International Civil Aviation Organization

The Eighth Meeting of the Asia/Pacific
Aerodrome Assistance Working Group (AP-AA/WG/8)

(Bangkok, Thailand, 21 to 24 April 2026)

Agenda Item 10: Any Other Business

SAFETY IMPLICATIONS OF RUNWAY MARKING OVERPAINTING ON RUBBER-CONTAMINATED SURFACES: RESULTANT FOREIGN OBJECT DEBRIS (FOD) RISKS AND MAINTENANCE CONSIDERATIONS

(Presented by AIRPORTS AUTHORITY OF INDIA, INDIA)

SUMMARY

This paper presents and highlights that repeated repainting of runway markings over rubber deposits creates composite paint–rubber layers that degrade and fragment into FOD. It proposes measures including rubber removal prior to repainting, establishment of maximum allowable cumulative marking thickness, periodic stripping of legacy markings, alternate maintenance methods, and SMS integration to reduce engine ingestion risk and improve runway surface integrity at high-traffic aerodromes.

1. INTRODUCTION

1.1 ICAO Annex 14, Volume I prescribes Standards and Recommended Practices (SARPs) for runway markings to ensure adequate visual guidance to pilots during take-off, landing, and ground operations.

1.2 Runway markings are routinely repainted to maintain visibility and regulatory compliance. However, at many aerodromes, repainting is undertaken repeatedly over existing markings without complete removal of legacy paint layers or underlying rubber deposits.

1.3 Operational experience indicates that this practice results in progressive accumulation of thick composite layers of paint and rubber on runway surfaces.

1.4 Over time, such accumulated layers, when subjected to aircraft loads, braking forces, environmental exposure, and adverse weather conditions, may lose adhesion and disintegrate into hardened fragments capable of becoming Foreign Object Debris (FOD).

2. DISCUSSION

Background

2.1 At aerodromes handling heavy traffic volumes, runway centerline and touchdown zone markings are rapidly contaminated by tyre rubber deposited during aircraft landings.

2.2 During landing rollout, aircraft nose wheels typically track along the runway centerline and deposit rubber directly over the centerline markings, while the main landing gear deposits rubber

predominantly over the touchdown zone marking. This progressive accumulation of tyre rubber obscures runway markings, causing them to darken and lose visual contrast against the surrounding bituminous pavement surface.

2.3 To restore marking conspicuity, aerodrome operators periodically repaint runway markings. At busy airports, runway painting is carried out as part of scheduled runway maintenance activities, requiring temporary runway closures promulgated by NOTAM for limited durations.

2.4 Due to operational constraints and short maintenance windows, aerodrome operators often prioritize rapid repainting and may omit comprehensive rubber removal, as repainting directly over rubber-contaminated surfaces is significantly quicker and easier to accomplish.

2.5 Consequently, new paint is frequently applied directly over accumulated rubber deposits and existing paint layers, resulting in progressively thicker composite paint–rubber build-ups.

2.6 This layered application significantly reduces adhesion between marking material and pavement substrate. In addition, interaction between accumulated paint, rubber deposits, and the underlying pavement may induce micro-cracking or hairline fractures at pavement edges adjacent to markings.

2.7 With continued operational loading, thermal cycling, and weather exposure, these composite layers progressively deteriorate and may detach in hardened strips or fragments of sufficient size and rigidity to pose ingestion or impact hazards to aircraft during take-off or landing roll.

2.8 Such fragments constitute an unpredictable and often undetected form of runway FOD, frequently identified only following pilot reports or post-flight aircraft inspections.

2.9 Many airlines have reported operational events involving paint debris ingestion or impact, leading to maintenance interventions and associated operational disruptions.

2.10 While ICAO guidance (including Annex 14, Volume I; Doc 9157; and ICAO runway rubber removal training material) recognizes runway marking degradation and rubber deposition. However, limited ICAO guidance currently exists addressing cumulative paint layer build-up and its potential to generate FOD.

Safety Considerations

2.11 Hardened paint–rubber debris presents a credible risk of:

- Engine foreign object damage;
- Under garage damage;
- Airframe impact;

Which may lead to Aircraft-on-Ground (AOG) events.

2.12 Deteriorated runway marking fragments are generated unpredictably, increasing exposure risk during critical phases of flight when engines are operating at high thrust settings.

2.13 From an SMS perspective, accumulated paint and rubber layers represent a latent runway surface integrity hazard requiring structured monitoring and mitigation.

Regulatory Considerations

2.14 Although ICAO Annex 14, Volume I prescribes runway marking patterns, colors and dimensions, detailed guidance remains limited with respect to the following:

- Rubber removal prior to repainting;
- Maximum cumulative paint thickness;
- Marking adhesion performance;
- Recognition of deteriorated markings as a FOD source.

2.15 Current practices vary between aerodrome operators, with repainting often driven by visual appearance or calendar intervals rather than performance-based criteria.

Discussion

2.16 High aircraft movement rates accelerate rubber accumulation while simultaneously restricting maintenance windows.

2.17 This operational pressure encourages rapid overpainting without rubber removal, creating a recurring cycle of composite layer build-up.

2.18 Over extended periods, this leads to adhesion failure, pavement edge cracking, and fragmentation.

2.19 There is currently no harmonised ICAO guidance requiring monitoring of cumulative marking thickness or systematic removal of legacy layers.

Alternate Runway Marking Maintenance Methods for High-Traffic Aerodromes

2.10 Alternate methodologies may include:

- High-pressure water blasting or mechanized rubber removal;
- Mechanical grinding or shot-blasting in high-rubber zones;
- Restoring runway markings in phases or sections instead of the entire runway at once;
- Periodic full stripping cycles based on cumulative runway marking paint thickness, and
- Condition-based maintenance triggered by contrast or adhesion performance.

These methods allow operational continuity while preventing hazardous composite layer formation and can be integrated into existing Aerodrome SMS.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the safety risks associated with accumulated runway marking layers;

b) consider ICAO guidance on rubber removal prior to repainting and on maximum allowable cumulative marking thickness;

c) encourage States to integrate runway marking condition monitoring into Aerodrome SMS;

d) request ICAO recognize deteriorated runway markings as a potential FOD source.

—END—

Information Paper

Safety Implications of Runway Marking Overpainting on Rubber-Contaminated Surfaces

Resultant Foreign Object Debris (FOD) Risks and Maintenance Considerations

ICAO

Information Paper

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AIRPORTS AUTHORITY OF INDIA

Safety Implications of Runway Marking Overpainting on Rubber-Contaminated Surfaces

Resultant Foreign Object Debris (FOD) Risks and Maintenance Considerations

SUMMARY

This Information Paper highlights that repeated repainting of runway markings over rubber deposits creates composite paint–rubber layers that degrade and fragment into FOD. It proposes measures including rubber removal prior to repainting, establishment of maximum allowable cumulative marking thickness, periodic stripping of legacy markings, alternate maintenance methods, and SMS integration to reduce engine ingestion risk and improve runway surface integrity at high-traffic aerodromes.

2. Background

2.1 At aerodromes handling heavy traffic volumes, runway centreline and touchdown zone markings are rapidly contaminated by tyre rubber deposited during aircraft landings.

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At busy airports, runway painting is carried out as part of scheduled runway maintenance activities, requiring temporary runway closures promulgated by NOTAM for limited durations.

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3. Safety Considerations

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- Engine foreign object damage;
- Under garage damage;
- Airframe impact;

Which may lead to Aircraft-on-Ground (AOG) events.

3.2 Deteriorated runway marking fragments are generated unpredictably, increasing exposure risk during critical phases of flight when engines are operating at high thrust settings.

3.3 From an SMS perspective, accumulated paint and rubber layers represent a latent runway surface integrity hazard requiring structured monitoring and mitigation.

4 . Reported Cases

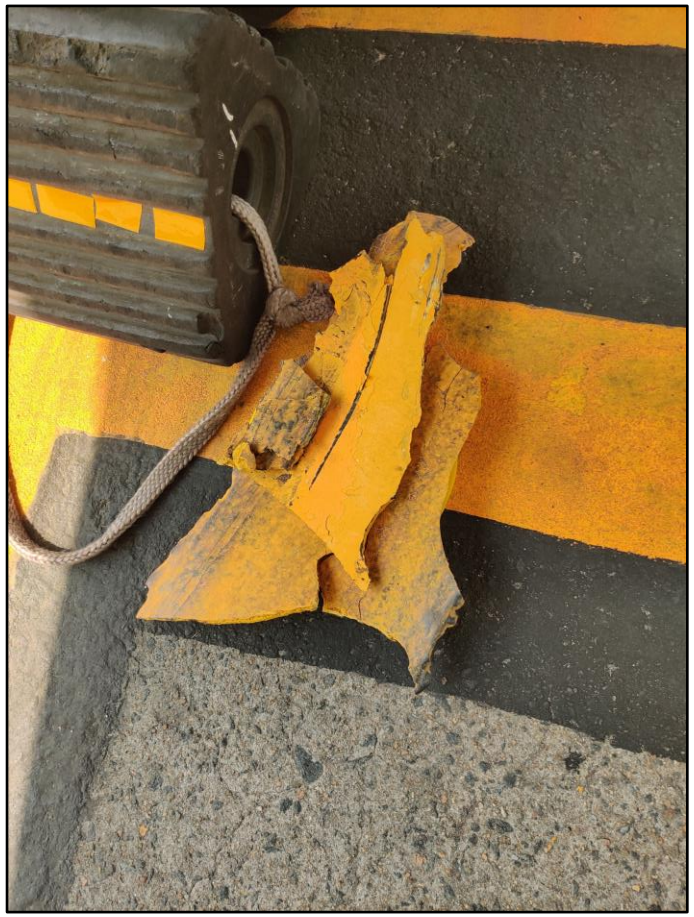
I. At approximately 2220 hrs, information was received from a KLM engineer regarding the arrival aircraft SQ528 (9V-SCJ), which was parked at Stand 29. The aircraft was found to have puncture-like scratches/damage on its belly, specifically near the left air conditioning access panel (Panel No. 195C). Upon investigation, it was observed that the aircraft belly had punctures at four locations, with yellow paint chips present inside the affected areas. Subsequently, a detailed inspection of the runway and taxiway routing was carried out. While no FOD or loose paint chips were detected during the inspection, certain sections of the runway were found to have accumulated layers of paint. It was also noted that, at a few locations, the paint could potentially dislodge if subjected to manual force.

Operational Impact : High speed tape was applied at the punctured spots. Aircraft having STD:2325 hrs, departed at 0017 hrs.

4 . Reported Cases

II. A Foreign Object Debris (FOD) incident was reported involving aircraft VT-YBF operating flight QP-1305 (IXZ–MAA) on 12.11.2025. Upon arrival, paint flakes were observed in the aircraft's wheel well. Immediately after receiving this information, operational jeep carried out a detailed inspection of the aircraft's Runway–Taxiway movement route. No FOD was detected along the inspected route. However, an area between Taxiway P and Taxiway V was identified where the taxiway guideline marking had multiple layers of paint. Although no loose paint material was found at the time of inspection, the condition of the marking was noted. This location lies approximately 0.375 meters to the left of the centerline of Runway 07.

Operational Impact: The aircraft experienced a ground delay of approximately one hour for inspection.



4. Regulatory Considerations

4.1 Although ICAO Annex 14 prescribes runway marking patterns, colors and dimensions, detailed guidance remains limited with respect to the following:

- Rubber removal prior to repainting;
- Maximum cumulative paint thickness;
- Marking adhesion performance;
- Recognition of deteriorated markings as a FOD source.

4.2 Current practices vary between aerodrome operators, with repainting often driven by visual appearance or calendar intervals rather than performance-based criteria.

5. Alternate Runway Marking Maintenance Methods for High-Traffic Aerodromes

Alternate methodologies may include:

I. High-pressure water blasting or mechanised rubber removal;
II. Mechanical grinding or shot-blasting in high-rubber zones;
III. Restoring runway markings in phases or sections instead of the entire runway at once;
IV. Periodic full stripping cycles based on cumulative runway marking paint thickness,
V. Condition-based maintenance triggered by contrast or adhesion performance.

These methods allow operational continuity while preventing hazardous composite layer formation and can be integrated into existing Aerodrome SMS.

6 . Discussion

6.1 High aircraft movement rates accelerate rubber accumulation while simultaneously restricting maintenance windows.

6.2 This operational pressure encourages rapid overpainting without rubber removal, creating a recurring cycle of composite layer build-up.

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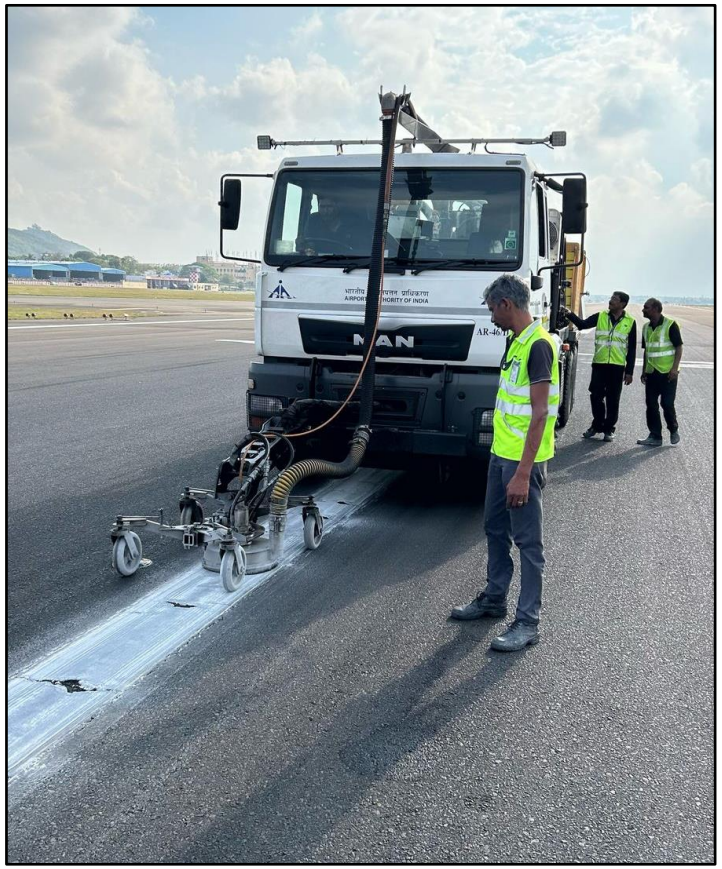

7. Action by the Meeting

The Meeting is invited to:

I. Note the safety risks associated with accumulated runway marking layers;

II. Consider ICAO guidance on rubber removal prior to repainting and on maximum allowable cumulative marking thickness;

III. Encourage States to integrate runway marking condition monitoring into Aerodrome SMS;

IV. Request ICAO recognise deteriorated runway markings as a potential FOD source.

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THANK YOU