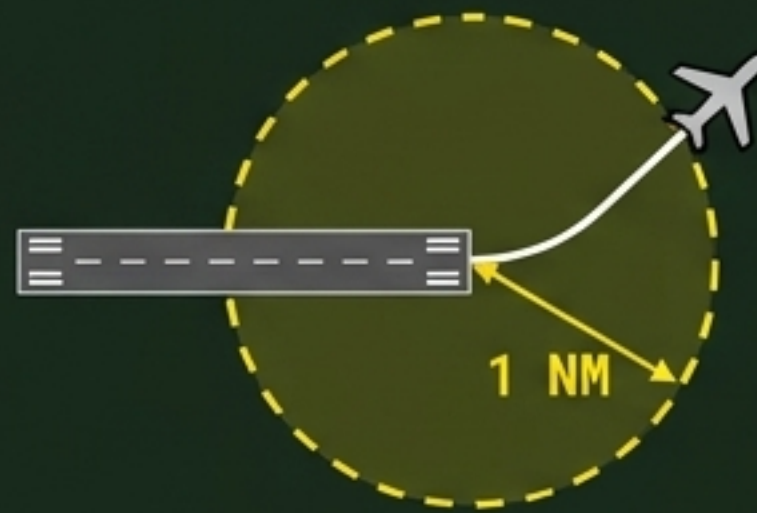
When SSR (transponder) is unavailable, ATC must identify the analog primary radar blip using flight path geometry.

1. Position Report



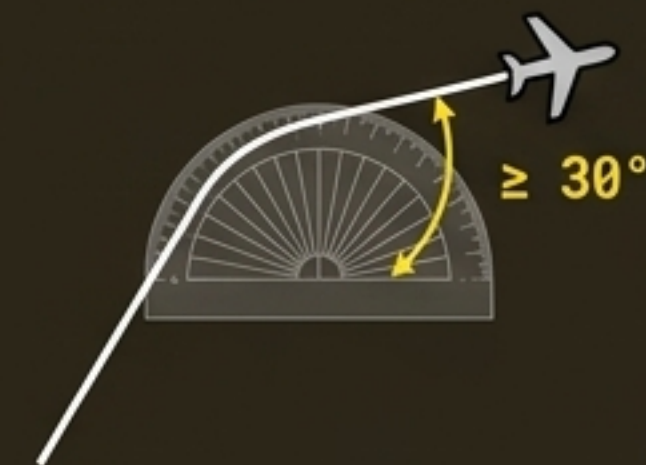
Track must be consistent with reported heading from a known point.

2. Departing Aircraft



Identification must be established within 1 NM from the end of the runway used.

3. The Turn Method



Instruct pilot to execute heading change(s) of 30° or more.

Exam Tip: Memorize the critical numerical limits: 1 NM for Departures, and 30° for the Turn Method.

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ATC Application: SSR & ADS-B Identification

Modern identification relies on digital data transmission: labels, discrete assigned codes, or physical switch compliance.

SSR / MLAT (6 Methods)



- Recognition of assigned discrete code
- Recognition of Mode S label
- Transfer of identification
- Compliance with instruction to set specific code
- Compliance with instruction to squawk IDENT
- Operating transponder from ON to STBY to ON

ADS-B (3 Methods)



- Direct recognition of ADS-B label
- Transfer of ADS-B identification
- Compliance with 'TRANSMIT ADS-B IDENT'

Exam Tip:

If the IDENT button is broken, switching the transponder from open ON to squawking IDENT.

If the IDENT button is broken, switching the transponder from ON → STBY → ON is legally and operationally equivalent to squawking IDENT.

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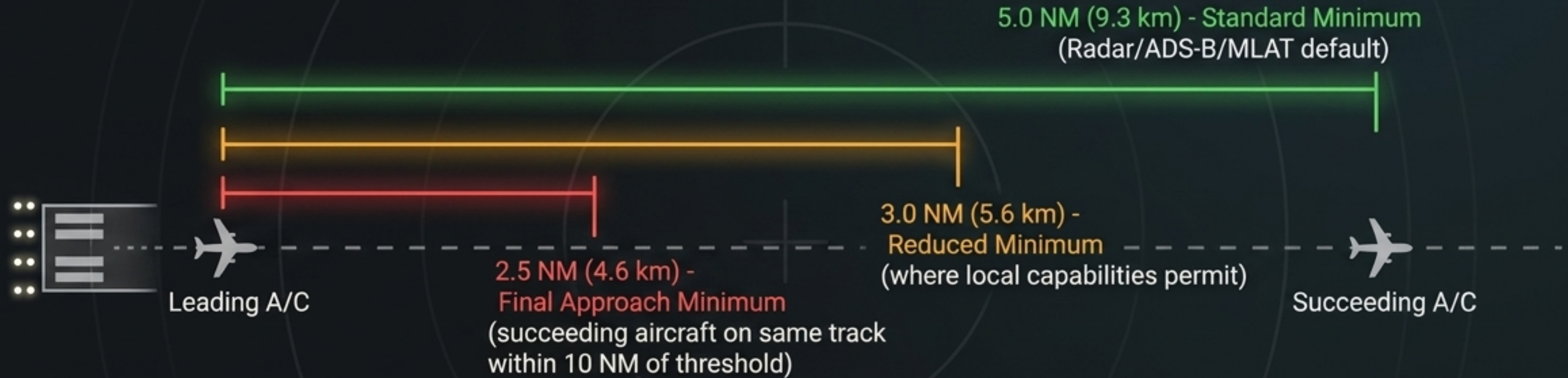
Q: An aircraft may be identified by one of the following procedures:

A: Observation of compliance with an instruction to operate transponder from 'ON' to 'STBY' and back to 'ON'.

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Regulatory Minima: Horizontal Separation

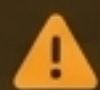
The absolute minimum horizontal distances required between identified aircraft to prevent collision.



Exam Tip

Never confuse the NM values with their km equivalents (5.0 NM = 9.3 km). The DGCA exam often mixes these units in multiple-choice options.

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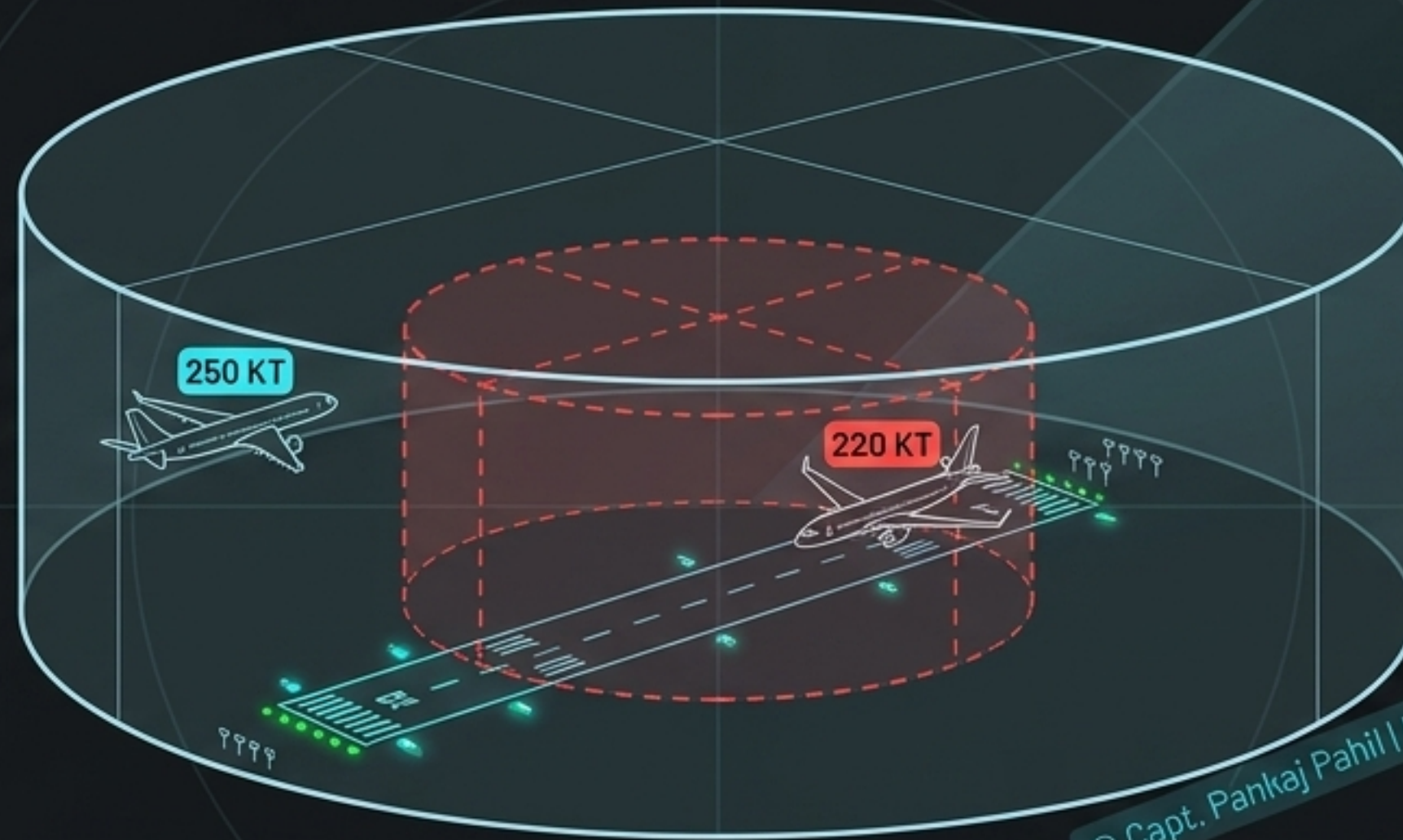
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Q: The minimum radar separation provided to aircraft established on the same localizer course shall be:
A: 2.5 NM between aircraft on the same localizer course.

Airspace Rules: Speed Control Procedures

Mandatory speed limits in terminal airspace sequence traffic safely. ATC may suspend these by stating exactly: "NO SPEED RESTRICTION".

Below 10,000 ft - ALL Aircraft (Arrivals & Departures): MAX 250 KT IAS



Within 15 NM radius of VOR/DME - ARRIVALS Only: MAX 220 KT IAS

Exam Tip

Ensure you mentally separate 'ALL aircraft' rules from 'ARRIVALS only' rules. Departures under 10,000 ft are restricted to 250 KT, but are NOT restricted to 220 KT within 15 NM.

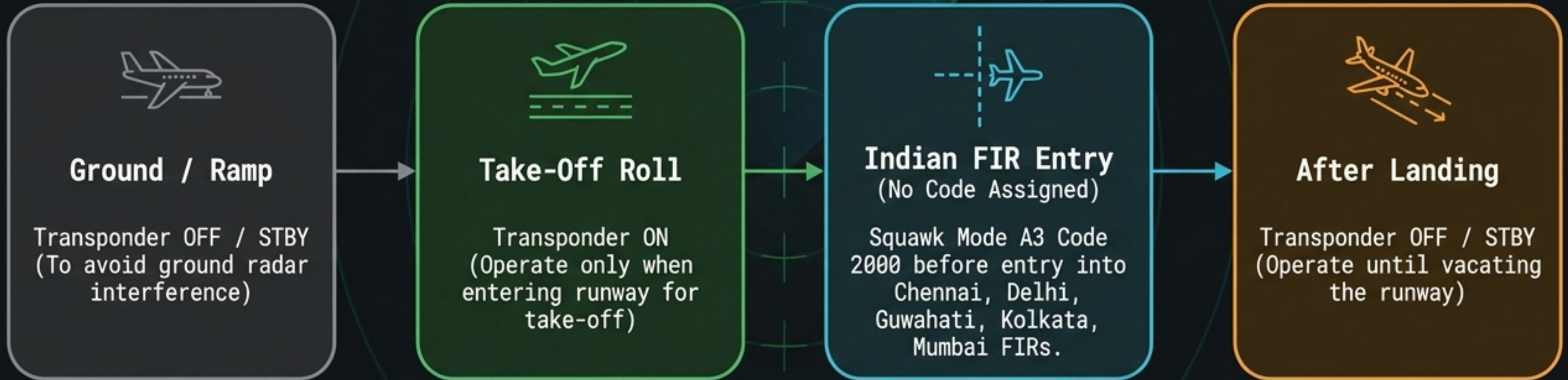
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High Probability: Remember the difference between **ALL aircraft** (250 KT) and **ARRIVALS** within 15 NM (220 KT). Do not mix these up on the exam.

Pilot Ops: Transponder Procedures (AIP India)

Mandatory operation rules to prevent radar clutter on the ground and maintain uninterrupted tracking in Indian airspace.

Phases of Flight



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Mandatory Rule: Operate the transponder AT ALL TIMES during flight within the 5 major Indian FIRs, regardless of whether ATC radar coverage exists.

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Q: All aircraft carrying serviceable transponder shall operate the transponder:

A: At all times during flight within Chennai, Delhi, Guwahati, Kolkata and Mumbai FIR regardless of whether SSR is used for

Emergency & Special Transponder Codes

Specific squawk codes instantly trigger alarms in the ATC centre, alerting them to distress without a single radio transmission.



General Emergency / Distress

Memory Aid:
Sevens, SAVE ME



Communication Failure (NORDO)

Memory Aid:
SIXES, SILENT



Unlawful Interference / Hijack

Memory Aid:
FIVE, HIJACK ALIVE

Default Code: 2000 is used when no SSR code is assigned before entry into an Indian FIR.

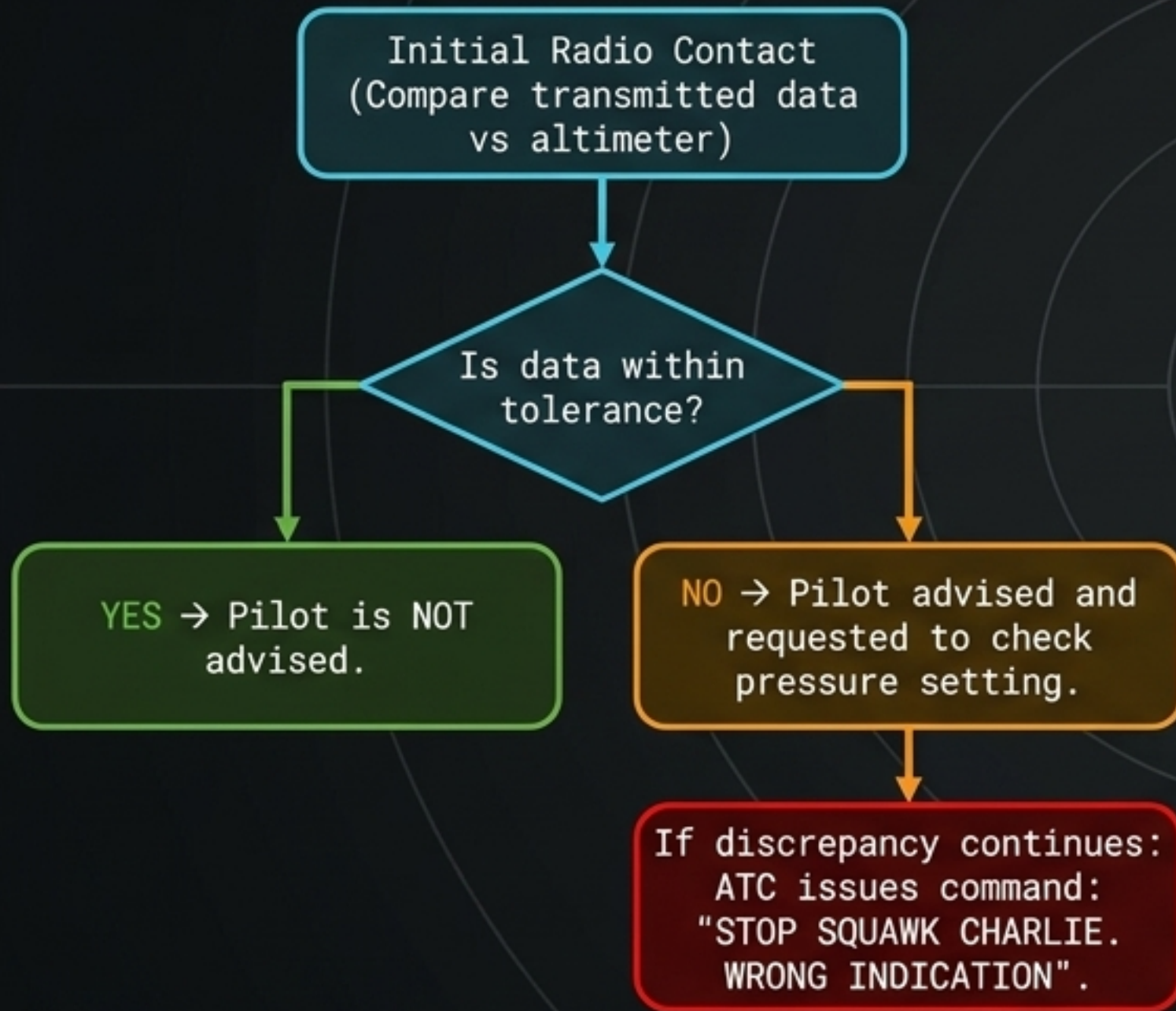
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Q: Which code shall be used on Mode A to provide recognition of an aircraft subjected to unlawful interference?

A: Code 7500.

System Verification: Mode C & ADS-B Altitude

Concept: The altitude displayed on the ATC screen must be mathematically verified against the pilot's altimeter on initial contact.



	Airspace Type	Tolerance
1	RVSM Airspace	±200 ft (±60 m)
2	Non-RVSM Airspace	±300 ft (±90 m)

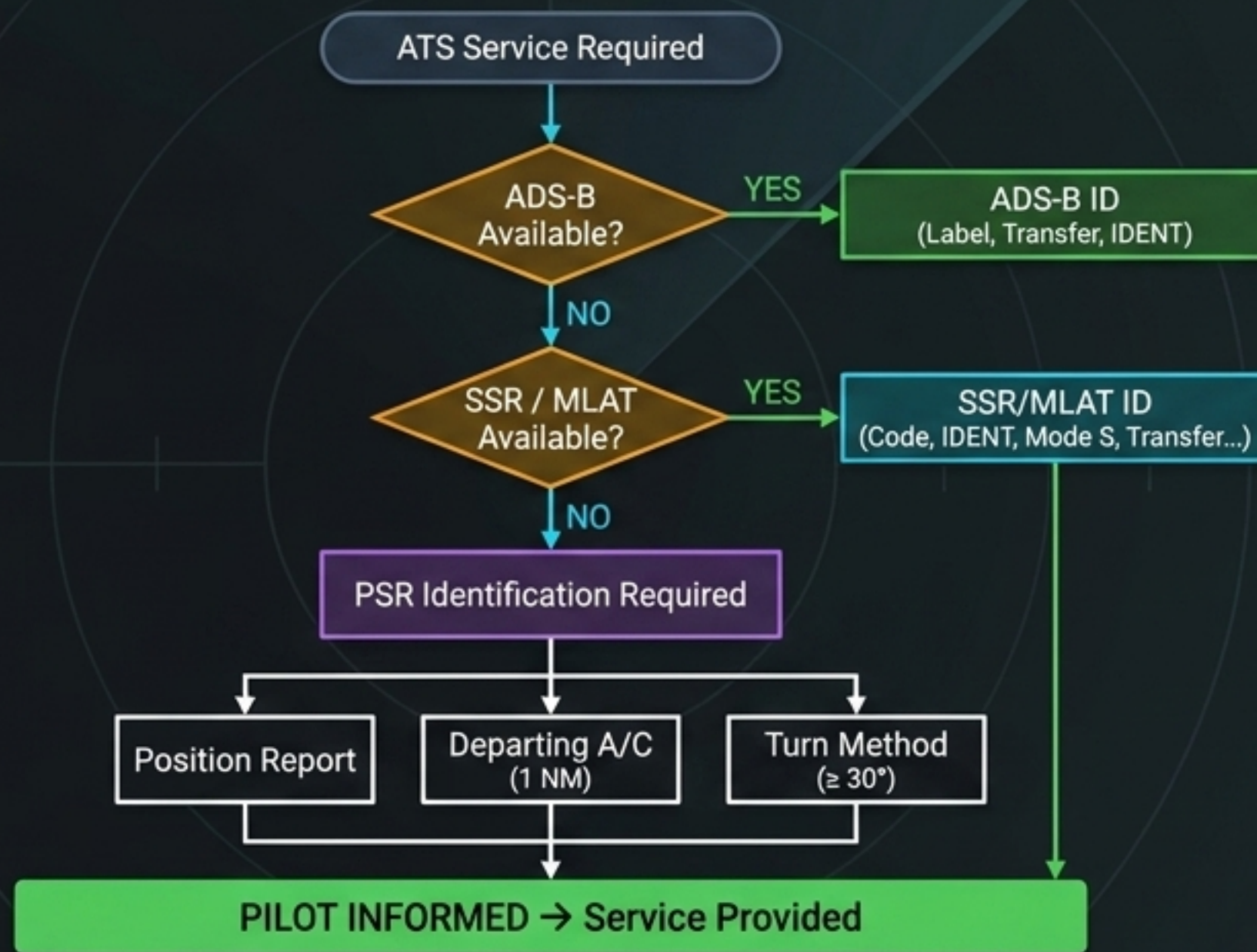


GEOMETRIC HEIGHT

Rule: Geometric height information shall NEVER be used for separation.

Synthesis: ATS Identification Decision Flowchart

Before providing any ATS surveillance service, identification MUST be established and the pilot explicitly informed.



Exam Tip

If identification is lost, the pilot shall be informed immediately, and instructions issued to restore non-radar procedural separation.



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Q: The Air Traffic Control Service: do not prevent collisions with terrain.
A: Correct, except when an IFR flight is vectored by radar.

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Masterclass Final Briefing: High-Yield Values

Consolidated numerical limits and critical thresholds. 100% of these values appear in the DGCA question bank.

Parameter	Value	Condition / Notes
Standard Horizontal Separation	5.0 NM (9.3 km)	Default for Radar / ADS-B / MLAT
Reduced Horizontal Separation	3.0 NM (5.6 km)	Where ATS authority permits
Final Approach Separation	2.5 NM (4.6 km)	Same track, within 10 NM of threshold
Departing Aircraft PSR ID	1 NM	Must identify within 1 NM from end of runway
PSR Turn Method	30° or more	Minimum instructed heading change
RVSM Altitude Tolerance	±200 ft (±60 m)	Mode C / ADS-B hard limit
Non-RVSM Altitude Tolerance	±300 ft (±90 m)	Mode C / ADS-B standard limit
Speed Limit: Below 10,000 ft	250 KT IAS	All aircraft (arrivals and departures)
Speed Limit: Arrivals 15 NM	220 KT IAS	Within 15 NM of VOR/DME

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Exam Tip

Take a mental snapshot of this matrix. Procedural (non-radar) separation is applied during surveillance failure, outside coverage areas, or if an aircraft lacks a transponder.

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Final Check: Ensure you understand that non-radar separation is applied during surveillance failure, outside coverage areas, and between an equipped and unequipped aircraft.